Myanmar Academy of Agricultural, Forestry,

Livestock and Fishery Sciences

PROCEEDINGS OF THE SEVENTH ANNUAL RESEARCH CONFERENCE HELD IN NAY PYI TAW ON JULY 25 - 26, 2008

(LIVESTOCK AND FISHERY SCIENCES)

YANGON, MYANMAR

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ဗိုလ်ချုပ်မှူးကြီးသန်းရွှေ

နိုင်ငံတော်ကာကွယ်ရေးနှင့်ဖွံ့ဖြိုးရေးကောင်စီ ဥက္ကဋ္ဌ

ဗိုလ်မှူးချုပ်မောင်မောင်သိမ်း

ဝန်ကြီး

မွေးမြူရေးနှင့်ရေလုပ်ငန်းဝန်ကြီးဌာန

မွေးမြူရေးနှင့်ရေလုပ်ငန်းဝန်ကြီးဌာနဝန်ကြီး ဗိုလ်မှူးချုပ် **ဖောင်းဖောင်သိမ်း**
မွေးမြူရေးနှင့်ရေလုပ်ငန်းကဏ္ဍ၏ သတ္တမအကြိမ် သုတေသနညီလာခံဖွင့်ပွဲအခမ်းအနားတွင်
တက်ရောက်မိန့်ခွန်းပြောကြားစဉ်

မွေးမြူရေးဆိုင်ရာဆေးတက္ကသိုလ်၌ ကျင်းပမြဲလုပ်သည့်
မွေးမြူရေးနှင့်ရေလုပ်ငန်းကဏ္ဍ၏ သတ္တမအကြိမ် သုတေသနညီလာခံသို့
တက်ရောက်လာကြသည့်ပုဂ္ဂိုလ်များ

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PROCEEDINGS OF THE SEVENTH ANNUAL RESEARCH CONFERENCE (LIVESTOCK AND FISHERY SCIENCE)

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မြန်မာနိုင်ငံ စိုက်ပျိုးရေး၊ သစ်တော၊ မွေးမြူရေးနှင့် ရေလုပ်ငန်းပညာရှင်အဖွဲ့၏ အခြေခံစည်းမျဉ်းများကို ၁၉၉၉-ခုနှစ်၊ အောက်တိုဘာလ (၈)ရက် နေ့စွဲပါ အမိန့်ကြော်ငြာစာ အမှတ် (၃/၉၉) ဖြင့် ထုတ်ပြန်ပြီး၊ ရည်ရွယ်ချက် (၅)ရပ်ကို အကောင်အထည်ဖော် ဆောင်ရွက်သွားရန် ချမှတ်ပေးခဲ့ပါသည်။ အဆိုပါ သတ်မှတ်ပေးခဲ့သည့် ရည်ရွယ်ချက်များမှာ-

(၁) အေးချမ်းသာယာပြီး ခေတ်မီဖွံ့ဖြိုးတိုးတက်သော နိုင်ငံတော်သစ် တည်ဆောက်ရာတွင် ပညာရှင်များက မိမိတတ်ကျွမ်းသော ပညာရပ်ဖြင့် နိုင်ငံတော်အား အထောက်အကူပြု ပံ့ပိုးရန်၊

(၂) နိုင်ငံတော်ကို အကျိုးပြုမည့် သုတေသနလုပ်ငန်းများဆောင်ရွက်ရန်နှင့် သုတေသနလမ်းညွှန်မှုများပေးရန်၊

(၃) နိုင်ငံတော်ကို အကျိုးပြုမည့် ပညာရှင်များ မွေးထုတ်ပေးနိုင်ရေးအတွက် စီမံဆောင်ရွက်ရန်၊

(၄) နိုင်ငံတော်တွင် လိုအပ်လျက်ရှိသော ပညာရပ်ဆိုင်ရာ အခြေခံကောင်းများ တိုးတက်ဖြစ်ပေါ်လာစေရန်၊

(၅) နိုင်ငံတော် တည်ဆောက်ရာတွင် ပါဝင်နေကြသော ပြည်သူတို့၏ ပညာဉာဏ် အမြော်အမြင်နှင့် ကျွမ်းကျင်မှုများ အစဉ်မပြတ် တိုးတက် ကောင်းမွန်စေရေး အတွက် စီမံဆောင်ရွက်ရန်တို့ ဖြစ်ကြပါသည်။

ဖော်ပြထားသည့် ရည်ရွယ်ချက်များ အောင်မြင်မှုရရှိစေရန်အတွက် ပညာရှင်အဖွဲ့သည် အခြေခံစည်းမျဉ်း၏ အခန်း (၄) တွင် ဖော်ပြပါရှိသော "ပညာရှင်အဖွဲ့၏ လုပ်ငန်း တာဝန်များနှင့် လုပ်ပိုင်ခွင့်များ" ကို အခြေခံ၍ ဆောင်ရွက်ရမည့်လုပ်ငန်းများကို ချမှတ်ခဲ့ကြပါသည်။ "လူ့စွမ်းအားဖွံ့ဖြိုးရေး" သည် နိုင်ငံတော်တည်ဆောက်ရေးတွင် အလွန်အရေးကြီးသည့်အလျောက် ပညာရှင်အဖွဲ့သည် ဝန်ကြီးဌာနများတွင် တာဝန်ထမ်းဆောင်နေကြသည့် ပညာရှင်ဝန်ထမ်းများ၏ အသိဉာဏ်ဖွံ့ဖြိုးတိုးတက်ရေး၊ လုပ်ငန်းစွမ်းဆောင်ရည် မြင့်မားရေး တို့ကို အဓိကဦးတည်၍ ဆောင်ရွက်ပေးလျက်ရှိပါသည်။ ထိုလုပ်ငန်းစဉ်များတွင် သုတေသန ညီလာခံများ၊ နည်းပညာရပ်ဆိုင်ရာ ဟောပြောပွဲများ၊ အလုပ်ရုံဆွေးနွေးပွဲများ ကျင်းပခြင်း၊ ပညာရပ်ဆိုင်ရာ စာအုပ်စာတမ်းများနှင့် မူဝါဒဆိုင်ရာ အကြံပြုစာတမ်းများ ပြုစုတင်ပြခြင်း လုပ်ငန်းများ ပါဝင်ပါသည်။

သုတေသနညီလာခံကို ပညာရှင်အဖွဲ့မှကြီးမှူး၍ ၂၀၀၀ ပြည့်နှစ်မှစ၍ တစ်နှစ်လျှင် တစ်ကြိမ် ကျင်းပပြုလုပ်ပေးလျက်ရှိရာ ယခု ၂၀၀၈ ခုနှစ်အထိ (၇)ကြိမ်တိုင်တိုင် ကျင်းပ ပြုလုပ်ခဲ့ပြီးဖြစ်ပါသည်။ သတ္တမအကြိမ် သုတေသနညီလာခံကို ၂၀၀၈ ခုနှစ်၊ ဇူလိုင်လ (၂၅)ရက်နေ့မှ (၂၇)ရက်နေ့အထိ ကျင်းပပြုလုပ်ခဲ့ပြီး၊ စိုက်ပျိုးရေး၊ သစ်တော၊ မွေးမြူရေးနှင့် ရေလုပ်ငန်းဆိုင်ရာစာတမ်း စုစုပေါင်း (၅၂)စောင်ကို ဖတ်ကြားခဲ့ပါသည်။ ထိုစာတမ်းများကို ပညာရှင်စာတည်းအဖွဲ့က စိစစ်တည်းဖြတ်ပြီး သုတေသနပညာရှင်များ၊ စိတ်ပါဝင်စားသူများနှင့် ကျောင်းသူကျောင်းသားများ လေ့လာနိုင်ရန် စာအုပ်အဖြစ် ပုံနှိပ်ထုတ်ဝေခြင်းဖြစ်ပါသည်။

အမှုဆောင်အဖွဲ့

မြန်မာနိုင်ငံ စိုက်ပျိုးရေး၊ သစ်တော၊ မွေးမြူရေးနှင့်ရေလုပ်ငန်းပညာရှင်အဖွဲ့

အကျိုးအကြောင်းဖေါ်ပြချက်

၁။ မြန်မာနိုင်ငံ စိုက်ပျိုးရေး၊ သစ်တော၊ မွေးမြူရေးနှင့်ရေလုပ်ငန်းပညာရှင်အဖွဲ့သည် လယ်ယာစိုက်ပျိုးရေးနှင့် ဆည်မြောင်းဝန်ကြီးဌာန၊ သစ်တောရေးရာဝန်ကြီးဌာန၊ မွေးမြူရေးနှင့် ရေလုပ်ငန်းဝန်ကြီးဌာနများအောက်ရှိ တက္ကသိုလ်များ၊ သုတေသနဌာနများ၊ လုပ်ငန်းဌာနများအသီးသီးမှ ဆောင်ရွက်ခဲ့သော သုတေသနလုပ်ငန်းများ၏ လေ့လာတွေ့ရှိချက်ရလဒ်များကို လယ်ယာသစ်တော သားငါးကဏ္ဍများ၏ ကုန်ထုတ်လုပ်မှုတွင် လက်တွေ့အသုံးချနိုင်ရန်လည်းကောင်း၊ နိုင်ငံတော်၏ သိပ္ပံနှင့် နည်းပညာရပ်များ ဖွံ့ဖြိုးတိုးတက်လာစေရန်အတွက်သော်လည်းကောင်း ရည်ရွယ်၍ သုတေသနညီလာခံများကို ၂၀၀၀ ပြည့်နှစ်၊ ဧပြီလမှစ၍ တစ်နှစ်လျှင်တစ်ကြိမ် ကျင်းပပြုလုပ်ပေးလျက်ရှိပါသည်။ ယခုအကြိမ်သည် (၇)ကြိမ်မြောက် သုတေသနညီလာခံဖြစ်ပါသည်။ နှစ်စဉ်ကျင်းပသော နှစ်ပတ်လည်သုတေသနညီလာခံများကို ဝန်ကြီးဌာန (၃)ခုရှိ ဝန်ကြီးများ၊ ဒုတိယဝန်ကြီးများ၊ ညွှန်ကြားရေးမှူးချုပ်များ၊ ဦးဆောင်ညွှန်ကြားရေးမှူးများနှင့် စိုက်ပျိုးရေး၊ သစ်တော၊ မွေးမြူရေးနှင့်ရေလုပ်ငန်းကဏ္ဍအသီးသီးမှ ပညာရှင်များ၊ ဘာသာရပ်ကျွမ်းကျင်သူများနှင့် လေ့လာသူများစုံညီစွာ တက်ရောက်ကြပါသည်။

၂။ နှစ်ပတ်လည်သုတေသနညီလာခံတွင် တင်ပြဆွေးနွေးခဲ့သော သုတေသနစာတမ်းများကို စိုက်ပျိုးရေး၊ သစ်တော၊ မွေးမြူရေးနှင့်ရေလုပ်ငန်းဘာသာရပ်များအလိုက် Proceedings စာအုပ်များအဖြစ် ပြုစုကာ နိုင်ငံတော်အစိုးရအဖွဲ့သို့ တင်ပြသည့်အပြင် ဝန်ထမ်းအဖွဲ့အစည်းများ၊ တက္ကသိုလ်များ၊ သုတေသနများ၊ လုပ်ငန်း၊ ဌာနများနှင့် အဆင့်မြင့်စာကြည့်တိုက်များသို့ ဖြန့်ဝေပေးပါသည်။ ယခုနှစ်တွင် CD များအဖြစ် ဆက်လက်ထုတ်ဝေဖြန့်ဖြူးမည်ဖြစ်ပါသည်။ ထို့အပြင် မြန်မာနိုင်ငံ၏ သုတေသနလုပ်ငန်းဆောင်ရွက်ချက်များကို နိုင်ငံအများအပြားမှ ဖတ်ရှုလေ့လာခွင့်ရရှိရန်အလို့ငှာ ယခုနှစ်များကဲ့သို့ Internet တွင်လည်း ထည့်သွင်းပေးရန် စီစဉ်ဆောင်ရွက်မည်ဖြစ်ပါသည်။

သတ္တမအကြိမ်နှစ်ပတ်လည်သုတေသနညီလာခံ

မြန်မာနိုင်ငံ၊ စိုက်ပျိုးရေး၊ သစ်တော၊ မွေးမြူရေးနှင့်ရေလုပ်ငန်းပညာရှင်အဖွဲ့၏ သတ္တမအကြိမ် သုတေသနညီလာခံကို ၂၀၀၈ ခုနှစ်၊ ဇူလိုင်လ (၂၅)ရက်မှ (၂၇)ရက်နေ့အထိ နေပြည်တော်၌ ပထမအကြိမ်အဖြစ် စတင်ကျင်းပပြုလုပ်ခဲ့ပါသည်။ ဖွင့်ပွဲအခမ်းအနားသို့ လယ်ယာစိုက်ပျိုးရေးနှင့်ဆည်မြောင်းဝန်ကြီးဌာနဝန်ကြီး ဗိုလ်ချုပ်ဌေးဦး၊ သစ်တောရေးရာဝန်ကြီးဌာနဝန်ကြီး ဗိုလ်မှူးချုပ်သိန်းအောင်၊ မွေးမြူရေးနှင့်ရေလုပ်ငန်းဝန်ကြီးဌာန ဝန်ကြီးဗိုလ်မှူးချုပ်မောင်မောင်သိမ်းနှင့် ဝန်ကြီးဌာန (၃)ခုအောက်ရှိ ညွှန်ကြားရေးမှူးချုပ်များ၊ ဦးဆောင်ညွှန်ကြားရေးမှူးများ၊ ပါမောက္ခချုပ်များ၊ ပညာရှင်အဖွဲ့ဥက္ကဋ္ဌနှင့် ဒုဥက္ကဋ္ဌများ၊ ပညာရှင်အဖွဲ့ဝင်များ၊ သုတေသနစာတမ်းရှင်များ၊ အထူးဖိတ်ကြားထားသောလယ်ယာ၊ သားငါး၊ သစ်တောကဏ္ဍဆိုင်ရာ စီးပွားရေးနှင့်လူမှုရေးအဖွဲ့အစည်းများ၊ တာဝန်ရှိပုဂ္ဂိုလ်များ၊ ဌာနဆိုင်ရာနည်းပညာရှင်ဝန်ထမ်းများ စုံညီစွာ တက်ရောက်ပါသည်။ အခမ်းအနားတွင် လယ်ယာနှင့်ဆည်မြောင်းဝန်ကြီးဌာနဝန်ကြီး ဗိုလ်ချုပ်ဌေးဦးမှ မိန့်ခွန်းပြောကြားပြီး ဖွင့်လှစ်ပေးပါသည်။

နံနက် (၀၉း၃၀) နာရီတွင် ဖွင့်ပွဲအခမ်းအနားပြီးဆုံးပြီးနောက် သက်ဆိုင်ရာဝန်ကြီးများ၊ ပညာရှင်အမှုဆောင်အဖွဲ့ဝင်များမှ မှတ်တမ်းတင်ဓါတ်ပုံရိုက်ကူးကြပါသည်။ ၎င်းနောက် ဝန်ကြီးများ၊ ဌာနဆိုင်ရာအကြီးအကဲများ၊ ပညာရှင်အဖွဲ့ဝင်များ၊ သုတေသနစာတမ်းရှင်များနှင့် ဧည့်သည်တော်များကို ဧည့်ခံကျွေးမွေးပါသည်။ သုတေသနစာတမ်းဖတ်ပွဲများကို နေပြည်တော်ရေဆင်း၌ မိမိတို့သက်ဆိုင်ရာကဏ္ဍအလိုက် အစည်းအဝေးခန်းမများတွင် ဆက်လက်ပြုလုပ်ကျင်းပခဲ့ပါသည်။

မွေးမြူရေးနှင့်ရေလုပ်ငန်းပညာရပ်ဆိုင်ရာသုတေသနညီလာခံ

မွေးမြူရေးနှင့်ရေလုပ်ငန်းပညာရပ်ဆိုင်ရာ သုတေသနညီလာခံကို နေပြည်တော် မွေးမြူရေးနှင့်ရေလုပ်ငန်းဝန်ကြီးဌာနဝန်ကြီး၏ ဝန်ကြီးရုံး စည်းဝေးခန်းမ၌ နံနက် (၁၁း၀၀) နာရီတွင် ဆက်လက်ကျင်းပပြီး၊ မွေးမြူရေးနှင့်ရေလုပ်ငန်းဝန်ကြီးဌာနဝန်ကြီးက အဖွင့်အမှာစကား ပြောကြားပါသည်။

မြန်မာနိုင်ငံ၊ စိုက်ပျိုးရေးသစ်တော၊ မွေးမြူရေးနှင့်ရေလုပန်ငန်းပညာရှင်အဖွဲ့.
မွေးမြူရေးနှင့်ရေလုပ်ငန်းဝန်ကြီးဌာနဝန်ကြီး ဗိုလ်မှူးချုပ်မောင်မောင်သိမ်း
မြွတ်ကြားသည့်မိန့်ခွန်း

မွေးမြူရေးနှင့်ရေလုပ်ငန်းကဏ္ဍပညာရှင်အဖွဲ့ကို ၁၉၉၉ ခုနှစ်မှစ၍ ဖွဲ့စည်းခဲ့သော အချိန်ကစပြီး သုတေသနညီလာခံကို နှစ်စဉ်မပြတ်ကျင်းပခဲ့သည်မှာ ဒီနေ့ကျင်းပမည့် သုတေသနစာတမ်းဖတ်ပွဲဆိုရင်း သတ္တမအကြိမ်သို့ ရောက်ရှိခဲ့ပြီးဖြစ်ပါတယ်၊ နိုင်ငံတော်ရဲ့ စီးပွားရေးတိုးတက်ဖွံ့ဖြိုးရေးလုပ်ငန်းများတို့ကို အကောင်အထည်ဖော်ရာမှာ သားငါးထုတ်လုပ်မှုကဏ္ဍဟာ အင်မတန်မှအရေးပါတယ်ဆိုဒါ အထူးပြောစရာမလိုအပ်ပါဘူး၊ သားငါးထုတ်လုပ်မှုကို ဆန်းစစ်ကြည့်မယ်ဆိုရင် အခြားသော သယံဇာတများကို ထုတ်ဖော်သကဲ့သို့ လျော့ကျခြင်းမရှိဘဲ နည်းစနစ်မှန်မှန်ကန်ကန်ကို အသုံးပြုထုတ်သွားနိုင်မယ်ဆိုရင် လျော့ကျသွားနိုင်မယ်မဟုတ်သည့်ပြင် ပို၍သာတိုးတက်လာမှာဖြစ်ပါတယ်၊ ဒါကြောင့် နှစ်စဉ်တိုးတက်လာမည့် လူဦးရေအတွက် အာဟာရ လုံလောက်မှုရရှိစေရန် သားငါးထုတ်လုပ်မှုကဏ္ဍဟာ အားအထားရဆုံးသော ကဏ္ဍတစ်ခုဖြစ်ပါတယ်၊ ဒါကြောင့် မွေးမြူရေးနှင့်ရေလုပ်ငန်းကဏ္ဍမှာ တိုက်ရိုက်ပါဝင်ဆောင်ရွက်နေကြသော အသိပညာရှင် အတတ်ပညာရှင်များအနေနဲ့ မိမိတို့တတ်ကျွမ်းထားကြတဲ့ ပညာရပ်ဖြင့် နိုင်ငံတော်၏ တိုးတက်ဖွံ့ဖြိုးရေးလုပ်ငန်းတို့ကို စွမ်းစွမ်းတမန်ဆောင်ရွက်ပေးကြပါလို့ တိုက်တွန်းလိုပါတယ်၊ ဝါရင့်ပညာရှင်ကြီးများအနေနဲ့ ဆည်းပူးရရှိလာတဲ့ အတွေ့အကြုံများ အသိပညာအတတ်ပညာရပ်တို့ကို မျိုးဆက်သစ်လူငယ်များတို့အား ထပ်ဆင့်လက်ကမ်းမျှဝေပေးပြီး ရေရှည်တည်တံ့တဲ့ အသားကဏ္ဍနဲ့ ငါးထုတ်လုပ်မှုကို ဆောင်ရွက်ပေးသွားကြပါလို့ တိုက်တွန်းလိုက်ရတယ်၊

လူသားများတို့ အသက်ရှင်နေထိုင်နိုင်ရန်အတွက် လိုအပ်တဲ့ အာဟာရဓာတ်များဖြစ်တဲ့ ကစီဓာတ်၊ အဆီဓာတ်နဲ့ အသားဓာတ်များကို အသားနှင့်ငါးများတို့မှာသာ အဓိကရရှိနိုင်မည်ဖြစ်ပါတယ်၊ ကလေးသူငယ်များ သန်မာထွားကြိုင်းပြီး ဉာဏ်ရည်ဖွံ့ဖြိုးတိုးတက်စေရန်အတွက် လိုအပ်တဲ့ ဗီတာမင်ဓာတ်များ သတ္တုဓာတ်များတို့ကိုလည်း အသား၊ ငါး၊ ဘဲဥနဲ့ နို့များမှ အများဆုံးရရှိနိုင်ပါတယ်၊ ယခုအခါ မွေးမြူရေးလုပ်ငန်းတွေမှာ နှစ်ရှည်လများ အသုံးပြုလာခဲ့တဲ့ ဓါတုဆေးဝါးပစ္စည်းများ၊ ပဋိဇီဝပစ္စည်း ဆေးဝါးများအထဲမှာ ရုပ်ကျင်းပစ္စည်းများ (Residues) အဖြစ် ကျန်ရစ်နေပြီး စားသုံးသူများအတွက် ကျန်းမာရေးကို ထိခိုက်နေသည်ကို တွေ့ရပါတယ်၊ ဒါကြောင့် ဒီပြဿနာကို ဖြေရှင်းဘို့အတွက် (Biofarming) ကို တခေတ်ဆန်း ပြန်လည်

ဆောင်ရွက်လာကြပါတယ်၊ မွေးမြူရေးနဲ့ရေလုပ်ငန်းပညာရှင်များတို့ အနေနဲ့လည်း နိုင်ငံတကာနှင့် ရင်ဘောင်တန်းလိုက်နိုင်ဘို့ အမြဲတစေ အချိန်နှင့်အမျှ တိုးတက်ပြောင်းလဲနေတဲ့ ခေတ်မီ နည်းစနစ်များတို့ကို မျက်ခြေမပြတ်လေ့လာပြီး လက်တွေ့ဆောင်ရွက်သွားကြဘို့ လိုအပ်ပါတယ်၊

မွေးမြူရေးနဲ့ရေလုပ်ငန်းဝန်ကြီးဌာနအနေနဲ့ သားငါးကဏ္ဍဖွံ့ဖြိုးရေးနဲ့ ရေရှည်တည်တံ့ရေး ကို မျှော်ကိုးပြီး အသိပညာရှင်များ အတတ်ပညာရှင်များ ပေါ်ထွန်းလာစေရန်အတွက် နိုင်ငံခြား တိုင်းပြည်များမှာ အတွေ့အကြုံဗဟုသုတနဲ့ ဘွဲ့လွန်ပညာရပ်များ သင်ကြားတတ်မြောက်ရန် စနစ်တကျ စီစဉ်ဆောင်ရွက်လျက်ရှိပါတယ်၊ ၁၉၈၈ ခုနှစ်မှစ၍ ယနေ့အထိ နိုင်ငံခြားများ တက္ကသိုလ်မှာ မဟာသိပ္ပံဘွဲ့နဲ့ ပါရဂူဘွဲ့ရရှိခဲ့သူများက အသားကဏ္ဍမှ (၁၈) ဦးနဲ့ ငါးကဏ္ဍမှ (၇)ဦး ဖြစ်ပါတယ်၊ လက်ရှိနိုင်ငံခြားမှာ ဘွဲ့လွန်ပညာသင်ယူလျက်ရှိနေသူများကတော့ ဩစတြေးလျနိုင်ငံမှာ (၁) ဦး၊ ဂျပန်နိုင်ငံမှာ (၁၅) ဦး၊ မလေးရှားနိုင်ငံမှာ (၄) ဦးနှင့် ဂျာမဏီနိုင်ငံမှာ (၂) ဦး၊ ထိုင်းနိုင်ငံမှာ (၃) ဦး ဖြစ်ပါတယ်၊ ယခု ဆယ်နှစ်တာကာလအတွင်း မွေးမြူရေးနှင့်ရေလုပ်ငန်းကဏ္ဍရဲ့ ရာဇဝင်တစ်လျှောက်မှာ ထူးခြားစွာ ပညာရှင်အမြောက်အများကို မွေးထုတ်ပေးနိုင်တဲ့အတွက် မွေးမြူရေးနဲ့ရေလုပ်ငန်းဝန်ကြီးဌာနအနေနဲ့ များစွာနှစ်ထောင်းအားရမှု ဖြစ်ခဲ့ပါတယ်၊ ယခုလိုပညာရပ်အသီးသီးမှာ အသိပညာရှင် အတတ်ပညာရှင်များတို့ရဲ့ အရည်အချင်း ရော အရေအတွက်ပါ တိုးတက်လာခဲ့တဲ့အတွက် သားငါးထုတ်လုပ်မှုကဏ္ဍအနေနဲ့ နိုင်ငံတော်ရဲ့ ဖွံ့ဖြိုးရေးကို အင်တိုက်အားတိုက် ဆောင်ရွက်သွားနိုင်မယ်လို့ အလေးအနက်ယုံကြည်ပါတယ်။

ယခု သတ္တမအကြိမ် စာတမ်းဖတ်မယ့် အစီအစဉ်မှာ စာတမ်းပေါင်း (၁၈)စောင် ဖတ်ကြားတင်သွင်းကြမယ်ဖြစ်ပါတယ်၊ ၎င်းစာတမ်းများအနက် အသားထုတ်လုပ်ရေးကဏ္ဍမှာ (၁၁)စောင်၊ ငါးထုတ်လုပ်မှုကဏ္ဍမှာ (၆)စောင်နဲ့ ပျားထွက်ပစ္စည်းထုတ်လုပ်မှာ (၁)စောင် အသီးသီးပါဝင်ဒါ တွေ့ရပါတယ်၊ ယခုလို မွေးမြူရေးနှင့်ရေလုပ်ငန်းဝန်ကြီးဌာနမှာရှိတဲ့ ဦးစီးဌာန လုပ်ငန်းဌာနများ အသီးသီးတို့က မိမိတို့သက်ဆိုင်ရာ ကျွမ်းကျင်ထားတဲ့ပညာရပ်ကို မိမိတို့ရဲ့ လုပ်ဖော်ကိုင်ဖက်များနဲ့ နှီးနှောဆွေးနွေးလျက် ပညာခြင်းဖလယ်ဘို့ အခွင့်အရေးရတဲ့အတွက် ယခုလိုရတောင့်ရခဲတဲ့အခွင့်အရေးကို အကျိုးရှိစွာ အသုံးပြုကြပါလို့ တိုက်တွန်းလိုပါတယ်၊

မွေးမြူရေးနှင့်ရေလုပ်ငန်းပညာရှင်အဖွဲ့ရဲ့ ဆောင်ရွက်မှုကို သုံးသပ်ရရင် -

(က) နှစ်စဉ်ဖတ်ကြားတဲ့ သုတေသနစာတမ်းများကို Proceedings စာအုပ်များ ထုတ်ဝေနိုင်ခဲ့တဲ့အတွက် မွေးမြူရေးသုတေသီများ၊ စီးပွားရေးပညာရှင်များ၊ မဟာသိပ္ပံ/ပါရဂူဘွဲ့ယူမည့် ပုဂ္ဂိုလ်များ၊ သုတေသနကျမ်းပြုပုဂ္ဂိုလ်များအတွက် အသုံးဝင်တဲ့ ကိုးကားကျမ်းများအဖြစ် ရပ်တည်နိုင်သည်ကို တွေ့ရပါတယ်။ စာတမ်းများကို Internet တင်နိုင်တဲ့အတွက်လည်း ပြည်တွင်း/ပြည်ပ သုတေသနပညာရှင်များအတွက် များစွာအကျိုးရှိနိုင်မှာ တွေ့ရပါတယ်။

(ခ) အဆင့်မှီ သုတေသနစာတမ်းများပါရှိတဲ့အတွက် အဲဒီစာတမ်းများကို ရွေးချယ်၍ "Journal of Agricultural, Forestry, Livestock and Fishery Sciences" အမည်နဲ့ ၂၀၀၄ ခုနှစ်မှ စတင်၍ ဂျာနယ်ထုတ်ဝေနိုင်ဒါကိုလည်း တွေ့ရပါတယ်။

(ဂ) မွေးမြူရေးနှင့်ရေလုပ်ငန်းပညာရှင်များဟာ မိမိတို့ကျွမ်းကျင်တဲ့ပညာရပ်များနဲ့ မွေးမြူရေးဆိုင်ရာဆေးတက္ကသိုလ်မှာ ဘွဲ့ကြို/ဘွဲ့လွန်သင်တန်းများကို စာပေးပို့ချခြင်း၊ မဟာသိပ္ပံနှင့် ပါရဂူဘွဲ့လွန်သင်တန်းများရဲ့ ဘွဲ့လွန်ကျမ်းစာကို စစ်ဆေးပေးခြင်း၊ ပြင်ပစာစစ်ပုဂ္ဂိုလ်များအဖြစ် စစ်ဆေးပေးခြင်း၊ အခြားသိပ္ပံနှင့်ဝိဇ္ဇာ တက္ကသိုလ်များမှာလည်း ပါရဂူဘွဲ့ (Ph. D) ပါရဂူကျမ်းကြီးများကို စစ်ဆေးပေးခြင်းများ ဆောင်ရွက်ခဲ့ဒါ တွေ့ရပါတယ်။

ဒီကနေ့နဲ့ မနက်ဖန် (၂)ရက်တိုင် ကျင်းပမည့် စာတမ်းများအားလုံးအထဲမှ အကောင်းဆုံးစာတမ်းတစ်စောင်ကို ရွေးချယ်ပြီး ယခုနှစ် အောက်တိုဘာလမှာ ကျင်းပမည့် ကမ္ဘာ့ကုလသမဂ္ဂမှ ကျင်းပမည့် ကမ္ဘာ့စားနပ်ရိက္ခာနေ့ (World Food Day) အထိမ်းအမှတ် အခမ်းအနားမှာ ဆုချီးမြှင့်မည်ဖြစ်ပါတယ်၊ အဲဒီအကောင်းဆုံးစာတမ်းရွေးချယ်ရာမှာ အောက်ဖော်ပြပါအချက် (၅)ချက်အပေါ် အခြေခံအကဲဖြတ်သွားမှာ ဖြစ်ပါတယ်၊

၁။ သုတေသနလုပ်ငန်းဆောင်ရွက်ထားရှိမှု ပီပြင်လျက် တွေ့ရှိချက်များခိုင်လုံခြင်း၊
၂။ သားငါးထုတ်လုပ်မှုကဏ္ဍကို အကျိုးပြုသော စာတမ်းဖြစ်ခြင်း၊
၃။ သုတေသန ဆောင်ရွက်တွေ့ရှိချက်များတို့ကို လက်တွေ့အကောင်အထည်ဖော်နိုင်သောစာတမ်းဖြစ်ခြင်း၊
၄။ စာတမ်းတင်ပြမှုစနစ်ကျပြီး ပရိတ်သတ်များတို့ကို ဆွဲဆောင်မှုရှိခြင်း၊
၅။ မွေးမြူရေးနှင့်ရေလုပ်ငန်းဝန်ကြီးဌာန၏ သားငါးထုတ်လုပ်မှု မူဝါဒနှင့် ကိုက်ညီခြင်း စတဲ့အချက်များဖြစ်ပါတယ်။

နိဂုံးချုပ်အနေနဲ့မှာကြားလိုဒါကတော့ -

- သားငါးကဏ္ဍဖွဲ့ဖြိုးတိုးတက်စေရန်အတွက် ပညာရှင်များအနေနဲ့ ကိုယ်စွမ်းဉာဏ်စွမ်းရှိသရွေ့ အစွမ်းကုန်ဆောင်ရွက်ပေးကြပါ။

- ပညာရှင်များအနေနဲ့ မိမိတို့တတ်ကျွမ်းထားသော ပညာနဲ့ အတွေ့အကြုံများတို့ကို လက်တွေ့ ဆောင်ရွက်နေကြတဲ့ မွေးမြူရေးတောင်သူများ၊ ရေလုပ်သားများတို့ကို လက်ဆင့်ကမ်းပေးသွားကြပါ။

- မွေးမြူရေးနှင့် ရေလုပ်ငန်းဝန်ကြီးဌာနမှာရှိတဲ့ ဦးစီးဌာန၊ လုပ်ငန်းဌာနများတို့နဲ့ အစဉ်မပြတ်လက်တွဲပြီး လုပ်ငန်းတိုးတက်အောင်မြင်ရေးအတွက် တက်ညီလက်ညီ ဆောင်ရွက်ပေးကြပါ။

ယနေ့ မွေးမြူရေးနဲ့ရေလုပ်ငန်းကဏ္ဍမှာ ပါဝင်လျက်ရှိတဲ့ အသိပညာရှင်အတတ်ပညာရှင်များ အားလုံး နိုင်ငံတော်ရဲ့အကျိုးကို စွမ်းစွမ်းတမန်ဆောင်ရွက်နိုင်ကြပါစေလို့ ဆုမွန်ကောင်းတောင်းလျက် နိဂုံးချုပ်အပ်ပါသည်။

ယင်းနေ့ မွန်းတည့် (၁၂း၀၀) နာရီတွင် သုတေသနညီလာခံ၊ စာတမ်းများဖတ်ပွဲ/ဆွေးနွေးပွဲ ကို နေပြည်တော်၊ ရေဆင်း မွေးမြူရေးဆိုင်ရာ ဆေးတက္ကသိုလ်တွင် ဆက်လက်ကျင်းပပါသည်။

ပထမနေ့ နံနက်ပိုင်းတွင် မြန်မာနိုင်ငံတိရစ္ဆာန်ဆေးပညာကောင်စီ ဥက္ကဋ္ဌ ဒေါက်တာမြညွှန့်က သဘာပတိအဖြစ် ဆောင်ရွက်ခဲ့ပါသည်။ ယင်းနေ့လယ်မွန်းလွဲပိုင်းတွင် ဒေါက်တာခင်မမ (ဒုတိယပါမောက္ခချုပ်) နှင့် ဒေါက်တာမောင်မောင်စံ (အငြိမ်းစား ဒုတိယပါမောက္ခချုပ်) တို့က သဘာပတိအဖြစ် ဆောင်ရွက်ပါသည်။

ဒုတိယနေ့ နံနက်ပိုင်းတွင် ဒေါက်တာမြင့်သိန်း (ပါမောက္ခချုပ်) နှင့် မွန်းလွဲပိုင်းတွင် ဒေါက်တာတင်တင်မြိုင် (ဒုတိယပါမောက္ခချုပ်) တို့မှ သဘာပတိများအဖြစ် ဆောင်ရွက်ကြပါသည်။ ယင်းနေ့မွန်းလွဲပိုင်းတွင် ဒေါက်တာမင်းစိုး၊ ဒုတိယဥက္ကဋ္ဌ မြန်မာနိုင်ငံစိုက်ပျိုးရေး၊ သစ်တောနှင့်မွေးမြူရေးနှင့်ရေလုပ်ငန်းပညာရှင်အဖွဲ့မှ သဘာပတိအဖြစ် ဆောင်ရွက်ပြီး နိဂုံးချုပ်အမှာစကားပြောကြားပြီးနောက် ၂၀၀၈ ခုနှစ်၊ ဇူလိုင်လ (၂၆) ရက်နေ့ ညနေ (၃း၃၀) နာရီတွင် သုတေသနနှီးနှောဖလှယ်ပွဲအောင်မြင်စွာ ပြီးမြောက်ခဲ့ပါသည်။

Myanmar Academy of Agricultural, Forestry, Livestock

and Fishery Sciences

PROGRAMME FOR THE SEVENTH ANNUAL RESEARCH

CONFERENCE

25-26 July, 2008

University of Veterinary Science, Yezin,

Nay Pyi Taw

Inaugural Session

25 July 2008 (Friday)

11:30 – 11:50 Inaugural Address by H.E. Brigadier General Maung Maung Thein, Minister for Livestock and Fisheries

Livestock and Fishery Sector
Chairperson : Dr. Mya Nyun

11:50 - 12:10 (1) Prevalence Study of *Brucella melitensis* in Goat Serum at Y.C.D.C. Abattoir and Their Related Risk Factors (Mya The Phyu Thant, Aung Tun Khaing and Zin Mar Aung)

12:10 - 12:20 Discussion

12:20 - 12:40 (2) presence of the Antigen and Local Immune Response in the Upper Respiratory Tract of Broilers to Avian *Metapneumovirus* Subtype A and B (Ye Htut Aung, Uirich Neumann and Silke Ruatenchlein)

12:40 - 12:50 Discussion

12:50 - 13:50 Lunch Break

Chairperson : Dr. Khin Ma Ma

13:30 - 13:50	(3) Use of L-ascorbyl-2-monophosphate-Na Ca as a Vitamin C Source for Juveniles Kumura Shrimp, *Metapenaeus Japonicus* (Yin Yin Moe and Shunsuke Koshio)
13:50 - 14:00	Discussion
14:00 - 14:20	(4) The Study of Fermentation Characteristics and in *Vitro* Gas Production of *Leucaena* Silage (Zaw Lin, Aye Min New, Aung Aung, Tin Tin Myaing and Tin Ngwe)
14:20 - 14:30	Discussion
15:00 - 15:20	(5) Expanding Export, Profitability and Changing Resources : A Case Study of Small-scale Shrimp Fishing in Rakhine Coastal Area (Ikuko Okamoto and Khin Maung Soe)
15:20 - 15:30	Discussion
15:30 - 15:50	Coffee Break
15:50 - 16:10	(6) The Successful Control of *Leucaena* (Bawzagaing) Toxicosis in Myanmar Sheep with Freeze-dried IBT Goellinger Bioreactor Grown *Syngestes jonessi* (Aung Aung, Tin Ngwe, Udo test Meulen and Helge Bohnet)
16:10 - 16:20	Discussion
16:20 - 16:40	(7) Evaluation of Elephant Grass, *Pennisetum purpureum* C.V Marker Through *in-vitro* Gas Production Using Rumen Inoculum of Fistulated Bull (Tin Ngwe, Aye Aye Khine, Myo Kywe, Khin San Mu and Mar Mar Kyu).
16:40 - 16:50	Discussion
16:50 - 17:10	(8) The Study on Quality and Safety Production of Some Value-added Seafood (Khin Maung Win).
17:10 - 17:20	Discussion
19:00 - 09:20	(9) Effect of Groundnut and Black Gram Residues on *in-situ* Degradation and Rice Straw and Wheat Straw Based Diets (Tin Maung Soe, Khin San Mu and Tin Ngwe)
09:20 - 09:30	Discussion
09:30 - 09:50	(10) Surgical Correction of Prolapsed Membrane Nictitans Glands (Myint Wynn)
09:50 - 10:00	Discussion

10:00 - 10:20	(11) Verification Studies of Food Safety Hazards in Dried Snake-head Fish Products (Tint Wai)
10:20 - 10:30	Discussion
10:30 - 10:50	Coffee Break
10:50 - 11:10	(12) Studies on the Effective Components in Silkworm Pupa Meal as Feed Ingredients for Common Carp *(Cyprinus carpio)* (Aung Naing Oo and Shuichi Satoh)
11:10 - 11:20	Discussion
11:20 - 11:40	(13) Duck Male Family Selection (Tin Nwe Yi)
11:40 - 11:50	Discussion
11:50 - 12:50	Lunch Break

Chairperson : Dr. Tin Tin myaing

12:50 - 13:10	(14) ပျားနို့ အမြောက်အများ ထုတ်ယူနည်းများနှင့် အသုံးဝင်ပုံကို လေ့လာခြင်းစာတမ်း (ဦးထွန်းမြင့်နှင့်ဦးစောအောင်မြင့်)
13:10 - 13:20	Discussion
13:20 - 13:40	(15) Effect of Equilibration Period on Viability of Frozen-thawed Striped Catfish *(Pangasius hypophthalmus)* Spermatozoa (Myint Wai, Myint Thein, Than Kyaw and Maung Chit)
13:40 - 13:50	Discussion
13:50 - 14:10	(16) A Comparative Study on the Effects of Different Leaf Protein Supplementation on the Performance of Pyar Zein Growing Calves Fed Rice Straw Based Diet (Yan Naing Soe and Mi Mi Thaw)
14:10 - 14:20	Discussion
14:20 - 14:40	(17) Selective Breeding and Proper Management of Village Chicken (Saw Plei Saw)
14:40 - 14:50	Discussion
14:50 - 15:00	(18) Words of Thanks by Dr. MinSoe, Vice President, Myanmar Academy of Agricultural, Forestry, Livestock and Fishery Sciences
15:00	Closing the Conference

Prevalence Study of *Brucella melitensis* in Goat Serum at Y.C.D.C Abattoir and their Related Risk Factors

Mya The Phyu Thant[1], Aung Tun Khaing[2] and Zin Mar Aung[3]

ABSTRACT

A survey was carried out on the seroprevalence of caprine brucellosis to compare the level of infection in the divisions that supply goat to the Y.C.D.C abattoir. The animals from which the sera collected come from Magwe and Mandalay divisions.

A total of 400 sera were collected and subjected to two serological tests (i.e. Rose Bengal Plate Test and Complement Fixation Test). Four hundred sera samples were screened using RBPT. Doubtful and positive results were further tested with CFT for confirmation. The serological prevalence derived from the samples positive to RBPT test was 4.25% but seroprevalence of CFT was 3%. The overall results was 3.63%. The overall results of prevalence of seropositivity in goat was stratified by sex and tested by using RBPT. The seroprevalence in male was significantly higher than in female $\chi^2 = 8.106$ ($P < 0.01$).

In male, the disease is more prevalent in goat with orchitis than male without orchitis. The seroprevalence is highly significant $\chi 2 = 27.031$ ($P < 0.01$).

The prevalence of disease in female was significantly higher than male in less than 2 years of age group. However, disease prevalence is significantly higher in male than female in over 2 years of age group. It can be assumed that older males and younger females are more susceptible to transmission of the disease.

In Myanmar, all goats which arrived to abattoir were slaughtered for human consumption. Before slaughter, all goats are kept together and disease contamination is of high risk to animal and after slaughter bacteria are exposed to human. According to findings in this study, females under 2 years and males with orchitis are more infective than others. In abattoir, no preslaughter examination related to brucellosis was made and workers employed in slaughter house are highly exposed to disease.

At the village level the intermingle of flocks of animal for grazing and the movement of breeding animals between flocks provide the possibility for the spread of the disease, and the region as a whole the trading of livestock between different regions would help spread of the disease.

As the incidence of caprine brucellosis is relatively low in Myanmar, adoption of vaccination programmers for sheep and goat should be considered later. In Myanmar, goat meat and milk is consumed after it is cooked and at the same time consumption of cheese made from goat milk is rare, transmission of disease from goat product may be very low to the consumers. Only those workers engaged in goat husbandry and goat meat industry have high risk.

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1 INTRODUCTION

Brucellosis is a disease of domestic livestock and wild animals with serious zoonotic implications in man causing huge economic losses to the livestock industry. Cattle, goats, pigs, sheep, horses and dogs play an important role in the transmission of this disease to man. It is defined as contagious systemic bacterial disease primarily of ruminants characterized by inflammation of the genital organs and foetal membranes, abortion, sterility and formation of localized lesion in the lymphatic system and joints (JOINT FAO/ WHO, 1986; Centers for Disease Control and Prevention, 2005).

Brucellosis is a chronic disease of animals caused by Gram negative and facultative non- motile intracellular bacteria of the genus Brucella (Cadmus, Ijagbone, Oputa, Asokean and Stack, 2006). Brucellosis has been an emerging disease since the discovery of Brucella melitensis by Bruce in 1887. Six species occur in humans and animals: *Brucella abortus*, *Brucella melitensis*, *Brucella ovis*, *Brucella suis*, *Brucella canis* and *Brucella neotomae* (Monaya and Reka, 2006; Osman, Huseyin, Hasan and Mehment, 2005).

In humans, Brucellosis can be caused by *B.melitensis*, *B.suis* and rarely, *B. cansis* (Monaya. *et.a.l,* 2005). Shehata, Adib and A1–Anzi (2001) stated that brucellosis was transmitted to the human population mostly as an occupational disease. People that have contact with infected animals may become infected with Brucella bacteria through a break in the skin and also spread by eating or drinking unpasturized milk, cheese and ice-cream that came from infected animals (Alfred De Maria, 2002).

Clinically, the disease is characterized by one or more of the following signs abortion, retained placenta, orchitis, epididymitis and rarely arthritis with excretion of the organisms in uterine discharges and in milk (OIE, 2008). Brucella infection has a predilection for both female and male reproduction organs in sexually mature animals. Organisms shed by infected animals, can remain viable in a moist environment for many months (Quinn, Markey, Carter, Donnelly and Leonard, 2003).

Transmission of *B.melitensis* from flock to flock usually follows the movement of infected pregnant females. The incubation period after infection varies from 15 days to several months depending on the invasion site and the infection dose. Abortion usually occurs at 3-4 months into pregnancy (F.A.O, 2006).

Brucellae are sensitive to direct sunlight, disinfectant and pasteurization. In optimal conditions Brucellae survive in tap water, damp soil, urine, aborted fetuses and uterine exudates and in frozen tissue (F.A.O, 2006).There is no vaccine against brucellosis currently available for humans; however, there is a vaccine available for animals (Alfred De Maria, 2002).

Brucella species represent a significant biohazard to laboratory workers and others at occupatational risk such as veterinarians, abattoir workers and farmers. Personnel working in slaughter houses have the potential of being exposed to animals infected with brucellosis. The risk of handling infected animals in abattoir is always high (F.A.O, 2003).

Prevention of human brucellosis depends on the control of the disease in animal (Corbel, 1997). Every sheep/goat older than 6 months must be tested for presence of specific Brucella antibodies, all positive reactors are culled. Male animals are tested by serology once yearly and it found positive, are slaughtered (Taleski, Zerva, Kantardjiev, Cventnic, Erski-Biljic, Nikolovski, Bosnjakovski, Katalinic-Jankovic, Panteliadou, Stojkoski and Kirandziski, 2002).

Brucellosis typically cannot be diagnosed clinically, as it is required the laboratory diagnostic procedure approached (Alton, Jones, Angus and Verger, 1998). The Rose Bengal Plate Test and the Complement Fixation Test are the most widely used methods for detecting infection with *Brucella melitensis* (Quinn, *et.al.*, 2003). RBPT is a simple dilution method which is simple and rapid. The C.F.T is considered to be the most effective test for diagnosing brucellosis in small ruminants (Joint F.A.O/W.H.O, 1986). The CFT is very specific (OIE, 2008). Treatment of brucellosis may be difficult (C.D.C, 2005). For effective zoonotic disease monitoring, surveillance and reporting, animal and human health services must be closely connected to develop the best possible information on population at risk. There is, thus, a need to share the information to governmental agencies (Charisis, 1998).

The purpose of this study was to investigate the disease in livestock and animal workers to access the current infection rates and the risk in human population and to provide useful information for future recommendations for the control of brucellosis.

2. MATERIALS AND METHODS

A cross- sectional survey was undertaken over a period of one month. A number of existing cases of serum antibodies for brucellosis was measured. A sample of goats arriving at the Y.C.D.C abattoir intended to be killed were used for the estimation of disease prevalence. The approximate sample size was calculated by using the following formula described by Thrusfield (1995). A sample population (384) had been calculated from the infinite population.

$$n = \{1 - (1-\alpha)^{1/d}\}\{N - d/_2\} + 1$$

Where N is the population size

d is the number of affected animals in the population

n is the required sample size

α is the desired confidence level (probability of finding at least one case in the sample)

Main study area was at the Y.C.D.C abattoir. However, the serosurveillance were selectively carried out with the animals coming from Mandalay and Magwe divisions (four regions). Two hundred animals from each division were investigated for the seroprevalence. Jugular blood (3-5ml) from each animal was collected using disposable syringes and needles. Sera were separated and RBPT were done within 6 hours. The rest of the sera were stored at 4°C until the further tests were done.

Sera were evaluated using the following serologic tests; Rose Bengal Plate test (RBPT) and complement fixation test (CFT) using whole-cell antigen of *Brucella abortus* strain 1119-3 prepared by the method of Alton *et al.*, (1988).

Statistical analysis

Data on various individual were analysesd by using SPSS 11.5 software and Win Episcope 2.0, and graphics were constructed by using Excel. Relationship of gender, age groups and divisions were assessed indepently with the chi- square test. The point estimates of seroprevalence are reported as percentages with 95 percent confidence intervals.

3 RESULTS

Serum samples were collected from 400 animals within one month. One hundred samples were collected at every week. Sera samples were analyzed after each collection. The final sampling including information on age, sex, sources of location and seroprevalence.

3.1 Seroprevalence

The result of Seroprevalence detected by RBPT and CFT are shown in table 1. A Total of 400 samples were tested by RBPT as a screening test. Positive samples in screening test were confirmed by complement fixation test. The animals that were positive to CFT were considered to be affected. Overall results of prevalence are 4% are shown in Table 1.

Table 1. Overall results of brucellosis

Sr No	Township	RBPT (+) ve				CFT (+) ve			
		Under 2 yrs	Over 2 yrs	Male	Female	Under 2 yrs	Over 2 yrs	Male	Female
1	Meikhtila	3	3	2	4	2	2	2	2
2	Pakokku	2	4	3	3	1	3	1	3
3	Myingyan	3	1	2	2	2	1	1	2
4	Taungdwingyi	-	1	-	1	-	1	-	1
TOTAL		8	9	7	10	5	7	4	8

3.2 Prevalence between male and female

Seropositivity in goats was stratified by sex and results are shown in Table 2. The seroprevalence in male was significantly higher $\div^2 = 8.106$ ($P < 0.01$) than in female.

Table 2. Seropositivity between male and female

Sex	RBPT			CFT		
	(+)ve	(-)ve	Seropositivity(%)	(+)ve	(-)ve	Seropositivity(%)
Male	7	58	10.77	4	61	6.15
Female	10	325	2.99	8	327	2.39

3.3 Prevalence between different localities

Seroprevalence between different localities are shown in table 3. There is no significant difference between two localities. Two hundred serum samples were collected from goats of Mandalay division and another two hundred samples were collected from goats of Magwe division. Seroprevalence was confirmed by C.F.T, it was 3.5% in Mandalay and 2.5% in Magwe division .There is no significant difference of seroprevalence between two different localities ($P>0.05$).

Table 3. Seropositivity between different localities

Location	RBPT			CFT		
	(+)ve	(-)ve	Seropositivity(%)	(+)ve	(-)ve	Seropositivity(%)
Mandalay	10	190	5	7	193	3.5
Magwe	7	193	3.5	5	195	2.5

3.4 Seroprevalence of goats between over and under 2 years of age

To know the difference between age susceptibility of brucellosis in goats, stratification between goats under 2 years and over 2 years was made and studied. Results of seroprevalence of under 2 years in goat are 2.5% and over 2 years in goat is 3.5% are shown in Table 4. There is a significant difference between two different ages.

However, in female, the prevalence of the disease was significantly higher than male in less than 2 years of age group. But, in contrary, disease prevalence is significantly higher in male than female in over 2 years of age group. Therefore, it can be assumed that older males and younger females are more susceptible to transmission of the disease.

Table 4. Seropositivity between under 2 yrs and over 2 yrs of ages

Age	RBPT			CFT		
	(+)ve	(-)ve	Seropositivity(%)	(+)ve	(-)ve	Seropositivity(%)
Under 2 yrs	8	269	4	5	272	2.5
Over 2 yrs	9	114	4.5	7	116	3.5

3.5 Seroprevalence of goats between with orchitis and without orchitis of disease

In male, the disease is more prevalent in goat with orchitis than male without orchitis. The seroprevalence is highly significant($\div^2$=27.013, P<0.01) .

Table 5. Seropositivity between with orchitis and without orchitis

Disease status	RBPT		CFT	
	(+)ve	(-)ve	(+)ve	(-)ve
With orchitis	4	1	4	1
Without orchitis	3	57	-	60
	7	58	4	61

4 DISCUSSION

The objectives of this study were to improve the understanding of the prevalence of brucellosis in goats which arrived to YCDC abattoir from various parts of Myanmar and also to provide information for disease control in livestock and human beings. Seropositivity was considered to be due to natural infection because vaccination had never been employed in Myanmar. The results showed that brucellosis was endemic in goats and evenly distributed in Mandalay and Magwe divisions.

True prevalence is lower than the apparent prevalence i.e. 3% and 4.25%. The sensitivity for RBPT was 100%. The results of the further testing of the suspicious and positive RBPT samples gives some guidance about the likely costs and benefits of an eradication programme. Thus 5 out of 17 positive goats were classed as false positive by the CFT ,the sensitivity of RBPT is similar to that of CFT(Stack and Mac Millan,2003) and RBPT is to be referred as a screening test, largely because it dose not require expensive equipment and is cheaper and needs less laboratory equipments.

The overall prevalence detected in goats at YCDC abattoir was 4.25% and it does not agree with Singh, Gupta, Shankar, Vihan and Tiwari (1998). They stated that incidence in goats slaughted in local goat abattoir in Agra (U.P) was 7.10%.

In this study, seropositivity in male is significantly higher than in female ($P<0.01$) detected by both diagnostics methods (Tables 1, 2 and 4). It does not agree with the findings of Jackson, Kennard, Ward,Stack, Domi, Romia and Dedushaj (2004). The seroprevalence stratified by sex and age of goats are shown in table (1), (2) and (4). They described the even distribution of prevalence in groups of sheep and goats of different ages although they expected that brucellosis would have been increased with age.

The seroprevalence among the different regions is described in table (1) and (3) but there is no significant difference of seroprevalence among the different localities. Jackson *et. al* (2004) elucidated the possible causes of seroprevalence among the different localities. They described that at the village level the mixing of flocks of animals for grazing and the movements of breeding animals between flocks provide opportunities for the spread of the disease, and in the region as a whole the trading of livestock between communities would help to spread the disease.

Banai (2007) described that aborted placenta and fetus are massively contaminated with Brucella and they lead to dissemination of the organisms in the environment and exposure of uninfected animals to the disease. The other reason is direct contamination of disease to susceptible animals. They another possible route of infection may occur through direct contact with infected flocks when common pasture is used. He also described that canides and other carnivores present special risk to intensively managed livestock as they scavenge and may carry aborted materials to clean areas.

In Myanmar, up to now, housing, management, nutrition and other practices in goat husbandry are nearly the same. Therefore, Prevalence of brucellosis is not significantly different in different localities. But if we can remove the possible risk factors which can cause disease, the prevalence will be reduced.

In this study we observed that male above two years of age and female under 2 years of age have high incidence of the disease . Teleski *et.,al.*(2002) stated that every sheep/goat older than 6 months must be tested for the presence of specific Brucella antibodies , all positive reactors should be culled . Male animals are tested by serology once yearly and if found positive, are slaughtered.It indicates that findings in this study agree with the suggestion of Teleski *et.,al.* Acording to finding in this study , male with orchitis should be culled and not allowed for sale. In abattoir, male with orchitis or epididymitis should be quarantined and destroyed.

Banai (2007) also stated that *B. melitensis* causes epididymitis and orchitis in the males and it can present another source of infection or transmission in flocks where natural mating is practiced. Human are highly susceptible to *Brucella melitensis*. At the same time *B. melitensis* is the major cause of infection in sheep and goat. Therefore, workers related to goat meat industry have high risk of infection. Since the bacteria are excreted in the milk, the requirement to remove the udder and internal organs from slaughtered cows would necessarily lead to exposure of the abattoir personnel to huge amounts of the organisms.

However, in Myanmar, workers related to goat meat industry have never been checked for incidence of the brucellosis. According to reports of other workers, worldwide, more than 500,000 new cases of human brucellosis occur each year (WHO,2006). The rate of laboratory acquired brucellosis to be 11.9 % (Sally and Culter, 2006), prevalence of this disease among veterinarians is about 22.5% (Mundi, Gill and Avapal, 2002) and the incidence of seropositivity was observed 2.0-12.5% among slaughter-house workers (Siimer, Z. Siimer, Alim, Nur and Ozdemir ,2003).

Brucella melitensis is the most virulent species of all the brucellae.The virulence is partly measured by their capability to cause brucellosis in cattle and human beings that are not considered natural or preferred host (Banai, 2007). At the same time bovine neutrophil were more bactericidal than human neutrophils but they kill rough organisms equally. Human neutrophils were less able to kill *B. melitensis* compared to *B. abortus* supporting the concept of greater virulence of *B.melitensis* than *B.abortus* in humans (Splitter, 2003). Humans easily contract *B.melitensis* due to the extremely low inoculums dose required to establish infection (Banai, 2007).

Thus, persons involved in the processing of animal products may be at high risk of exposure to brucellosis. These include slaughterman, butchers, meat packers, processor of hides, skin and wool and dairy workers. Direct and environmental contamination may present hazards through inhalation, ingestion, mucous contamination and skin contact or penetration.

In Myanmar, all goats which arrived at abattoir were slaughtered for human consumption. Before slaughter, all goats are kept together and disease contamination is of high risk to animal and after slaughter bacteria are exposed to human. According to findings in these study females under 2 years and males with orchitis are more infective than other. In abattoir, preslaughter examination has been carried out on clinical basis and therefore brucellosis may be over tooked and workers employed in slaughter house are highly exposed to disease.

At the village level the mixity of flocks of animal for grazing and the movement of breeding animals between flocks provide and possibility for the spread of the disease, and the region as a whole the trading of livestock between different regions would increase the spread of the disease.

An alterative explanation is that farmers sell animals that abort, either for slaughter or as a replacement elsewhere. In concern with the control of the disease, Jackson *et.al.*, (2004) described that the occurrence of the disease in people and the distribution of the prevalences among livestock, appeared to be spatially related. A better transmission pathway from animals to people, through the animal products, husbandry system and human behavior that affect the occurrence of the disease could be exploited in integrated control programmes aimed at reducing the exposure of people to the disease.

This study has provided useful information for future recommendation for the control of brucellosis both in field and in abattoir. As the incidence of caprine brucellosis is relatively low in Myanmar, adoption of vaccination programmers for sheep and goat should be considered later. In Myanmar, goat meat and milk is consumed after it is cooked and at the same time consumption of cheese made from goat milk is rare, transmission of disease from goat product may be very low to the consumers. Only those workers engaged in goat husbandry and goat meat industry have high risk.

5. REFERENCES

Alfred De Maria, 2002. Brucellosis, Public Health Fact Sheet.

Alton G.G.,L.M.Jones,R.D.Angus and J.M.Verger 1988.Techniques for the Brucellosis laboratory / NRA,Paris.

Banai.M, 2007; Control of Brucella melitensis (http://www.moag.gov.il/Burnet/ doc/ melcont.doc) accessed on-5.12.2007

Cadmus S.I.B., I.F.Ijagbone, H.e.Oputa,H.K.Adesokan and J.A.Stack, 2006.

Serological Survey of Brucellosis in livestock Animals and Workers in Ibadan, Nigeria. In African Journal of Biomedical Research, Vol 9: pp.163-168.

Centers for Disease Control and Prevention, 2005. Division of Bacterial and Mycotic Diseases.. Brucellosis. pp.1-3. (http://www.bt.cdc.gov/) accessed on-8/25/2006.

Charisis. N, 1998. Surveiliance and Control in the Mediterranean and middle east

region (WHO/MZCP Workshop).

Corbel.M.J, 1997. Brucellosis: an overview. 1st International Conference on

Emerging Zoonosis: In Emerging Infectious Diseases Vol .3, No.2

pp.1-16. (http://www.cdc.gov/ncidod/EID/vol 3 no 2/corbel.htm)

accessed on-3.9.2008.

Food and Agriculture Organization of the United Nations Animal Production and Health Paper, 2003. Guidelines for coordinated human and animal brucellosis surveillance. Surveillance of ovine and caprine brucellosis pp.1-6. (http://www.fao.org/documents/docrep) accessed on-5/3/2007.

Year of publications braches, should be nailed.

Food and Agriculture Organization of the United Nations Animal Production and Health Paper, 2006. Brucellosis Ovine/ Caprine Agriculure and Animal Health Diseases Cards pp.1-17

(http://www.fao.org/documents/docrep) accessed on-5/3/2007

Jackson. R.,L.Pite, R.Kennard,D.Ward,J.Stack,X. Domi,A. Romia and I.Dedushaj, 2004. Survey of the seroprevalence of brucellosis in ruminants in Kosovo.

Joint FAO/WHO, Expert Committee on Brucellosis, 1986. Technical Report

Series No.740, Sixth Report WHO, Geneva, Switzerland.

Monaya. E., K. Reka, 2005. Bovine brucellosis .National Institute of Animal

Health (NIAH) Kasetklang, Chatuchak, Bangkok 10900, Thailand.

Mundi, J.P.S, J.P.S.Gill and R.S. Avapal, 2002. Brucellosis symptoms, diagnosis,

treatment and control in animals and its implication in man.

Office International Des Epizooties Terrestrial Manual, 2008; chapter 2.3.1. Bovine Brucellosis. Bovine Disease in list B. pp.598-605.

Osman.E,H. Huseyin Hadimli, H.Solmaz and M.Corlu, 2005. Comparison Of

Rose Bengal Plate Test Antigens Prepared From BrucellaAbortus,

Brucella melitensis and Brucella suis.In Bull Vet Inst Pulaway 49,

pp.165-167,2005.

Quinn,P.J., B.K.Markey, M.E.Carter., W.J. Donnelly and F.C. Leonard, 2003.

Brusella species. In :Veterinary Microbiology pp.162-167.

Sally,J.C and R.R.Cutler, 2006. Brucellosis. The most common bacterial zoonosis?. Biomedical Scientist: pp.336-341.

Shehata, A., S.M. Adib, A.A. Al-Anzi, 2001. Risk factor and Clinical presentation of Brucellosis in Al–Jahra Hospital. Kuwait Medical Journal pp.44 - 47.

Siimer.H., Z.Siimer, A.Alim, N.Nur and L.Ozdemir, 2003. Seroprevalence of Brucella in an Elderly Population in Mid-Anatolia, Turkey.

Singh, S.V., N. Singh, V.K.Gupta, H.Shankar, V.S.Vihan and H.A. Tiwari, 1998. Seroprevalence of brucellosis in a few important Indian goat breeds.

Splitter.G.A, 2003. The Immune Response to Brucella. In brunet Publications. (http://www.fao.org/ag/agah/id/brunet-main/brunet/public-sub7- p3.html).

Stack.J.A and A.P.MacMillan, 2003. Brucella Serology. In BruNet Publications. (http://www.fao.org/ag/agah/id/brunet-main/brunet/public-sub7-p3.html).

Taleski.V., L. Zerva, T. Kantardjiev, Z. Cvetnic, M. Erski-Biljic, B. Nikolovski J. Bosnjakovski, V. Katalinic-Jankovic, A. Panteliadou, S. Stojkoski, T. Kirandziski, 2002. An overview of the epidemiology and epizootology of brucellosis in selected countries of Central and Southeast Europe. In Veterinary microbiology 90- P.P 147-155.

Thrusfield, M, 1995. Types of sampling. In: Veterinary Epidemiology 2nd education. Blackwell Science, USA.

ဆွေးနွေးချက်

Dr. မင်းစိုး

- Seroprevalenc test အရ (၂)နှစ်အောက်ငယ်သော ဆိတ်များတွင် (၃)% ခန့်ဖြစ်ပြီး(၂)နှစ်ထက်ကြီးသော ဆိတ်များတွင် ၇%ရှိခြင်းသည်မည်သည့် ကြောင့်ဟု ယူဆပါသနည်း။
- *Brucellosis* ကို ကုသခြင်းနှင့် ကြိုတင်ကာကွယ်ခြင်းများတွင် မည့်သည့် Antibiotics များက Sensitive ဖြစ်ပါသနည်း။

ဖြေကြားချက်

- Sexually matured ဖြစ်သော အကောင်ဖြစ်ခြင်းကြောင့်ဟု ယူဆပါသည်။
- Gram-negative ကို နိုင်သော Antibiotics ကို သုံးပါသည်။

Dr. မောင်မောင်စံ

- Chi-square analysis of the age incidence ကို မည်သည့်ကြောင့် သုံးပါ သနည်း။ R_{xy} ခေါ် Coefficient of Relationship ကိုသုံး၍ ရနိုင် ပါမည်လား။

ဖြေကြားချက်

- Chi-square test ကို သုံးခြင်းမှာ အသက် (၂)နှစ်အထက်နှင့် (၂)နှစ်အောက်ကို နှိုင်းယှဉ်ရန်လည်းကောင်း၊ အထီးနှင့်အမကို နှိုင်းယှဉ်ရန်လည်းကောင်း သုံးခြင်းဖြစ်သည်။

Dr. ယဉ်ယဉ်မိုး

- မြန်မာနိုင်ငံရှိ သားသတ်ရုံများတွင် ဈေးကွက်သို့ တင်ပို့မည့် ဆိတ်များကို Sacrifice မလုပ်မီ ရောဂါစစ်ဆေးခြင်းမရှိပါကြောင်း တွေ့ရှိရသည်။ ထို့ကြောင့် ဌာနဆိုင်ရာ အကြီးအကဲထံ တင်ပြ၍ မြန်မာနိုင်ငံသားသတ်ရုံ များတွင် လူတို့စားသုံးမည့် တိရစ္ဆာန်များကို ရောဂါစစ်ဆေးရန် စီစဉ် ဆောင်ရွက်သင့်ကြောင်း အကြံပြု တင်ပြ အပ်ပါသည်။

ဖြေကြားချက်

- အထက်လူကြီးများထံသို့ RBPT test နှင့် စမ်းသတ်ရန် ဆုံးဖြတ်ထားပါသည်။

Presence of the Viral Antigen and Local Immune Response in the Upper Respiratory Tract of Broilers to Avian Metapneumovirus Subtype A and B

Ye Htut Aung[1], Ulrich Neumann[2] and Silke Rautenschlein[2]

ABSTRACT

Swollen head syndrome associated with avian Metapneumovirus (aMPV) subtype A or B in broilers and broiler breeders has been reported worldwide. Since aMPV affects upper respiratory tract of broilers, local immune response in this tract might involve in the defence mechanism against aMPV. Most of the studies on immune mechanisms against aMPV have been conducted in turkeys but not in broilers. Therefore, two separate experiments were carried out to investigate local humoral and cell-mediated immunity (CMI) to aMPV subtype A and B in commercial broilers. Sixteen-day-old and 14-day-old commercial Ross type broilers free of aMPV maternal antibodies were used in the first and second experiment, respectively. Two groups of broilers were inoculated oculonasally with 10^4 median ciliostatic dose (CD_{50}) of turkey isolates of aMPV subtype A or aMPV subtype B. The third group received virus free trachea organ culture (TOC) supernatant. The distribution of aMPV genome in different tissues was investigated by RT-nested PCR. At 3 and 6-dpi, the viral genome was detected in both infected groups in the upper respiratory tract tissues such as nasal turbinate, Harderian gland and trachea. Subtype B genome was detected up to 10 to 11-dpi in Harderian gland or trachea in subtype B inoculated groups, whereas subtype A genome was cleared in subtype A inoculated groups after 6-dpi. In both experiments, VN-antibody titres in tracheal washes increased significantly at 6 dpi ($P<0.05$) in virus-inoculated broilers in comparison to virus free broilers. In both virus-inoculated groups VN-antibody titres in tracheal washes reached peak levels at 14 dpi in Experiment 1 and at 10 dpi in Experiment 2 and then declined gradually. The infiltration of CD4+ and CD8+ T cells in the Harderian gland was observed at 6 dpi and in the nasal turbinate epithelium at 6 and 11 dpi. Since massive infiltration of CD4+ and CD8+ T cells in the Harderian gland and nasal turbinate epithelium was observed in both subtypes-inoculated broilers, local CMI might play a critical role in the local antiviral response to aMPV infection in broilers. Overall, the present study indicates that both aMPV subtypes induced local humoral and CMI responses in the upper respiratory tracts of broilers, and local immunity might probably be major defence mechanism against aMPV infections in broilers.

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1. Introduction

Avian Metapneumovirus (aMPV), which causes Turkey Rhinotracheitis (TRT) in turkeys, is also associated with swollen head syndrome (SHS) in broilers and broiler breeders. Initially, SHS in broiler was thought to be due to combined infection of coronavirus and *Escherichia coli* (Morley and Thomson, 1984). Later TRT-like virus was isolated from hens and guinea fowl in France (Picault *et al.*, 1987) and from broilers in South Africa (Buys *et al.*, 1989a). SHS is mainly observed in broilers at 4 to 6 weeks of age and broiler breeder at 30 weeks of age. The infection causes high economic losses by increased mortality, increased medication costs, drop in egg production, and decrease in hatchability (Reviewed by Hafez, 1993; Naylor and Jones, 1993; Cook, 2000).

aMPV has a single-stranded, non-segmented, negative-sense RNA genome and is classified as a member of the subfamily *Pneumovirinae* under the family *Paramyxoviridae* (Pringle, 1998). The recently identified human Metapneumovirus also belongs to this virus subfamily (van den Hoogen *et al.*, 2001). Related viruses include human, bovine, ovine and caprine respiratory syncytial viruses and pneumonia virus of mice (Easton *et al.*, 2004). aMPV was first isolated in South Africa during the late 1970s (Buys *et al.*, 1989a,b). Only one serotype of aMPV has been identified and four different subtypes of aMPV have been differentiated by nucleotide sequence analysis on the basis of the attachment (G) protein (Juhasz and Easton, 1994) and neutralization test using monoclonal antibodies (Collins *et al.*, 1993; Cook *et al.*, 1993).

The cell-mediated immunity (CMI) to aMPV has not been studied well in broilers. Studies done in turkeys provide circumstantial evidence that CMI plays a major role in resistance to aMPV (Cook *et al.*, 1989; Williams *et al.*, 1991; Jones *et al.*, 1992). Vaccinated turkey poults without detectable aMPV antibodies were protected against challenge with virulent aMPV (Cook *et al.* 1989; Williams *et al.*, 1991). In addition, vaccinated turkey poults, which had been B cell depleted by cyclophosphamide treatment did not seroconvert, but were still protected against challenge with virulent aMPV (Jones *et al.*, 1992).

Experimental infection of turkey poults with different subtypes of aMPV stimulated the accumulation of CD4+ T cells subpopulations in the Harderian gland (Sharma and Gerbyshak-Szudy, 2002; Liman and Rautenschlein, 2007) and induced up-regulation of interferon γ (IFN-γ) transcript levels in the Harderian gland (Chary *et al.* 2002; Sharma *et al.*, 2004; Liman and Rautenschlein, 2007). In addition, aMPV subtype A and B induced local humoral antibodies in the tracheal wash of turkey poults (Liman and Rautenschlein 2007). IgA+ cells infiltrated in the nasal turbinate of turkeys exposed to aMPV C at 7 days post infection (Cha *et al.*, 2007).

There is increasing evidence that local immunity, specific humoral or CMI, in the respiratory tract of chickens play an essential role in protection against infections with Newcastle disease virus (Malkinson and Small 1977; Takada and Kida 1996) infectious bronchitis virus (Holmes, 1973; Gough and Alexander, 1979; Gillette 1981; Collisson *et al.*, 2000), and infectious laryngotracheitis (Fahey and York 1990). Since aMPV affects upper respiratory tract of chickens (Jones *et al.*, 1987; Majó *et al.*, 1995; Catelli *et al.*, 1998; Aung *et al.*, 2006a,b, 2007, 2008), we speculate that local immunity may play an important role in aMPV infection of broilers.

Most of the studies regarding local immune reactions to different subtypes of aMPV have been done in turkeys. However, not much is known about local immune responses of broilers to aMPV subtype A and B. On the other hand, SHS associated with aMPV subtype A or B in broilers and broiler breeders has been reported worldwide (Wyeth *et al.*, 1987; Cook *et al.*, 1988; Pattison *et al.*, 1989; Hafez and Löhren, 1990; Lu *et al.*, 1994; Mase *et al.*, 2003; Owoade *et al.*, 2006).

Therefore, the objective of this study is to compare local immune responses of broilers to experimental infections with virulent aMPV A and B of turkey origin. Investigation was made on local antibody responses in trachea washes. We also observed for local CMI by detection of T cells infiltrations in Harderian gland and in nasal turbinate epithelium was observed.

2. Materials and Methods

2.1. Viruses

A virulent aMPV subtype A (BUT 1- 8544 strain) and a virulent aMPV subtype B (Italian strain), both isolated from turkeys, were used in this study (kindly provided by Dr. R. C. Jones, Liverpool, UK). Both strains had been passaged various times in tracheal organ culture (TOC), and were then back-passaged in turkey poults to increase virulence. TOC rings prepared from 19 to 20-day-old SPF chicken embryos were used for propagation of the virus (Gough *et al.*, 1998). Both types of virus were propagated in separate tubes. No cross contamination occurred as confirmed by subtype specific RT-nested PCR. The propagated viruses were titrated in chicken TOC and the median ciliostasis dose (CD_{50}) was calculated by the method of Reed and Muench (1938).

2.2. Chickens

One-day old commercial Ross-type broilers were obtained from a local commercial hatchery (BWE-hatchery, Lower Saxony, Germany) and raised in the isolation units of the Clinic for Poultry, University of Veterinary Medicine Hannover, according to animal welfare guidelines and under strict biosecurity measures. Feed and drinking water were provided *ad libitum*.

2.3. Detection of the viral genome

The aMPV genome was detected in the nasal turbinate, Harderian gland and trachea samples by subtyping reverse transcriptase-nested-polymerase chain reaction (RT-nested-PCR) based on the attachment protein gene (G) sequence and allowed to differentiate aMPV A and B subtypes (Cavanagh *et al.*, 1999).

2.4. Sample collection for antibody detection

Parts of the trachea from glottis to syrinx at the level of the bifurcation were dissected. The trachea was clumped with two artery forceps at the region of larynx and syrinx. The trachea was washed with 750µl of phosphate buffered saline (PBS), which contained penicillin (100 U/ml) and streptomycin (100µg/ml) (Biochrom AG, Germany), using a 1 ml syringe and a 19 gauge (1.1 x 30 mm) injection needle. Tracheal washes were centrifuged at 3000 x *g* for 5 minutes and the supernatants were collected.

2.5. Detection of aMPV antibodies
2.5.1. Enzyme-Linked Immunosorbent Assays (ELISA)

aMPV-antibodies in samples were detected by a commercially available enzyme-linked immunosorbent assay (ELISA) system (Avian Rhinotracheitis Antibody Test Kit©, CK 120, BioChek, Netherlands) according to the manufacturer's recommendation. For the detection of specific aMPV-antibodies in tracheal washes, was modified the recommended dilution of the test sample; we used a dilution of 1:5 instead of 1:500 was used. The coating antigen in the ELISA kit was subtype B (Barend van Dam, BioChek B.V., Netherlands, Personal communication, 2007).

2.5.2. Virus Neutralization Test

aMPV specific neutralizing antibodies in trachea washes were detected by the β method of the virus neutralization test (with constant virus concentration of 10^2 TCID/ 50µl/well and serial 2-fold dilution of samples) in chicken embryo fibroblast (CEF) cells (Baxter-Jones *et al.*, 1989; Cook and Cavanagh, 2002). We used a CEF cells culture adapted aMPV subtype A strain BUT1-8544 for the VN test was used (Wilding *et al.*, 1986; Baxter-Jones *et al.*, 1989).

2.6. Immunohistochemical staining of immune cell populations

CD4+ and CD8+ cells in the frozen cryostat section of Harderian gland and nasal turbinate samples were detected by indirect immunohistochemical staining using the VECTASTAIN® *Elite* ABC Kit (Vector Laboratories, Inc., Burlingame, CA 94010 USA) with some modifications to the manufacturer's recommendation. Nasal turbinate and Harderian gland samples were sectioned (5µm) (Jung Frigocut 2800E, Leica Instruments GmbH, Nussloch, Germany) and mounted on SUPERFROST *ULTRA* PLUS® glass slides (Menzel GmbH & Co. KG, Braunschweig, Germany). For fixation, sections were immersed in ice-cold (-20°C) acetone for 10 minutes, and then air dried at room temperature for 10 minutes. After an endogenous peroxidase block (0.04% hydrogen peroxide for 5 min at room temperature), followed by a block of endogenous biotin or biotin-binding proteins using an avidin-biotin blocking kit (Vector Laboratories, Inc., Burlingame, USA). Following blocking of the Fc receptors with 3% normal mouse serum, tissue sections were incubated with the primary antibodies: CD4+ at 0.5µg/ml (1:1000) and CD8+ at 0.625µg/ml (1:800). All monoclonal antibodies were purchased from SouthernBiotech (Birmingham, USA). After 60 minutes of primary antibody incubation, 3 washing steps with PBS followed. Tissue sections were then incubated with (1.5%) secondary biotinylated antibody conjugate (Goat anti mouse IgG) for 30 min. After washing 3 times with PBS, sections were incubated with 1% Avidin DH and 1% biotinylated horseradish peroxidase H reagents (ABC reagent). After 3 washes with PBS, colour development was achieved by addition of 4% 3,3-diaminobenzidine (DAB) substrate (SK-4100; Vector Laboratories) containing 2% hydrogen peroxide and 2% buffer stock solution. Tissue sections were counter stained with hematoxylin for 5 minutes, mounted with aquatic mounting medium (Microscopy Aquatex®, Merck, Darmstadt, Germany), and covered with a coverslip. All antibodies used for immunohistochemical studies were diluted in PBS, and all incubation steps were carried out at room temperature.

All immunostained cells were counted in 5 randomly selected microscopic fields (400X magnification). The average number of positive cells per 400 x microscopic field was calculated for each cell type and sample.

2.7. Experimental design

Two experiments were carried out.

2.7.1. Experiment 1

One hundred and twenty one-day-old commercial Ross type broilers were used in Experiment 1. At 7 and 12-days of age, fifteen-serum samples were collected randomly and maternally derived aMPV-antibody titres were determined. At 16 days of age, when maternally derived aMPV antibodies of birds had waned, broilers were randomly divided into three groups (n=40). Chickens from the first group were inoculated oculonasally with 10^4 CD_{50} of aMPV subtype A, and chickens of the second group were inoculated with 10^4 CD_{50} of aMPV subtype B. The third group received virus-free TOC supernatant. All groups were maintained in separate isolation units. Five birds from each group were sacrificed at 3, 6, 11, 14, 17, 20, and 24 dpi, and tracheal washes were collected for assessment of specific aMPV-antibodies. Samples of nasal turbinate, Harderian gland, and the middle part of trachea were collected in TRIzol® for detection of the aMPV genome by RT-nested-PCR. Harderian gland and nasal turbinate samples were snap-frozen in tissue freezing medium® (Leica Microsystems Nussloch GmbH, Nussloch, Germany) for detection of CD4+ and CD8+ T cells by immunohistochemistry.

2.7.2. Experiment 2

This experiment was a repeat of Experiment 1 with 96 one-day-old Ross type broilers to confirm the observation made in Experiment 1. Five birds from each group were sacrificed at 3, 6, 10, 14, and 21 dpi and samples were collected for detection of the viral genome, aMPV antibodies, and for detection of CD4+ and CD8+ T cells by immunohistochemistry.

2.8. Statistical Analysis

The data obtained were analysed by one-way analysis of variance (ANOVA), and the differences between means were compared by Duncan's multiple range test (DMRT) using SPSS 11.5 (SPSS Inc., Chicago, IL). $P<0.05$ was considered as statistically significant.

3. Results

3.1. Distribution of the aMPV genome

The distribution of the aMPV genome in different respiratory tissues of broilers from Experiment 1 and 2 is summarized in Table 1. Both aMPV subtypes were detected at 3 and 6 dpi by RT nested-PCR in tissues of the upper respiratory tract such as nasal turbinate, trachea and Harderian gland. In subtype B-inoculated groups, the viral genome was detected in the trachea up to 11 dpi in Experiment 1, and up to 10 dpi in the Harderian gland in Experiment 2. No aMPV genome was detected at 14 dpi and later in either group of broilers. No aMPV genome was detected in virus free TOC-media-inoculated birds.

3.2. Development of VN and ELISA antibodies in tracheal washes

In both experiments, VN-antibody titres in tracheal washes increased significantly at 6 dpi ($P<0.05$) in virus-inoculated broilers in comparison to virus free broilers (Figure 1a). In both virus-inoculated groups VN-antibody titres in tracheal washes reached peak levels at 14 dpi in Experiment 1 and at 10 dpi in Experiment 2. After reaching peak level, VN-antibody titres in tracheal washes declined gradually. There was no significant difference between VN antibody titres of virus-inoculated groups and virus free control groups at 24 dpi (Experiment 1).

In subtype B inoculated broilers, ELISA antibody levels in tracheal washes reached peak levels at 14 to 17 dpi in Experiment 1, and at 10 dpi in Experiment 2. ELISA antibodies in trachea washes still remained peak level until the end of experiments (Figure 1b).

3.3. Number of CD4+ and CD8+ T cells in the Harderian glands and Nasal turbinate epithelium

Infiltration of CD4+ and CD8+ T cells in the Harderian gland and nasal turbinate was investigated by immunohistochemistry. In Harderian glands, the numbers of CD4+ T cells increased significantly ($P<0.05$) up to four-fold at 6 dpi in aMPV A and B-inoculated groups in comparison to virus free birds (Experiment 1). In Experiment 2, numbers of CD4+ cells were significantly higher ($P<0.05$) at 3 and 6 dpi in subtype B inoculated broilers, and at 6 dpi in subtype A inoculated broilers in comparison to virus free broilers (Figure 2a). CD4+ T cells infiltrated not only in a scattering pattern but also formed lymphoid clusters (Figure 4a and 4b).

In both experiments, numbers CD8+ T cells in the Harderian gland had increased significantly ($P<0.05$) two–three-fold at 6 dpi in aMPV A and B-inoculated groups in comparison to virus free controls (Figure 2b). CD8+ cells infiltrated mainly in a scattering pattern (Figure 5a and 5b).

Immunohistochemical analysis of snap-frozen nasal turbinate tissue revealed that aMPV subtype A and B-inoculated broilers had significantly higher($P<0.05$) numbers of CD4+ (four-five times) (Figure 3a) and CD8+ T cells (three-four times) than virus free control broilers between 6 and 11-dpi (Figure 3b) in both experiments. CD4+ cells had both clustered and scattered within the epithelium and lamina propria (Figure 6a and 6b), whereas CD8+ cells are diffusely scattered within the epithelium and lamina propria (Figure 7a and 7b).

4. Discussion

In this study, investigation was made on the distribution of the viral genome in the upper respiratory tract of broilers and local immune responses of broilers after experimental infections with subtype A and B aMPV of turkey origin.

Both aMPV A and B genome can be detected in upper respiratory tract tissues such as nasal turbinate, Harderian gland and trachea. Subtype B genome was detected longer persistence than subtype A. The presence of aMPV viral antigen in nasal turbinate and trachea of chickens had been demonstrated by using immunofluorescence (Jones *et al.*, 1987; Majó *et al.*, 1995), immunoperoxidase (Majó *et al.*, 1995; Catelli *et al.*, 1998) and RT-PCR (Shin *et al.*, 2000).

Tracheal washes have been used as an indicator for local humoral immunity in chickens (Parry and Aitken 1973; Powell *et al.*, 1979; Baba *et al.* 1990: Animas *et al.*, 1994; Javed *et al.*, 2005). Both subtypes transiently induce aMPV-VN antibodies in the trachea washes of broilers. VN-antibodies were also detected in tracheal washes of subtype A and B–inoculated turkey poults between 5 and 28 dpi (Liman and Rautenschlein 2007). The VN-antibody titres in trachea washes declined when the aMPV genome was cleared from the upper respiratory tract.

aMPV specific ELISA antibody titres of subtype B inoculated groups were significantly higher than that of subtype A inoculated groups. It has been demonstrated before that ELISAs based on subtype A or B antigens can detect antibodies raised against both subtypes, but the heterologous antibodies may be detected to a lesser extent (Eterradossi *et al.*, 1992; Bäyon-Auboyer *et al.*, 1999; Toquin *et al.*, 2000). The coating antigen of the ELISA kit, which was applied in the current experiments, was subtype B (Barend Van Dam, BioChek B.V., Netherlands, Personal communication, 2007). This may explain why ELISA titres in trachea washes of subtype B inoculated groups were higher than of subtype A inoculated groups in both experiments.

The present study indicates that tracheal washes contained aMPV-specific IgG. Ig A was not detectable in the ELISA system, because the conjugate was based on anti-chicken IgG. In the experimental studies with Newcastle disease virus, the mucosal secretion initially consist of Ig A, later IgG become predominant and inhibit virus replication in the trachea for 4 weeks (Aitken *et al.*, 1976; Ewert *et al.*, 1979). Similarly, after experimental infection with virulent infectious bronchitis virus, IgA appeared transiently in tracheal secretions, and later IgG becomes the principal immunoglobin (Gillette 1981; Hawkes *et al.*, 1983).

aMPV-VN-antibodies in the tracheal washes may have been locally synthesized or may have transuded from serum. There have been indications of transudation of serum antibodies onto mucosal surfaces (Aitken and Parry 1976; Toro *et al.*, 1993; Suresh and Arp 1995). On the other hand, the Harderian gland is a microenvironment, which may also support terminal B cells differentiation and immunoglobulin class switch (Mansikka *et al.*, 1989) leading to the secretion or synthesise of IgA, IgG, and IgM (Davelaar *et al.*, 1982; Baba *et al.*, 1990; Gallego *et al.*, 1992; Scott *et al.*, 1993). The induction of local antibodies detectable in tracheal washes coincides with massive infiltration of lymphoid cells in the respiratory mucosa and paraocular glands of both subtype-infected broilers. Therefore, most of the antibodies in the tracheal washes were probably synthesized by local B cells in the respiratory tract. Several reports had indicated the importance of local antibodies as a primary barrier at the respiratory mucosal surface against some respiratory pathogens, such as respiratory syncytial virus (Weltzin *et al.*, 1996) pseudorabies virus (Takada and Kida 1995) Newcastle disease virus (Takada and Kida 1996), and influenza virus (Liew *et al.*, 1984; Tamura *et al.*, 1988, 1990, Watanabe *et al.*, 2003).

Both subtypes induced a significantly increase ($P<0.05$) of up to four-fold of local CD4+ T cell numbers in the Harderian glands at 6 dpi. This finding is in agreement with previous findings in turkeys with aMPV C (Sharma and Gerbyshak-Szudy 2002) and with aMPV A and B (Liman and Rautenschlein 2007), where aMPV induced a transient increase of CD4+ T cells locally in the Harderian glands of turkey poults. T cells infiltrating the Harderian glands of turkeys were shown to be activated and produce cytokines (Chary *et al.*, 2002; Sharma *et al.*, 2004; Liman and Rautenschlein 2007). Similar cytokines response may also occur in broilers and this is an area of future studies.

The current study also demonstrated a two to three-fold increase in CD8+ T cell numbers in the Harderian gland of aMPV A and B-inoculated broilers at 6 dpi. CD8+ T cells are important contributors to viral clearance in respiratory virus infections, utilizing contact-dependent effector functions (perforin and CD95L) as well as IFN-γ and tumor necrosis factor-α (TNF-α) (Bruder *et al.*, 2006). We may speculate that CD8+ T cells may play also a role in controlling aMPV infections in broilers. Involvement of locally infiltrated CD8+ T cells in immune reactions of chickens against other respiratory pathogens, such as Newcastle disease virus (Russell *et al.* 1997), infectious bronchitis virus (Janse *et al.*, 1994; Collisson *et al.*, 2000), and *Mycoplasma gallisepticum* (Javed *et al.*, 2005) have been reported. However, the present finding was not in agreement with previous finding in turkeys, where CD8+ T cell numbers in the Harderian gland were not affected by the same aMPV strains (Liman and Rautenschlein 2007). This difference between broilers and turkey poults may provide a possible explanation why the aMPV genome was cleared relatively earlier in broilers than in turkey poults.

Our current study documents significantly increase of CD4+ and CD8+ T cells numbers in the nasal turbinate epithelium of aMPV subtype A and B-inoculated broilers in comparison to virus-free broilers on days 6 and 10 (Figure 6b and 7b). Most of the infiltrated lymphoid follicles are clusters of CD4+ cells. These cells probably play a role in limiting acute stage of aMPV infections in broilers. It is well known that CD4+ T cells are essential for the generation of antibody responses and influence cytotoxic responses as well (Arstila *et al.*, 1994).

In conclusion, this is the first study which detects local humoral and CMI responses of broilers to aMPV subtype A and B. The present study indicates that both subtypes induced local humoral and CMI responses in the upper respiratory tracts of broilers, and local immunity might probably be major defence mechanism against aMPV infections in broilers. The presence of the virus antigen in the upper respiratory tract may have stimulated lymphoid cell proliferation and aggregation in this tract. Since massive infiltration of CD4+ and CD8+ T cells in the Harderian gland and nasal turbinate epithelium was observed in both subtypes-inoculated broilers, local CMI play critical role in the local antiviral response to aMPV infection in broilers.

Table 1. Detection of the aMPV genome by RT-nested PCR (Experiment 1/Experiment 2)

Tissue samples	Detection of aMPV at days post inoculation of					
	3-dpi		6-dpi		11/10-dpi	
	aMPVA	aMPVB	aMPVA	aMPVB	aMPVA	aMPVB
Harderian gland	+/+*	+/+	+/-	+/+	-/-	-/+
Nasal turbinate	+/+	+/+	+/+	+/+	-/-	-/-
Trachea	-/+	+/+	+/-	+/+	-/-	+/-

*n=5. Total RNA was isolated from individual samples, then pooled per organ, group, and day. aMPV A: Broilers were inoculated with 10^4 CD_{50} of aMPV subtype A; aMPV B: Broilers were inoculated with 10^4 CD_{50} of aMPV subtype B. + = aMPV positive, - = aMPV negative. The aMPV genome could not be detected at 14 dpi and later. Virus free broilers are free of the viral genome throughout both experiments.

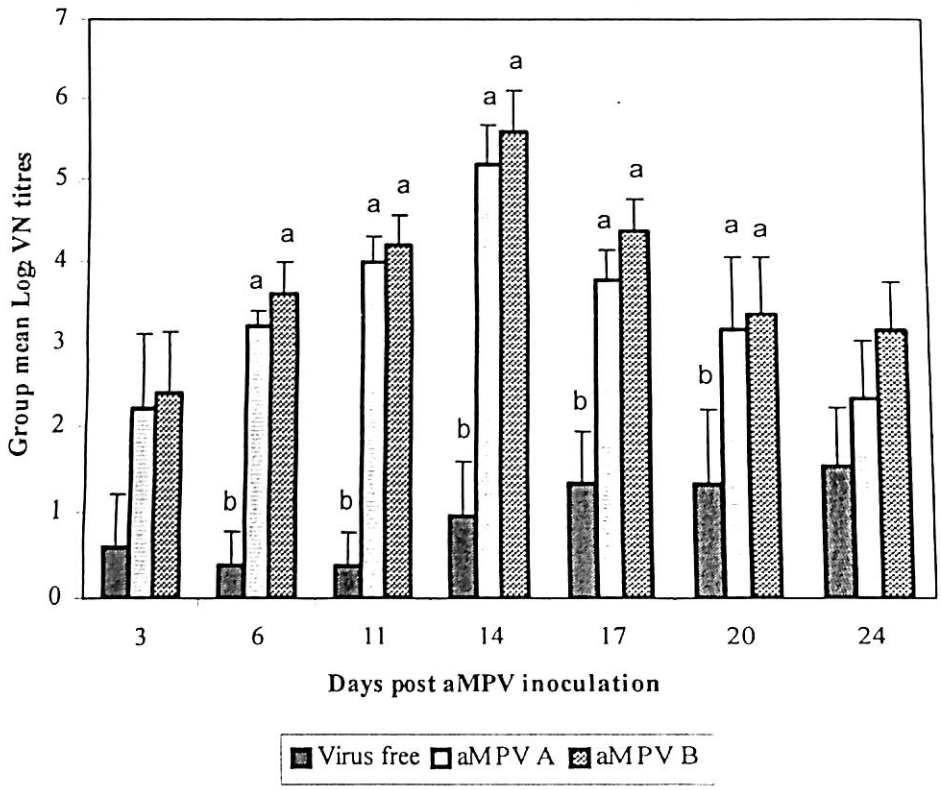

Figure 1a Trachea wash aMPV-VN titres in three groups of broilers (Experiment 1, as a representative experiment).

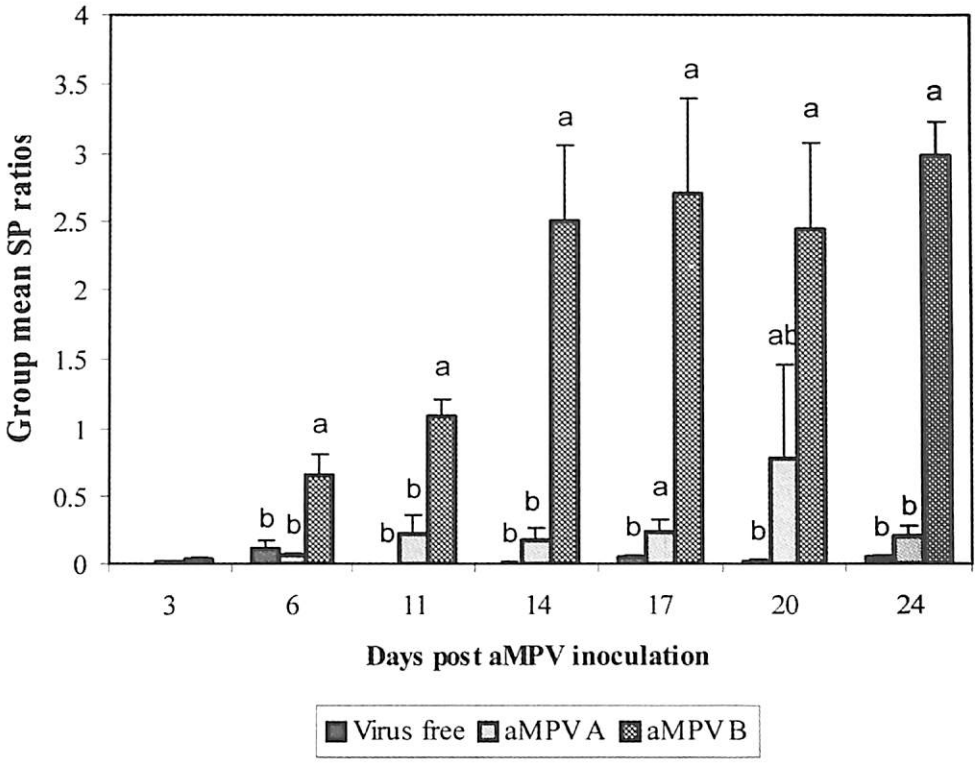

Figure 1b Trachea wash aMPV-ELISA titres in three groups of broilers (Experiment 1, as a representative experiment).

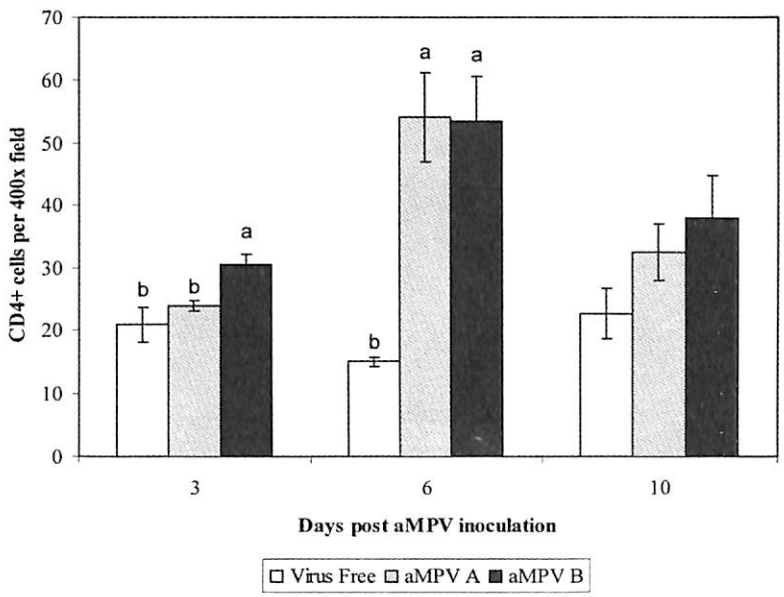

Figure 2a CD4+ cells in the Harderian glands of three groups of broilers (Experiment 2, as a representative experiment).

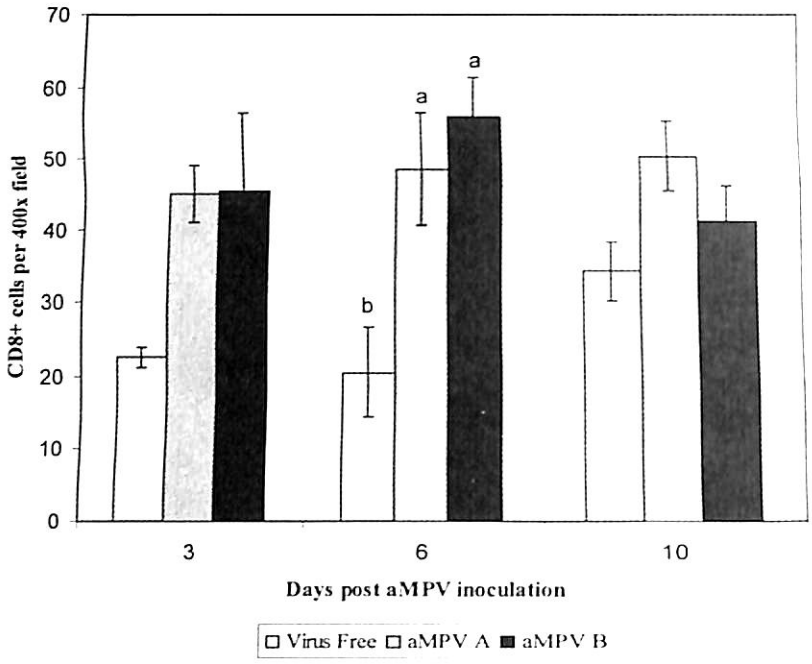

Figure 2b CD8+ cells in the Harderian glands of three groups of broilers (Experiment 2, as a representative experiment).

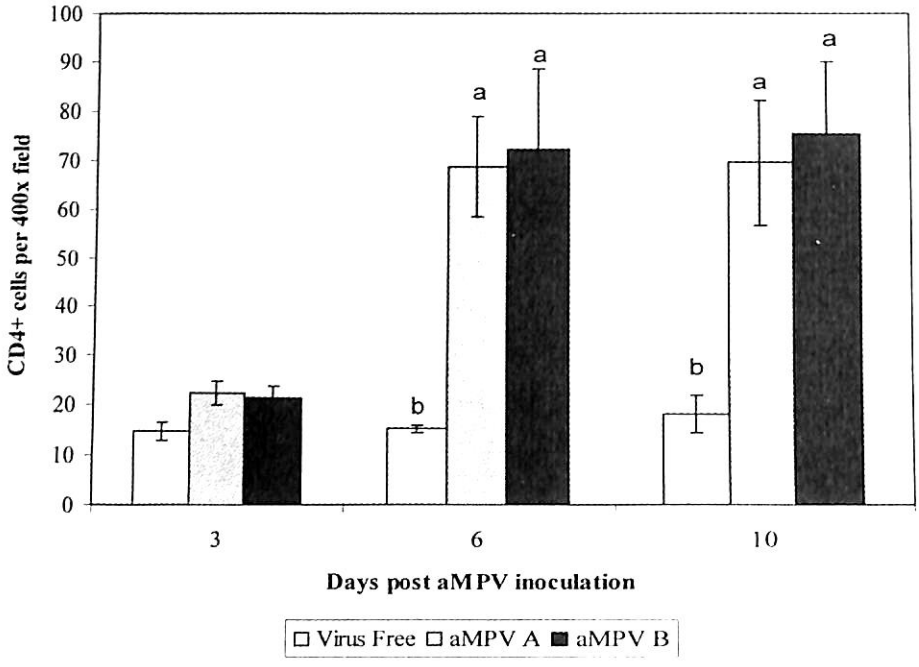

Figure 3a CD4+ cells in the nasal turbinate epithelium of three groups of broilers (Experiment 2, as a representative experiment).

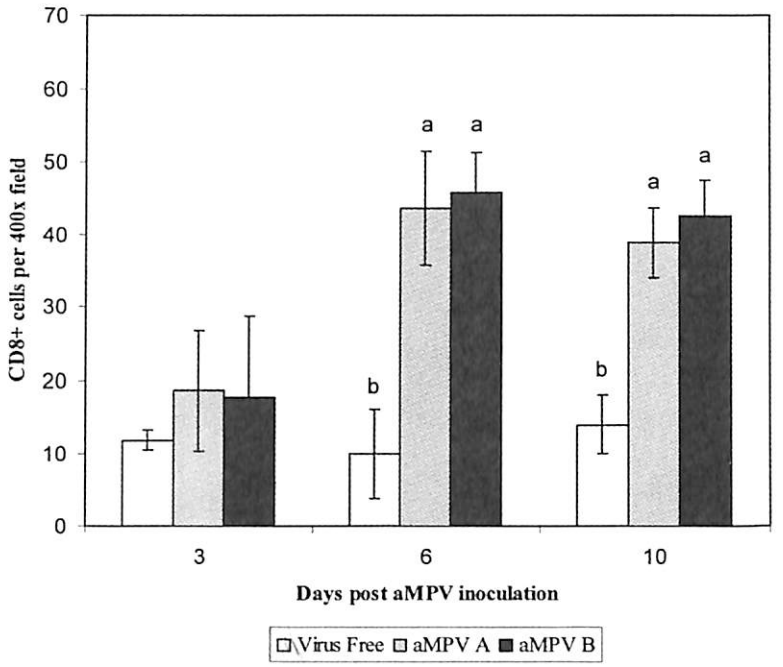

Figure 3b CD8+ cells in the nasal turbinate epithelium of three groups of broilers (Experiment 2, as a representative experiment).

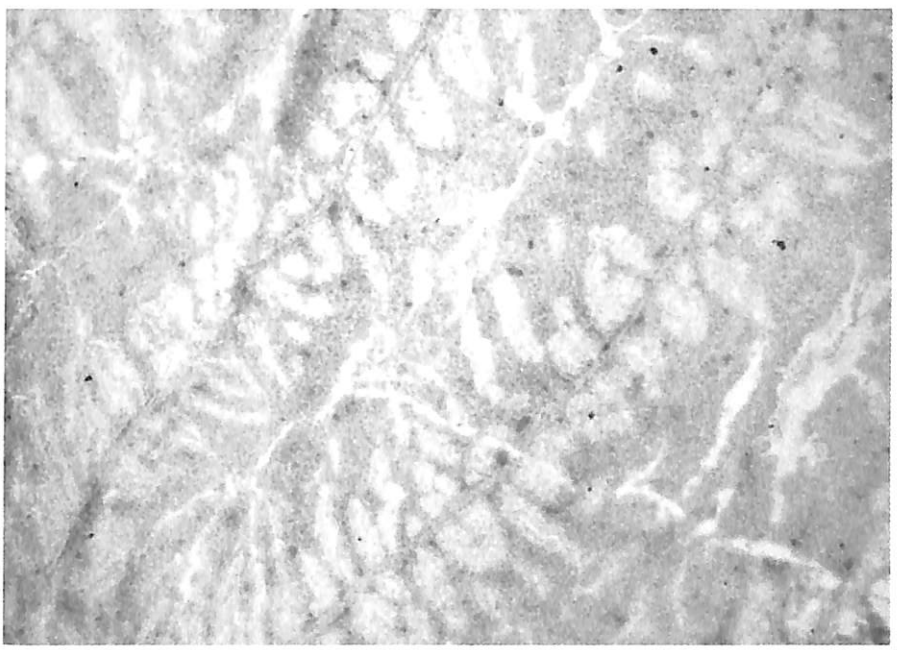

Figure 4a CD4+ cells in Harderian gland of virus free broiler at 6dpi, CD4+ cells are stained brown (100x magnification).

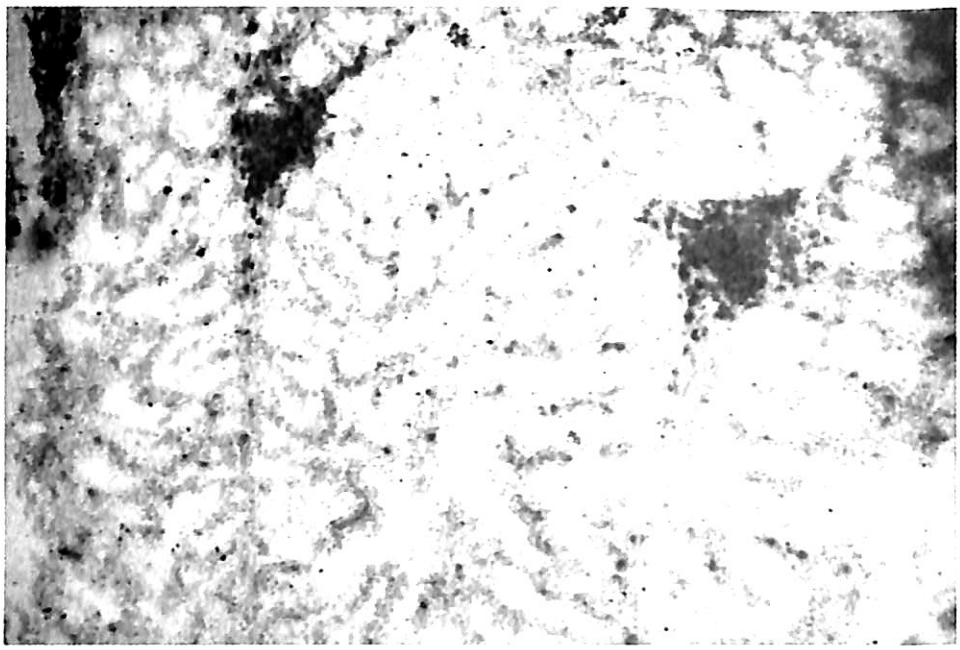

Figure 4b CD4+ cells in Harderian gland of aMPV B inoculated broilers at 6dpi, CD4+ cells are stained brown (100 x magnification). (Harderian gland of aMPV A inoculated broilers show similar pattern of CD4+ cells infiltration)

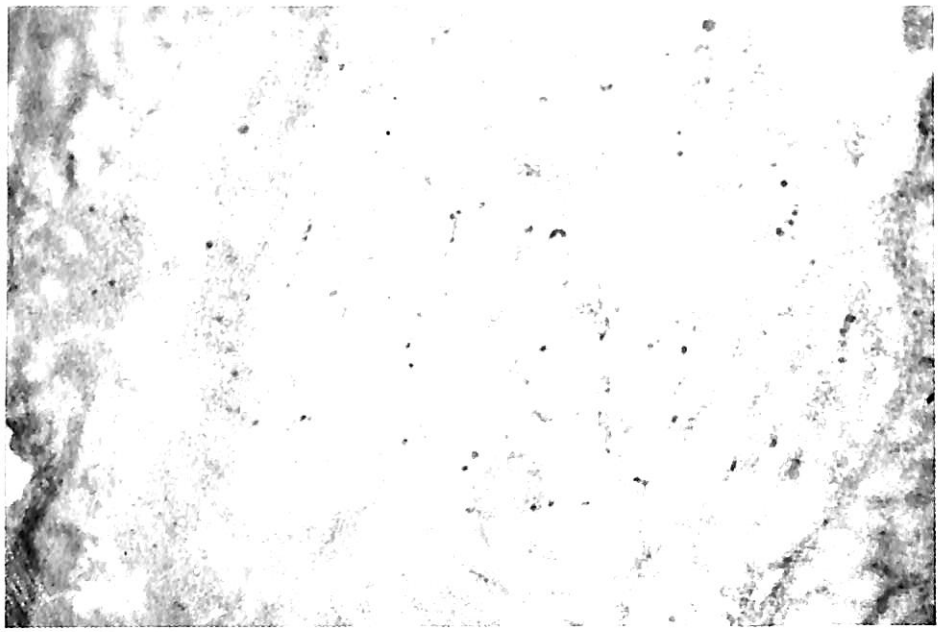

Figure 5a CD8+ cells in the Harderian gland of virus free broiler at 6 dpi, CD8+ cells are stained brown (100x magnification).

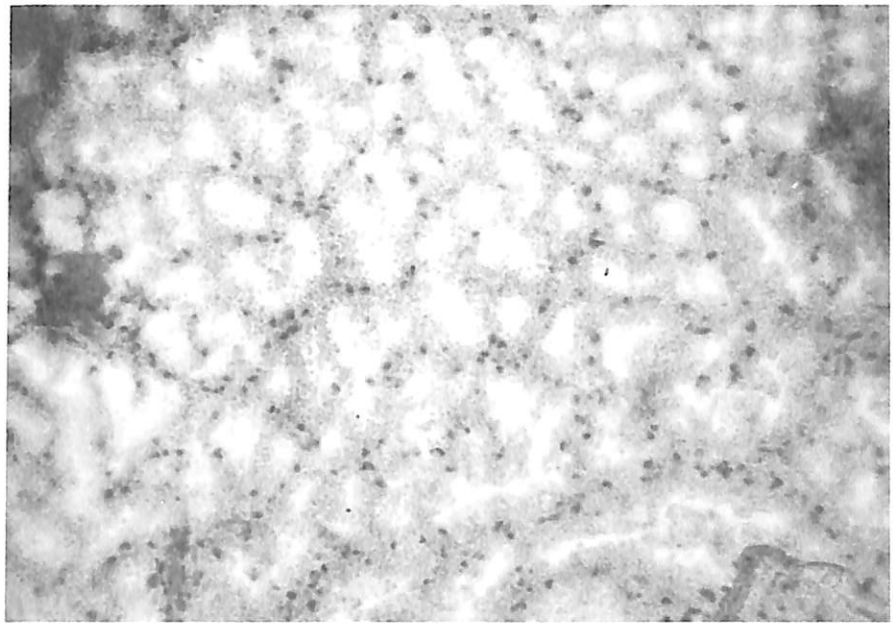

Figure 5b CD8+ cells in the Harderian gland of aMPV A inoculated broiler at 6dpi, CD8+ cells are stained brown (100x magnification). (Harderian gland of aMPV B inoculated broilers show similar pattern of CD8+ cells infiltration)

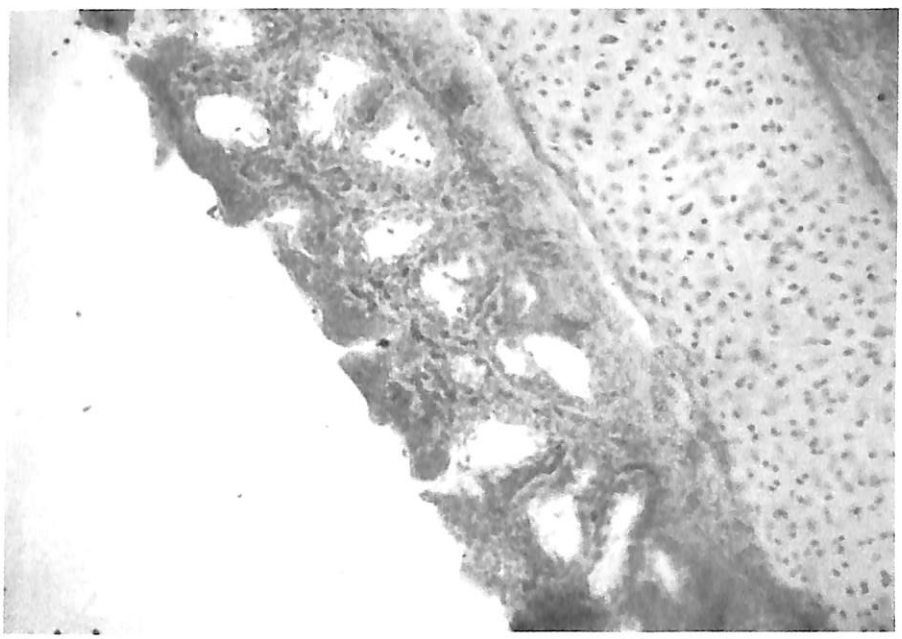

Figure 6a CD4+ cell in nasal turbinate epithelium of virus free broilers at 6dpi, CD4+ cells are stained brown (200x magnification).

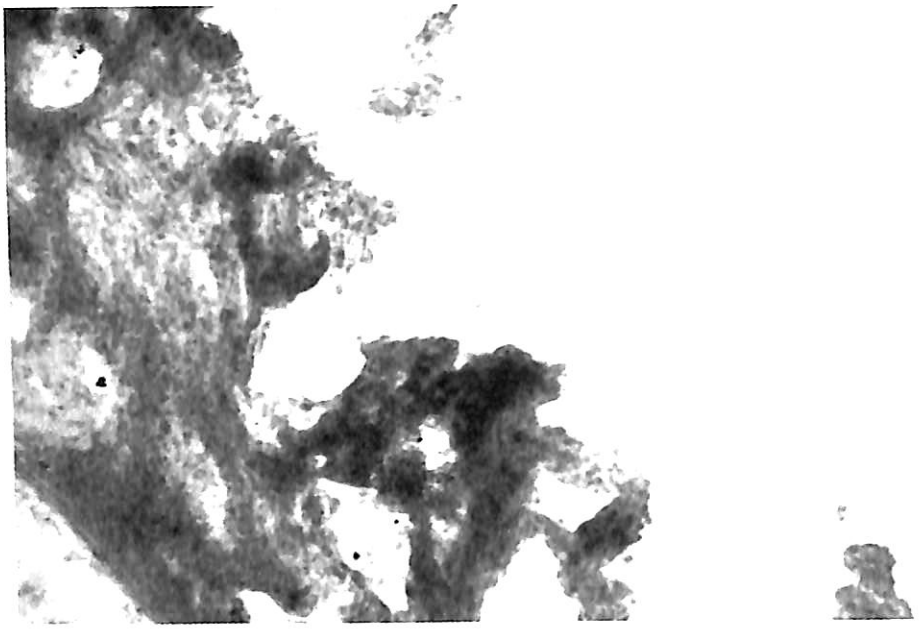

Figure 6b CD4+ cell in nasal turbinate epithelium of aMPV A-inoculated broiler at 6dpi, CD4+ cells are stained brown (200x magnification). (Nasal turbinate of aMPV B inoculated broilers show similar pattern of CD4+ cells infiltration)

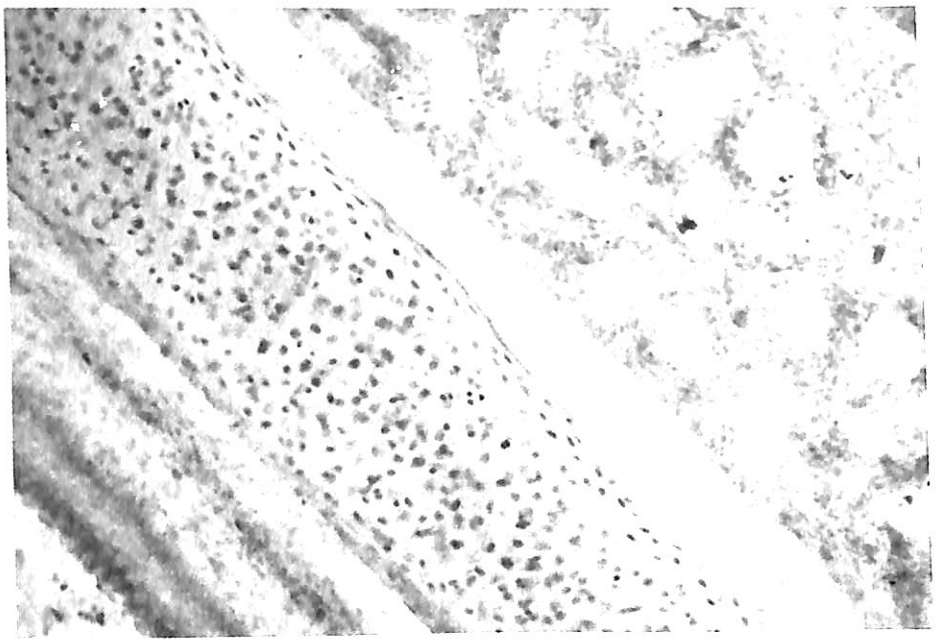

Figure 7a CD8+ cell in nasal turbinate epithelium of virus free broilers at 6dpi, CD8+ cells are stained brown (200x magnification).

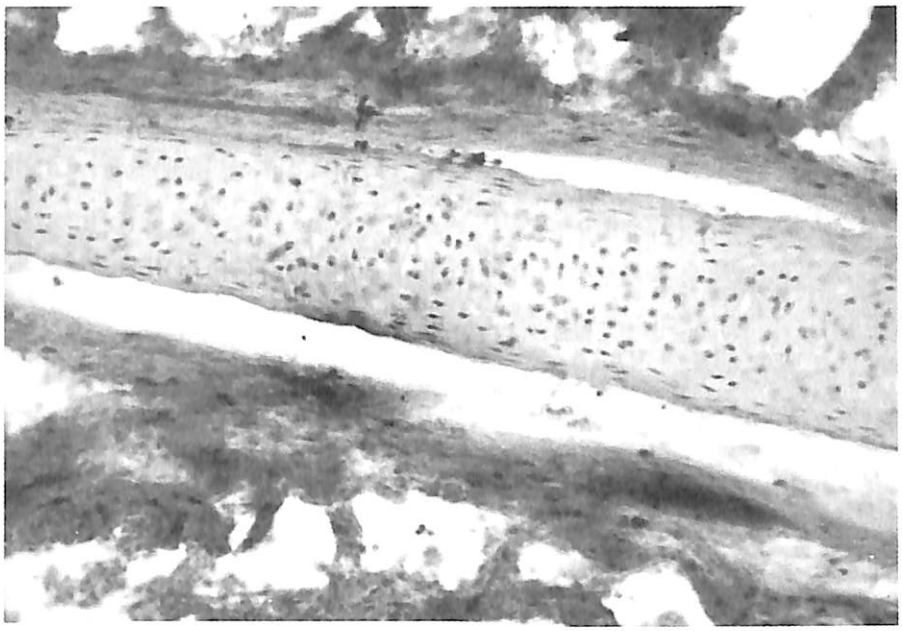

Figure 7b CD8+ cell in nasal turbinate epithelium of aMPV B-inoculated broiler at 6dpi, CD8+ cells are stained brown (200x magnification). (Nasal turbinate of aMPV A inoculated broilers show similar pattern of CD8+ cells infiltration).

5. References

Aitken, I. D. and Parry, S. H. 1976. Local immunity in the respiratory tract of the chicken I. Transudation of circulating antibody in normal and virus-infected birds. *Immunology, 31*, 33-37.

Aitken, I. D., Parry, S. H., Powell, J. R. And Survashe, B. D. 1976. Local immunity in Newcastle disease: some recent experiments. *Development in Biology Scandinavian, 33*, 140-148.

Animas, S. B., Otsuki, K., Tsubokura, M. and Cook J. K. A. 1994. Comparison of the susceptibility of chicks of different ages to infection with nephrosis/nephritis-causing strain of infectious bronchitis virus. *Journal of Veterinary Medical Science, 56 (3)*, 449-453.

Arstila, T. P., Vainio, O. and Lassila, O. (1994). Central role of CD4+ T cells in avian immune response. *Poultry Science, 73*, 1019-1026.

Aung, Y. H., Liman, M., Block, H., Rubbenstroth, D. and Rautenschlein, S. (2006a). Pathogenesis of avian Metapneumovirus (aMPV) in Broiler-type Chickens: Experimental Studies and Field Observations. In: *Proceedings of 5th International Symposium on Avian Corona- and Pneumoviruses and Complicating Pathogens.* (Eds. Heffels- Redmann, U. and Kaleta E. F.). Page 58-69.

Aung, Y. H., Liman, M. and Rautenschlein, S. (2006b). Experimental Infection of Broilers with avian Metapneumovirus Subtype A and B. *World's Poultry Science Journal, 62*, 134.

Aung, Y. H., Neumann, U. and Rautenschlein. S (2007).Comparative Pathogenicity of Subtype A and B avian Metapneumoviruses in Commercial Broilers. In: *Proceedings of 15th World Veterinary Poultry Congress Abstract Book.* Page 185.

Aung, Y. H., Liman, M., Neumann, U. and Rautenschlein, S. (2008). Reproducibility of Swollen Sinuses in Broilers by Experimental Infection with avian Metapneumovirus Subtype A and B of Turkey Origin and their Comparative Pathogenesis. *Avian Pathology, 37*, 65-74.

Baba, T., Kawata, T., Masumoto, K. and Kajikawa, T. (1990). Role of the Harderian gland in immunoglobulin A production in chickens lacrimal fluid. *Research in Veterinary Science, 49*, 20-24.

Baxter-Jones, C., Grant, M., Jones, R. C. and Wilding, G. P. (1989). A comparison of three methods for detecting antibodies to turkey rhinotracheitis virus. *Avian Pathology, 18*, 91-98.

Bäyon-Auboyer, M. H., Jestin, V., Toquin, D.,Cherbonel, M. and Eterradossi, N. (1999): Comparison of F-, G- and N-based RT-PCR protocols with conventional virological procedures for the detection and typing of turkey rhinotracheitis virus. *Archive of Virology, 144*, 1091–1109.

Bruder, D., Srikiatkhachorn, A. and Enelow, R. I. (2006). Cellular immunity and lung injury in respiratory virus infection. *Viral Immonology, 19*, 147-155.

Buys, S. B., Du Preez, J. H. and Els, H. J. (1989a). Swollen head syndrome in chickens: a preliminary report on the isolation of a possible aetiological agent. *Journal of South African Veterinary Association, 60,* (4), 221-222.

Buys, S. B., Du Preez, J. H. and Els, H. J. (1989b). The isolation and attenuation of a virus causing rhinotracheitis in turkeys in South Africa. *Journal of Veterinary Research, 56*, 87-98.

Catelli, E., Cook, J. K. A., Chesher, J., Orbell, S. J., Woods, M. A., Baxendale, W. and Huggins, W. (1998). The use of virus isolation, histopathology and immunoperoxidase techniques to study the dissemination of a chicken isolate of avian pneumovirus in chickens. *Avian Pathology, 27*, 632-640.

Yean of publication bracket, should not be used.

Cavanagh, D., Mawditt, K., Britton, P. and Naylor, C. J. (1999). Longitudinal field studies of infectious bronchitis virus and avian pneumovirus in broilers using type-specific polymerase chain reactions. *Avian Pathology, 28*, 593-605.

Cha, R. M., Khatri, M. and Sharma, J. M. (2007). B cells infiltration in the respiratory mucosa of turkeys exposed to subtype C avian Metapneumovirus. *Avian Diseases, 51*, 764-770.

Chary, P., Rautenschlein, S., Njenga, M. K. and Sharma, J. M. (2002). Pathogenic and immunosuppressive effects of avian pneumovirus in turkeys. *Avian Diseases, 46*, 153-161.

Collins, M. S., Gough, R. E. and Alexander, D. J. (1993). Antigenic differentiation of avian pneumovirus isolates using polyclonal antisera and mouse monoclonal antibodies. *Avian Pathology, 22*, 469-479.

Collisson, E. W., Pei, J. Dzielawa, J. and Seo, S. H. (2000). Cytotoxic T lymphocytes are critical in control of infectious bronchitis virus in poultry. *Developmental and Comparative Immunology, 24*, 187-200.

Cook, J. K. A. (2000). Avian Rhinotracheitis. *Scientific and Technical Reviews, Office International des Epizootics, 19,* (2): 602-613.

Cook, J. K. A. and Cavanagh, D. (2002). Detection and differentiation of avian pneumoviruses (metapneumovirus). *Avian Pathology, 31*, 117-132.

Cook, J. K. A., Dolby, C. A., Southee D. J. and Mockett, A. P. A. (1988). Demonstration of antibodies to turkey rhinotracheitis virus in serum from commercially reared flocks of chickens. *Avian Pathology, 17*, 403-410.

Cook, J. K. A., Holmes, H. C., Finney, P. M., Dolby, C. A., Ellis, M. M., and Huggins, M. B. (1989) A live attenuated turkey rhinotracheitis virus vaccine. 2. The use of the attenuated strain as an experimental vaccine. *Avian Pathology, 18*, 523-534.

Cook, J. K. A., Jones, B. V., Ellis, M. M., Jing, L. and Cavanagh, D. (1993a): Antigenic differentiation of strains of turkey rhinotracheitis virus using monoclonal antibodies. *Avian Pathology, 22*, 257-273.

Davelaar, F. G., Noordzij, A., and Van Der Donk, J. A. (1982). A study on synthesis and secretion of immunoglobulins by the Harderian gland of the fowl after eyedrop vaccination against infectious bronchitis at 1-day-old. *Avian Pathology, 11*, 63-79.

Easton, A. J., Domachwske, J. B. and Rosenberg, H. F. (2004). Animal pneumoviruses: Molecular genetics and pathogenesis. *Clinical Microbiology Reviews, 17*(2), 390-412.

Eterradossi, N., Toquin, D., Guittet, M., and Bennejean, G. (1992). Discrepancies in turkey rhinotracheitis ELISA results using different antigens. *Veterinary Record, 131*, 563-564.

Ewert, D. L., Berger, B. O. And Eidson, C. S. (1979). Local antibody response in chickens: analysis of antibody synthesis to Newcastle disease virus by solid-phase radioimmuno assay and immunofluorescence with class-specific antibody for chicken immunoglobulins. *Infection and Immunity, 24*, 269-275.

Fahey, J. K. and York, J. J. (1990). The role of mucosal antibody in immunity to infectious laryngotracheitis virus in chickens. *Journal of General Virology, 71*, 2401-2405.

Gallego, M., del Cacho, E., Felices, C. and Bascuas, J. A. (1992). Immunoglobulin classes synthesised by the chicken Harderian gland after local immunisation. *Research in Veterinary Science, 52*, 44-47.

Gillette, K.G. (1981): Local antibody response in avian infectious bronchitis virus-neutralizing antibody in tracheobronchial secretions. *Avian Diseases, 25*(2): 431-443.

Gough, R. E. and Alexander, D. J. (1979). Comparison of duration of immunity in chickens infected with a live infectious bronchitis vaccine by 3 different routes. *Research in Veterinary Science, 26*, 329-332.

Gough, R. E., Alexander, D. J. and Wyeth, P. J. (1998). Avian Rhinotracheitis (Pneumovirus). In: *A laboratory manual for the isolation and identification of avian pathogens*. (pp. 164-168). 4th Edition. Published by the American Association of Avian Pathologists.

Hafez, H. M. (1993). The role of pneumovirus in swollen head syndrome of chickens. *Archiv für Geflügelkunde, 57* (4), 181-185.

Hafez, H. M. and Löhren, U. (1990). Swollen head syndrome: clinical observations and serological examination in West Germany. *Deutsche Tierärztliche Wochenschrift, 97*, 322-324.

Hawkes, R. A., Darbyshire, J. H., Peters, R. W., Mockett, A. P. A. and Cavanagh, D. (1983). Presence of viral antigens and antibody in trachea of chickens infected with avian infectious bronchitis virus. *Avian Pathology, 12*, 331-337.

Holmes, H.C. (1973): Neutralizing antibody in nasal secretions of chickens following administration of avian infectious bronchitis virus. *Archiv für die Gesamte Virus Forschung, 43*, 235-241.

Janse, E. M., Van Roozelaar, D. and Koch, G. (1994). Leukocyte subpopulations in kidney and trachea of chickens infected with infectious bronchitis virus. *Avian Pathology, 23*, 513-523.

Javed, M. A., Frasca, S., Rood, D., Cecchini, K., Gladd, M., Geary, S. J. and Silbart, L. K. (2005). Correlates of immune protection in chickens vaccinated with *Mycoplasma gallisepticum* Strain GT5 following challenge with pathogenic *M. gallisepticum* strain R_{low}. *Infection and Immunity, 73*,(9) 5410-5419.

Jones, R. C., Naylor, C. J., Al-Afaleq, A., Worthington, K. J. and Jones, R. (1992). Effect of cyclophosphamide immunosuppression on the immunity of turkeys to viral rhinotracheitis. *Research in Veterinary Science, 53*, 38-41.

Jones, R.C., Baxter-Jones, C., Savage, C. E, Kelly, D. F. and Wilding, G. P. (1987). Experimental infection of chickens with a ciliostatic agent isolated from turkeys with rhinotracheitis. *Veterinary Record, 120*, 301-302.

Juhasz, K. and Easton, A. J. (1994). Extensive sequence variation in the attachment (G) protein gene of avian pneumovirus: evidence for two distinct subgroups. *Journal of General Virology, 75*, 2873-2880.

Liew, F. Y., Russell. S. M., Appleyard, G., Brand, C. M. and Beale. J. (1984). Cross protection of mice infected with influenza A virus by the respiratory route is correlated with local IgA antibody rather than serum antibody or cytotoxic T cells reactivity. *European Journal of Immunology, 14*, 350-356.

Liman, M., and Rautenschlein, S. (2007). Induction of local and systemic immune reactions following infection of turkeys with avian Metapneumovirus (aMPV) subtype A and B. *Veterinary Immunology and Immunopathology, 115*, 273-285.

Lu, Y. S., Shien, Y. S., Tsai, H. J., Tseng, C. S., Lee, S. H. and Lin, D. F. (1994). Swollen head syndrome in Taiwan-isolation of an avian pneumovirus and serological survey. *Avian Pathology, 23*, 169-174.

Majó, N., Allan, M., O'Loan, C. J., Pages, A. and Ramis, A. J. (1995). A sequential histopathologic and immunocytochemical study of chickens, turkey poults, and broiler breeder experimentally infected with turkey rhinotracheitis virus. *Avian Diseases, 39*, 887-896.

Malkinson, M. and Small, P. A. (1977). Local immunity against Newcastle disease virus in the newly hatched chicken's respiratory tract. Infection and Immunity, 16, 587-592.

Mansikka, A., Sandberg, M., Veromaa, T., Vainio, O., Granfors, K. and Toivanen, P. (1989). B cell maturation in the chicken Harderian gland. *The Journal of Immunology, 142*, 1826-1833.

Mase, M., Yamaguchi, S., Tsukamoto, K., Imada, T., Imai, K. and Nakamura, K. (2003). Presence of Avian Pneumovirus Subtypes A and B in Japan. *Avian Diseases, 47*, 481-484.

Morley A. J. and Thomson, D. K. (1984). Swollen head syndrome in broiler chickens. *Avian Diseases, 28* (1), 238-243.

Naylor, C. J. and Jones, R. C. (1993): Turkey Rhinotracheitis: a review. *Veterinary Bulletin, 63*, 439-449.

Owoade, A. A., Ducatez, M. F. and Muller, C. P. (2006). Seroprevalence of Avian Influenza virus, Infectious Bronchitis virus, Reo virus, Avian Pneumovirus, Infectious Laryngotracheitis virus, and Avian Leukosis virus in Nigerian poultry. *Avian Diseases, 50*, 222-227.

Parry S. H. and Aitken I. D. (1973). Immunoglobulin A in the respiratory tract of chicken following exposure to Newcastle disease virus. *Veterinary Record, 1*, 258-260.

Pattison, M., Chettle, N., Randall, C. J. and Wyeth, P. J. (1989). Observations on swollen head syndrome in broiler and broiler breeder chickens. *Veterinary Record, 125*, 229-231.

Perelman, B., Meroz, M. and Samberg, Y. (1988). Swollen head syndrome in broiler breeder in Israel. *Veterinary Record, 123*, 135.

Picault, J. P., Giraud, P., Drouin, P., Guittet, M., Bennejean, G., Lamande, J., Toquin, D. and Gueguen, C. (1987). Isolation of a TRTV-like virus from chickens with swollen head syndrome. *Veterinary Record, 121*, 135.

Powell, J. R., Aitken, I. D. and Survashe, B. D. (1979). The response of the Harderian gland of the fowl to antigen given by the ocular route II. Antibody production. *Avian Pathology, 8*, 363-373.

Pringle, C. R. (1998). Virus Taxonomy- San Diego 1998. *Archives of Virology, 143* (7), 1449-1459.

Reed, L. J. and Muench, H. (1938). A simple method for estimating fifty percent endpoints. *American Journal of Hygiene, 27*, 493-497.

Russell, P. H., Dwivedi, P. N. and Davison, T. F. (1997). The effects of cyclosporin A and cyclophosphamide on the populations of B and T cells and virus in the Harderian gland of chickens vaccinated with the Hitchner B1 strain of Newcastle disease virus. *Veterinary Immunology and Immunopathology, 60*, 171-185.

Scott, T. R., Savage, M. L. and Olah, I. (1993). Plasma cells of the chicken Harderian gland. *Poultry Science, 72*, 1273-1279.

Sharma, J. M. and Gerbyshak-Szudy, H. (2002). Immunopathogenesis of avian Pneumovirus of turkeys. In: DVG Fachgruppe Geflügelkrankheiten: *4th International Symposium on turkey diseases*, Berlin, Germany. 16-19 June.

Sharma, J. M., Chary, P., Khatri, M., Cha, R., and Palmquist, J. M. (2004). Pathogenesis and control of avian Pneumovirus. In. *IV International Symposium on Avian Corona and Pneumovirus Infections*, Rauischholzhausen, Germany, 20-23 June.

Shin, H. J., McComb, B., Back, A., Shaw, D. P., Halvorson, D. A. and Nagaraja, K.V. (2000). Susceptibility of broiler chicks to infection by avian pneumovirus of turkey origin. *Avian Diseases, 44*, 797-802.

Suresh, P. and Arp, L. H. (1995). A time course study of the transfer of immunoglobulin G from blood to tracheal and lacrimal secretions in young turkeys. *Avian Diseases, 39*, 349-354.

Takada, A. and Kida, H. (1995). Induction of protective antibody response against pseudorabies virus by intranasal vaccination with glycoprotein B in mice. *Archives of Virology, 140*, 1629-1635.

Takada, A. and Kida, H. (1996). Protective immune response of chickens against Newcastle disease, induced by the intranasal vaccination with inactivated virus. *Veterinary Microbiology, 50*, 17-25.

Tamura, S. I., Samegai, Y., Kurata, H., Nagamine, T., Aizawa, C., and Kurata, T. (1988). Protection against influenza virus infection by vaccine inoculated intranasally with cholera toxin B subuinit. *Vaccine, 6*, 409-413.

Tamura, S. I., Funato, H., Hirabayashi, Y., Kikuta, K. Suzuki, Y., Nagamine, T., Aizawa, C., Nakagawa, M. and Kurata, T. (1990). Functional role of respiratory tract haemagglutinin-specific IgA antibodies in protection against influenza. *Vaccine, 8*, 479-485.

Toquin, D., Bäyon-Auboyer, M. H., Senne, D.A. and Eterradossi, N. (2000). Lack of antigenic relationship between French and recent North American non-A/non-B turkey rhinotracheitis viruses. *Avian Diseases, 44*, 977-982.

Toro, H., Lavaud, P., Vallegos, P. and Ferreira, A. (1993). Transfer of IgG from serum to lachrymal fluid in chickens. *Avian Diseases, 37*, 60-66.

van den Hoogen, B. G., de Jong, J. C., Groen, J., Kuiken, T., de Groot, R., Fouchier, R. A. and Osterhaus, A. D. (2001). A newly discovered human pneumovirus isolated from young children with respiratory tract disease. *Natural Medicine Journal, 7*, 719-724.

Watanabe. I., Ross, T. M., Tamura, S. I., Ichinohe, T., Ito, S., Takahashi, H., Sawa, H., Chiba, J., Kurata, T., Sata, T., and hasegawa, H. (2003). Protection against influenza virus infection by intranasal administration of C3d-fused hemagglutinin. *Vaccine, 21*, 4532-4538.

Weltzin, R. Traina-Dorge, V., Soike, K. and Zhang, J. Y. (1996). Intranasal monoclonal IgA antibody to respiratory syncytial virus protects Rhesus monkeys against upper and lower respiratory tract infection. *The Journal of Infectious Diseases, 174*, 256-261.

Wilding, G.P., Baxter-Jones, C., and Grant, M. (1986). Ciliostatic agent found in rhinotracheitis. *Veterinary Record, 118*, 735.

Williams, R. A., Savage, C. E., Worthington, K. J. and Jones, R. C. (1991). Further study on the development of a live attenuated vaccine against turkey rhinotracheitis. *Avian Pathology, 20*, 585-596.

Wyeth, P. J., Chettle, N. J., Gough, R. E. and Collins, M. S. (1987). Antibodies to TRT in chickens with swollen head syndrome. *Veterinary Record, 120*(12), 286-287.

ဆွေးနွေးချက်

Dr. နွဲ့နွဲ့ထင် - Why did you start your two experiments at different ages of broilers?
Experiment 1. At 14 days of age
Experiment 2. At 16 days of age
- How did you detect the viral genome at 3 days post infection and 6 days post infection

ဖြေကြားချက် - Pre-existing maternal antibody to avian Metapneumovirus can reduce severity of clinical sign due to experimental infection. We detected maternal antibody to avian Metapneumovirus in boilers from both experiments. Therefore, we started experiment 1 at 14 days of age and experiment 2 at 16 days of age.

Dr. ခင်မမ - အထက်ပါ ရောဂါ Asian country တွင် ဖြစ်ပွါးခြင်း ရှိ / မရှိ၊
- ရောဂါ၏ Morbidity and mortality ကို ပြောပြပါ။

ဖြေကြားချက် - အထက်ပါရောဂါသည် Asian country တွင် Japan နှင့် Taiwan နိုင်ငံ များတွင် ဖြစ်ပွါးပါသည်။
- Turkey : 100% morbidity
  10% mortality
- Broiler : 54% morbidity
  3.5% mortality

Dr. စောပလယ်စော - Local humoral နှင့် Systemic humoral မည်သို့ ကွာခြားပါသနည်း။

ဖြေကြားချက် - Local humoral နှင့် Systemic humoral ကွာခြားမှု မရှိပါ။ Local humoral ဟု သုံးခြင်းမှာ ပို၍ Specific ဖြစ်အောင် သုံးထားခြင်းဖြစ်ပါ သည်။

Dr. မြင့်သိန်း

- ဆွေးနွေးတင်ပြချက်များ အလွန်ရှင်းလင်းပြီး စနစ်တကျ ရှိပါသည်။
- တက္ကသိုလ်တွင် ဆရာကောင်းတစ်ယောက်အဖြစ်လည်းကောင်း၊ နိုင်ငံတော် အတွက် Avian Medicine Specialist တစ်ဦးအဖြစ်လည်းကောင်း ကြိုဆိုဂုဏ်ပြုပါသည်။

Dr. သန်းကျော်

- RT tested PCR အတွက် Primer ကို ကိုယ်တိုင်ရှာဖွေပါသလား၊
- Abstract မှာ ဖော်ပြထားတာ အတော်ပြည့်စုံပါသည်။ သို့သော် မည့်သည့် Statistical analysis ကို သုံးသည်၊ မည်သည်ကို အခြေခံ၍ တွက် သည်ကို ဖော်မပြထားပါ၊ ပြောကြားပေးပါ။

Dr. သန်းကျော်

- Statistical analysis သဘောတရားအရ တိုင်းတာ ရရှိသော Data များမှာ Count ဖြစ်နေ၍ t-test ကို သုံးခြင်းမှာမမှန်ဟု ထင်မြင်ယူဆပါသည်။

ဖြေကြားချက်

- မဟုတ်ပါ၊ ရှာထားသော Primer ကို သုံးပါသည် Modify လုပ်၍ သုံးတာတော့ ရှိပါသည်။
- IHC (Immuno-histochemistry) မှရသော Cell count) နှင့် Tracheal wash ပါသော Antibody t-test ကို အသုံးပြုထားပါသည်။

Use of L-ascorbyl-2-monophosphate-Na/Ca as a vitamin C Source for Juveniles kuruma shrimp, *Marsupenaeus japonicus*

Yin Yin Moe [1] and Shunsuke Koshio[2]

ABSTRACT

A feeding trial was conducted to examine the effect of vitamin C (ascorbic acid, AsA) on growth and stress resistance of kuruma shrimp juvenile, *Marsupenaeus japonicus* using L-ascorbyl-2-monophosphate-Na/Ca (AMP-Na/Ca) as a vitamin C source. Six different levels of AMP-Na/Ca, equivalent AsA level of 0, 48, 92, 165, 367 and 748 mg/kg in diet were incorporated in semi-purified diets and fed to four replicate groups of juvenile shrimp, *M. japonicus* (mean weight 0.31 ± 0.03 g) for 60 days. After the growth trial, shrimp were immersed in fresh water to evaluate the tolerance against osmotic stress. Data showed that diets containing 48mg AsA / kg gave the best weight gain (WG, %) and specific growth rate (SGR) of shrimp. Shrimp survival was significantly reduced by feeding AsA-free diet at the end of the trial ($P<0.01$). Number of moult per shrimp was significantly higher in the diet containing 92 mg AsA / kg diet than those fed AsA-free diet ($P<0.02$). Tolerance against osmotic stress was a significantly strong in the diets containing 367 and 748 mg AsA/kg ($P<0.0001$). AsA concentration in body tissues of hepatopancreas, muscle, and whole body generally reflected the level of AsA containing in the diets. Results indicated that the minimum supplementation of 25 mg AsA/kg (71 mg AMP-Na/Ca) in diet is enough to promote the growth performance of kuruma shrimp. The minimum dietary level, however, of 333 mg AsA/kg (950 mg AMP-Na/Ca) was needed for hepatopancreatic tissue saturation, which gave a high tolerance in stressful condition.

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Introduction

Vitamin C (ascorbic acid, AsA), an important antioxidant, is involved in hydroxylation of praline and lysine during collagen formation (C.Y. Cho et al., 1985). Ascorbic acid therefore is required for the synthesis of repair collagen and deficiency of ascorbic acid caused incomplete molting in shrimp, resulting in death (Chen and Chang, 1994). Lightner et al. (1979) demonstrated that black-death syndrome or blackened sub- cuticular tissues, a deficiency death occurred in penaeid shrimp, *Penaeus californiensis*, *Penaeus aztecus*, and *Penaeus stylirostris* when fed an insufficient dietary AsA. Similar symptoms have been described in other penaeid shrimp, *Penaeus monodon*, (Catacutan and Lavilla-Pitogo, 1994), *Penaeus vannamei* (Montoya and Molina 1995), as well as the freshwater prawn, *Macrobrachium rosenbergii* (Heinen, 1984). In *Marsupenaeus japonicus*, being a de-colorization and development of abnormal grayish-white color on the carapace margins, lower abdomen and tips of walking legs (Deshimaru and Kuroki, 1976), and reduced moulting frequency (Guary et al., 1976).The quantitative requirements of vitamin C for penaeid species; *Penaeus monodon*, *Penaeus vannamei* and *Marsupenaeus japonicus*, have also been determined using several derivative forms of ascorbic acids, such as L-ascorbic acid (AsA) (Deshimaru and Kuroki, 1976, Lightner et al., 1977, Guary et al., 1976, Shiau & Jan, 1992); L-ascorbyl-2-sulphate (AsS) (Shaiu and Hsu, 1994, Hsu and Shiau, 1997), L-ascorbyl-2-polyphosphate (ApP) (He and Lawrence, 1993, Kontara et al., 1997); L- ascorbyl-2-monophosphate-Na (AMP-Na) (Hsu and Shiau, 1998), and L-ascorbyl-2- monophosphate-Mg (AMP-Mg) (Shigueno and Itoh, 1988, Giri et al., 1994; Lavens et al., 1999), generally based on the growth performance. Furthermore, ascorbic acid efficacy not only for growth and survival, but also stress resistance and immune response in *Penaeus vannamei* (Kontara et al., 1997) and *Penaeus monodon* (Merchie et al., 1998; Lee and Shiau, 2001) have also documented. This information, however, is lacking in kuruma shrimp, *Marsupenaeus japonicus*.

Additionally, studies on the qualitative and quantitative requirements of ascorbic acid for penaeid shrimp are very limited and vary with species, the initial weight of the shrimp or shrimp stage, the water temperature, the duration of the study and experimental conditions, and used vitamin C derivative, which is the most important indicator to determine the AsA requirement. Recently, L-ascorbyl-2-monophosphate-Na/Ca (AMP-Na/Ca) is widely used in aquaculture and has shown its AsA activity in marine fish; European sea bass, *Dicentrarchus labrax* and gilthead sea bream, *Sparus aurata* L (Alexis et al., 1999); rainbow trout, *Oncorhynchus mykiss* (Wahli et al., 2003); parrot fish, *Oplegnathus fasciatus* (Wang et al., 2003a) and Korean rockfish, *Sebastes achlegeli* (Wang et al., 2003b). However, its AsA activity on penaeid species, including kuruma shrimp is still scare.

Therefore, the present study was conducted to: (1) examine the efficacy of AMP- Na/Ca on growth and stress resistance of kuruma shrimp juvenile; and (2) assess the dietary optimum level of AsA for the maximum growth and highest stress tolerance of juvenile kuruma shrimp, *Marsupenaeus japonicus*, which is a mainly cultured penaeid species in Japan due to its delicious seafood item and high market price.

Materials and Methods

Experimental diets

Basal composition of test diets was shown in Table 1. The diets contained casein (vitamin free; Wako Pure Chemical Industries, Osaka, Japan), defatted squid meal and krill meal (Nippon Suisan, Tokyo, Japan) as protein sources. The compositions of vitamin and mineral mixtures were based on a formula for the species (Kanazawa et al., 1977). L-ascorbyl-2-mono-phosphate-Na/Ca (AMP-Na/Ca), 35 % bioavailability (STAY-C® 35, DSM Nutrition Japan, K. K.) was used as a vitamin C source. AMP-Na/Ca was added to other ingredients by mixing with cellulose powder to 100 % total proportions. Dry ingredients and lipids with fat-soluble vitamins were well mixed with 40% water and passed through the disc pellet machine (1.5 mm diameter). The pellets were then oven-dried at 50°C for 1 hr. After processing, tests diets were analyzed by DSM Nutrition Japan, K.K. for AsA concentrations in diets (Table 2). Six different concentrations of AMP-Na/Ca (0, 129, 232, 397, 906 and 1854 mg kg^{-1} diet, AsA activities with 0, 48, 92, 165, 367 and 748 mg kg^{-1} diet, respectively) were performed in the experiment diets. Test diets were stored at -20°C until feeding. Protein, lipid, moisture, and ash analyses of test diets were conducted according to the AOAC method and described in the Table 2.

Feeding trial

The shrimp juvenile *M. japonicus* used in this study were supplied by rearing larvae, which were hatched from the egg spawned by berried females at Kamoike Marine Production Laboratory, the Faculty of Fisheries, Kagoshima University and maintained with commercial diet (Higashimaru Foods, Kagoshima, Japan) until up to juvenile stage. Ten days before starting the trial, they were fed with a vitamin C free diet to acclimatize them to the experimental diet and to deplete the body stores of ascorbic acid.

A total of 240 numbers of shrimp (mean wet weight 0.31 ± 0.03 g) were randomly selected for the experiment. Ten shrimp per tank with four replications per treatment were randomly distributed in 20L rectangular, white tank with 2 cm thickness sand bottom. Four shrimp were dried and powdered for whole body AsA contents as an

initial group. Sea water with 34 ppt, continuously supplied at a flow rate of 3 l h^{-1} was re-circulated through a sand bottom filter. Water temperature during 30 days was 25.0 ± 1.0 °C and declined after 30-day feeding (21.2 ± 0.4 °C). Shrimp were fed the experimental diet twice a day at 10% of total body weight based on average initial weight. Uneaten feed and exuviae (shell) were removed before feeding and examined the molting condition every morning. Uneaten feed were dried in freeze drier for feed efficiency ratio and feed intake calculation. Shrimp were bulk-weighed and counted a tank at a time every 10 days to adjust the feeding ration. During sampling, all tanks and sand filter were cleaned. After the growth trial, osmotic stress test was conducted. The efficacy of dietary vitamin C was evaluated based on the data from growth performance i.e., survival (%), weight gain (WG, %), specific growth rate (SGR, %), and number of moult per shrimp, tolerance against osmotic stress (LT_{50}) and AsA concentration in hepatopanceras, muscle and whole body after the 60day feeding trial.

Stress resistance test

After the feeding trial, osmotic stress test was conducted as follows: A rectangular polyvinyl chloride (PVC) tank (100 x 66 x 12 cm) was used as a water bath. It was supplied with continuously flowing seawater at a rate of 12 L min^{-1} to maintain temperature which was as similar as possible with the cultured water (25°C). Before conducting the stress test, six 5 L-capacity glass bottles (with covers) were placed inside the water bath and filled with 3 L tap water which was de-chlorinated by aeration for 24 hours. Five shrimp from each treatment were taken randomly and placed in bottle, in which de-chlorinated water were supplied. Aeration was not supplied during conducting the stress test. Mortality was monitored every 10 min. Shrimp sank to the bottom was considered dead. The death time of shrimp was recorded and the values were converted to common logarithm value (Log_{10}). The stress test was provided four times per treatment, but duplication was done in AsA-free diet due to low survival.

Vitamin C analysis

AMP-Na/Ca in test diets was analyzed by DSM Nutrition Japan K.K. AsA analyses for body tissue such as hepatopancreas, muscle and whole body were conducted by high performance chromatography (HPLC) (Koshio et al., 1997). The HPLC system was composed of a reversed-phase column (COSMOSIL $5C_{18}$, 10 x 250 mm, Nacalai Tesque). Mobile phase (flow rate, 1.2 ml/ min) was an aqueous solution of 0.1 M KH_2PO_4, and 0.5% metaphosphoric acid (Wako Pure Chemical Industries Ltd., Japan). The pH was adjusted to 3.7 with 30% KOH. The HPLC system

used was as follows: column oven (Shimadzu CTO-6A, temp, 40°C), detector (Shimadzu SPD-6A, UV 257 nm), pump (Shimadzu LP-6A), and chromatopak (Shimadzu CR4-A). In extraction of vitamin C, samples (0.05 to 0.1 g) were added to 5 ml of mobile phase, 500 µl 1,2-dichloroethane (Kanto Chemical Co., Japan), and homogenized with an ultrasonic cell dispenser for one min, and then centrifuged at 4000 rpm, 4°C for 40 min. The supernatant was passed through Sep-Pak C^{18} cartridge (Waters, Millipore Corp., USA) and filtered through a 0.45 µm cellulose acetate disposable syringe filter (Advantec, THRIVE, Japan). The filtrate 20 µl was injected into the HPLC injection port. L-ascorbic acid (AsA, Wako Pure Chemical Industries, Ltd, Japan) was used as a standard. All samples for analysis were stored in a deep freezer at -85°C until use.

Statistical analysis

Data were analyzed using one-way ANOVA (package super-ANOVA; Abacus Concepts, Berkeley, CA, USA). Significant differences between means were evaluated by Duncan New Multiple Range Test. Probabilities of $P<0.05$ were considered significant. Broken-line analysis (Robbins et al., 1979) was used to estimate the ascorbic acid level needed for maximal growth and hepatopancreas sustaining which give a high tolerance in stressful condition.

Results

Data on survival, WG (%), SGR (%), number of molt per shrimp, tolerance against osmotic stress (LT_{50}), and tissue AsA concentrations of kuruma shrimp juvenile after 60 days feeding were presented in Table 3. Poor survival was found in AsA-free diet after 40-day feeding and had significantly lowest survival at the end of the experiment ($P<0.01$). The shrimp fed the diet contained 748 mg AsA/kg had the highest survival but the diet with 92 mg AsA/kg and above this level, showed no significant differences among them.A significantly highest WG and SGR were detected in the diets containing 48 mg AsA/kg after 60-days trial. SGR (%) generally followed the same pattern as WG (%). Number of molt per shrimp was also examined during the 60-day feeding period. After 20 days feeding, molt per shrimp significantly reduced in the group fed AsA deprived diets ($P<0.05$). Significantly highest molting rate was detected in the diets 48 and 92 mg AsA/kg, however, these two groups were no statistically significant difference each other at the end of the experiment.

Accordingly, significantly high survival was detected in these diet groups. The 48 mg AsA/kg diet performed the best results in all parameters of growth performance in this study. The adequate dietary AsA level for maximum growth of juvenile kuruma shrimp was found to be 25 mg/kg (71.43 mg AMP-Na/Ca/kg), based on the broken-line analysis of weight gain (Fig. 1), the regression equation used were $Y=240.03+2.325X$ ($R^2=1$) and $Y=298.15$.

As dietary AsA increased, shrimp survival increased after subjecting with osmotic stress. Shrimp fed without AsA diet showed lowest resistance than other AsA containing diets. Tolerance against osmotic stress was a significantly strong in the diets containing 367 and 748 mg AsA/kg ($P<0.0001$), but those two groups were not statistically significant each other. When the broken-line model analysis of hepatopancreatic ascorbic acid was employed, value of 332.47 mg AsA/kg (949.91 mg AMP-Na/Ca/kg), the regressing equations used were $Y=12.892+0.0647X$ ($R^2=0.96$) and $Y=25.659+0.0263X$ ($R^2=1$), was estimated to be required for hepatopancreatic tissue saturation of *M. japonicus* (Fig. 2), which gave the significantly high resistance in osmotic stress. A high positive correlation ($R^2=0.96$) was found between hepatopancreatic AsA concentrations and tolerance against formalin stress (Fig. 3). AsA concentration in body tissues of hepatopancreas, muscle, and whole body generally reflected the level of AsA containing in the diets.

Discussion

In the present study, shrimp fed the AsA-free group was obviously diagnosed high mortality by reduced molting. It was the similar symptoms with previous study for this species (Guray et al., 1976). The diets affecting in high molting, showed clearly the significantly high shrimp survival. However, no other deficiency signs were detected as reported in the previous study (Deshimaru and Kuroki, 1976). This study suggests that ascorbic acid is required for the collagen formation and it may play an important role for the survival of penaeid species (Lightner et al., 1979; Heinen et al., 1984; Catacutan and Lavilla-Pitogo, 1994; Chen and Chang, 1994; Montoya and Molina, 1995).

An adequate dietary AsA level for maximum growth of juvenile kuruma shrimp was found to be 25 mg/kg (71.43 mg AMP-Na/Ca/kg), based on the broken-line analysis of weight gain in this study. This value is lower than that in the previous studies reported by Shigueno and Itoh, 1988), in which a supplement of 215~430 mg AMP-Mg in 1 kg diet, but this value was very similar with that of *P. monodon* (Giri et al., 1994), is sufficient to prevent clinical signs of vitamin C deficiency for kuruma shrimp, *M. japonicus* juvenile. For comparison with other species, present result is more or less similar with that of *P. monodon* (Hsu an Shiau, 1997, 1998), where 29.27 and, 26.7 and 22.5 mg AsA/kg were the adequate dietary levels when ApP, AMP-Na and AMP-Mg were used as vita-

min C sources, respectively. However, our finding is too much lower than other previous studies (Cheng and Chang, 1994; Hsu and Shiau, 1997) when ApP and AsS were used as vitamin C sources for *P. monodon*, (209 and 73.83 vs 25 mg AsA/kg). Furthermore, our present result is lower than that of *P. vannamei* juvenile where dietary AsA level 120 and 41 mg/kg gave the normal survival for juvenile 0.1 and 0.5 g initial body weight, respectively (He and Lawrence, 1993), however, it was very near with the adequate level of *P. vannamei* postlarvae, in which, 15 mg AsA/kg diet was sufficient for postlarval production, when ApP was used as a vitamin C source in those studies. For the same species, Laven et al. (1999) reported that 130 mg AsA/kg is the optimal dietary level to increase body weight using AMP-Mg as a vitamin C source.

Results from the studies as above mentioned, indicated that the qualitative and quantitative requirements of ascorbic acid for penaeid shrimp may rely on species, stage (initial size), experimental period or duration of the study and used AsA derivative, which is the most important factor to determine the AsA requirement for shrimp.

In stress resistance, a significantly highest resistance in osmotic stress was found in the diet containing 748 mg AsA/kg but there was no statistically significance between 367 and 748 mg AsA/kg diet groups. Accordingly, no statistically significant difference in hepatopancreatic AsA concentration was observed in those diet groups. The value of 332.47 mg AsA/kg estimated by the broken-line model analysis for hepatopancreatic tissue saturation of *M. japonicus*, gave the satisfactory high resistance in osmotic stress in this study. It means that more or less 35 μg/g hepatopancreatic AsA content is needed to increase tolerance against osmotic stress. In the previous studies, Kontara et al., 1997 and Merchie et al. (1998) reported that dietary 720 mg AsA/kg and 47 μg/g whole body AsA concentration were needed to enhance stress resistance in salinity stress for *P. vannamei* and *P. monodon*, respectively. According to the results from this study, the minimum supplementation of 25 mg AsA/kg (71 mg AMP-Na/Ca) in diet is sufficient to promote the growth performance in kuruma shrimp, however, 333 mg AsA/kg (950 mg AMP-Na/Ca) was needed for hepatopancreatic tissue saturation, which gave a high tolerance in stressful condition. It supports the hypothesis that stress creates increased AsA requirements for larval fish and crustaceans (Dabrowski, 1992).

In conclusion, we suppose that the optimum dietary level for maximum growth of kuruma shrimp juvenile was 25 mg AsA/kg under the culture conditions in this study. The minimum dietary level, however, of 333 mg AsA/kg (950 mg AMP-Na/Ca) was needed for hepatopancreatic tissue saturation, which gave a high tolerance in stressful condition.

Acknowledgements

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Table 1.Composition of the test diet

Ingredients	%
Casein (vitamin free)	40.0
Squid meal*1	10.0
Krill meal*1	5.0
Dextrin	10.0
α-Starch	5.0
L-arginine-HCl	2.5
Glucosamine-HCl	1.0
Na-succinate	0.5
Na-citrate	0.5
Pollack liver oil	4.0
n3-HUFA	1.0
Soybean lecithin	3.0
Cholesterol	0.5
Vitamin mixture*2 (V.C free)	3.0
Mineral mixture*3	5.0
Activated gluten	5.0
AMP-Na/Ca*4 + α-Cellulose	4.0

*1 Defatted

*2,3 According to Kanazawa et al., 1977.

*4L-ascorbyl-2-monophosphate-Na/Ca.

Table 2.Proximate composition, AMP-Na/Ca[*1] and AsA[*2] concentration of test diets

Diet No	Analyzed AMP-Na/Ca [*3] level (mg/kg diet)	Calculated AsA level[*4] (mg/kg diet)	Diet Composition (%)[*6]			
			Moisture	CP[*7]	CL[*8]	Ash
1	ND[*5]	ND	13.2	51.8	9.7	6.9
2	138	48	12.0	51.6	9.6	6.8
3	262	92	13.0	51.5	9.6	6.8
4	470	165	13.8	51.8	10.0	6.9
5	1047	367	13.0	51.5	9.7	6.8
6	2136	748	13.5	51.6	9.8	7.0

[*1] L-ascorbyl-2-monophosphate-Na/Ca (AMP-Na/Ca).

[*2] L-ascorbic acid.

[*3] Analyzed by DSM Nutrition Japan K.K., Tokyo, Japan.

[*4] Calculated AsA efficacy of AMP-Na/Ca based on manufacturer' declaration.

[*5] Not detected.

[*6] Dry weight basic (AOAC Method).

*7 Crude protein.

[*8] Crude lipids.

Table 3. Survival (%), WG (%), SGR (%), FE and Number of molt per shrimp fed diets containing different levels of AsA after 60 days feeding.

Dietary AsA level (mg/kg)	Survival (%)	WG (%)*3	SGR (%)*4	FE*5	Number of moult per shrimp*6
0	23.681 [a] ± 18.67	240.03 [a] ± 5.84	7.20 [a] ± 0.49	3.44 [a] ± 0.54	3.15 [a] ± 0.64
48	54.03 [ab] ± 18.46	351.63 [b] ± 58.55	10.46 [c] ± 1.76	4.86 [a] ± 1.44	7.2 [bc] ± 2.38
92	65.60 [b] ±18.98	302.09 [ab] ± 49.64	9.97 [bc] ± 1.89	3.71 [a] ± 1.05	8.70 [c] ± 1.87
165	75.42 [b] ± 11.90	300.73 [ab] ± 58.55	9.08 [abc] ± 1.93	7.20 [a] ± 5.29	6.00 [abc] ± 2.27
367	71.15 [b] ±19.13	257.17 [a] ± 25.83	7.68 [ab] ± 0.77	3.74 [a] ± 0.68	5.70 [abc] ± 0.52
748	87.50 [b] ±15.00	279.11 [a] ± 34.74	8.24 [abc] ± 1.19	4.16 [a] ± 0.86	4.95 [ab] ± 0.90

*1 Values are mean ± s.d. of four replicate groups. (n = 4)

*2 Values are mean ± s.d. of triplicate groups. (n = 3)

*3 Weight gain (%)={(Mean Final BW- Mean Initial BW)/Mean Initial BW} x 100

*4 Specific growth rate (%)= {(Mean Final BW- Mean Initial BW) / Experimental period (60-days)} x 100

*5 Feed efficiency={Weight gain (g)/ Feed intake as dry matter (g)}

*6 Number of molt per shrimp during experimental period (60-days)= $\sum_{i=1}^{n} \frac{y_i}{x_i}$

where x_i and y_i = number of shrimp survived and molted at i days, respectively;

n = experimental periods

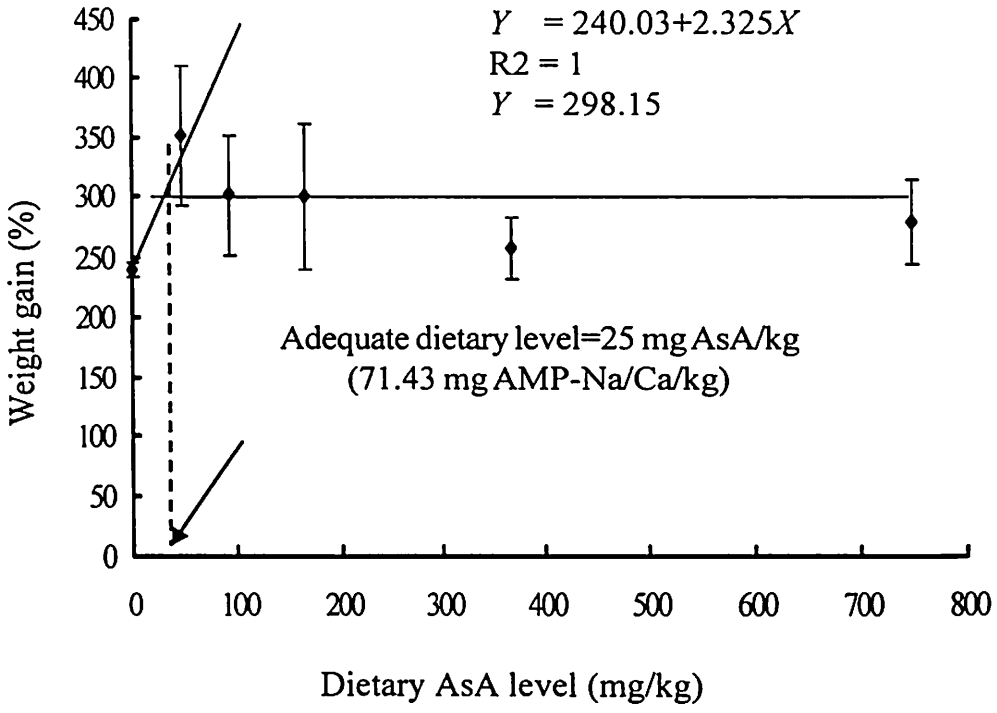

Fig. 1. Effect of vitamin C on weight gain (%) of kuruma shrimp, *Marsupenaeus japonicus* after 60 days feeding. Each point represents the mean ± S.D. of four groups of shrimp, with 10 shrimp per group (n=4).

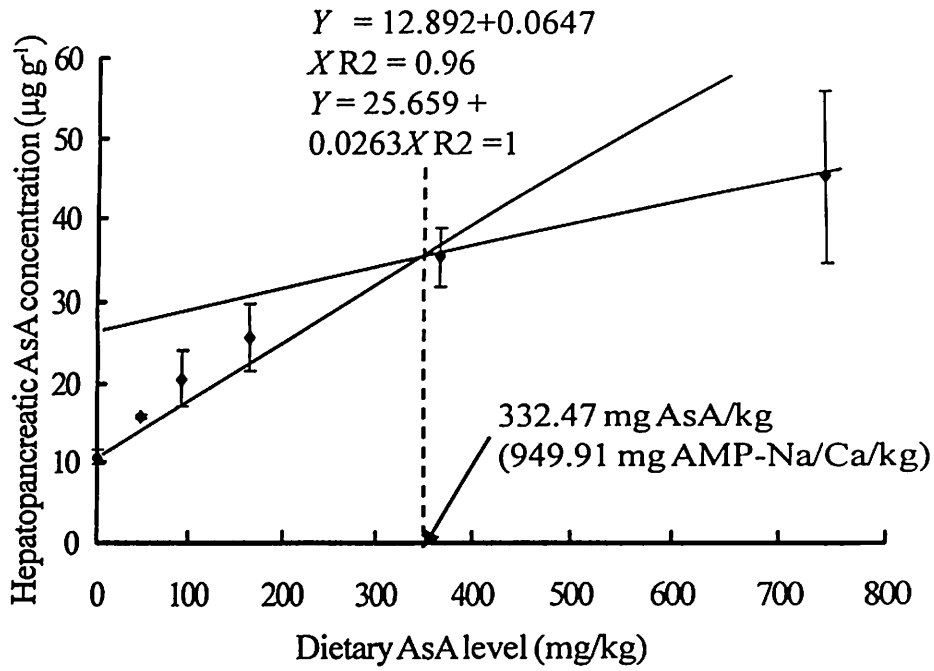

Fig. 2. Effect of vitamin C on hepatopancreas AsA concentration of kuruma shrimp, *Marsupenaeus japonicus* after 60 days feeding. Each point represents the mean ± S.D. of four groups of shrimp, with 10 shrimp per group (n=4).

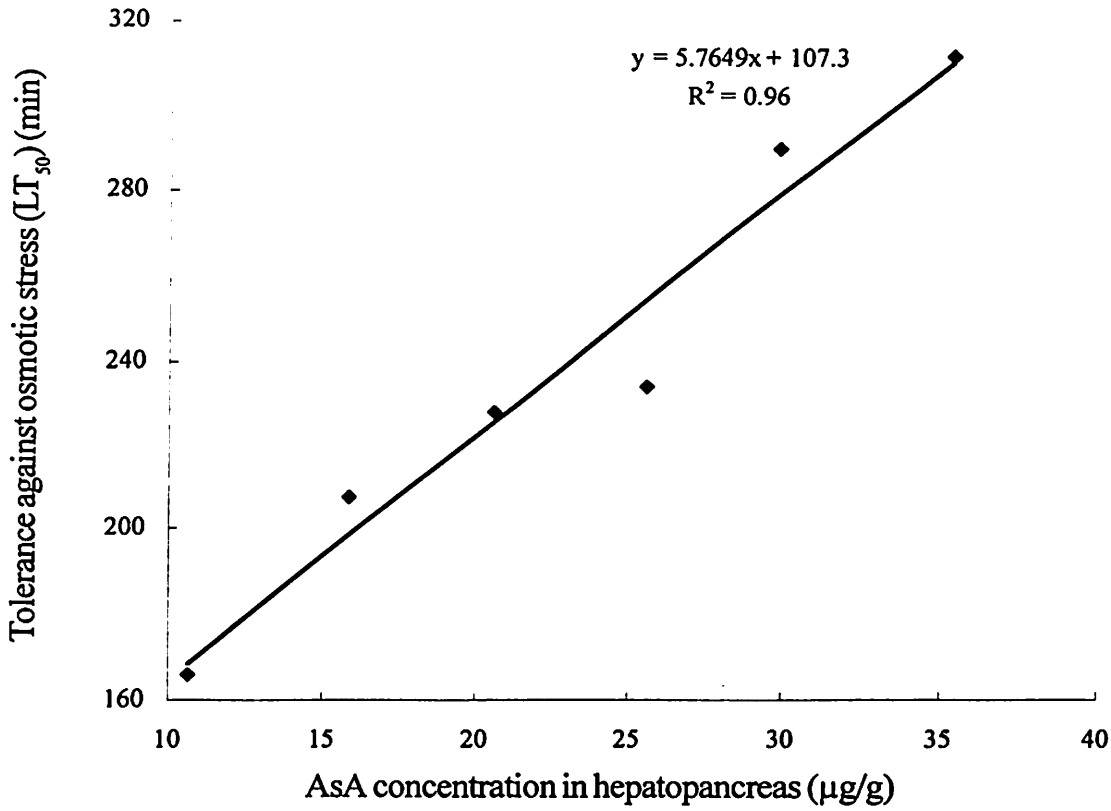

Fig 3. Relationship between ascorbic acid concentration in hepatopancreas and stress tolerance (LT_{50}) of juvenile kuruma shrimp *Marsupenaeus* japonicus.

References

Alexis, M. N., Nengas, I., Fountoulaki, E., Papoutsi, E., Andriopoulou, A., Koutsodimou and M., Gaubaudan, J., 1999. Tissue ascorbic acid levels in European sea bass *Dicentrarchus labrax* and gilthead sea bream *Sparus aurata* L. fingerlings fed diets containing different forms of ascorbic acid. Aquaculture 179: 447-456.

AOAC, (Association of Official Analytical Chemists) 1990. Official methods of analysis, 15th edition. Arlington, Verginia, USA.

Catacutan, M.R and Lavilla-Pitogo, C., 1994. L-ascorbyl-2-phosphate Mg as a source of vitamin C for juvenile *Penaeus monodon.* The Israeli J. Aquacult-Bamidgeh. 46, 40-47.

Chen, H.Y and Chang, C.F., 1994. Quantification of vitamin C requirements for juvenile shrimp, *Penaeus monodon* using polyphosphorylated L-ascorbic acid. J. Nutr 124, 2033-2038.

Cho, C.Y., Cowey and C. B., Watanabe, T., 1985. Finfish nutrition in Asia: Methodological approaches to research and development. Ottawa, Ont., IDRC, 154 p.

Dabrownski, K. 1992. Ascorbate concentration in fish ontogeny. J. Fish. Bio. 40: 273-279.

Deshimaru, O and Kuroki, K., 1976. Studies on a purified diet for prawn. VII Adequate dietary levels of ascorbic acid and inositol. Bull. Jpn. Soc. Sci. Fish. 42: 571-576.

Giri, N.A., Kuma, C., Yoshida, K.and Kanazawa, A., 1994. Effect of L-ascorbyl-2-phosphate-Mg on the growth of *Penaeus monodon* juveniles. The 3rd Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines.

Guary, M., Kanazawa, A., Tanaka, N., Ceccaldi, H. J. 1976. Nutritional requirements of prawn -VI. Mem Fac Fish Kagoshima Univ. 25: 53-57.

He, H., Lawrence, A.L., 1993. Vitamin C requirements of the shrimp *Penaeus vannamei.* Aquaculture 114, 305-316.

Heinen, J. M., 1984. Vitamin requirements of freshwater prawns, *Macrobrachium rosenbergii.* Program Abstracts, The World Aquaculture Society 19th Annual Meeting. Honolulu, Hawaii, p.39.

Hsu, T.S. and Shiau, S.Y., 1997. Comparison of L-ascorbyl-2-polyphosphate with L-ascorbyl-2-sulphate in meeting vitamin C requirements of juveniles grass shrimp *Penaeus monodon.* Fisheries. Sci. 63, 958-962.

Hsu, T.S., Shiau, S.Y., 1998. Comparison of vitamin C requirement for maximum growth of grass shrimp, *Penaeus monodon*, with L-ascorbyl-2- mono- phosphate-Na and L-ascorbyl-2-monophosphate-Mg. Aquaculture 163, 203-213.

Kanazawa, A., Teshima, S and Tokiwa, S., 1977. Nutritional requirements of prawn-VII. Effect of dietary lipids on growth. Bull.Jpn.Soc.Sci.Fish. 43, 849-856.

Kontara, E.K., Merchie, G., Lavens, P., Robels, R., Nelis, H., De Leenheer, A. and Sorgeloos, P., 1997. Improved production of postlarval white shrimp through supplementation of L-ascorbyl-2-polyphosphate in their diet. Aquacult, Int. 5, 127-136.

Koshio, S., Sakakura, Y., Iida, Y., Tsukamoto, K., Kida, T and Dabrowski, K., 1997. The effect of vitamin C intake on schooling behavior of Amphidromous fish, Ayu *Plecoglossus altivelis*. Fisheries Sci. 63, 619-624.

Lee, M. H andShiau, S. Y., 2002. Dietary vitamin C and its derivatives affect immune responses in grass shrimp, *Penaeus monodon*. Fish and Shellfish Immunol. 12, 119-129.

Lightner, D.V., Hunter, B., Magarelli, P.C.Jr and Colvin, L.B., 1979. Ascorbic acid: nutritional requirement and role in wound repair inp enaeid shrimp. Proc. World Maricul. Soc. 10, 513-528.

Montoya, N and Molica, C., 1995. Optimum supplemental level of A-ascorbyl-2- phosphate-Mg to diet for white shrimp *Penaeus vannamei*. Fish. Sci. 61: 1045-1046.

Robbins, K. R., Norton, H. W and Baker, D. H., 1979. Estimation of nutrient requirements from growth data. J. Nutr. 109, 1710-1714.

Shiau, S.Y and Jan. F.L, 1992. Ascorbic acid requirements of Shrimp *Penaeus monodon*. Nippon Suisan Gakkaishi 58, 363.

Shiau, S.Y and Hsu, T.S., 1994.Vitamin C requirement of grass shrimp, *Penaeus monodon*, as determined with L-ascorbyl-2-monophosphate. Aquaculture 122, 347-357.

Shigueno, K. and Itoh, S., 1988. Use of Mg-L-ascorbyl-2-phosphate as a vitamin C source in shrimp diets. J. World Aquacult. Soc. 19, 168-174.

Wahli, T., Verlha, V., Girling, P., Gabaudan, J. and Aebischer, C., 2003. Influence of dietary vitamin C on the wound healing process in rainbow trout *Oncorhynchus mykiss*. Aquaculture 225: 371-386.

Wang, X., Kim, K.W., Bai, S.C., Huh, M.D and Cho B.Y., 2003a. Effect of the different levels of dietary vitamin C on growth and tissue ascorbic acid change in parrot fish (*Oplegnathus fasciatus*). Aquaculture 215, 203-211.

Wang, X., Kim, K. W and Bai, S. C., 2003b. Comparison of L-ascorbyl-2-mono phosphate-Ca with L-ascorbyl-2-monophosphate-Na/Ca on growth and tissue ascorbic acid concentrations in Korean rockfish (*Sebastes schlegeli*). Aquaculture 225, 387-395.

ဆွေးနွေးအကြံပြုချက်များ

Dr. ရဲထွဋ်အောင် - Vitamin C ကြောင့် ပုစွန်များတွင် Disease resistance ပိုကောင်းစေပါ သလား။ Vitamin C ထည့်ခြင်းကြောင့် Immuno-stimulatory effect ရှိ ပါသလား။

ဖြေကြားချက် - ယခုစမ်းသပ်ချက်တွင် Stress ကို စမ်းသပ်ခဲ့ပါသည်။ Stress resistance ကောင်းမွန်ကြောင်း တွေ့ရှိရပါသည်။

- Reference အရ Vitamin C သည် ပုစွန်မျိုးစိတ်များတွင် Resistance ကောင်းစေကြောင်း အထောက်အထားများ ရှိပါသည်။

- Vitamin C သည် Immuno-stimulatory effect (Phagocytic rate) ကို မြင့်တက်စေခဲ့၍ ဒီအကြောင်း မိမိ၏ Ph.D Thesis အရ တွေ့ရှိခဲ့ပါသည်။ သို့သော် Further investigation ထပ်မံဆောင်ရွက်ရန် လိုအပ်ပါ သည်။

Dr. မောင်မောင်စံ - အခြို့ Results များတွင် SO အလွန်များနေခြင်းကိစ္စ 1± SO တွင် ၅၄. ၀၃ ± ၁၈. ၅ ဖြစ်နေဒါမျိုးတွေ့ရသည်။

ဖြေကြားချက် - Diet တစ်မျိုးလျှင် Triplication ဆောင်ရွက်ပြီး DMRT ဖြင့် Statistically Analysis လုပ်ခဲ့ပါသည်။ Data ကို အတည်ပြုခြင်းမှာ <0.05 ဖြစ်ပါသည်။

- Mean SO တွင် SO များနေခြင်းမှာ Diet Group တွင် ရရှိခဲ့သော Diet များသည် Nearly မဖြစ်ခဲ့ကြောင့် ဖြစ်ပါသည်။

- Mean ± SO rsm;vQif Data ခိုင်မာမှု အားနည်းခြင်း ရှိတတ်ပါသည်။

- သို့သော် Significant Difference သိသာထင်ရှားမှု <0.05 ရရှိခဲ့ရာ အသုံးပြုနိုင်သော Reliable Data ဖြစ်ခဲ့ပါကြောင်း တွေ့ရှိရပါသည်။

Dr. စန်းအောင် - မြန်မာပင်လယ်ပြင်မှ စီးပွါးဖြစ်ပုစွန်များသည် ဥများကို သယ်ဆောင်ထားခြင်းမရှိသော (Not berried) ပုစွန်အမျိုးအစားများ ဖြစ်ပါသည်။ ယခု သုတေသနပြုလုပ်ထားသော ပုစွန်သည် ဥသယ်ဆောင်ထားခြင်း ရှိ/မရှိ (Egg carried) ကို အသေးစိတ်ရှင်းပြစေလိုပါသည်။

ဖြေကြားချက် - *Metapenaeus japonicus*) Kuruma shrimp ပုစွန်မျိုးစိတ်သည် ဂျပန် နိုင်ငံတွင် အဓိကမွေးမြူရေးကို ဆောင်ရွက်နေသော Main culture လုပ်နေသော ပုစွန်မျိုးစိတ်ဖြစ်ပါသည်။ ဥသယ်ဆောင်ထားသော (Egg carried/ Berried) ပုစွန်မျိုး ဖြစ်ပါသည်။

Dr. ထွန်းစိန် - Vitamin C သည် ရေတွင် ပျော်ဝင်နေသည်အတွက် ရေငန်ပုစွန်မှာ Vitamin C မဆုံးရှုံးအောင် အဘယ်ကဲ့သို့ ကျွေးမွေးပါသနည်း၊ စမ်းသပ်သည့် Vitamin C အမျိုးအစား (၀၊ ၄၈၊ ၉၂၊ ၁၆၅၊ ၃၆၇၊ ၇၄၈) mg/kg ppm နှင့် ညီမျှသည့် AMP Na / Ca အရေအတွက် အတိအကျကျွေး၍ ရအောင် မည်ကဲ့သို့ ကျွေးမွေးပါသနည်း၊

ဖြေကြားချက် - Soluble compound ဖြစ်၍ မိမိကိုးကားသော Supplementation ကို Vitamin C Activities နှင့် တွက်ချက်၍ အရင်ဆုံး စမ်းသပ်ပါသည်။ Analyzed data ဖေါ်ပြထားပါသည်။ ၄င်း Vitamin C level သည် ပုစွန် Body ထဲသို့ ဘယ်လိုရောက်သွားသလဲကို သိရန် Tissue analysis လုပ်၍ ထပ်မံဆုံးဖြတ်ရပါသည်။

- ယခု Presentation တွင် ဖေါ်ပြထားသော Vitamin C level များသည် Analyzed data များဖြစ်ပါသည်။ အတိအကျ ထည့်ထားသလောက် မကျန်တဲ့အတွက် Analyzed data နှင့် Presentation ပေးရခြင်းဖြစ်ပါသည်။

Dr. သန်းကျော် - Treatment 6 ခုတွင် တစ်ခုနှင့်တစ်ခု (၂)ဆစီ ထည့်သွားရာမှ နောက်ဆုံး နှစ်ခုခြားနားချက် (၃၈၀) pp ရှိပါသည်။ ၄င်းခြားနားချက်ဖြစ်နိုင်ပါသလား၊

- Conclusion တွင် 25mg ဟုဖော်ပြထားပါသည်။ စမ်းသပ်ချက်တွင် ထို တန်ဖိုးများ ဖော်မပြထားပါ၊ စမ်းသပ်ချက် တန်ဖိုးများ အတိုင်းဖော်ပြပေး နိုင်လျှင် ပိုကောင်းမည် ထင်ပါသည်။

<u>ဖြေကြားချက်</u> - စမ်းသပ်ချက်အရ Significant ဖြစ်သော တန်ဖိုးများမှာ ကြားတန်ဖိုးများ ဖြစ်၍ Robinns ၏ Broken Line Analysis နည်းဖြင့် တွက်ချက်ကာ ဖော်ပြထားခြင်းဖြစ်သည်။ ယခုစပ်သပ်ချက်သည် Ph.D Thesis တွင် အပါအဝင်ဖြစ်သော တစ်ခုသော စမ်းသပ်ချက် တစ်ခုဖြစ်ပါသည်။ ယခင် ဆောင်ရွက်မှုများကို အခြေခံ၍ စပ်းသပ်ချက်အတွက် Vitamin C ကို Deficit or Insufficient level, တစ်နည်း (or) Adequate level တစ်နည်း (၅၀မှ ၂၀၀)နှင့် Excess level, တစ်နည်း (၅၀၀မှ ၁,၀၀၀) သတ်မှတ်ခဲ့ခြင်း ဖြစ်ပါသည်။

<u>ဦးခင်ကိုလေး</u>

<u>အကြံပြုချက်</u> - စာတမ်းတွင် တွေ့ရှိချက်အရ ပုစွန် ၀. ၀၃ ဂရမ် အရွယ်သည် Juvenile ဟု မခေါ်နိုင်ကြောင်း သုံးသပ်ပါသည်။

- ပုစွန်များတွင် Stress အများအပြားရှိသည်အနက် ယခုဆွေးနွေးသည်မှာ Osmosis stress ဖြစ်ပါသည်။ အခြား Temperature stress, pH stress များလည်းရှိပါသည်။

- ကန်ထဲရှိ ရေ၏အင်နှုန်း အပြောင်းအလဲ Osmosis ကို ခံရခြင်းဖြင့် ရောဂါဖြစ်ရခြင်း အကြောင်းရင်းဖြစ်သည်။ Environment, pathogen, host သုံးခုအနက် Environment ဒါဏ်ခံနိုင်ရည်ရှိခြင်းဖြင့် ရောဂါ ဒါဏ်ကို ခံနိုင်ရန် အထောက်အကူ တစ်ခုဖြစ်သည်ဟု ပြောလိုပါသည်။

- သို့ရာတွင် မြေကြီးကန်များတွင် Phytoplankton, zooplankton များမှ Vitamin C ကို ရရှိသည့်အတွက် မြေကန်များတွင် အခြေအနေ တစ်မျိုး ဖြစ်နေပါသည်။ လက်ရှိကာလတွင် ပုစွန်စာငါးစာတောင့်များကို စက်ရုံများမှ Feed quality ကို တိုင်းတာရာတွင် Protein ကို အဓိကထား၍ တိုင်းလျှက်ရှိပါသည်။ မြန်မာမွေးမြူရေးဖွံ့ဖြိုး တိုးတက်ရေးအတွက် အစာတောင့်များ၏ Quality ကို အသေးစိတ် ဆက်လက်၍ လုပ်ဆောင် သင့်ပါသည်။

ဖြေကြားချက်

- 0.03 gm အရွယ်ပုစွန်ကို *M. japonicus* မျိုးစိတ်အတွက် Juvenile ဟု သတ်မှတ်ပါသည်။ (Small juvenile ဖြစ်ပါသည်)။

- *M. japonicus* သည် ဥမှ ပေါက်ပြီးနောက် သားလောင်းဘဝ (၁၁)ရက် တွင် Post Larva (PL) ဘဝသို့ ရောက်၍ PL 30 အဆင့်တွင် Juvenile ဟု သတ်မှတ်ပါသည်။ မြန်မာနိုင်ငံရှိ ရေချိုပုစွန်တုပ်ကြီးသည် ရက် (၃၀) အကြာတွင် Post Larva (PL) ဘဝသို့ ရောက်ပါသည်။

The Study of Fermentation Characteristics and *In vitro* Gas Production of Leucaena Silage

Zaw Lin [1], Aye Min Nwe [2], Aung Aung [4], Tin Tin Myaing [3] and Tin Ngwe [4]

ABSTRACT

The main aim of forage conservation is to store up plant material to feed the animals during favorable or unfavorable time. Additives are used to improve silage preservation by ensuring that lactic acid bacteria dominate fermentation phase. Silage additives are used fermentation stimulant, such as molasses (sugar-rich material), starch, inoculants and enzyme which encourage the development of lactic acid bacteria. The major objective in silage fermentation is to achieve a stable low pH at which biological activity virtually ceases. Protein-rich feeds with low energy content are very difficult to ensile successfully, and should be mixed with easily fermentable, energy-rich products. Therefore, in the present study, an attempt was made to investigate the fermentation characteristics, the nutritive value and digestibility through the gas production of silage with and without molasses and starch sources. Ensiling technology requires at least 30% of dry matter (DM) in the forage. The chopped leucaena 18kg alone, 18kg chopped leucaena with molasses 5% and 18kg chopped leucaena with 5% boiling rice powder, respectively were ensiled in four pit silos (total of 12 pit silos). Plastic bags (2'·2?x 3'·2?) were used to get completely anaerobic condition when chopped leucaena was ensiled in every pit silo. Leucaena silage without any additive (Tc) did not decrease below pH 5 but leucaena silage with starch source (Ts) and leucaena silage with molasses (Tm) decreased nearly pH 4 from 24 days to 33 days. The fermentation stimulant additives should be added in leucaena silage making. Temperature was about 25°C from 21days to 33 days. Dry matter content of Tc, Ts and Tm were 41.3%, 36.8% and 42.9% in 10 days, 42.6%, 38.0% and 46.0% in 20 days and 35.6%, 38.2% and 42.2% in 30 days respectively. Physical characteristic of three treatments of silage were the same colour, texture, odour and no fungus contamination. Crude protein contents of fresh leucaena and three types of silage were not different. Gas productions were not significant each hour in Fig .2, Fig .3, but significant different ($p<0.04$) at 18 hours in the Fig.4. When gas production of leucaena silage at 30 days was compared with fresh leucaena, gas production of three types of silage was higher than original leucaena.

Key words: Additives, conservation, gas production, pH, pit silo, temperature

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Introduction

Ruminants have an important economic role in village systems to provide draft power, meat, manure, hides and milk in most countries of South–East-Asia. It is well recognized that rice straw is the main feedstuff for ruminants. Rice straw alone was not adequate amounts of digestible protein for normal growth of cattle (National Research Council, 1981). Therefore, supplementation with fodder leaves is often the source of nitrogen for ruminants during dry season.

Ranjhan (1983) recommended that feeding straw mixed with green fodders, whether these are grasses or legumes, in the ratios of 3:1 or 1:1 should meet the requirements of ruminants for maintenance and growth, respectively. Although a shrub, Leucaena is very palatable to livestock, thickened stem is far less palatable and nutritious than leaf or young stems. The leaves, young stems, flowers and pods are all excellent sources of protein and minerals (Jones, 1979).

Forage, crop residues and by-products are usually consumed fresh by domestic animals. However, it is possible to conserve them for use during future periods of feed shortages (Mannetje, 1999). Ensiling technology requires at least 30% of dry matter (DM) in the forage. With less than 30%, undesirable fermentation takes place and result in effluent, which creates an environmental pollution problem and increase losses (Ashbell and Weinberg, 2000). The main aim of forage conservation is to store up plant material to feed the animals during favorable or unfavorable time. Generally, most smallholders in Myanmar are not aware of the importance of forage conservation and preservation. Suitable technology of forage conservation and preservation should be studied to enhance forage production and so, increasing the animal population. Forage preservation can be made in different form such as silage, haylage and hay (Modh Najib et al, 1993). They can be kept for a longer period of time without much deterioration in nutrient of forage resources.

Additives are used to improve silage preservation by ensuring that lactic acid bacteria dominate fermentation phase (Henderson, 1993 and Bolsen *et al.*, 1995). The group of fermentation stimulant additives or potential additives operates by encouraging rather than suppressing the silage fermentation (Woolford, 1984). Silage additives are used fermentation stimulant, such as molasses (sugar-rich material), inoculants and enzyme which encourage the development of lactic acid bacteria (McDonald *et al.*, 2002). In Myanmar, silage making is one of the possible options that can solve the scarcity of feed problem during summer in every year.

Therefore, in the present study, an attempt was made to investigate the fermentation characteristics, the nutritive value and digestibility through the gas production of silage with and without molasses and starch sources.

Materials and Methods

Twelve silos made by concrete were used to make silage fermentation with four replications for Leucaena. Each pit silo was made up of 1 foot × 1 foot × 2 feet for length, width and depth. Leucaena was obtained from 2 Nay Pyi Taw area. Three treatments (control, molasses and starch) with four replications are used for this silage making process. The Leucaena was chopped into 2-4cm length and mixed with and without molasses and starch. They were filled into silo and covered by polythene film for 33 days. Randomized Complete Block Design (RCBD) was used in this study and three treatments were as follows:

Treatment (1) - Chopped Leucaena ensiled without any additive (Tc)

Treatment (2) - Chopped Leucaena ensiled with molasses (Tm)

Treatment (3) - Chopped Leucaena ensiled with starch (Ts)

Experimental procedure

Twelve silos were randomly selected to make leucaena silage. Weather conditions at harvest were fine and warm (Max 32°C, Min 30°C). The Leucaena plants were harvested on 10 July 2007 by manual cutting. The branches were chopped into 2-4 cm particle length by using a simple electric chopper. The chopped Leucaena 18 kg alone as control, 18 kg chopped Leucaena with molasses 5% as molasses silage and 18 kg chopped Leucaena with 5% boiling rice powder as starch silage, respectively were ensiled in four pit silos (total of 12 pit silos). Plastic bags (2'·2?x 3'·2?) were used to get completely anaerobic condition when chopped Leucaena was ensiled in every pit silo.

After filling the chopped leucaena in the pit silo, the plastic bags were sealed with plastic string manually. And then, each pit silo was fitted with concrete-cover and all pit silos were covered with polythene film.

Measurement (1) - The temperature, physical characteristics (colour, odour and texture), fermentation characteristics (pH) and chemical composition were measured at 3 days interval for 33 days.

Measurement (2)-The gas production was measured by *in vitro* gas analysis method (Menke, and Steingass, 1988).

Chemical analysis

Ground samples of forage and silage were analysed for dry matter (DM), organic matter (OM) by the method described by AOAC (1970). Nitrogen was determined by using Kjeldahl method (Foss 2020 digestor and Foss 2100 Kjeltec distillation unit) and crude protein (CP) was calculated as 6.25×N (AOAC, 1970).

Statistical analysis

The data were subjected to the analysis of variance using ANOVA and the significance of difference between treatment means was compared by Duncan's Multiple Range test (DMRT) for each trial (Steel, and Torrie, 1980).

Results and Discussions

The pH values of these silages are presented in Table 1. The pH values of Tc, Ts and Tm decreased below 6 after 9 days. Although Tc did not decrease below pH 5, Ts and Tm decreased nearly 4 from 24 days to 33 days. The pH of Ts and Tm were 4.55 and 4.70 which were significantly ($P<0.05$) lower than Tc (5.5) after 21 days. This result showed that the fermentation stimulant additives should be added in Leucaena silage making because the major objective in silage fermentation is to achieve a stable low pH at which biological activity virtually ceases. Additives are being recommended to improve fermentation and reduce the pH (Bates, et al., 1989; Staples, 1995). Protein-rich feeds with low energy content are very difficult to ensile successfully, and should be mixed with easily fermentable, energy-rich products (Kayouli Chedly and Stephen Lee, 2000).

Physical characteristics of silage are shown in Table 2. The three treatments showed the same colour, texture, odour and no fungus contamination.

The chemical compositions of fresh leucaena (To) and 10 days old silages are shown in Table 3. The dry matter contents of To, Tc, Ts and Tm were 35.6%, 41.3%, 36.8% and 42.9%, respectively. The chemical compositions of fresh leucaena (To) and 20 days old silages are shown in Table 4. The DM contents of To, Tc, Ts and Tm were 35.6%, 42.6%, 38.0% and 46.0% respectively. The chemical compositions of fresh leucaena (To) and 30 days old silages are shown in Table 5. The dry matter contents of To, Tc, Ts and Tm were 35.6%, 38.2%, 33.2% and 41.16% respectively. All values except dry matter were expressed in DM basis. At day 10, day 20 and day 30 of fermentation processes, the dry matter contents of Ts were significant ($P<0.05$) lower than Tc and Tm. This might be considered that the presence of starch source in Ts would increase the moisture content which would cause DM losses due to effluent. Woolford

(1984) revealed that there have been various estimates of DM loss caused by the discharge of effluent. Bastimal (1976) observed that some of additives caused loss of DM according to moisture holding capacity of plant material.

The organic matter contents and crude protein contents of fresh leucaena and three types of silage were not different. It was indicated that no loss of nutrient content was observed during ensilage due to good acidification, (pH 4-5). The rate of acidification occurring in the silo is important for the conservation of protein (Virtanen, 1933). Carpinteroa et al. (1979) showed that the addition of formic acid or cultures of lactic acid bacteria to herbage reduced the extent of proteolysis during ensilage.

It was observed the temperature changes between 26-28°C during the fermentation process before 18 days but these changes were decreased below 26°C after 18 days shown in the Fig. 1. Increased temperature was occurred before 18 days. McDonald, et al (2002) stated that respiration lead to a depletion of sugar, and it usually results in the evolution of heat. In the silo, the heat is retained in the mass of herbage causing an increase in temperature.

Gas productions at day 10, day 20 and day 30 are shown in Fig .2, Fig .3 and Fig. 4, respectively. Gas production were not significant each hour in Fig .2, Fig .3, but significantly different ($p<0.05$) at 18 hours in the Fig.4. Gas production of Ts was significantly higher than Tc and Tm at 18 hours shown in the 30 days leucaena silage due to the utilization of remaining energy source, carbohydrate by the ruminal bacteria for their biosynthesis. Woolford (1984) stated that the use of starchy materials in silage will influence its nutritive value if they survive the ensiling process, in which event they will be available to amylolytic organisms in the rumen.

In Fig.5, it shows that gas production of Leucaena silage at 30 days was compared with fresh leucaena. Gas production of three types of silage was higher than original leucaena. It might be tended to decreased anti-nutritional effect such as mimosine and tannin contained in leucaena by the degradation during the fermentation process (Sethi *et al.*, 1995).

Table 1. PH changes during the fermentation processes of Leucaena silage

Days(D)	Tc	Ts	Tm
3	6.80 ± 0.02	6.65 ± 0.20	6.77 ± 0.06
6	6.82 ± 0.05	6.61 ± 0.29	6.53 ± 0.22
9	6.83 ± 0.02	6.78 ± 0.24	6.65 ± 0.16
12	5.88 ± 0.15	5.58 ± 0.85	5.20 ± 0.59
15	5.18 ± 0.30	5.23 ± 0.50	4.68 ± 0.42
18	5.75 ± 0.13	4.40 ± 0.69	5.23 ± 0.36
21	5.93 ± 0.15	4.80 ± 0.69	5.45 ± 0.19
24	5.60^{a} ± 0.02	4.48^{b} ± 0.26	4.60^{b} ± 0.50
27	5.50^{a} ± 0.08	4.55^{b} ± 0.24	4.70^{b} ± 0.37
30	5.15^{a} ± 0.13	4.33^{b} ± 0.35	4.38^{b} ± 0.19
33	5.40^{a} ± 0.16	4.55^{b} ± 0.45	4.55^{b} ± 0.24

[1)] Tc: Leucaena ensiled without any additive
[2)] Ts: Leucaena ensiled with starch sources
[3)] Tm: Leucaena ensiled with molasses

Table 2. Physical characteristic of control, starch and molasses treated Leucaena

Items	Colour	Texture	Odour	Fungus contamination
Tc	Golden yellow	Soft	Fermentation Odour	Nil
Ts	Golden yellow	Soft	Fermentation Odour	Nil
Tm	Golden yellow	Soft	Fermentation Odour	Nil

silage
[1] Tc, Ts, and Tm see in table 1

Table 3. Chemical composition (%) of 0 day and 10 days old leucaena silage

Description	T_0	Day-10		
		Tc	Ts	Tm
DM	35.6	41.3[a]	36.8[b]	42.9[ac]
OM	90.3	88.9	89.2	88.1
CP	23.9	21.9	21.6	20.9

[1] DM: Dry matter, OM: Organic matter, CP: Crude protein, To: Fresh leucaena forage
[2] All values except DM are on DM basis
[3] Tc, Ts, and Tm see in table 1

Table 4. Chemical composition (%) of 0 day and 20 days old leucaena silage

Description	T_0	Day-20		
		Tc	Ts	Tm
DM	35.6	42.6[ac]	38.0[b]	46.0[c]
OM	90.3	88.4	90.0	90.0
CP	23.9	24.0	24.1	25.1

[1] DM: Dry matter, OM; Organic matter, CP: Crude protein
[2] All values except DM are on DM basis
[3] To: Fresh leucaena forage. Tc, Ts and Tm See in table 1.

Table 5. Chemical composition of 0 day and 30 days old leucaena silage

Description	T_0	Day-30		
		Tc	Ts	Tm
DM	35.6	38.2 [ac]	33.2[b]	41.16[c]
OM	90.3	90.3	91.0	90.1
CP	23.9	23.2 [a]	21.7 [b]	21.7 [b]

[1] DM: Dry matter, OM: Organic matter, CP: Crude protein
[2] All values except DM are on DM basis
[3] To: Fresh leucaena forage.
Tc, Ts and Tm see in table 1.

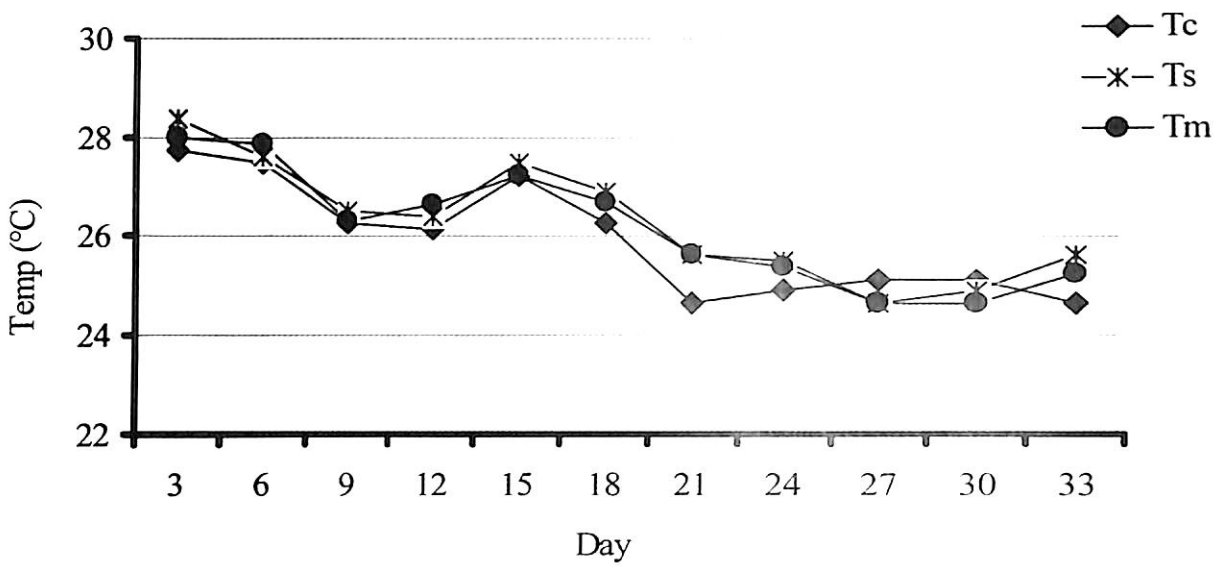

Fig. 1 Temperature changes during the fermentation process of Leucaena silage

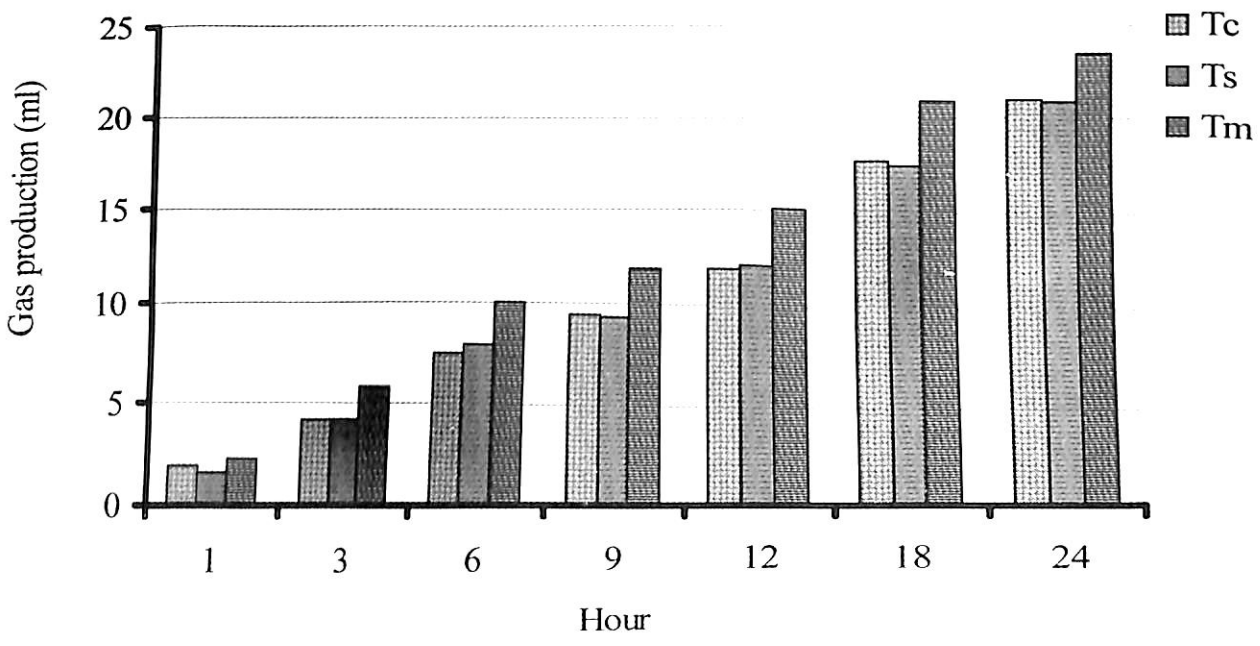

Fig. 2 Gas production (ml/200mg) of 10 days old Leucaena silage

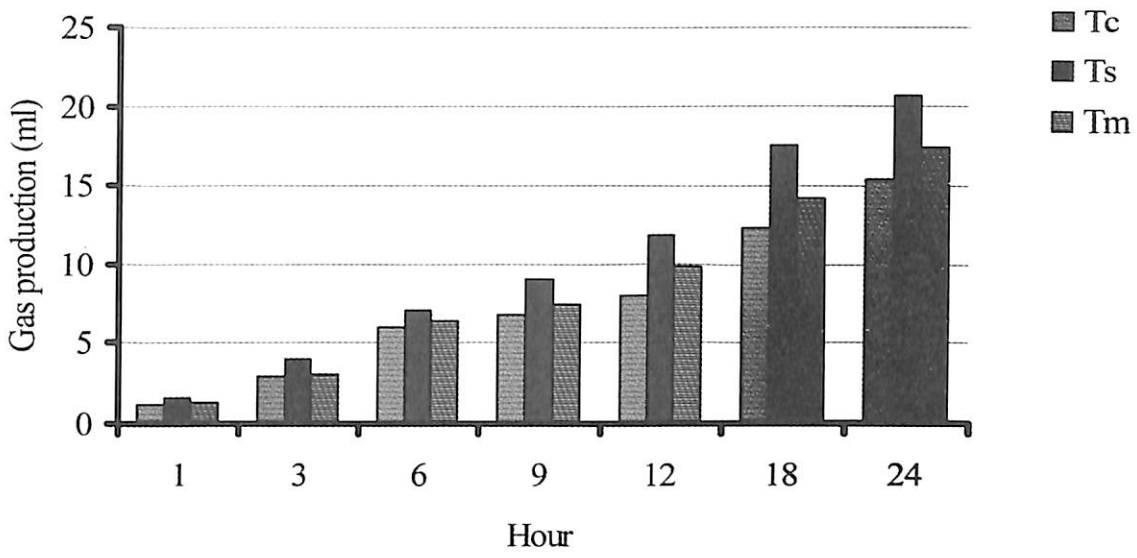

Fig. 3 Gas production (ml/200mg) of 20 days old leucaena silage

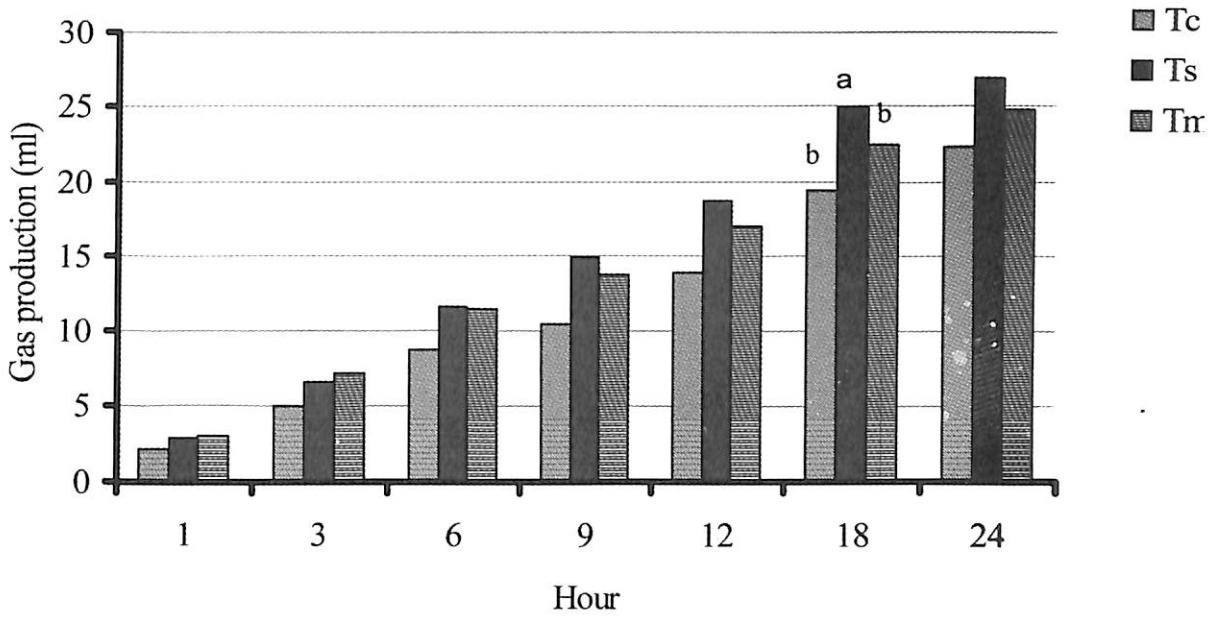

Fig. 4 Gas production (ml/200mg) of 30 days old Leucaena silage

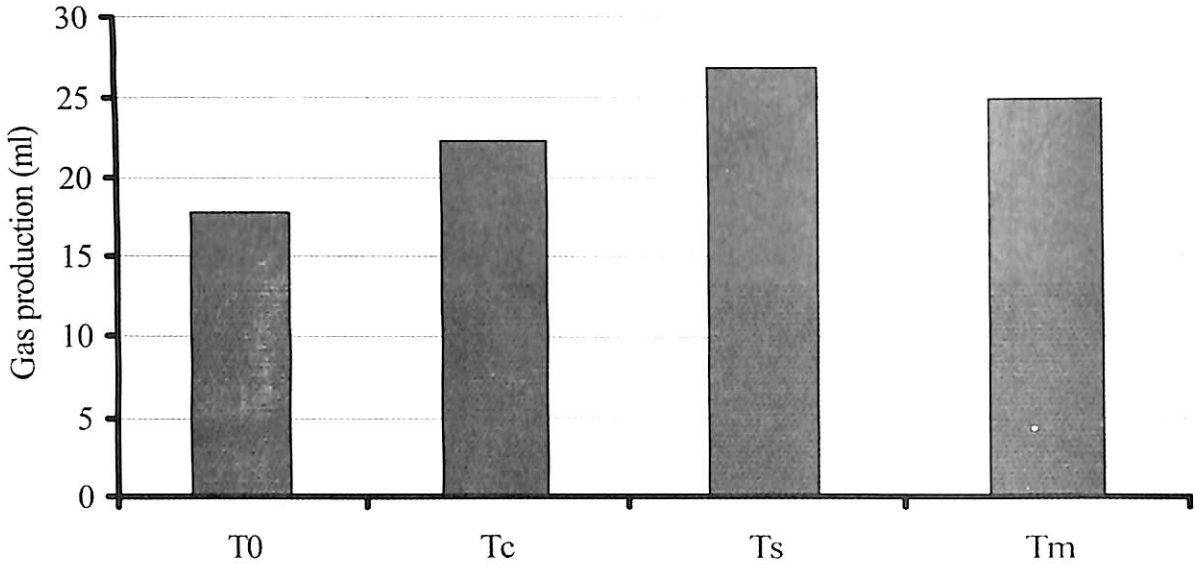

Fig. 5 Gas production (ml/200mg) of Leucaena silage at 30 days in comparison with fresh Leucaena

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References

A.O.A.C. 1970. Official Methods of Analysis, 11th edn., A.O.A.C., Washington D.C.

Ashbell, G and Weinberg, Z.G 2000. In silage making in tropics, with particular emphasis on smallholders, Silage from tropical cereals and forage crops. P.110.

Bates, D.B., Kunkle, W.E. and Dawson, T.E. 1989. Round bale silage - a forage harvesting alternative. In: Proceedings 38th Annual Florida Beef Cattle Short Course. Univ. of Florida, Gainesville, Fl., 3-5May 1989.

Bolsen, K.K., Ashbell, G and Wilkinson, J.M. 1995. Silage additives.p.33-54. In: Chesson A. and Wallace R.J. (eds.) Biotechnology in Animal Feeds and Animal Feeding. Weinhein, Germany: VCH Press.

Bastiman, B. 1976. Factors affecting silage effluect production. Experimental Husbandry, 31. 40-46.

Carpintero, C.M., Henderson, A.R. and McDonald, P. 1979. The effect of some pre-treatments on proteolysis during the ensiling of herbage. Journal of the British Grass land Society, 34.311-315.

Goering, H.K. and Van Soest P. J. 1970. Forage fibre Analysis. Agricultural Hand book. 379. USDA, Washinton D.C. 8-12.

Henderson, N. 1993. Silage additives. An.Fd. Sci.Techn., 45. 35-56.

Jones, R.J. 1979. The value of *Leucaena leucocephala* as a feed for ruminants in the tropics. Wld. Anim. Rev. 31.13-23.

Kayouli C. and Stephen L. 2000. In silage making in tropics, with particular emphasis on smallholders. Silage from by-products for smallholders, p.85.

Mannetje, L.'t. 1999. Introduction to the conference on silage making in the tropics. In: Proceeding of F.A.O Electronic conference on tropical silage. Edited by Mannetje,L.'t. 2000. Silage making in the tropics with particular emphasis on smallholders, p.1.

Mcdonal, P., Edwards R.A., Greenhalgh J.F.D. and Morgan C.A. 2002. Animal nutrition 6th edn. Person Education Limited, Edinburgh Gate, Harlow, Essex CM 202 JE.

Menke, K.H. and Steingass, H. 1988. Estimation of the energetic feed value obtained from chemical analysis and in vitro gas production using rumen fluid. Ani.Res.Dev.28.7 – 55.

Mohd Najib, M.A., Aminah A. and Idris, A.B. 1993. hold conservation for livestock smallholders in Malaysia. p.103-109. In: Strategies for suitable forage-based livestock production in Southeast Asia. Proceedings of the Third Meeting of the Regional Working Group on Grazing and Feed Resources of Southeast Asia. 31 January - 6 February 1993, Khon Kaen, Thailand.

National Research Council. 1981. Nutrient Requirements of goats: Angora, Dairy and Meat Goats in Temperate and Tropical Countries. Washington, D.C., National Academy Press.

Ranjhan, S.K. 1983. Economic evaluation of various processing methods for improving the nutritive value of fibrous agricultural residues for backyard ruminant production system in South and South-East Asian countries. Cited by Xing, T. 1988. Possibility and possible methods of improving the nutritive value of cereal straw without pretreatment.

Sethi. P, P. Ushpa, R. Kulkarni, 1995. In: Food science. Leucaena leucocephala as a nutritional profile. The United Nations University press. Food, Nutrition Bulletin, 16 http://www. unu. edu/unpress/foos/8F163e/ 8F163E08. htm

Staple, C.R. 1995. Bermudagrass: growing, storing, and feeding for dairy animals. Circular 1140, Florida Coop. Extension Service, Inst. of Food and Agricultural Sci., Univ. of Florida.

Steel, R.G. and Torrie J.H. 1980. Principles and procedures of statistics. A biometrical approach: 2nd edn. Mc Graw-Hill Book Company, New York.

Virtanen, A.I. 1933. The AIV method of processing fresh fodder. Empire Journal of experimental Agriculture, 1.143-155.

Woolford, M.K. 1984. Fermentation stimulants. In: The Silage fermentation. p.215 – 248, edited by Marcel Dekker, INC. New York.

Woolford, M.K. 1984. Fermentation stimulants. In: The Silage fermentation. p.251, edited by Marcel Dekker, INC. New York.

ဆွေးနွေးချက်

Dr. နွဲ့နွဲ့ထင် - Additive ကို Silage ပြုလုပ်ရာတွင် အသုံးပြုခြင်းကို ဖော်ပြရာ၌ To obtain the adequate amount of pH ဟူသော စကားလုံးအစား To obtain adequate level of pH ဟု ပြင်၍ ရေးသားသင့်ကြောင်း အကြံ ပေးပါသည်။

Dr. ထွန်းစိန် - Silage additive molasses အစား Starch ကို သုံးပြီး Silage fermentation ဖြင့်စား Stable slow pH ရရှိရန် အသုံးပြုသည် ကို တွေ့ရှိရပါသည်။ Molasses နှင့် Starch တွင် ပါဝင်သော Constituents တူညီပါသလား၊ မတူညီပါက မည်သည့် ပစ္စည်းများပါဝင်၍ Silage fermentation ဖြင့် Stable slow pH ကို ထိန်းနိုင်ပါသနည်း။

ဖြေကြားချက် - Molasses နှင့် Starch တွင် ပါဝင်သော ပစ္စည်းများ၏ Content မတူညီပါ။ မိမိလိုချင်သော Stable pH ရရန်အတွက် Glucose ရနိုင်ရန် Starch ကို ထည့်သုံးခြင်းဖြစ်ပါသည်။ Molasses ထက် Starch source ဖြစ်သော ဆန်မှုန့်သည် ပို၍ ဈေးသက်သာပါသည်။

Dr. ရဲထွဋ်အောင် - Molasses silage နှင့် Starch silage တွင် ပါဝင်သော Taste နှင့် Palatability ကွာခြား နိုင်ပါသလား၊

ဖြေကြားချက် - Silage product ၏ Palatability ကို စမ်းသပ်မထားသော်လည်း Silage နှစ်မျိုးကို ကျွေးကြည့်သောအခါ စားသည်ကို တွေ့ရှိရပါသည်။ Palatability ဖြစ် မဖြစ်ကို သီးခြား စမ်းသပ်လုပ်ရမည် ဖြစ်သည်။

Expanding Export, Profitability and Changing Resources: A Case Study of Small-Scale Shrimp Fishing in Rakhine Coastal Area

Khin Maung Soe [1] Ikuko OKAMOTO [2]

ABSTRACT

This paper examines the impact of the recent shrimp export expansion in Myanmar on the economic state of small-scale fishermen. Results indicate that there has been an active increase in shrimp fishing stimulated by expanding export demand. With this, the income of shrimp fishermen has increased dramatically in the past 10 years. However, future prospects appear gloomy due to the possibility of over exploitation of shrimp resources. The paper concludes with some recommendation to achieve sustainable development of Myanmar's fishery sector, emphasizing the importance of monitoring the current status of fishery resources, economic status of fishermen as well as the needs to feedback the information to the stakeholders.

Introduction

Globalization is a rather recent phenomenon for Myanmar's fishery sector. In the British colonial period, a wide range of commodities such as rice, timber, and minerals from Myanmar were sold in the international market. However, marine resources remained largely untapped (U Khin 1948). In the socialist period, only limited amounts of fishery products were exported through state owned economic enterprises. Only after private export began in the mid 1990's did fishery exports grow in any significant way, and this lead to the expansion of fishing activities geared toward the international market. In neighboring Southeast Asian countries, export oriented fishing industry developed in the 1960's and 1970's (Hirasawa 1984). Thus, Myanmar was 30 years behind in the shift to export oriented fishing. In a sense, Myanmar was the last frontier in Southeast Asian marine waters to which the wave of the globalization came.

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Shrimp is the commodity primarily leads the recent expansion of Myanmar's fishery exports. After the economic transition in the late 1980's, shrimp began to account for about 70% of total fishery exports in value and continues to increase by 20% per annum. The purpose of this paper is to examine the impact of the shrimp export expansion on the economic state of small-scale fishermen in the coastal areas of Myanmar.

Concerning the process of transformation from subsistence-oriented to commercial-based fishing, it is often said that even though total catch may increase at the national level, the economy of small-scale fishermen may not necessarily improve (Bene 2003). Based on surveys conducted in a fishing village in Rakhine State in Myanmar, this paper examines such propositions by providing research to answer the following three questions: (1) Who are the small-scale fishermen engaging in expanding shrimp fishing? (2) What is the extent of the benefit? To be more precise, what is the income that fishermen obtain from shrimp fishing? (3) Will the benefit last?

One of the objectives is to identify small-scale fishermen actively engaged in Myanmar's shrimp industry. Thus, the main target of analysis is owners of shrimp fishing boats. Crews hired by these shrimp boat owners [3] and those who engage in other type of fishing are only referenced when necessary.

As far as the authors are aware, only limited research has been done on the current condition of Myanmar's fishing industry, and the paucity of statistical information may be one of the primary reasons. Another may be the fact that the changing status of this industry is a quite recent development. This paper is a case study, and more research is necessary for a comprehensive understanding of Myanmar's fishery sector. However, this paper aims to clarify the rapidly changing status of fishing village economy and to set a precedent for further research on Myanmar's fishery sector and fishing communities.

Section 1 includes discussion of the general condition of Myanmar's fishery sector and especially the expansion of shrimp exports. Section 2 describes the study village and associated fishing activities. Characteristics of small-scale shrimp fishermen and the factors that determine their entry into fishing are clarified in Section 3. Section 4 includes examination of income and profitability in the shrimp fishing industry. Section 5 presents analysis of the short and mid-term income fluctuations and indicates that the income from shrimp fishing is likely to decrease in the long term. Conclusions are provided in the final section.

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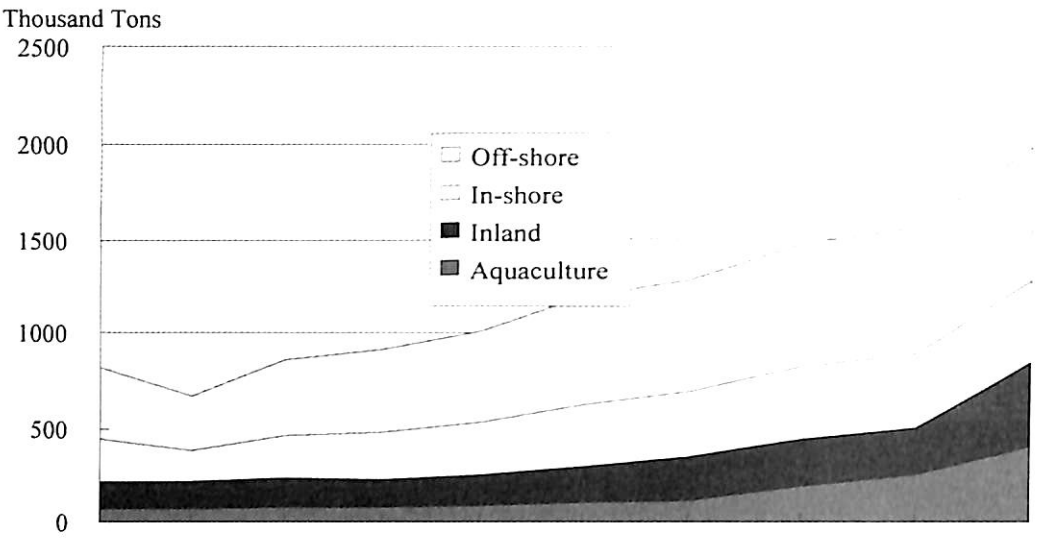
[3] Analysis of these crews is very important for understanding the improvement of the economy of the fishing community and is left for future research.

1. Development of the Fishing Industry in Myanmar

Figure 1 shows changes in the total catch in Myanmar. Availability of statistics allows the change since 1994-95 to be shown. The catch has been increasing constantly since 1995-96 irrespective of the type of fishing off-shore on-shore,[4] inland or aquaculture. The total catch reached two million tons in 2003-04; this is a three-fold increase compared to 1995-96. The increase is two-fold in the coastal fisheries where small-scale fishermen mainly engage in fishing activity.

[4] In-shore fishing refers to those operations within 5 nautical miles of the waters of Rakine State, Ayeyarwaddy Division and Mon State, and within 10 nautical miles of the waters of Tanintharyi Division.



Source: CSO Statistical Yearbook 2004, DOF[2004].

Fig 1 Changes in Total Catch

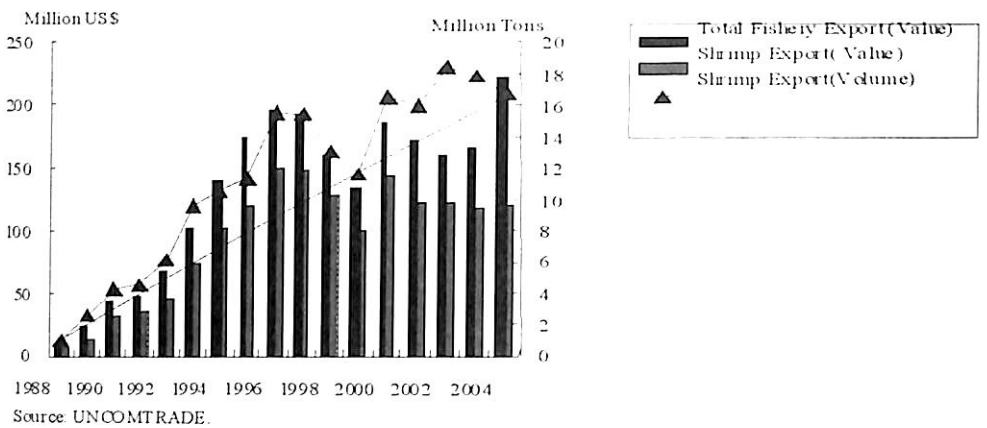
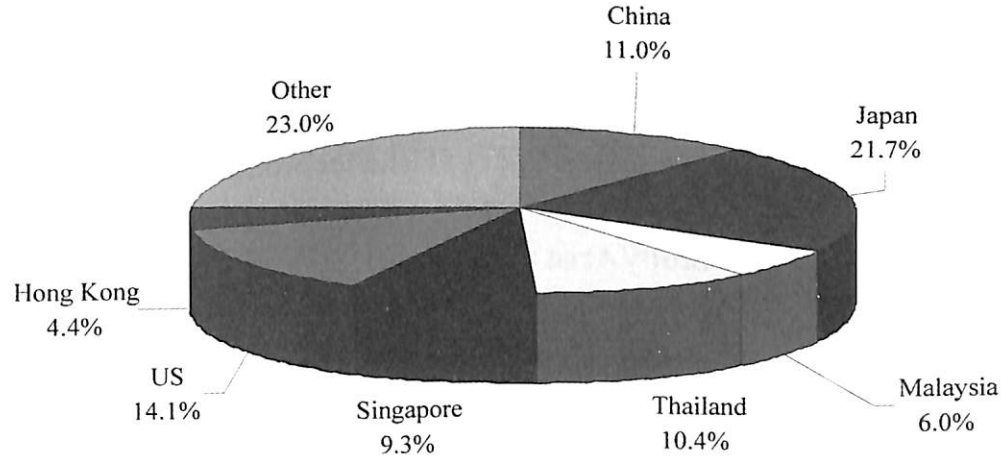


Fig. 2, Changes in Fisheries and shrimp Export

This increase of total catch results from the growing demand for export, especially shrimp. Changes in the value of exports of fishery products that have been compiled from importer statistics since 1988 are shown in Figure 2. Exports have been increasing constantly and reached US $347 million in 2004-05. Frozen shrimp accounts for the largest share and averages 72% of the total export value for 1988-2004. Though reasons are unclear, shrimp exports decreased dramatically both in terms of value and volume in 1999, but thereafter volume again increased rapidly. These shrimp were exported not only to developed countries such as Japan, the US, and the EU, but also to neighboring countries such as China, Malaysia, Thailand, and Singapore (Figure 3). The increase of exports to China has drawn particular attention in recent years. Export to China was only 27 tons in 1995-96 but grew to 2900 tons in 2002-03. The rate of increase in value is moderate compared to that of volume, and this is probably because the destination of Myanmar's shrimp shifted from developed countries to markets such as China and Thailand where the unit price was lower.[5]

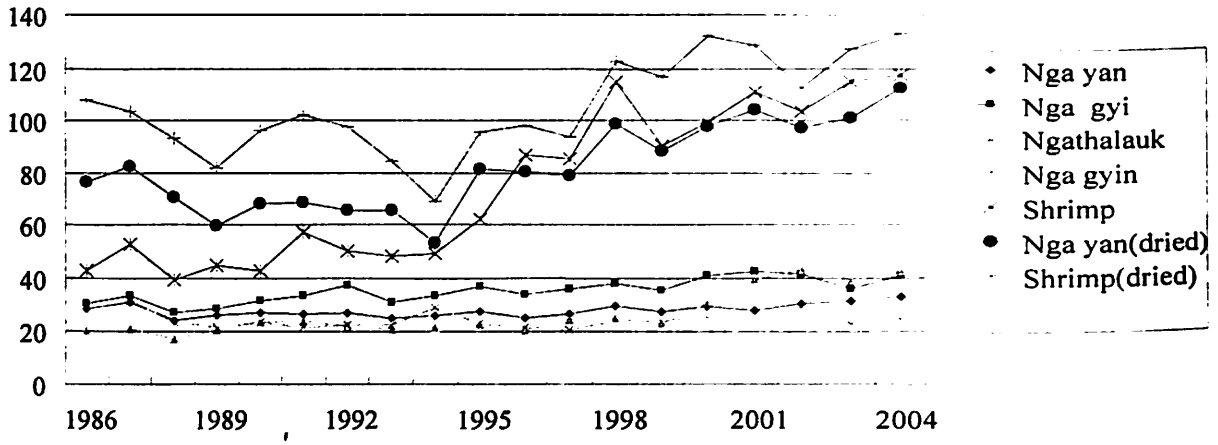


Source: DOF [2005].

Fig. 3, Share of Shrimp Importers (Based on Import value) (FY 2002-03)

[5] The import unit price of shrimp (total import value divided by total import volume) is US $6.1 for the US, US $5.1 for Japan, and US $4.1 for China.

The trend in prices clearly reflects the steady increase of fishery exports. Figure 4 shows prices of fish products (wholesale) deflated by CPI. It indicates that the price of fresh shrimp has been soaring since 1994. The price of dried prawns accompanies the upward trend of fresh shrimp prices. This is in clear contrast to the prices of carp and cat fish which are consumed primarily in the domestic market. The sharp increase in the price of shrimp after 1994 reflects the beginning of private export of shrimp on a wider scale.



Note: Deflated by using CPI (1986=100).
Source: *Statistical Yearbook*. 1993,1997, 2001, 2003. *Mmonthly Economic Indicator*June, 2005.

Fig. 4, Changes in Real Price of Fisheries Product

2. General Overview of the Study Area and Village

The study was conducted in a fishing village in Thandwe Township, Thandwe District in Rakhine State. Thandwe Township consists of a town and 63 village tracts. The population is about 140,000. The main industries in the Township are fishing, agriculture, and tourism.

The fishing sector in Thandwe consists of off-shore fishing and in-shore fishing. Extensive type of shrimp farming has also been practiced in some areas since 2000. However, due to decreasing yield (as it is unavoidable due to the nature of extensive type of shrimp farming) and a surge in production costs, some shrimp farms have stopped production in recent years. Thus, the share of cultured shrimp is nominal, and the majority of shrimp are from marine fishing, as indicated in Table 1. In-shore fishing plays an important role in terms of catch (fish and shrimp) for marine fishery. Among fishing commodities marketed to other areas, shrimp is the second most important commodity following salted dried fish[6] (Table 2).

[6] "Salted dried fish" refers to anchovies and sardines. These are primarily for the domestic market, but some are exported to China and Bangladesh through border trade.

Table 1. Total Catch in Thandwe Township
(December, 2004 ~ November, 2005)

	Fish	Shrimp
Offshore	374	452
Inshore	5006	517
Total	5380	969

Source : DOF Thandwe

Table 2. Outflow of Fishing Products from Thandwe Township

December 2004 – November 2005

Type	Volume (Metric Ton)
Shrimp	533.60
Salted dried fish	1660.00
Marine fish	224.70
Squid	66.40
Salt pickled fish	239.00
Canned products	11.50
Mollusks	5.00
Freshwater fish	2.40
Lobster	3.40
Crab	22.60
Total	**1108.60**

Source: DOF, Thandwe

Shrimp and fish landed in Thandwe Township are processed in factories either in Yangon or in Thandwe. Because the number of frozen processing factories in Thandwe has been increasing since the mid 1990's (Table 3), it is very likely that the volume processed in local factories is now larger. The increase of factories in Thandwe is due to competition designed to assure the supply of raw material, shrimp. In order to obtain high and stable prices in the export market, the acquisition of fresh raw materials as well as their prompt processing is indispensable for export companies. In fact, A company listed in Table 3 purchased shrimp from village brokers since the establishment of the factory in 1996, but it opened its own purchasing depot in villages in 2005. This is a reflection of the competition among processors for the raw material. According to a village broker who was in the job well before the expansion of shrimp exports, the volume that can be collected at present is only one-twentieth of what could be collected in 1996, and the number of the fishermen that can be dealt with has decreased to one-third the number of 1992, even though the total number of shrimp fishermen in the area was increasing. The competition is great even at the very end of the marketing chain.[7]

Table 3. Factories Established in Thandwe

	Established Year	Main Destination of the Products	
A	1996	Japan	China
B	1998	Japan	China
C	2002	China	
D	1998	China	

Source: Authors' Survey.

[7] This is based on an interview with a shrimp trader in the Singaung Village Tract (October 2006).

The field survey was done in a fishing village (Singaung Village Tract) which is located about 19 km from Thandwe town. Singaung Village Tract consists of 5 sub-villages, and the total population was 1143 in 2006. As indicated in Table 4, many households are dependent on fishing for their livelihood.[8] The survey was done in the two sub-villages (Singaung and Nyaung Chitauk). These two sub-villages have the largest number of households and are the center of fishing activities of the village tract. There are agricultural households in these sub-villages, but generally the acreage they hold is small (two to five acres on average), and cultivation is primarily practiced for their own consumption.

Table 4. Household Distribution in Singoung Village Tract

Village	Sin Goung	Nyaung Chitauk	Kyauk Pyu Maw	In Daing Gyi	Sin Kyat
- Total HH (A+B+C)	564	327	98	70	84
A. Fishery Household (Owner + Crew)	278	170	59	15	68
- Owner House hold	143	70	19	1	22
- Crew Household	135	100	40	14	46
B. Agriculture Household	130	83	14	39	8
C. Non Agriculture/Fishery HH	156	74	25	16	8
Share of Fishery Household (%)	49.3	52.0	60.2	21.4	81.0
- Owner Household	25.4	21.4	19.4	1.4	26.2
- Crew Household	23.9	30.6	40.8	20.0	54.8
Share of Agriculture Household (%)	23.0	25.4	14.3	55.7	9.5
Share of Non Agriculture/Fishery HH (%)	27.7	22.6	25.5	22.9	9.5

Source: Authors' Survey

[8] The compiling of this kind of data to clarify the livelihood patterns is not easy as it may appear for fishery villages. This information is compiled after making a list of all the households in the village, together with the information of the work each household member engage at the specific point of time.

	Total	Singaung	Nyaung Chitauk
Boat Owners	32	12	20

Source: Authors' Survey.

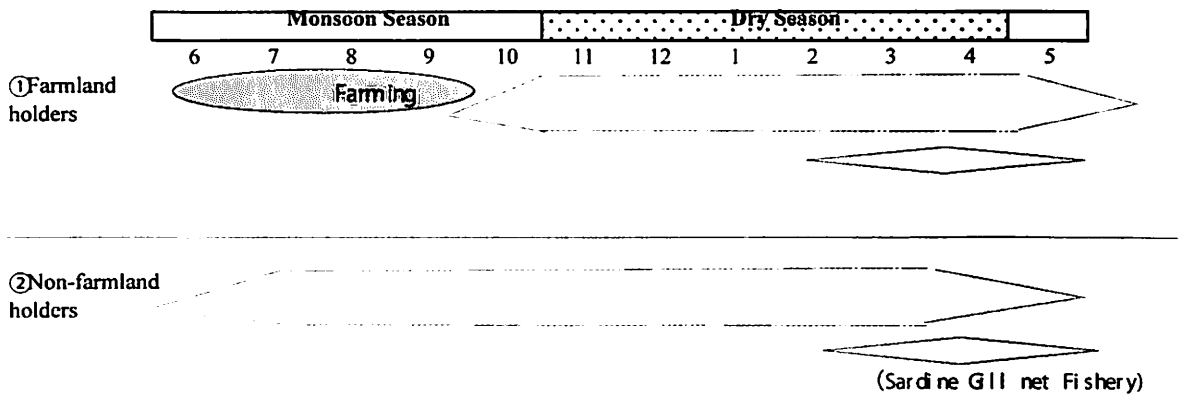
Interviews using questionnaires were conducted with fishermen twice in 2006 after a preliminary survey in 2005. Thirty-two boat owners (who are engaged in three-layered gill net shrimp fishing) were interviewed (Table 5). Main questions related to household structure, assets held, history of fishing, fishing season, ownership of fishing gear, catch, sales prices, non-fishing income, and credit relationships. In addition to that, information on the other type of fishing, such as anchovy purse seine fishing, sardine gill net fishing and baby trawling trawl fishing. Small-scale shrimp trawl fishing is prohibited in the area. But the operation is still in some Rakine waters. Thus information is collected from various sources and presented as reference.

3. Shrimp Fishing and its Actors

3.1 Background of Shrimp Fishermen

Within the study area, the major gear used for shrimp fishing is the trammel three layered net, and this has been used for a long time in the study village. A shrimp broker, who was an agent for the State Fishery Enterprise then, first introduced the net to this village in 1978. The catch obtained by the three-layered nets is far larger than that obtained with the one layer net that had been commonly used until then. Thus, fishermen quickly switched to the three-layered net. Motorization of fishing boats equipped with 5-6 HP engines also began at about the same time in the late 1970's.

Figure 6 shows the typical fishing season in the study village. Besides shrimp fishing, sardine and anchovy fishing is common in the village. Those who own farmland do not fish in the monsoon season because this is the busiest time for farming. Since the catch of shrimp tends to decrease around March in the dry season, a majority of shrimp fishermen switch to sardine gill net fishing which they expect larger catches.



Source: Author's Survey

Fig.6, Fishing Season

Shrimp trammel net fishing is normally done by three crew. Most boat owners work as a crew on their own boat. Owners and crew divide the total catch by a ratio of 6:4. Each crew receives rewards by dividing the total share of all crew by the numbers of crew. If working as a crew member, the owner can also receive a portion of the crew's share. All operating costs, such as for fuel and repairs, are borne by the owner of the boat and gear.

Table 6 includes major characteristics of the fishermen who engage in shrimp fishing. Not only are those who were born into fishermen households engaging in shrimp fishing but also many whose fathers were farmers, traders, and public servants. It signifies that there is an active entry into the fishing sector from other sectors.

Table 6, Characteristics of Shrimp Fishermen

No of Samples	No. of Family Members	Avg. Age of HH Heads (Years)	Education (Years)	Main Occupation of Father					
				Farming	Fishery	Public Servants	Commerce	Other	Unknown
32	4.8	41.3	6.5	17	6	4	2	1	2

Source: Authors' Survey

Table 7, Background of Shrimp Fishermen

	Number	Crew—► Owner	Entry from Other Sector
New	14		
Old	18		
Total	32		

Note1: "New" refers to those who became the shrimp fishing boat owner for the first time.
Note2: In others, four are from agriculture, one from public service, two from grocery store, and one is unknown. Some from agriculture, some are still continuing to farm
Source: Author's Survey.

Table 7, showing the fishing history of interviewed fishermen, endorses this point. Class mobility among fishermen is especially noteworthy. There are many "new" fishermen who have entered from other occupations (farmers, public servants, and grocery store management). This implies that fishing in the area holds very attractive economic opportunities even for those who have no experience. Further, six owners used to be members of crew. This indicates a strong possibility for upward class movement among fishermen. Even those that started fishing without production assets can become owners of such assets. This is in clear contrast to those landless agricultural laborers who are hardly able to be landed farmers in most areas of Myanmar.[9] Shrimp fishermen in the study area are consisted of those who have been fishing quite a long time and those who have just started. And the mobility of the fishermen class is high, and crew members can become owners in a relatively short period of time.

[9] It has been almost impossible for agricultural laborers to be farmers even in the case of exported pulse production areas that developed rapidly in the 1990's. See Okamoto (forthcoming).

3.2 Requirements to Become a Shrimp Fisherman

The key to becoming an owner of a shrimp fishing boat is in being able to acquire sufficient capital. Table 8 compares the required fixed costs according to different types of fishing (prices are for 2005-06). The amount of capital needed for the shrimp trammel net fishing is almost equal to that of sardine gill net fishing and far less than anchovy purse seine fishing. In this sense, capital needed for shrimp fishing is not so large if they only engaged in gill net fishing. However, if one would engage in mini / baby trawl fishing, the capital costs could be very high, which is almost 4 times larger than the trammel net fishing.

Table 8, Comparison of Initial Investment Costs According to the Type of Fishing Price in 2005-06

		Reference		
	Shrimp Gill Net Fishing	Baby Trawl Fishing	Sardine Gill Net Fishing	Anchovy Purse Seine Fishing
Boat	0.3-0.4	2-3	0.3-0.4	2 - 2.5 ; 3-5
Engine	0.25-0.3	0.5-0.7	0.25-0.3	0.5-0.7
Net	0.2-0.3	0.2-0.3	0.5-0.6	6
	0.75-1.0	2.7-4.0	1.05-1.3	11.5-14.2

Note1: Horse power of the engine is as follows. (1) Shrimp /sardine gill net fishing boat (5-6 HP), (2) Anchovy Purse Seine boat (18-25 HP)

Note2: Anchovy purse sene fishing requires two boats.

Note3: The market exchange rate was 1120 kyat/US$ (2005-06 average)

Source: Authors' Survey.

How is the required capital financed? According to Table 9, owners have to have a certain amount of their own capital. Because the financial market in Myanmar is generally underdeveloped, owners cannot depend on institutional finance such as banks. Instead, if funds are short, they must depend on either traders or relatives and friends. In these cases, half of the required capital is usually financed by personal funds, and the rest comes from credit or gifts from others.

Table 9, Means of Raising Capital to Purchase Fishing Gears

Own Capital	Own Capital+ Credit from Traders			Own Capital+ Credit from Relatives and Friends		
	No Interest	With Interest	Unknown	No Interest	With Interest	Unknown
2	4	2	3	2	1	0

Note1: The interest rate was 10% for two cases and 6 % for one case.
Note2: This was obtained from only 14 fishermen.
Source: Authors' Survey.

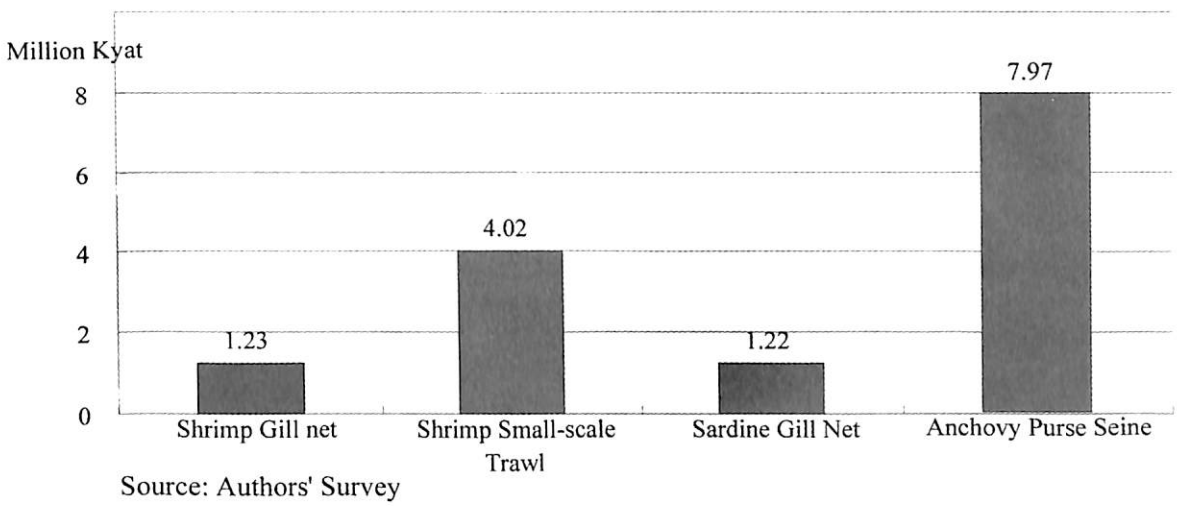
Viewing details of financing for the interviewed fishermen, several patterns emerge. The first pattern includes those who financed themselves and in addition used credit from the trader who introduced the three-layered shrimp net to the village in the socialist period (8 fishermen out of 14). In those days, it is very likely that information related to new techniques or gear was not accessible to small-scale fishermen in distant areas. However, the traders not only introduced new gears that could dramatically increase catches but also financed fishermen in order to allow them to purchase the new gear. Fishermen in the study village took advantage of this arrangement and started shrimp fishing on a wider-scale.

The main interest of this paper is not on the financing of these "old" fishermen but rather on those "new" fishermen who began shrimping after 1990. There are two patterns here: First, some started as crew members in Trammel net shrimp fishing. They accumulated some money in this process. At the same time, they obtained some assistance from traders and relatives, and they became the owners of boats (4 persons). The period that they worked as crew members was not so long and ranged from three to eight years. If they could acquire credit to supplement their own savings, there was a good possibility that they could become the owner of the fishing boat. The second pattern is that some members of the younger generation received full support from their parents when they started working independently (2 persons).

Basically, the financial barrier to begin shrimp fishing as an owner of the boat is not so high since fishermen can start with accumulated capital through fishing (within relatively short period of time) or even with the financial assistance from relatives and traders (meaning that is affordable scale for those providers who are not necessarily affluent).

4. Income and Profitability of Shrimp Fishing

Figure 7 shows the income estimation of shrimp trammel net fishing compared with other type of fishing.[10] The estimation was done as follow. Tiger, white, and pink are the major species of shrimp caught in the waters of the study area. Gross revenue is estimated based on the days and months that each fisherman goes fishing, multiplied by the average daily catch according to each variety of shrimp and the median price. Other fish are also caught while shrimping, and these are also an important income source for fishermen. However, these are excluded from the estimation of income because the species of fishes caught is great, and the fishermen do not usually remember the details of these catches. Calculation of the ratio of the share between owners and crews was explained in Section 3. If the owner goes fishing, the share as a crew member is added to his total income. This part signifies the wage for the owner's own labor. Current expenditures such as for fuels, wage payments for crew, interest on loans, license fees, and depreciation costs are included in the "cost". In calculating the depreciation cost, it was not possible to obtain all necessary information for the year in which fishing gear was purchased or the price paid by each household. Thus, the lowest price of the gear in Table 8 is taken as a base price, and the durable years for a boat are assumed to be ten. An engine is assumed to have six years, and the net is thus four years. If a fisherman is engaged in two types of fishing activities using the same boat and engine, half of the depreciation cost is accounted for in each type of fishing.



Source: Authors' Survey

Fig. 7, Income According to Type of Fishing

[10] For a detailed explanation of the estimation, see Appendix Table.

The result of estimation shows the income of this type of shrimp fishing to be almost the same level as that of sardine gill net fishing, but it is far less than anchovy purse seine fishing or shrimp small-boat trawling. This implies that income from shrimp trammel net fishing is not as high as might be expected. Nevertheless, this level of income is quite high compared to income that could be obtained from other sectors. There are 19 households that also get income from the farm sector (average holding is 3.8 acres). Based on their holding acres and yield, the average gross revenue is 296,000 kyats.[11] Note that this is not "income", but "gross revenue" before deducting the production cost. Nevertheless, the scale of fishery income is far larger than farm gross revenue. Even the income from grocery stores, which is one of the most lucrative income sources in the non-farm sector, is 420,000 kyats on average. It is still far lower than fishery income, including that from shrimp fishing.

Looking at profitability, the shrimp gill net fishing seems to provide a better picture when compared to other types of fishing. Table 10 gives an estimation of capital profitability based on the profit and the initial investment cost for each type of fishing activity. The initial investment cost used in this estimation is the minimum and maximum investment cost shown in Table 8. Since credit is usually provided on a monthly basis in rural Myanmar, the profitability is indicated on a monthly basis to allow comparison with the prevailing interest on credit. The profitability of shrimp gill net fishing ranges between 7.1 and 9.5 % per month, and it is much higher than sardine gill net or anchovy purse seine fishing and almost equal to shrimp small-scale trawl fishing.

Table 10, Comparison of Profitability

	Reference (% / month)			
	Shrimp Gill Net	Shrimp Small-scale	Sardine Gill Net	Anchovy Purse Seine
Case of Minimum Investment Cost	9.50	9.87	7.07	6.04
Case of Maximum Investment Cost	7.13	6.66	5.71	4.68

Source: Authors' Survey.

[11] Since it was not possible to obtain information regarding the production cost for each paddy, the author could not estimate income. Besides paddy farming, some farmers are also cultivating ground-nuts, but the author could not obtain detailed information. Thus, the estimation of paddy gross revenue is shown as a rough reference.

The common interest rate found in rural Myanmar is 5 to 15 % per month, and it can be over 10% if there is no collateral (Okamoto 2006, p. 242-246). Based on the profitability of shrimp fishing, this shows that initiating shrimp fishing by depending on loans does not pay financially if fishermen cannot provide collateral. In fact, this supports the fact that most shrimp fishermen started fishing by depending on their own capital, and fewer depended on loans carrying interest.

5. Short-Term Fluctuation and the Long-Term Decrease of Shrimp Fishing Income

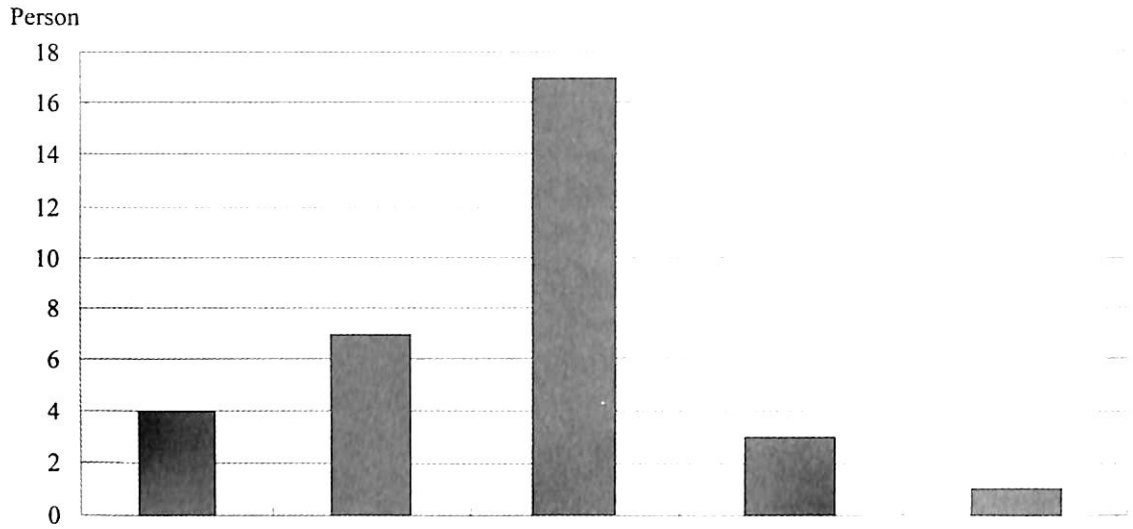
The previous section showed that shrimp fishing provides relatively high income with very good profitability. However, fishery income, including that from shrimp fishing, tends to fluctuate quite widely in a very short term, and this creates a large discrepancy in income among the fishermen.

There are three main factors related to short-term fluctuation of income. The first factor involves natural conditions such as weather. It is quite obvious that fishermen cannot go fishing if the weather is bad. For example, there may be 15 fishing days per month in a normal monsoon season, but once the weather gets rough, fishermen may be able to go out to sea only three to four days per month. Even if fishermen can go out fishing, the condition of the fishing grounds and the variety of fish in the sea changes every day. One day may yield a bumper catch, but the next day may produce none.

The second factor concerns the difference in technique and experience among fishermen. Even if fishermen go out under the same weather conditions, the same fishing ground conditions, and with the same equipment, the catch can vary significantly among different boats. This is due to differences in the knowledge and experience of fishermen. The coefficient of variation for the catch of sample fishermen (assuming they face the same fishing conditions) is 1.09 for tiger, 0.66 for pink, and 1.04 for white shrimp. All exceed 1 and show that there is a wide variation among fishermen.

The third factor relates to the fluctuation of operating costs, especially the cost of fuel. Fuel costs account for the largest share in current expenditures. The total cost of diesel oil and engine oil is about 70% of the total cost (Appendix Table). If the cost of fuel rises, profit will be reduced dramatically. Oil prices have been increasing worldwide since 2005, and Myanmar has not been an exception in receiving a negative impact as an oil importer. The price of diesel oil was rather stable (between 1.4 and 1.9 dollars per gallon from 2000 to 2004) but increased to 2.5 dollars in 2005 and further to 3.4 dollars in

2006.[12] Under these circumstances, fishermen reduced fishing days per month and/or shortened the overall fishing period.[13] The fluctuation of input prices can change patterns of fishing and thus lead to fluctuations in income from fishing.



Source: Authors' s Survey.

Fig. 8, Distribution of Monthly Income

Figure 8 includes the distribution of monthly income from shrimp fishing. It shows wide variation among those whose income is minus to those over 1 million kyats. Even if a fisherman has good knowledge and much experience, there are uncontrollable factors such as weather and natural conditions of the fishing grounds. This kind of short term income fluctuation can be regarded as unavoidable.

How can shrimp fishermen continue operations despite income fluctuation that may even lead to negative income? Credit from shrimp traders plays a role. There are about 10-15 shrimp traders in the study village. These shrimp traders often provide loans to the boat owners as working capital for operation. The provision of working capital assures a stable supply of raw materials (shrimp from those fishermen). As noted earlier, the competition among traders is increasing sharply. Thus, traders see the credit provision as a very useful tool to hold a continuous trading relationship and get stable supply of

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[12] This was calculated using the market exchange rate. Diesel oil prices were provided by Tokyo-Mitsubishi Bank, Yangon Office, and the exchange rate was obtained from various sources in Yangon. The price of diesel in Thandwe is usually a bit higher than the price in Yangon. However, it was not possible to collect time-series data for Thandwe, so the Yangon price was used as an alternative.

[13] Since 2006, some off-shore fishing boats have also stopped operating because of high fuel prices.

shrimp. Normally, no repayment date is set, and there is no explicit interest payment for this kind of credit. However, the price paid for the shrimp of those credit-linked fishermen is usually less than the price paid to non-credit receivers. The price of the village traders is generally lower than that initially offered by the companies. Nevertheless, fishermen continue to deal with traders in the villages so that they can depend on them when they find themselves short of capital. Given the wide fluctuation of income in shrimp fishing, they view the relationship with the traders as a kind of insurance. Table 11 indicates to whom fishermen are selling their shrimp according to the level of monthly fishing income. It clearly shows that the lower the income, the higher the share of the fishermen that have trading relationships with the traders in the villages and receive credit from these traders. Fishermen with negative income sell shrimp to the traders in the village and depend on credit from them.

Table 11, Buyers and Credit Relationship

Monthly Income (Kyat)		Minus	0-01 Million Kyat	0.1-0.5 Million Kyat	0.5- 1.0 Million Kyat	Over 1 Million Kyat
Buyer	Processing Factory	-	1	5	-	2
	Village Trader	5	8	11	1	2
	Family	-	1	1	-	-
	No Fixed Buyers	-	-	-	2	-
	Total	5	10	17	5	4
Those have credit relation with the buyer		5	3	5	-	-

Sources: Authors' Survey

In addition to the short term fluctuation of income, there is a strong possibility of long-term change in income level within the study area. This is due to the decreasing trend of catch per shrimp boat.

Table 12, Changes in Catch per Boat per Day

Viss / Day

No	Shrimp Species	Mid 1980s	Mid 1990s	2000	2003	2004	2005
1	Tiger				3.0		0.2
	White				2.0		2.0
	Pink				0.1		0.1
2	Tiger				0.5	0.4	0.3
	White				3.0	2.3	2.0
	Pink				0.4	0.4	0.4
3	Tiger	4.0	3.3	1.3			0.5
	White	8.0	6.7	2.5			1.7
	Pink	8.0	6.7	3.3			0.5
4	Tiger			0.5			0.2
	White		5.0	3.0			1.0
	Pink		5.0	4.0			1.0
5	Tiger		0.3				0.1
	White		1.2				1.0
	Pink		0.3				
6	Tiger			0.5			0.2
	White			2.0			1.0
	Pink			0.5			
7	Tiger	10.0	5.0	3.0			2.0
	White	20.0	5.0	3.0			3.0
	Pink	5.0	3.0	2.0			1.5
8	Tiger	3.0					0.3
	White	5.0					0.5
	Pink	5.0					0.5
9	Tiger		2.0	0.5			0.3
	White		10.0	1.0			1.0
	Pink		5.0	1.0			0.5

Note One viss equals 1.63 Kgs
Source: Authors' Survey

Table 12 illustrates changes in catch per boat based on interviews with the fishermen. These estimates primarily depend on the memory of the fishermen, so some related to earlier times may not be precisely accurate. Nevertheless, figures are sufficient to grasp the general trend of how catches are changing. According to the table, catch per boat per day has been continuously decreasing when compared to 10 or 20 years ago. This is probably due to the growing number of shrimp fishing boats in the waters surrounding the village. Since the mid 1990's, shrimp fishing income and profitability have risen along with the expansion of shrimp exports. This has led to more people entering the shrimp fishing business. As a result, there are many more fishing boats in the same fishing grounds than there were in the past. Further, there are reports that some in-shore and off-shore trawls are operating in the same area, although such activity is prohibited.[14] Because of this rapid increase in the number of boats chasing shrimp resources, the catch per boat per day has decreased quite dramatically in a short period.

The decreasing rate of catch in the past five years ranges between 30 to 80 % depending on the type of shrimp (calculated based on Table 12). If a catch were 30% higher than the present level, the shrimp fishermen's income could be as high as 1.8 million kyats. If it were 60% higher, it would reach 2.4 million kyats; this exceeds the income from anchovy purse seine fishing. Profitability would also rise to 15.1 to 20.1 % per month. It is quite likely that shrimp fishing was very attractive when fishermen could get these levels of catch compared to other types of fishing. High income and high profitability led to continuous new entry into shrimp fishing. Thus, shrimp could have been over exploited, leading to the present level of the catch.

Unfortunately, no comprehensive resource survey has been done since the 1980-83, and no systematic data related to catch according to fish species is available. Thus, it is difficult to know exactly how much shrimp resources remain in the sea. However, even with limited information from fishermen, the declining status of resources seems quite obvious. This is a typical example of "Tragedy of Commons" (Hardin 1968).

What will happen if the current trend continues? Assuming the present rate of profitability in shrimp fishing, it is most plausible that entry into the business will continue given that there are no other attractive economic activities in the area.[15] Suppose the level of operation costs remains the same. Table 13 gives an estimate of the profitability when the average catch decreases 30%, 40%, and 50% of the present level. If the catch decreases by 30%, the profitability would be reduced to from 2 to 4 % per month. In the case of a 50% decrease, there would be no profit. Same picture applies to in-shore shrimp trawl fishing, when the possible changing profitability is calculated in the same way.

[14] The catch of shrimp in off-shore areas has also been decreasing in recent years. Consequently, off-shore boats sometimes come into in-shore areas. The catch by the in-shore shrimp trawlers is reported to be decreased as well.

[15] Anchovy purse seine fishing seems to be getting popular in the Thandwe area as an alternative high income source. The level of potential income is shown in Figure 7. However, compared to shrimp fishing, the initial investment cost is quite high, and entry may not be so easy.

Table 13, Changes of Profitability According to Change in Catch

(% month)

	Present	Catch Decreased by 30%	Catch Decreased by 40%	Catch Decreased by 50%
Case of Minimum Investment Cost	9.50	3.82	1.93	0.00
Case of Maximum Investment Cost	7.13	2.87	1.45	0.00

Source: Authors: Survey

Short term income fluctuations noted earlier occur under this long-term decreasing trend of catch per boat. The average income gradually decreases, and income fluctuation is inevitable. This suggests that fishermen with negative income are very likely to increase in future. Some may have to exit from shrimp fishing.

If fishing efforts continue to increase at the present level, shrimp fishing will not be an attractive economic opportunity as it stands now. New entry will stop at some point. However, it is possible that shrimp resources are overexploited to the extent that recovery is no longer possible by that time.[16] In such a case, the dynamic improvement of the economy of small-scale fishing which occurred in the past 10 years will no longer be sustainable.

[16] According to interviews conducted at a Japanese shrimp export company in Yangon, if shrimp fishing continues at the present level, shrimp will be depleted in the coastal waters of Myanmar within 10 years. If fishing boats with higher levels of equipment are used, the resource depletion will proceed much faster (October 2006).

Conclusion

Globalization of Myanmar's fishing industry led to growing shrimp exports from the mid 1990's. Based on a village case study, this paper examined the impact of this globalization on the economic status of small-scale fishermen. Major findings of the analysis are as follow.

Entry into small-scale shrimp fishing became very active from the mid 1990's due to growing shrimp exports. In addition to those fishermen who had been shrimp fishing since the socialist period, there were many new entries from other sectors.

Financial constraint was not a serious threat to entry into shrimp fishing. The initial requirement for purchasing fishing gear and boats remained in a scale that could be met by the accumulation of capital from fishing activities together with financial assistance from relatives and loans from traders.

Income that can be obtained from shrimp fishing is far larger than income from other sectors. Indeed, it is more than farm income or major non-farm income. Further, the profitability of shrimp fishing is much higher than that of other types such as sardine or anchovy fishing. High income and high profitability have been the main incentive for entry into shrimp fishing. Thus, small-scale fishing in the coastal areas, at least with those who own shrimp boats, has received great benefit from the expansion of shrimp exports.

However, high income from shrimp fishing is probably not sustainable in the mid and long term because of the increasing competition due to continuous entry into shrimp fishing. This "Tragedy of Commons" is continuing steadily and rapidly. With the expansion of small-scale trawl fishing for shrimp, the shrimp resource can be easily overexploited. When income fluctuates under a long-term declining trend of catch, more fishermen may have to exit the shrimp fishing business. If some kind of the fishing resource management is not begun soon, the dynamism that improved the economy of small-scale fishermen in the coastal areas of Myanmar in the past 10 years will not be sustainable in the future.

Based on this case study, even it is confined to a single village tract, several points can be made on fishing resource management for sustainable development of Myanmar's fishery sector.

First, it is very important to grasp the changing status of fishing resources according to each variety of fish. Without good understanding and monitoring of the existing fishing resources in Myanmar waters, appropriate resource management as well as its utilization schemes cannot be formulated. For that purpose, resource monitoring and management system/ institutions need to be established for collection of information and data at the very local level and for analyzing them in the ministry headquarter.

Second, it is also very critical to understand the economic factors of expansion and declining of different type of fishing. The case study clearly showed that economic incentives certainly have an influence on the fishing efforts by specific fishing gears in quite a short period of time. For that purpose, it is necessary to grasp and monitor the current status of economy of fishing at the very local level as well the marketing condition (both domestic and international) of those fishery products.

Two ways of gathering information will be effective. One is the periodic collection (weekly and monthly) of landing of major fishes, their prices and important inputs cost such as diesel oils. Second is conducting fishery economic surveys in the major fishing points once a year in different areas (such as Tanintharyi, Rakhine and Ayeyarwaddy) to analyze and check the profitability of different types of fishing. These studies can cover in-shore, off-shore and inland fisheries. By combining the information and analysis from these two sources, policy makers will be able to monitor as well as forecast the changes of production and it would enhance the capacity of policy formulation for future development.

Third, by collecting and analyzing the information on the resource status and economic status of different type of fishing, it is also indispensable to disseminate the information/ analysis to the fishermen, fishing community and marketing intermediaries. It is well known now that the proper resource management cannot be achieved with the legal / administrative enforcement alone, but public awareness and participation of local community is critical making those efforts effective in real terms. To encourage the participation, the access to these kinds of information needs to be extended to every stakeholder in the fishery sector.

References

Bene, Christophe, 2003 "When Fishery Rhymes with Poverty: A First Step Beyond the Old Paradigm on Poverty in Small-Scale Fisheries", *World Development.* Vol.31, No.6 pp.949-975. Central Statistical Office. [Various Issues] *Statistical Yearbook.*

Department of fisheries, [2004] *Livestock and Fisheries Statistics (2002-2003)*, Yangon

Department of Fisheries (DOF) [2005] *Fisheries Statistics (2003-2004) Yangon.*

Developing Economies. (in Japanese).

Hardin, G. [1968] "The Tragedy of the Commons", *Science* 163 (December): 1243-1248.

Hirasawa, Yutaka. [1984]. *Fishery and Aquaculture in Southeast Asia.* Tokyo: Institute of

Okamoto, Ikuko. [Forthcoming] *Economic Disparity in Rural Myanmar.* Singapore: National University of Singapore Press.

U Khin [1948] *Fisheries in Burma* Rangoon: Office of the Superintendent, Government Printing and Stationery.

Appendix Table, Estimation of Income for fishing Boat Owners

		Shrimp Gillnet	Sardine Gillnet	Anchovy Purse Sene
Number of Samples		32	30	11
Average Operating Months	Months	5.8	4.0	6.0
Average Operating Day per Month	Days	16	17	21
Catch (Viss / day) (1viss is equal to 1.63 kilogram)	Tiger	0.7		
	White	1.8		
	Pink	1.6		
	Flower			
	Sardine		250	250
	Anchovy			400
Selling Price (Kyat / viss)	Tiger	13,000		
	White	8,000		
	Pink	4,000		
	Flower			
	Sardine		250	250
	Anchovy			400
Owners Gross revenue @	Kyat	2,840,432	2,459,930	33,075,000
(A) Wage payment to crew	Kyat	1,136,173	983,972	21,498,750
(B) Current Cost		798,455	433,606	1,997,500
- Fuel	Kyat	555,820	387,119	1,200,000
- Net Purchasing	Kyat	200,000	0	0
- Fishing net maintenance	Kyat	42635	46487	797,500
(C) Depreciation Cost	Kyat	32,175	144,675	1,575,000
- -Boat and engine	Kyat	32,175	32,175	495,000
- -Fishing net			112,500	1,080,000
(D) Interest payment	Kyat	7,500	0	0
(E) License fees	Kyat	10,950	6,450	35,500
(F) Total Cost‡ (A+B+C+D+E)	Kyat	1,985,253	1,568,703	25,106,750
(G) Owner's Net Revenue	Kyat	855,179	891,227	7,968,250
(H) Revenue as Crew	Kyat	378,724	327,991	0
(I) Owners Annual Total Income				

Note 1: The shared of the crews are converted to monetary terms and treated as hired wages
Note 2: Shrimp gill net is only can be used for one year, Thus there is no depreciation cost
Note 3: If the sardine and shrimp fishers use the same boat and engine, half of the depreciation cost is accounted for each fishing venture
Note 4: Licenses fees for crew are paid by the owner
Note5: The wages for labor of an owner working as a crew as well
Sources: Authors' Survey

ဆွေးနွေးချက်

Dr. စန်းအောင်	-	စာတမ်း Page 4 တွင် Export FE US$ 347 million, Instead
အကြံပြုချက်		of US$ 200 million.
	-	Page 8, last 2nd line တွင် trammel net/three layer net instead of trammel gill net.
	-	Page 9, 4th line တွင် motorization instead of mechanization.
ဖြေကြားချက်	-	Export earning ကို မွေး/ရေဝန်ကြီးဌာန DOF မှ Statistics အတိုင်း ပြန်လည်ပြင်ဆင်သွားပါမည်။
	-	Trammel net ဟူ၍ ပြန်လည် ပြင်ဆင်သွားပါမည်။
	-	Mechanization အစား Motorization ဟူ၍ ပြင်ဆင်သွားပါမည်။
ဦးတင့်ဝေ	-	ပုစွန် Export data များသည် ငါးလုပ်ငန်းဦးစီးဌာနမှ ထုတ်ဝေ
အကြံပြုချက်		သည့် Data နှင့် ကွာခြားချက်ရှိ၍ ပြန်လည်သုံးသပ်ရန် အကြံပြုပါသည်။
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The Successful Control of Leucaena (Bawzagaing) Toxicosis in Myanmar Sheep with Freeze-dried IBT- Goettinger Bioreactor Grown *Syngestes jonesii*

Aung Aung[1], Tin Ngwe[1], Udo ter Meulen[2] and Helge Böhnel[3]

ABSTRACT

Subcultures of *Synergestes jonesii*, a species of rumen bacteria were supplied by Mr. R. Anderson. It was said that this bacterium was a strict anaerobic bacteria. These bacteria were multiplied under anaerobic conditions using IBT-Goettinger Bioreactor at the Institute of Biotechnolgy, University of Goettingen, Germany. Then the suspensions were freeze-dried and carried to Myanmar for field experiment. Feeding trail was conducted at the Department of Physiology and Biochemistry, University of Veterinary Science, Myanmar. Nine sheep of Myanmar breed with similar age (6-8 weeks) and liveweight ranging form 12-22 kg from Pyawbwe area were allocated in 3 groups (3 sheep in each group) with CRD design. The animals from group I were fed with normal feedstuffs (rice straw + sesame + rice bran) and the other groups were fed on rice straw supplemented with leucaena at 40 % of total diet. The diets were isonotrogenous at 17 % of CP. The animals from group III were inoculated with Freeze-dried *Synergestes jonesii* to investigate *in vivo* mimosine degradation while the animals from group II were inoculated without bacteria. There were no clinical symptoms of leucaena toxicosis in the animals of group III while the animals of group II showed clinical symptoms of leucaena toxicosis. Moreover, body temperature of the animals from group II (39.3-40.6 °C) was higher than that (37.7-37.8 °C) of animals from group I and III. Besides the achievements such as rice straw intake, digestibilities of nutrients, daily nutrient intake, digestible nutrient intakes and nitrogen retention of group II were statistically lower while those achievements of group III were almost the same to those of group I. It could be concluded that *S. jonesii* can maintain its ability to degrade mimosine after freeze-dried. Therefore freeze-dried *S. jonesii* could be recommended to improve the usage of leucaena fodder as ruminant feed in Myanmar.

Key words; digestibilities of nutrients, mimosine, nutrient intake, rice straw intake, rumen bacteria

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Introduction

Ruminants have an important economic role in village systems to provide draft power, meat, manure, hides and milk in most countries of South-East-Asia. There is an evident that high human population densities will continue to ensure that the first priority of land use must be on production of food and plantation crops. In global consideration, this demographic pressure leads to a greater emphasis on the development of livestock and agricultural systems. Therefore, ruminants are important to provide draft power, meat, manure hides and milk especially at the village systems in most countries of Sout-East-Asia.

The animals, especially monogastric animals, often compete with human beings for food resources. However, ruminants play an important role in this aspect because of their ability to convert feed that cannot be used by monogastric animals into meat and milk for human consumption. It is well recognized that rice straw is the main feedstuff for ruminants in Myanmar during dry season. Despite its widespread use and availability, straw has severe nutritional limitations for ruminants in particular, because of its low digestibility, low crude protein contents, high in silica, lignin and low intakes. Its nutritive value, 2.5% CP (Tin Ngwe *et al.*, 1993b), digestibility (DDM-50.5%, DOM-58.2%, DCP-21.2 % & DCF- 36.4 % in the report of Tin Ngwe, et *al.*, 1993a) and palatability are quite low. Therefore, cattle and buffaloes cannot maintain their live weight when rice straw is fed as a sole diet. Wanapat *et al.* (1984) mentioned that the liveweight changes of cattle and buffaloes after feeding rice straw only were – 1.34g/d and – 108 g/d respectively. Thus, ruminants cannot maintain their liveweight when rice straw is fed as sole diet. Supplementation with protein rich feedstuff is one of the common ways to overcome the low quality nutritive value of rice straw, however still being the main limiting factor in ruminants in tropical countries. It is because; supplementation with fodder leaves is often the only source of nitrogen for ruminants during dry season. Leguminous forages may provide specific substrates and nutrients, such as protein. Cellwalls are better fermentable than those of straw and essential minerals and vitamins, which increase microbial activity in the rumen. Therefore, leucaena forage is one of the options to be used as supplement. It is widely used as feed forage for cattle in tropical agriculture (Shelton 1998). It is used as a protein source in urea-molasses multinutrient blocks for ruminants in Myanmar (Ni Ni Maw *et al.*, 2002).

Although *Leucaena leucocephala* (leucaena) is one of the recommended forages, it is not a fully satisfied feed for ruminants. It contains a toxic amino acid, mimosine that has antimitotic and depilatory effects on animals. Mimosine is an alkaloid, β-3-hydroxy-4 pyridone and it is a toxic non-protein free amino acid. The concentration of mimosine in the leaves and seeds of *L. leucocephala* (leucaena) varies with the different types and strains of the plant. Ter Meulen *et al.* (1979) found that mimosine concentration in samples of plants grown in Zaire were 7.19 % and 12.13 % of the total

protein in the leaves and seeds. Therefore it was recommended that leucaena should be fed up to 30% of total diet (Sethi and Kulkarni, 1990). Kumar (1996) reported although leucaena toxicosis can be controlled with mineral supplements, it was not cost benefit for livestock production. Later as biological solution, the anaerobic rumen bacteria, *Synergestes jonesii* was found in the rumen of which pummels some countries in the Americas and South-East Asia (Jones, 1979). He has proved in 1981, that these bacteria can completely degrade mimosine in Australia and subsequently to Africa and China (Jones, 1981). However, the use of these bacteria has still limitations for end users in deed, because it is a strict anaerobic bacterium and takes long time to grow on media plates. Moreover, there are some limitations such as storage and inoculation for end users are still needed to be solved. Therefore this was conducted with the intention for the easier way of storage for the end users.

This experiment was carried out with the following objectives;

1. To test the maintenance on mimosine degrability of S. jonesii after freeze-drying,
2. To control mimosine toxicity in Myanmar sheep,
3. To improve the usage of leucaena forage as ruminant feed in Myanmar.

Material and Methods

Subculture of *S. jonensii*, the rumen bacteria responsible for mimosine degradability was provided by Mr. Anderson. These bacteria were multiplied at the Institute of Biotechnology in the Tropics, University of Goettingen, Germany using IBT-Goettinger Bioreactor anaerobic condition and suspension was freeze-dried for field experiment (Aung Aung *et al.*, 2007). The feeding trial was carried out at the Department of Physiology and Biochemistry, University of Veterinary, Myanmar.

Source of rice straw

Rice straw used in this experiment was collected from the farms of Department Agricultural Research, Yezin, Myanmar. Rice straw was obtained from the paddy harvested within May and July.

Manipulation of feedstuffs and experimental animals

Rice straw was dried under sunlight until the weight became constant and stored under the shade. The leucaena leaves around the University of Veterinary Science were collected and dried and kept under the shade. The sesame cakes were also bought from the animal feed distributors in Yezin. Nine sheep of local breed from Pyawbwe area

(near the University of Veterinary Science, Myanmar) with similar age (6- 8 weeks) and liveweight ranging from 12 kg to 20 kg were used to evaluate detoxification of mimosine with digestion trial. Each animal was kept in individual metabolic cages that enabled complete collection of dung and urine, and determination of voluntary intake of rice straw. The diets were formulated (17 % CP of total diet) according to the recommendation for nutrient requirement of sheep (NRC, 1985).The animals were fed on supplements preceding rice straw *ad libitum*. Water was also given free access. Feeding regime can be seen in Table 1. Animals from group II and III were supplemented with leucaena at 40 % of total diet according recommendation of Aung Aung (2007). The experimental period was carried out from August to November, 2005. The temperature during the experimental period ranged from 28-32 °C.

Experimental design, period and sample collection

The animals were allocated in a complete randomised design (CRD) including 10 animals in each group.

Group I	control animals fed without leucaena leaves
Group II	control animals fed leucaena inoculated no bacteria
Group III	animals inoculated with freeze-dried *S. jonesii* (4.37×10^{10}/ bottle)

Freeze-dried bacteria were resuspended with normal saline and the animals were drenched with a syringe (Fig. 1).

Digestion trial was carried out to determine digestibility by conventional collection method. It consisted of 7 d for preliminary experiment, 14 d for feeding trial and 5 consecutive days for collection of faecal and urine samples. Daily samples of rice straw feed, sesame meal, rice bran and leucaena leaves were taken and rice straw residues were removed, weighed and sampled before next morning feeding. During collection period, faeces samples were taken (5 % of the total mass) weighed, and put into the plastic bottles. Two to three drops of formaldehyde solution was put into the bottles to prevent the putrefaction. For the collection of urine, sulphuric acid was added into the urine to become pH 4.

Observations

The presence of the clinical signs and symptoms of mimosine toxicity for the animals were observed daily. Moreover, the daily body temperatures of the animals were recorded.

Chemical analysis

The samples of feeds and residues collected during voluntary periods were analysed for dry matter (DM), organic matter (OM), crude protein (CP) and, and ether extract (EE) by the methods described by AOAC (1984) and, neutral detergent fibre (NDF) and acid detergent fibre (ADF) according to the methods of Goering and van Soest (1970). Faeces were dried under sunlight until weight became constant at ambient temperature for chemical analysis and this facilitated in grinding faecal samples. Urine samples were analysed for protein content.

Statistical analysis

Data were analysed using Microsoft Excel (office 2003 Professional) and subject to statistical analysis of variance. The means were compared by Duncan's multiple range test (DMRT) at $P< 0.05$ by using SPSS 11.5 for windows.

Results

Clinical symptoms of Leucaena toxicosis

It was observe that body temperature of animals from treated control group ranged from 39.3-40.6 °C while the animals from group I and III had 37.7- 37.8 °C. The clinical signs such as alopecia (Fig. 2), decreased in feed intake, dullness and drooling saliva were observed after one week of experiment. Nontheless, the animals of group III showed no clinical symptoms.

Chemical composition of feedstuffs and diets

The chemical composition of feedstuffs and diets are presented in Table 2 and 3. As the diets were isonitrogenously formulated, there was no difference between chemical constituent of diets.

Voluntary feed intake

Fig 3. shows comparison of rice straw intake of animals from three groups (% BW). All animals showed increased in rice straw intake till day 7 of experiment. However, the animals from group II showed decreased rice straw intake after that while the others were having improvement in rice straw intake. It can be found that voluntary intake of group was lower than others. They ingested 25.71 g /kg $BW^{0.75}$/d rice straw whereas the other groups ingesting more than 27 g /kg $BW^{0.75}$/d.

Digestibilities of nutrients and nutritive values of diets

The digestibilities of nutrients are shown in Table 4. Among these findings, dry matter digestibility of group II is 58.64 % and it is significantly lower than that of other groups ($P<0.05$). The percent OM digestibilities of group I and III (63.02-66.64 %) were also significantly higher than that of group II ($P<0.05$). Digestibility of protein and ether extract of group II are 64.89 % and 68.89 %, whereas those of other groups are higher than 70 %. In this experiment, it was also found that mimosine affected on the digestibilities of fibres (ADF and NDF) of group II (50.39 and 56.46%) which were statistically lower than those of group I and III showing relative similarity to group I ($P<0.05$). According to these findings, digestibilities of nutrients in treatment groups III was almost the same to group I that animals fed without leucaena leaf meal.

Nutritive values of dietary treatments are shown in Table 5. TDN, % DM of group II was 62.82 and significantly lower than other groups. Although no significant difference between DCP, % DM of groups was found, that of group II (12.77 %) was numerically lower than others.

Daily nutrient intakes and digestible nutrient intakes

Daily nutrient intakes are presented Table 6. Although DMI of group II (57.35 g/ kg $BW^{0.75}$/d) was not significantly different from other groups ($P<0.05$). However, in comparison of DDMI, that of group II was significantly lower. OMI of group III was similar to group I while that of group II showed significantly lower than that of group I. The DOMI of group II was entirely different with findings of other groups ($P<0.05$).

CPI & DCPI of dietary treatments are also shown in the Table 6 and 7. Although, CPI of group II is almost the same to others, DCPI of that showed statistically unsatisfied finding when compared with others ($P<0.05$). However, comparing EEI and DEEI, significant differences among the groups were not observed. In comparison of daily intakes and digestible intake of fibre fractions, those of group II could not show satisfactory achievements. TDN intakes of animals are also shown in Table 7. That of group II

(33.31 g/ BW $kg^{0.75}$/ d) also showed unsatisfactory effect while that of group III was statistically comparable to that of group I.

Nitrogen utilization

Table 8, shows nitrogen utilization of experiment. There was no significant difference of nitrogen intake of the groups, but faecal nitrogen of group II (0.82 g/ d / $kgBW^{0.75}$) was significantly higher than that of others. Moreover, other treatment groups showed relatively the same value of nitrogen retention and faecal nitrogen with those of group I. However, urine nitrogen all groups was the same. There was also no significant difference between the groups incubated with different microbes. As faecal nitrogen of group II was significantly higher than that of others, nitrogen retention (0.68 g/kg $BW^{0.75}$/ d) of this group showed significantly lower than that of other groups.

Discussion

Toxic symptom of leucaena mimosine

As shown in Fig. 2, control sheep inoculated with no microbes showed loss of hair after 7 d of experiment. This finding similar to earlier reports (Hegarty *et al.*, 1964). They reported that sheep shed the hairs after 6-7 d of feeding leucaena. Reis *et al.* (1978) also found loss of hair in sheep 7 d after infusion of mimosine. Moreover, the toxic effects of leucaena feeding observed in this experiment are similar to those reported for cattle in earlier studies (Jones *et al.*, 1978; Jones and Hegarty, 1984). In the experiment of Szyszka *et al.* (1980), the goats lost hair after two weeks of experiment showing no other signs. The signs of toxicity in 4 crossbred calves indicated that rumen microorganisms were unable to break down mimosine or DHP to non-toxic metabolites, unlike Hawaiian ruminants (Jones and Megarrity, 1983). In the experiment of Ram *et al.* (1994), the calves on a sole diet of leucaena had loss of appetite and loss of weight gains with emaciation, alopecia, loss of hair from the tail switch, scaly skin, ear and eye lesion, mouth ulceration and drooling viscid saliva and these are the same to the findings in this experiment. As in treatment groups inoculated with mimosine degrading bacteria showed no clinical signs, it meant that there was no toxicity in those animals also they ate the toxic level of leucaena leaf meal as group II. Samata *et al.* (1994) have discussed that occurrence of leucaena toxicity has two phases. Phase I is caused by mimosine itself and phase II is brought about by 3-4 DHP.

The body temperature of the sheep associated with toxic symptoms had 39.3-40.6 °C. This finding was similar to that of Hegarty *et al.* (1964). They found that body temperature of sheep was 105 °F (40.56 °C) after 4 d of infusion of mimosine. That

sheep was died of mimosine toxicity 5 d after infusion. The cause of increase in temperature is not clear. DHP inhibit iodine uptake (Hearty *et al.*, 1976) and then it can lead to overload of thyroid gland in acute case. The overload of thyroid gland might cause increased body temperature. However, in the experiment of Jones *et al.* (1978), rectal temperature of all cattle showing toxic symptoms were normal.

Chemical composition of leucaena and diets

The % DM of leucaena in this experiment is a little bit lower than earlier reports (Sobale, 1978; Yadav and Yadav, 1988; Hilal *et al.*, 1991, Ni Ni Maw *et al.*, 2002). In their reports, leucaena contains more than 91 % DM. Dry matter content of leucaena in this study is 89.32 % and it might be due the weather condition of research period, but this is similar to the findings of Gupta and Atreja (1998a). This experiment was conducted during the raining season of Myanmar and there might be some moisture content in leucaena meal. It is also found that leucaena used in this experiment contained 91.0 % OM and similar to former report (91.22 % OM) of Ni Ni Maw *et al.* (2002). Crude protein content of leucaena in this study (22.72 %) is lower than that from the reports of Sobale (1978) and Kale (1979). In their report, leucaena contained 29 % of CP. However, it is simlar to other reports (Yadav and Yadav, 1988; Hilal *et al.*, 1991, Ni Ni Maw *et al.*, 2002). Especially leucaena used in this study was from the same area and CP content is almost the same to the report of Ni Ni Maw *et al.*(2002). However, it is higher than in the report of Aletor and Omdara (1993). Ether extract of leucaena in this experiment is 5.27 %. This finding is higher than that of report from Gieseke (1984) but lower that from some reports (Aletor and Omdara, 1993). The finding of NDF content is almost the same to the report of Ni Ni Maw *et al.* (2002), but ADF content is lower than that of their finding.

In this experiment all diets were isonitrogenous and protein contents (17.3 -17.5%) covered the need of animals according to NRC (1985) and this is also almost the same to protein content (18 % of total DM) used by Singh *et al.* (2002). However, NDF content of diet for group I is a little higher than that of other treatment groups and lower in acid detergent fibre. It might be due to higher content of readily degradable fibre in sesame cake. These findings are in agreement to the findings of Tin Ngwe (1990). He discussed that although protein content in sesame cake is lower than that of groundnut cake, protein digestibility of sesame cake in ruminants is higher because of favouring the cellulolytic bacteria by these readily degradable fibres. Other chemical compositions are almost the same to all diets. Increased amount of EE in the diet for group I might be due to excess amount of sesame than in other diets. Beside, inclusion of rice bran also increased EE content in the diet for group I.

Nutrient intakes and nitrogen retention

As shown in Table and Fig. 3, rice straw intake of animals from group II were decreased after one week of experiment while the other treatments showing comparable intake of rice straw to group I. This might be due to influence of rice straw intake influenced on DM intake. This reduction of DM intake after 7 d of experiment was similar to reports for Australian Kimberley Shorthorn steers (Jones and Hegarty, 1984). Nutrients intakes (Table 6) of animals were also same to other reports (Haque *et al.*, 1997; Fraser *et al.*, 2000).

However, in the experiment of Gupta and Atreja (1998a), DM decreased intake in cattle supplemented leucaena 50 % of total diets and above was found after 14 d of experiment. The different duration for reduction of intake was associated with appearance of toxic symptoms. The difference of appearance of toxic symptoms and beginning of decreased intake might be due to different adaptability of animals to leucaena mimosine.

Dry matter intake (g/kgBW$^{0.75}$) of group II is also significantly lower (Fig 2.). The animals from group II refused and were monotonous to eat leucaena after one week of experiment. However, force-feeding of leucaena was used for that control group although sheep from other treatment groups could eat all of leucaena supplemented. Gupta and Atreja (1998a) also discussed that decreased intake was declined due to an attempt of animals to reduce intake of toxic mimosine. The reduction of feed intake in calves fed more than toxic level of mimosine was also found in India (Ram *et al.*, 1994).

It was discussed that mimosine was degraded as DHP in the rumen and then DHP might be responsible for the depressed appetite of the calves (Jones and Hegarty, 1984). Therefore, decline in RSDMI and DMI in group II was possibly due effect of mimosine toxicity and similar to report of Gupta and Atraja (1998b). The increased feed intake was associated with a reduction in circulating DHP, since feed intake of steers also increases dramatically when leucaena is replaced by cowpea hay in the diet (Jones *et al.*, 1978). Toxic symptoms of leucaena such as loss of appetite, reduced DM intake were brought about by DHP (Samata *et al.*, 1994).

Nitrogen retention of group II was also significantly lower than other groups (Fig. 6). The growing bull calves showed better nitrogen retention when they were fed *ad libidum* of leucaena (Sobale *et al.*, 1978). However, mimosine intake in their experiment was lower than daily accepTable intake. According to increased in faecal nitrogen in animals from group II, nitrogen retention (g /kgBW$^{0.75}$) was lower than that of others. This might be due to decreased digestibility of protein although there were no differences of nitrogen intake and urine nitrogen between the groups. This finding was in agreement agreed with the report of Hindrichsen *et al.* (2002). They reported that faecal nitrogen output increased linearly with increasing levels of supplementation with leucaena.

However, the animals from group III did not show this positive linear regression as they were inoculated with freeze-dried *S. jonesii*.

Correspondence of mimosine on digestibility of nutrients

As shown in Fig 4, digestibility of nutrients in control group I and III were statistically higher than group II. In the experiment of Bosni *et al.* (1995) digestibilities of DM, OM, NDF, and ADF of sheep supplemented with leucaena at 257 g/d (22.2 % DM of total feed) were 50.1%, 52.6%, 46.3 % and 41.3 % respectively. All these digestibilities were lower than those found in this study. The higher digestibility of nutrients in the experiment might be due to supplementation of sesame cake. Tin Ngwe (1990) discussed that sesame cake has gradually degradable fibre, which provide energy for the cellulolytic bacteria. Apart form the findings of group II, the achievements of this experiment were similar to the findings of Haque *et al.* (1997) as experimental processes were similar to each other. They also used concentrates as supplement to reach required amounts of nutrients. In the experiment of Yami *et al.* (2000) goats fed more than 40 % leucaena of total diet showed lower DM digestibility to goats fed 15 % and 30 % leucaena respectively. In this experiment digestibilities of nutrients of sheep from group II were statistically lower than others ($p<0.05$). This might be due to interference of mimosine on activity of cellulytic microbes (Ruskin, 1977) because of lack of DHP degrading bacteria. Gupta and Atreja (1998b) also discussed that DHP has inhibitory effect on the microbial species.

This inhibitory effect of mimosine and DHP on ruminal microbes in the rumen control animal (group II) may be due to blockage of mimosine on cell division. In various biological systems, DNA, RNA and protein synthesis are inhibited by mimosine. Ward and Harris (1976) suggested that primary action of mimosine on the inhibition of wool biosynthesis *in vivo* was the inhibition of follicle cell DNA and consequently of cell division. In the presence of mimosine, DNA synthesis was reduced according to the lower (3 H) thymidine uptake (Serrano *et al.*, 1983). It was suggested that mimosine might inhibit DNA replication at its origin in Chinese Hamster cell (Mosca *et al.*, 1995; Tsvetkow *et al.*, 1997). Lin *et al.* (1996) also expressed that gly cell line was sensitive to mimosine because it might inhibit both the mitochondrial and systolic forms by making a complex with serine hydromethyl transferase. Moreover, Mikhailov *et al.* (2000) expressed that treatment of the cycling cell population with 400 mg mimosine caused inhibition of DNA replication and it indicated that the effects of mimosine on DNA synthesis and cell cycle might be a result of introduction of breaks into DNA. A single break in a key gene can kill a cell or cause it to kill itself by apoptosis (Goodsell, 2005). In the animals inoculated with mimosine degrading ruminal bacteria, those bacteria colonized in the rumen. This colonization might lead to increase the degradation of mimosine

and DHP to non-toxic substances. Therefore, it might be no interference on the activity of cellulolytic bacteria and then those animals showed comparable digestibilities of nutrients to those of animals from group I.

Conclusion

According to these findings, freeze-dried *S. jonesii* can maintain its ability of mimosine degradation. It could be recommended that freeze-drying is a suitable preservative method for *S. jonesii* for the end users.

Table 1. Feeding regime

Feed Stuffs	Group I	Group II & III
Urea treated rice straw	*Ad lib.*	*ad lib.*
Sesame meal	30 % of total diet	20 % of total diet
Rice Bran	32 % of total diet	-
Leucaena leaf meal	-	40 % of total diet

Table 2. Chemical composition of feedstuffs

	Chemical composition					
Feedstuffs	DM%	OM%	CP%	EE%	NDF%	ADF%
Rice straw	89.94	84.21	2.7	1.85	40.71	61.31
Leucaena leaf	89.32	91.00	22.92	5.27	22.72	13.71
Sesame meal	86.13	84.00	37.03	10.5	17.42	9.63
Rice bran	91.91	89.94	12.22	12.51	31.62	9.34

Table 3. Chemical composition of diets

	Chemical composition					
Groups	DM%	OM%	CP%	EE%	NDF%	ADF%
Group I	89.47	86.04	17.30	5.84	38.59	22.43
Group III	89.19	86.70	17.57	5.58	37.56	23.25

Table 4. Digestibility of nutrients

Description (%)	I	II	III	SEM
DM	66.64*a	58.64b	63.39a	0.55
OM	69.70a	62.47b	66.10a	0.73
CP	74.87a	64.61b	71.55a	0.73
EE	79.73a	68.87b	75.48a	0.64
NDF	67.31a	56.46b	64.92b	0.66
ADF	61.90a	50.39b	58.17a	0.90

* Means in each row followed by the same letter do not differ significantly at $p < 0.05$ by DMRT.

Table 5. Nutritive values

Description	I	II	III	SEM
TDN, %DM	70.06*a	62.82b	69.35a	0.83
DCP, %DM	14.90NS	12.77NS	14.72NS	3.67

* Means in each row followed by the same letter do not differ significantly at $p < 0.05$ by DMRT.

NS = not significant

Table 6. Daily nutrient intakes

Description	Groups			SEM
(g /d)	I	II	III	
DMI	477.17	487.65	461.23	13.54
OMI	450.53	491.32	453.63	13.57
CPI	90.75	103.63	100.32	4.30
EEI	31.00	26.64	25.40	1.56
NDFI	206.70	210.12	198.33	5.84
ADFI	120.19	142.48	129.87	3.75
(g /kgBW$^{0.75}$/d)				
RSDMI	28.85*^{a}	25.71^{b}	28.80	0.55
DMI	63.72^{a}	57.35^{b}	62.47^{ab}	0.55
OMI	62.88^{a}	54.72^{b}	60.77^{ab}	0.28
CPI	13.69^{NS}	13.06^{NS}	13.08^{NS}	0.35
EEI	4.41^{NS}	3.63^{NS}	3.74^{NS}	0.13
ADFI	16.61^{a}	15.9^{b}	18.01^{a}	0.28
NDFI	27.92^{a}	23.32^{b}	26.85^{a}	0.37

* Means in each row followed by the same letter do not differ significantly at $p< 0.05$ by DMRT.

^{NS} = not significant

Table 7. Digestible nutrient intakes

Description	Groups			SEM
(g /d)	I	II	III	
DDMI	318.38	293.51	301.41	9.14
DOMI	288.13	265.26	272.24	7.17
DCPI	74.96	64.89	71.83	3.14
DEEI	24.68	17.90	19.18	1.18
DNDFI	139.34	122.49	130.20	4.42
DADFI	83.33	71.72	75.47	2.08
(g /kgBW$^{0.75}$/d)				
DDMI	41.98*^{a}	29.96^{b}	39.82^{a}	0.74
DOMI	39.08*^{a}	31.36^{b}	36.46^{a}	0.54
DCPI	10.11*^{a}	6.39^{b}	9.32^{a}	0.29
DEEI	3.33 ^{*NS}	1.94 ^{NS}	2.45 ^{NS}	0.13
DADFI	11.28*^{a}	8.30^{b}	10.03^{c}	0.19
DNDFI	18.95*^{a}	13.66^{b}	17.18	0.37
TDNI	43.25*^{a}	33.31^{b}	39.19^{a}	1.24

* Means in each row followed by the same letter do not differ significantly at $p < 0.05$ by DMRT.

^{NS} = not significant

Table 8. Nitrogen retention

Description	Groups			SEM
g/d/kgBW$^{0.75}$	I	II	III	
N_2 Intake	2.19^{*NS}	2.09^{NS}	2.09^{NS}	0.32
Faecal N_2	0.53^{b}	0.83^{a}	0.69^{b}	0.51
Urine N_2	0.57^{NS}	0.58^{NS}	0.49^{NS}	0.15
N_2 Retention	1.09^{a}	0.68^{b}	0.91^{a}	0.17

* Means in each row followed by the same letter do not differ significantly at $p < 0.05$ by DMRT.

^{NS} = not significant

Fig. 1, Oral inoculation of freeze-dried *S. jonesii*

Fig. 2, Animal showing toxic symptoms of leucaena

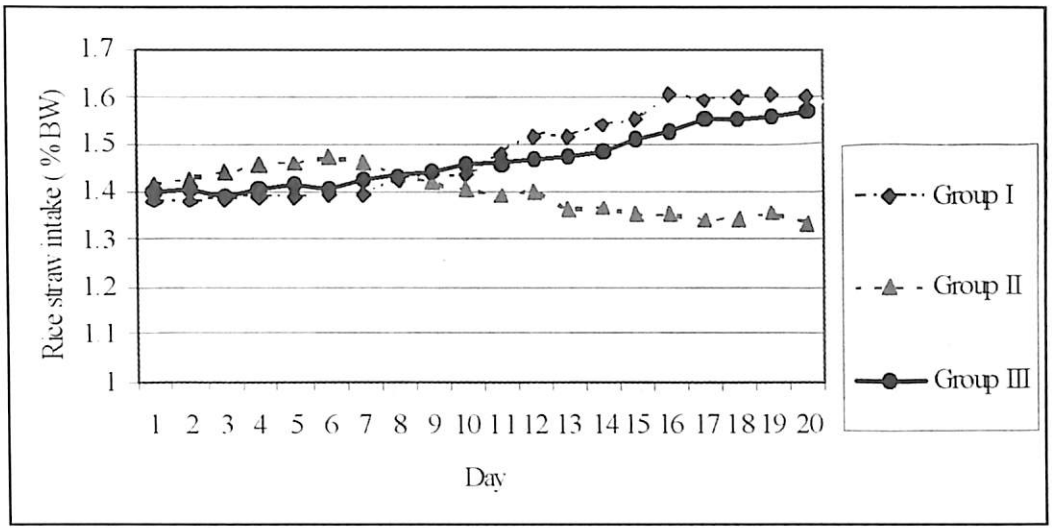

Fig 3, Comparison of daily rice straw intake

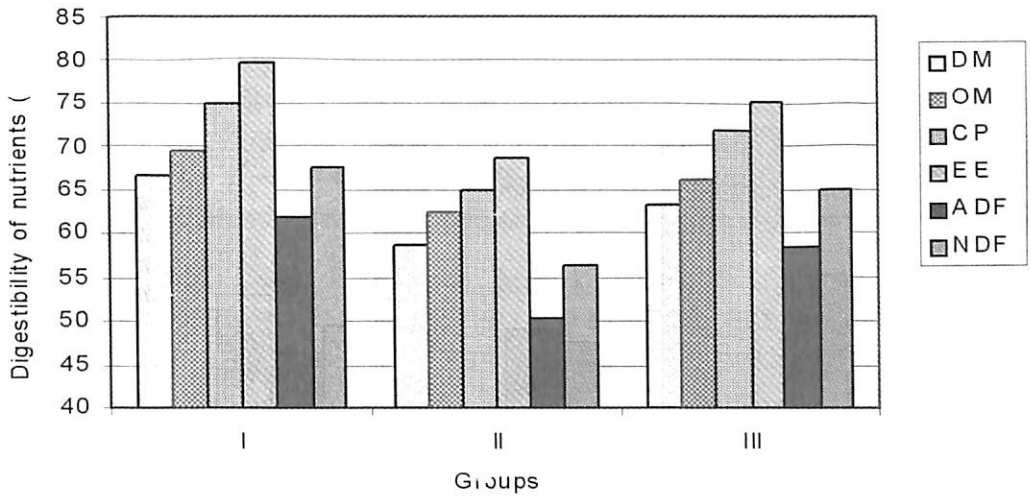

Fig 4, Digestibilities of nutrients

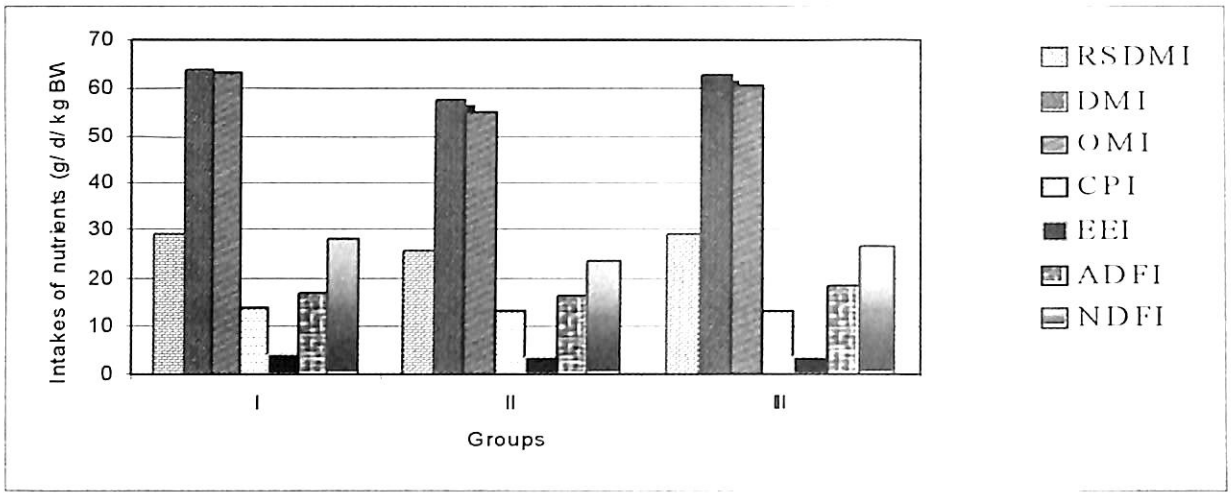

Fig 5, Intakes of nutrients

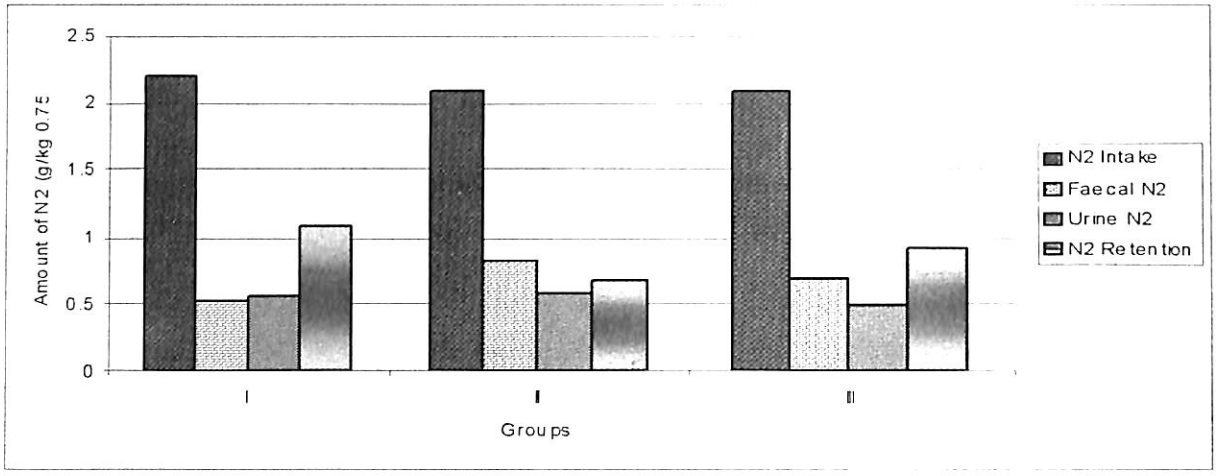

Fig 6, Utilization of nitrogen

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References

Aletor, V. A., and Omdara, O. A, 1994. Studies on some leguminous browse plants, with particular reference to their proximate, mineral, some endogenous anti-nutritional constitutents. Anim. Feed Sci. Technol. **46 :** 343-348.

AOAC, 1984. Official methods of analysis of the Association of Official Analytical Chemists. 14. edn. Arlington.

Aung Aung, Tin Ngwe, U. ter Meulen, H. Böhnel 2007. An attempt to control mimosine toxicity in Myanmar sheep using freeze-dried IBT-Goettinger Bioreactor grown *Synergestes jonesii* (in press). Paper presented at the paper reading session of Golden Jubilee of University of Veterinary Science, held on 25-26.11.2007, Yezin.

Bosni, M. L. K., Osuji, P. O. Tuah, A. K. Umunna, N. N, 1995. Intake, digestibility, nitrogen balance and certain rumen characteristics of Ehtiopian Menz sheep fed teff straw supplemented with cotton seed cake, dry sesbania, dry leucaena or fresh leucaena. Agroforestry System **31**: 243-256.

Fraser, M. D., Fychan, Jones, R. R. 2000. Voluntary intake, digestibility, nitrogen utilization by sheep fed ensiled forage legumes. Grass Forage Science. **55**: 271-279.

Gieseke, A., 1984. Untersuchungen zur Verdaulichkeit und umsetzbaren Energie von *Leucaena leucocephala an* Kanichen. Diplomarbeit, Uni. Göttingen.

Goering, H.K, and Van Soest, P.J. 1970, Forage fobre analysis agricultural handbook. 379. USDA, Washington DC. 8-12.

Goodsell, D. S., 2005. The molecular perspective: Double-stranded DNA breaks. The Oncologist. **10**: 361-362. http://theonologist. alphamedpress. org/cgi/content/full/10/5/361, 02.08.06).

Gupta, H. K., and Atreja, P. P. 1998a. Influence of gradual adaptation of *Leucaena leucocephala* leaf meal on biodegradation of mimosine, 3-hydroxy- 4(1H)-pyridone (3,4-DHP) in rumen, their levels in blood, fate, influence of absorbed DHP on thyroid hormones, liver enzymes. Anim. Feed Sci. Technol. **74:** 29-43.

Gupta, H. K., and Atreja, P. P. 1998b. Influence of ferric chloride treated *Leucaena leucocephala* on metabolism of mimosine, 3-4 pyridone in growing rabbits. Anim. Feed Sci. Technol. **74:** 45-55.

Haque, N. M., Khan, Y. and Sparihar, N. 1997. Nutritional, histopathological studies on Jamunapari goats fed on concentrate diets supplemented with various levels of leucaena leaves. Ind. J. Anim. Sci. **67** 524-527.

Hegarty, M. P., Schinkel, P. G. Court, T. D. 1964. Reaction of sheep to the comsumption of *Leucaena glauca* Benth, its toxic principle mimosine. Austr. J. Agric. Res. **15:** 153-167.

Hegarty, M. P., Court, R. D. Christie, G. S. Lee, C. P. 1976. Mimosine in *Leucaena leucocephala* is metabolized to a goitrogen in ruminants. Austr. Vet. J. **52:** 490.

Hilal, S. H., Saber, A. H. Haggag, M. Y. El-Zalabani, S. M. Ahmed, F. I. F. 1991. Protein, common amino acids, mimosine contents of *Leucaena glauca Benth* cultivated in Egypt. Egypt J. Pharm. Sci. **32:** 91-101.

Hindrichsen, I. K., Osuju, P. O. Odenyo. A. A. Madsen, J. Hvelplund, T. 2002. Effects of supplementation of a basal diet of maize stover with different amount of *Leucaena diversifoilia* on intake, digestibility, nitrogen metabolism, rumen parameters in sheep. Anim. Feed Sci. Technol. **98:** 131-142.

Jones, R. J, and Hegarty, M. P. 1984. The effect of different proportions of *Leucaena leucocephala* in the diet of cattle on growth, feed intake, thyroid function, urinary excretion of 3-hydroxy,4-(1H) pyridone. Austr. J. Agri. Res. **35**: 317-325.

Jones, R. J, and Hegarty, M. P. 1984. The effect of different proportions of *Leucaena leucocephala* in the diet of cattle on growth, feed intake, thyroid function, urinary excretion of 3-hydroxy,4-(1H) pyridone. Austr. J. Agri. Res. **35**: 317-325.

Jones, R. J., 1979. The value of *Leucaena leucocephala* as feed for ruminants in the tropic. World's Anim. Rev. **31:** 13-23.

Jones, R. J., 1981. Does ruminal metabolism of mimosine explain the absence of leucaena toxicity in Hawaii? Austr. Vet. J. **57**:55-56.

Jones, R. J., Blunt, C. G. Nurnberg, I. 1978. Toxicity of *Leucaena leucocephala*. The effect of iodine, mineral supplementation on penned steers fed a sole diet of leucaena. Austr. Vet. J. **54**: 387-392.

Jones, R. J., Megarrity. R. G 1983. Comparative toxicityresponses of goats fed on *Leucaena leucocephala* in Australia, Hawaii. Austr. J. Agric. Res. **34**: 781-790.

Kale, U., 1987. Nutritive value of *Leucaena leucocephala* (subabul). Doctoral thesis, Uni. Bombay.

Kumar, R., 1999. Anti-nutritional factors, the potential risks of toxicity, the methods to alleviate them. **In:** Leguminous trees, other fodder trees as protein sources for live-stock. FAO. An animal production and health paper **102:** 145-161.

Mikhailov, I., Russev, G Anachkova, B. 2000. Treatment of mimalian cells with mimosine generates DNA breaks. Mutation Res. **31:** 299-306.

Mosca, P. J, Lin, H. B. Hamlin, 1995. Mimosine, a novel inhibitor of DNA replication, binds to a 50 KDa protein in Chinese hamster cells. Nucleic Acids Res. **32**: 261-268.

Ni Ni Maw, Khin San Mu, Aung Aung, Moe Thida Htun, 2002. Preliminary report on nutritive value of tree foliages available in Yezin area. Proceedings of Myanmar Agricultural, Forestry Livestocks, Fishery Sciences. pp 128-134.

NRC, 1985. Nutrient Requirements of Sheep. 6th ed. pp 42-45. Natl. Acad. Press, Washington DC.

Ram, J. J., Atreja, P. P. Chopra, R. C. Chhabra, A. 1994. Mimosine degradation in calves fed a sole diet of *Leucaena leucocephala in* India Trop. Anim. Health Prod. **26:** 199-206.

Reis, P. J., Tunks, D. A. Megarrity, M. P. 1978. Mimosine administered orally to sheep, its effectiveness as a defleecing agent. Austr. J. Biol. Sci. **28**: 495-501.

Samanta, A. K., Chopra, R. C., Atreja, P. P. A. Chrabre, 1994. An attempt to inactivate mimosine of *Leucaena leucocephala* by mineral supplementation for feeding to ruminants. Anim. Feed Sci. Technol. **50:** 157-165.

Serrano, R. P., Flag, L. L. Mendoza, E. M. T. 1983. Biochemical mechanism of mimosine toxicity to *Sederotium rolfasi Sau.* Aust, J. Biol. Sci. **36:** 445-454.

Sethi, P. 1989. Nutritional, biochemical aspects of *Leucaena leucocephala*. Doctoral Thesis, Department of Chemical Technology, Univ. Bombay.

Shelton, H. M., 1998. The leucaena genus. New opportunities for agriculture (A review of workshop outcomes). **In:** Leucaena adaptation, quality, farming systems. Ed H. M. Shelton, R. C. Gutteridge, B. F. Mullan, R. A Brayl. Australian Centre for International Agricultural Research, Canberra. pp 15-24.

Singh, S., S. S. Kundu, Negi, A. S. Gupta, S. K. Sihgn, N. P. and Pachouri, V. C. 2002. Leucaena seeds as protein supplement in the rations of growing sheep. Asian-Austr. J. Anim. Sci. **15**: 1433-1438.

Sobale, B. N., Kharat, S. T. Parasat, V. L. Joshi, A. L. Rangnekar, D. V. Deshmukh, S. S. 1978. Nutritve value of *Leucaena leucocephala* for growing bulls. Trop. Anim. Hlth. Prod. **10**: 237-241.

Ter Meulen, U., Struck, S. Schulke, E. Al Harith, E. A. 1979. A review on the nutritive value, toxic aspect of *Leucaena lecocephala*. Trop. Anim. Prod.**14**: 113-126.

Tin Ngwe, 1990. The effect of different sources of protein supplement on the utilization of rice straw based diet in castrated growing young calves. M. Agr Thesis, division of Animal Science, Graduate School of Agriculture, Hokkaido University, Japan.

Tin Ngwe, Mar Mar Mar Kyi, Cho Cho Thein and Zaw Win Maung 1993a. Effect of level of rice bran on voluntary intake of rice and digestibility of rice straw in growing bulls. Myanmar J. Agric. Sci. **5(1)**: 65-75.

Tin Ngwe, Mar Mar Mar Kyi, Cho Cho Thein and Zaw Win Maung 1993b. Effect of groundnut meal or sesame meal with or without chickpea husk on voluntary intake of rice straw and digestibility of rice based diet in growing bulls. Myanmar J. Agric. Sci. **5(1)**: 145-156.

Tsvetkov, L. M., Russev, G. C, Anachkova, B. B. 1999. Effect of mimosine on DNA synthesis in mammalian cells. Cancer Res. **1**: 22252-22255.

Wanapat, M., P. Sariwattansombat and S. Chanthi (1984). The utilization of diets containing urea-treated rice straw and urea-ammonia treated rice straw and water hyacinth. **In**: The Utilization of Fibrous Agricultural Residues as Animal Feed. Ed. P.T Doyle, School of Agriculture and Forestry, The University of Melbourne, Perkville, Victoria, pp 156-165.

Ward, K. A., R. L. N. Harris, 1976. Inhibition of wool follicle DNA synthesis by mimosine, related 4 (1H) –pyridone. Austr. J . Biol. Sci. **26**: 189-196.

Yadav, P. S., and Yadav, I. S. 1988. Protein composition, mimosine contents from the different parts of cultivars of subabul. Ind. J. Anim. Sci. **58**: 953-958.

Yami, A., Litherland. A. J. Davis, J. J. Sahle, T. Puchalar, R. Coetsch, A. L 2000. Effects of dietary level of *Leucaena leucocephala* performance of Angora, Spanish goats. Small Ruminant Res. **38**: 17-27.

ဆွေးနွေးချက်

Dr. ခင်မမ - ယခုသုတေသနသည် "သိုး" များတွင် ပြုလုပ်နိုင်သကဲ့သို့ "နွား" များတွင်လည်း အထက်ပါသုတေသန လုပ်နိုင်ခြင်း ရှိ/မရှိ သိလိုပါသည်။

Dr. နွဲ့နွဲ့ထင် - First line တွင် Clinical sign များသည် Farmer's report အရ အားလုံးအတူတူပင်ဖြစ်ကြောင်း ဖော်ပြထားရာ ၄င်း Clinical signs များ ကို တိတိကျကျ သိလိုပါသည်။ Leucena နှင့် Mimosine ကိုလည်း စိတ်ဝင်စားကြောင်း ဆွေးနွေးမေးမြန်းပါသည်။

ဖြေကြားချက် - Clinical sign of mimosine toxicity များမှာ-

- Loss of hair
- Esophageal lesion
- Salivation
- Vomiting
- Decrease feed intake, digestibility, and body weight.
- Swollen coronary
- Lameness
- Dullness

Dr. မိုသီတာထွန်း - မြန်မာနိုင်ငံရှိ Sheep lumen များတွင် *Synergestes jonesii* bacteria များလုံးဝ မရှိ၍လား (သို့မဟုတ်) ၄င်း Bacteria ၏ Population size က နည်းနေသည့်အတွက် Mimosine ကို Degrade လုပ်နိုင်သော Population size ရောက်အောင် Incubation လုပ်ပေးခြင်းလား သိရှိလိုပါ သည်။

- *Synergestes jonesii* bacteria ရှိလျှင် Mimosine toxicity sign လုံးဝ မဖြစ်နိုင်ဟု ဆိုလိုပါသလား။

ဖြေကြားချက် - မြန်မာပြည်တွင် Mimosine နှင့် ပတ်သက်၍ Toxicity ရှိ/မရှိ သိရန် စမ်းသပ်ရာ Preliminary sheep (၆)ကောင်တွင် ၂၀-၃၀%၌ Sign မရှိ သော်လည်း ၄၀%တွင် Toxic sign တွေ့ရှိ ရပါသည်။ ထို့ကြောင့် မြန်မာသိုးတွင် Mimosine ကို ခြေဖျက်နိုင်သော Bacteria မရှိဟု ယူဆနိုင်ပါသည်။

- ၄င်း Bacteria ကို တစ်ကြိမ်ကျွေးပါက Long life degrade လုပ်နိုင်သဖြင့် ဘောစကိုင်းအမြဲကျွေးရပါမည်။ မကျွေးဘဲ နှစ်လဖြတ်ချလိုက်လျှင် Mimosine ကို သိုးက Degrade မလုပ်နိုင်တော့ပါ။

Evaluation of Elephant Grass Quality *Pennisetum purpureum* c.v marker through *In vitro* Gas Production Using Rumen Inoculum of Fistulated Bull

Tin Ngwe [1)*], Aye Aye Khaing [2)], Myo Kywe [2)], Khin San Mu [1)] and Mar Mar Kyu [2)]

ABSTRACT

The biomass production, the chemical compositions and the digestion of elephant grass (*Pennisetum purpureum* c.v marker) through the gas production analysis method were investigated. Elephant grass was grown at the Department of Agronomy, Yezin Agricultural University from November 2006 to May 2007. The experimental design was completely randomized design (CRD) with three replications. Treatments were six sowing times started from November to April monthly. The fistulated 262 kg body weight was used as a donor of rumen inoculum for the *in vitro* gas analysis at the laboratory of Department of Physiology and Biochemistry, University of Veterinary Science, Yezin. Six treatments of elephant grass harvested at 1, 2, 3, 4, 5 and 6 months after planting (MAP) were used in this study. The dry matter (DM), organic matter (OM) and crude protein (CP) yield plant^{-1} were the lowest at 1 MAP and highest at 6 MAP. The DM content of the grass harvested at 1 MAP was 13.7% and significantly ($P<0.05$) lower than those (30.1and 34.1%) at 5 and 6 MAP, respectively. The CP content of the grass harvested at 1 MAP was 9.1% and significantly ($P<0.05$) higher than those (5.8, 4.0, 3.5, 3.2 and 3.2%) at 1, 2, 3, 4, 5 and 6 MAP, respectively. The acid detergent lignin (ADL) content of the grass at 1 MAP was 2.0% and significantly ($P<0.05$) lower than those of others. The gas production (ml/200 mg) of the grass harvested at 6 MAP at the incubation of 24, 36 and 48 hours were 23.4, 32.9 and 36.5 and significantly ($P<0.05$) higher than those of others. The rapidly degradable fraction *(a,%) was 4.8%* and found to be the highest at 1 MAP and the slowly degradable fraction *(b,%) of the grass harvested* at 4, 5, and 6 MAP were significantly ($P<0.05$) higher than those of others.

Key words: Chemical compositions, crude protein yield, degradation constants, dry matter yield, forage grass, organic matter yield.

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1. Introduction

The factors limiting livestock production in Myanmar are high losses due to animal disease, the feed supplied to most livestock is seriously inadequate quantitatively and/or qualitatively; little use of pasture to maintain grazing animals and traditional systems of livestock management contain serious faults and livestock owners. Pastures are of such poor quality that supplementary feeding is necessary in Myanmar. A simple and effective ways to increase livestock production is to grow improved pastures. Throughout Myanmar; extensive areas of idle land could grow excellent pasture. At present most of the pasture consists of low rank, poor quality grasses and a limited range of edible shrubs. During prolonged dry periods, grazing animals subsist on dry matter roughages of poor quality. The overgrazing increases erosion when the monsoon begins and accelerates a vicious circle of deterioration.

Some 89% of Buffaloes and 80% of the cattle in Myanmar are owned by small holder farmers. Most of these animals are used as draught animals and draught power is economically important to the farmers for growing of rice, wheat, pulses, oil seed crops, etc. Whatever grazing is done on paddy bunds, fallow land and common grazing grounds, crops residues after harvest also contributes to the feeding of ruminant animals. Livestock production in Myanmar can be increased through increasing the output per animal and the productivity per unit area of land. A major factor in increasing livestock productivity will be improvement of animal nutrition and feed supplies. Improved animal disease and parasite control, breeding and management will also be important, but initially a major emphasis must be placed on providing better nutrition (Whiteman, 1980).

The ruminant animal is particularly valuable because of its ability to convert forages, roughages and by products, which cannot be used, directly in human nutrition. The importance of animal products in human nutrition has been recognized because of the role of animal proteins in relation to the quality of the human diet. In some areas where improved disease control and management schemes have been instituted increasing animal populations have led to overgrazing of rangelands. The expansion of arable agriculture into traditional grazing lands also reduces animal forage resources (Pearse, 1970).

The increment of cattle and buffalo were 8.7 and 8.6 % respectively from 2000 to 2004 which were lower than those of sheep and goats. The increment of pigs was 31.3 % from 2000 to 2004 and was found to be the highest among the livestock in Myanmar. It was found that the milking cows were 11.6% of the total cattle population. Total milk animal increased 10.9 % from 2000 to 2004. It was noted that there was no increment of milk yield per animal during 2000 to 2004. It should be born in mind that the genetics,

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nutrition, disease etc. might be the limiting factors to improve the milk yield. Total milk production was increased 9.4 % from 2000 to 2004. The eggs primary production in 2000 was 88,000 and 111,000 metric tons in 2004 respectively and it was increased 26.1 % from 2000 to 2004. Hen eggs production was also promoted 22.0 % during 200- 2004 It was found that the ruminant increment was much lower than those of chicken and pigs. It might be due to feedstuffs scarcity and improper feeding strategy (FAO, 2005).

As a method of land utilization, grazing is of enormous importance on a world scale (Hodgson, 1990). Approximately 25 percent of the total land area of the world is classified as grazing lands, and grazing animals also make substantial use of the cropping lands which occupy a further 10-15 per cent of the land area. Natural grassland is grassland where there is an absence of sown or planted species. The vegetation is constantly changing as a result of changing climate, natural plant migration and evolution, and natural fires and cyclones. The rate of change is of course greatly increased by the activities of man by introducing grazing animals, removing trees and shrubs, and burning vegetation.

The factors which define the local ecosystem are firstly the characteristics of physical environment, climatic, edaphic (soil) and physiographic. Secondly there are biotic influences such as the natural fauna of the area domestic grazing animals, firing, clearing and other modifications made by man (Humphrey, 1984).

Many research workers in Myanmar are extensively carrying out to improve ruminant production at their best effort with available resources of feedstuff especially rice straw as a basal diet (Tin Ngwe et al., 1989; Tin Ngwe, 1990; Tin Ngwe *et al.*, 1993a; Tin Ngwe *et al.*, 1993b; Mar Mar Kyi *et al*, 1998; Yan Naing Soe, 2001; Aung Aung *et al.*, 2001; Ni Ni Maw *et al.*, 2002; Tin Ngwe, 2003; Tin Ngwe *et al.*, 2004; Khin San Mu *et al.*, 2005; Khin Htay Myint *et al.*, 2006; Tin Maung Soe *et al.*, 2007 etc.).

However, dairy productions in Myanmar mainly depend on the concentrate based diet and some of farms used excessive amount of concentrate resulting with high cost of feed (Tin Ngwe et al., 2005; Tin Maung Soe et al., 2007). That was due to feeding of low quality roughages such as rice straw. If dairy farmers expect the good performance of dairy production with low cost of feed, they have to engage the proper utilization of pasture.

Therefore, the objective of the present study was to investigate the biomass production, the chemical compositions and the digestion of elephant grass through the gas production analysis method so as to introduce the premature utilization of pasture for ruminant production in Myanmar.

2. Materials and Methods

2.1. Sowing and plantation of elephant grass

Elephant grass was grown at the Department of Agronomy, Yezin Agricultural University from November, 2006 to May, 2007. The experimental design was completely randomized design (CRD) with three replications. Treatments were six sowing times started from November to April monthly.

The basal nodes were cut consisting of three nodes in each piece as planting materials. Two nodes were buried in the soiled and one node was just above the soil. Three stem cuttings were planted at every planting time in each pot and then two stem cuttings were removed 10 – 15 days after. The pots were filled with 20 kg of soil in each pot. Soil pH is 6.5. All treatments were harvested at 24 May, 2007. Watering and weeding were done as necessary.

2.2. Chemical compositions and *in vitro* gas analysis

2.2.1 Chemical analysis

Dried residues were analyzed for dry matter (DM) and organic matter (OM) by the method described by AOAC (1970) and analyzed for neutral detergent fibre (NDF) and acid detergent fibre (ADF) by Goering and Van Soest (1970). Nitrogen was determined by using Kjeldahl method (Foss 2020 digestor and Foss 2100 Kjeltec distillation unit) and crude protein (CP) was calculated as 6.25×N (AOAC, 1970). All chemical analyses were carried out at the laboratory of Department of Physiology and Biochemistry, University of Veterinary Science, Yezin.

2.2.2 Experimental animal, experimental feed and experimental period

The fistulated 262 kg body weight was used as a donor of rumen inoculum for the *in vitro* gas analysis at the laboratory of Department of Physiology and Biochemistry, University of Veterinary Science, Yezin.

Six samples with three replicates used in this study were as follows:

(1) Elephant grass harvested at 1 month after planting (MAP)

(2) Elephant grass harvested at 2 MAP

(3) Elephant grass harvested at 3 MAP

(4) Elephant grass harvested at 4 MAP

(5) Elephant grass harvested at 5 MAP

(6) Elephant grass harvested at 6 MAP

2.2.3. Experimental procedure

Day before incubation

The Menke and Steingass (1988) gas production technique was used. The samples were ground to pass through 1 mm sieve, and 200 ± 10 mg of samples were weighed in a small polypropylene weighing spoon. The weighing spoon containing feed sample to a glass rod with a rubber adapter was fixed and the sample were transferred quantitatively, to the closed end of the syringe. Each sample was weighed in triplicates. With every batch of incubations, 3 syringes were used as blank (i.e., without feedstuff), 3 syringes for concentrate reference standard and 3 syringes for roughage reference standard. After weighing of all samples, Vaseline was applied to the pistons which were then inserted into the syringes. The samples should not be blown out through the nozzle. The silicone tube were clamped and fitted to the nozzle. Syringes were kept in an incubator or a water bath set at 39°C.

Day of incubation

The medium prepared on the previous day in a water bath was kept and set at 39°C, and carbon dioxide was bubbled slowly for 15 to 20 minutes. The medium was kept continuously stirred with a magnetic stirrer. Then the rumen fluid was collected from a rumen fistulated animal. Reducing solution was prepared and added to the medium. The medium should turn to pink and eventually colourless. Rumen fluid was measured to 650 ml and added to the medium. Carbon dioxide was continued to bubble through the medium. Rumen inoculum was dispensed to 30 ml into the syringe through the silicone tube fitted to nozzle. The gas bubble was pushed out, and closed the silicone tube with the clamps. The volume was recorded and put the syringe on the rotor of the incubator or in a water bath set at 39°C. The reading was recorded at the incubation period of 1, 3, 6, 9, 12, 18, 24, 36 and 48 hours. If the syringe was full of the gas, the silicone tube was unclamped, the gas was pushed out, the tube was clamped, and the reading was recorded and kept in the incubator. The gas production (GP) data were then fitted to the equation $GP = a + b (1\text{-}e^{-ct})$ (Ørskov E.R, 1985), where a, b and c are constants and GP is the gas production from the substrate at time t.

2.2.3. Statistical analysis

The data were analyzed by using IRRI STAT software version-5 with mean comparison at LSD 5 % level.

Results and Discussion

The yield of DM, OM and CP plant^{-1} are shown in Table 1. The yield of DM, OM and CP plant^{-1} of elephant grass harvested at 1 MAP were 5.43, 4.45 and 0.49 g, respectively. It was found that the yield of DM, OM and CP of the grass increased as the months harvested gradually advanced. The DM and OM of the grass harvested at 1 MAP were significantly ($P<0.05$) lower than those of others. The contents of DM and OM at 6 MAP were found to be the highest. The DM, OM and CP at 6 MAP were 59.22, 51.75 and 1.87, respectively and they were significantly ($P< 0.05$) higher than those of others. Therefore, if one would expect higher DM, OM and CP yield, advanced age of the grass could be more preferable.

Table 2 presents the chemical compositions of elephant grass harvested at different MAP. The DM contents were 13.7, 21.3, 25.4, 30.0, 30.1 and 34.1% for the grass harvested at 1, 2, 3, 4, 5 and 6 MAP, respectively. The DM content of the grass was the lowest at 1 MAP and significantly ($P<0.05$) lower than those of others. The changes of OM contents of the grass were not found and it would indicate that the gross energy content and minerals contents of the grass might be similar to each other regardless of MAP in this experiment. The CP contents were 9.1, 5.8, 4.0, 3.5, 3.2 and 3.2% for the grass harvested at 1, 2, 3, 4, 5 and 6 MAP, respectively. The CP content of the grass was the highest at 1 MAP and it was significantly ($P<0.05$) higher than those of others. The pattern of CP content of the grass at MAP was reversed in comparison with the DM content as the months harvested advanced. This finding was agreed with the report of Bogdon (1977) that the CP content decreased as the growth of the grass progressed. Therefore, it would indicate that the higher CP content of the grass harvested at 1 MAP could not represent the higher yield of CP because of lower DM content (table 1 and 2). The yield of CP of the grass harvested at 6 MAP was nearly three times more than that of 1 MAP (1.87% vs 0.49%), although the CP content of the grass harvested at 6 MAP was nearly three times less than that of 1 MAP (9.1% vs 3.2%). The contents NDF, ADF, ADL, Hemicellulose and cellulose of the grass gradually increased as the plant growth advanced. The contents of NDF, ADF, ADL, Hemicellulose and cellulose were the lowest at 1 MAP and they were significantly lower than those of the grass harvested at 2, 3, 4, 5 and 6 MAP.

Gas production (ml/200mg) and degradation constants of elephant grass at different MAP are shown in Table 3 and Table 4. The gas productions of the grass harvested at each MAP at incubation times were relatively similar to one another. The gas production of the grass harvested at 6 MAP was significantly ($P<0.05$) lower than those of the grass harvested at 1, 2, 3, 4 and 5 MAP at the incubation times of 3, 6 and 9 hours. Beyond 18 hours of incubation times, the gas production of the grass harvested at 6 MAP was found to be the highest. However, the gas productions of the grass harvested at 6 MAP were 23.5, 32.9 and 36.5 ml/200mg for 24, 36 and 48 hours incubation times, respectively and they were significantly higher than those of the grass harvested at 1, 2, 3, 4 and 5 MAP. It would indicate that the higher amount of gas production of the grass harvested at 1, 2, 3, 4 and 5 MAP at earlier incubation times might be due to high inclusion of soluble carbohydrates and the higher amount of gas production of the grass harvested at 6 MAP at later incubation times might be due to high fibre contents which were slowly degradable (Table 2 and Table 3). This was agreed with the report of Vadivello (1995) in which the stem of rice straw with lower CP and higher NDF was more digestible. This was supported by the degradation constants shown in the Table 4. It was found that the *a* constant of the grass harvested at 6 MAP was the lowest and it was significantly ($P<0.05$) lower than those of others. The reversed pattern of *b* constant was found in comparison with constant *a*. The rate of gas production (*c*,% h^{-1}) increased as the growth of the grass advanced. That might be due to higher contents of NDF and ADF which gradually increased with advanced age of the grass.

Contents of (%,DM basis) of NDF and ADF in compared with that of CP at different MAP are presented in fig.1. It was found that the CP content was gradually decreased as the NDF and ADF contents increased with the age of the grass. Contents (%,DM basis) of NDF and ADF in compared with that of lignin at different months after planting are shown in Fig. 2. It was found that the lignin content was the reversed pattern in compared with CP as the NDF and ADF contents increased. Fig. 3 shows the contents of CP (%,DM basis) in compared with that of DM at the different months after planting. The DM content and CP content were in reversed direction to each other. All these figures would indicate that the time of harvesting is important for the proper management of the elephant grass to enable to have the maximal nutritive values as well as biomass production.

In conclusion, the DM content of the grass was the lowest at 1 MAP and it was significantly lower than those of others. It was found that the yield of DM, OM and CP of the grass increased as the months harvested gradually advanced. The higher amount of gas production of the grass harvested at 4 and 6 MAP at later incubation times was also investigated. Therefore, it is postulated that it would be more preferable to harvest at advanced growth regarding with higher DM, OM and CP yield and higher gas production. Further study of OM and CP degradation in the rumen and feeding trial using the ruminant

animals should be carried out for further information of the degradation patterns and digestibility which would indicate the utmost advantage of harvesting time of elephant grass.

Acknowledgements

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Table 1. Yield of DM, OM and CP plant $^{-1}$ at different months after planting

Month after planting	Yield of DM [1] plant^{-1} (g)	Yield of OM [2] plant^{-1} (g)	Yield of CP plant^{-1} (g)
1	5.43^{a}	4.45^{a}	0.49^{a}
2	30.74^{b}	26.81^{b}	1.80^{bc}
3	34.63^{b}	30.20^{b}	1.38^{b}
4	35.55^{b}	31.08^{b}	1.24^{b}
5	43.05^{b}	37.44^{b}	1.37^{b}
6	59.22^{c}	51.75^{c}	1.87^{c}

[1] DM: Dry matter, OM: Organic matter, CP: Crude protein,

[2] All values except DM are on DM basis Significant differences between treatments means over the whole experiment within the same column are indicated by dissimilar superscript.

a,b,c:P<0.05

Table 2. Chemical compositions of elephant grass at different months after planting

Months after planting	DM[1]	OM [2]	CP	NDF	ADF	ADL	Hemi-cellulose	Cellulose
1 month	13.7^{a}	82.0^{a}	9.1^{a}	64.4^{a}	37.9^{a}	2.0^{a}	26.5^{a}	35.8^{a}
2 month	21.3^{b}	87.2^{b}	5.8^{b}	71.5^{b}	43.2^{b}	4.1^{b}	28.4^{ab}	39.1^{b}
3 month	25.4^{b}	87.2^{b}	4.0^{c}	72.2^{b}	44.2^{b}	5.8^{b}	28.0^{ab}	38.4^{b}
4 month	30.0^{cb}	87.4^{b}	3.5^{c}	73.0^{b}	43.1^{b}	5.1^{b}	29.8^{b}	38.0^{b}
5 month	30.1^{c}	87.0^{b}	3.2^{c}	73.0^{b}	44.2^{b}	5.5^{b}	28.8^{ab}	38.8^{b}
6 month	34.1^{c}	87.4^{b}	3.2^{c}	73.5^{b}	44.6^{b}	5.2^{b}	29.0^{ab}	39.4^{b}

[1] DM: Dry matter, OM: Organic matter, CP: Crude protein,

[2] All values except DM are on DM basis

Significant differences between treatments means over the whole experiment within the same column are indicated by dissimilar superscript.

a,b,c:P<0.05

Table 3. Gas production (ml/200mg) of elephant grass at the different months after planting

Months after planting	Incubation time (hour)								
	1	3	6	9	12	18	24	36	48
1 month	1.8	3.6^{a}	6.1^{a}	8.6^{a}	11.5	18.4^{a}	19.1^{a}	25.9^{a}	29.2^{a}
2 month	2.1	4.0^{a}	6.8^{a}	9.3^{a}	12.5	20.4^{ab}	21.1^{ab}	27.9^{ab}	31.5^{ab}
3 month	1.4	3.6^{a}	6.4^{a}	9.3^{a}	12.5	18.6^{ab}	18.2^{ab}	23.5^{ab}	26.0^{ab}
4 month	1.8	3.6^{a}	6.5^{a}	9.1^{a}	13.1	21.8^{b}	22.5^{c}	30.5^{c}	33.8^{c}
5 month	1.5	2.9^{a}	6.2^{a}	9.2^{a}	12.5	21.3^{b}	21.6^{ab}	28.6^{ab}	31.5^{ab}
6 month	1.4	2.1^{b}	4.7^{b}	6.9^{b}	11.2	21.0^{b}	23.5^{c}	32.9^{c}	36.5^{c}

Significant differences between treatments means over the whole experiment within the same column are indicated by dissimilar superscript.

a,b,c:$P<0.05$

Table 4. Degradation constants of gas production of elephant grass at different months after planting

Description[1)]	Months after planting					
	1	2	3	4	5	6
A (ml)	4.8^{a}	5.0^{a}	4.8^{a}	4.8^{a}	3.0^{ab}	2.5^{b}
B(ml)	20.2^{a}	22.5^{ac}	18.2^{a}	25.8^{b}	24.5^{bc}	27.5^{b}
Rate of gas production (%,h^{-1})	3.90^{a}	5.23^{b}	6.10^{b}	6.21^{b}	5.63^{b}	5.68^{b}
a+b (ml)	25.0	27.5	23.0	29.0	27.5	30.0

[1)]Exponential equation: $GP = a + b\ (1\text{-}e^{-ct})$

a: Rapidly degradable fraction

b: Slowly degradable fraction

c: Rate of degradation of *b*.

a + *b*: Potentially degradable fraction.

Significant differences between treatments means over the whole experiment within the same row are indicated by dissimilar superscript.

a, b, c: $P<0.05$

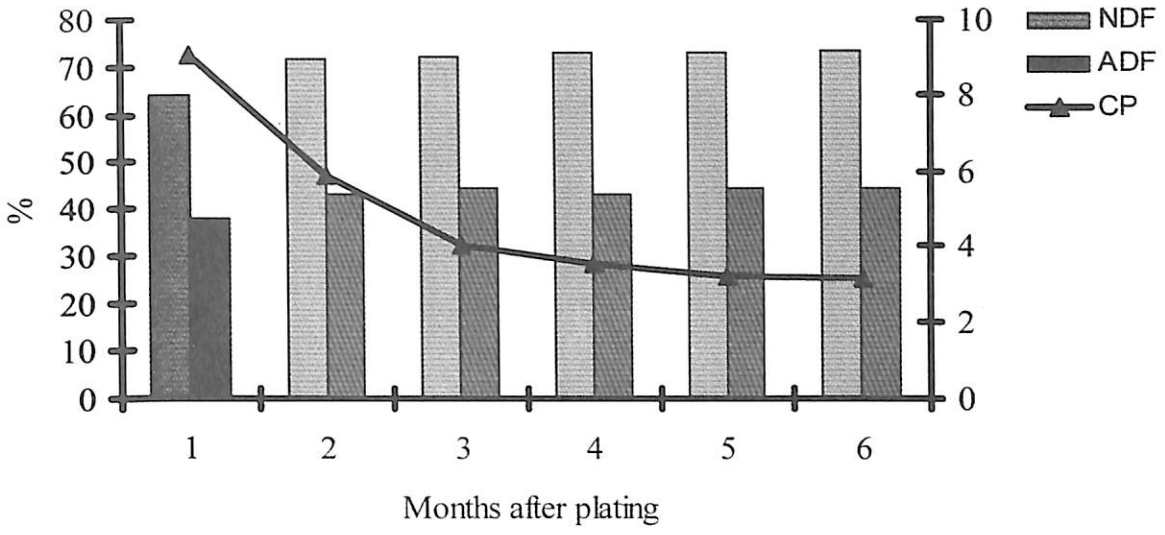

Fig.1 Contents (%,DM basis) of NDF and ADF in compared with that of CP at different months after planting

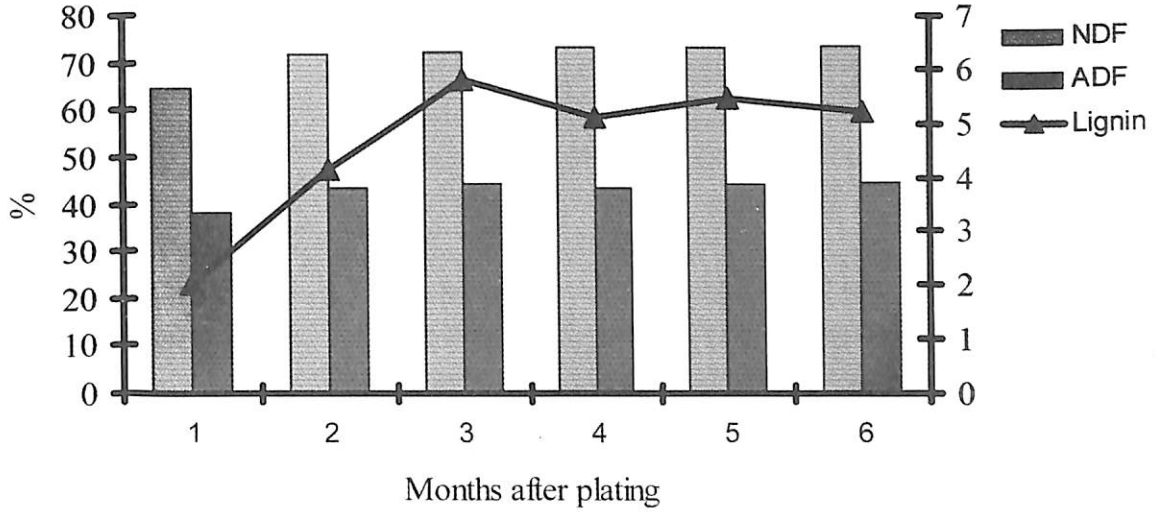

Fig.2 Contents (%, DM basis)of NDF and ADF in compred with that of lignin at different months after planting

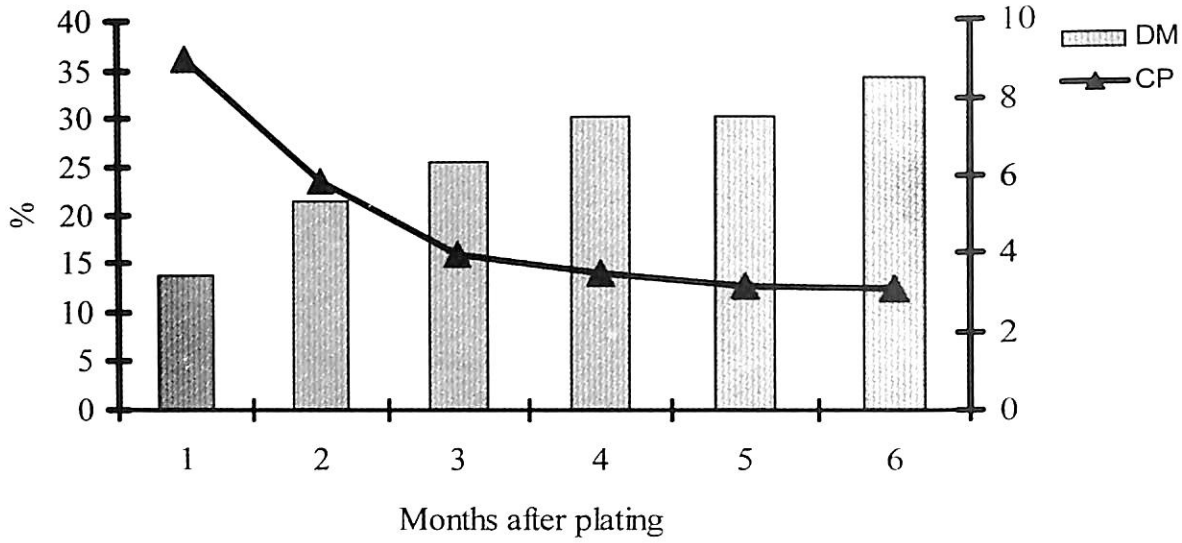

Fig.3 Contents of CP (%,DM basis) in compared with that of DM at the different months after planting

References

A.O.A.C.,1970. Official Methods of Analysis, Vol.1, 15th edn. Association of Official Analytical Chemists. Arilingoton, va, PP.69-90.

Aung Aung, Khin San Mu, Mar Mar Kyi, Tin Ngwe and Ni Ni Maw.2001. Effect of combination of untreated or heat-treated sesame meal and two rates of chickpea (*Cicer Arietinum*) husk to supplement urea-treated rice straw for growing bulls. . Proceedings of the 7th annual research conference (Livestock and Fishery Sector). Myanmar Academy of Agricultural, Forestry, Livestock and Fishery Sciences. August, 2001, Yangon, Myanmar.

Bogdon, A.V., 1877. Tropical Agricultural series: Tropical Pasture and Fodder plants. Longman. pp.15 – 238.

Food and Agriculture Organization. 2005. Livestock production. www.fao.org.

Goering H.K and Van Soest P.J.,1970. Forage fibre Analysis. Agricultural Hand book. 379. USDA, Washinton D.C. 8-12.

Hodgson, J.1990. Grazing management: Science into Practice. Longman Scientific and Technical, New York.

Humphrey, L.R.,1984. Tropical Pasture and Fodder Crops. Longman, England.

Khin Htay Myint, Khin San Mu, Tin Maung Soe, Ni Ni Maw and Tin Ngwe. 2006. The effect of *leucaena leucocephala* and *ziziphus mauritiana* as sources of tannin, on the digestibility and nitrogen utilization in goat. Proceedings of the annual research conference held in Yangon on May 25 – 27, 2006. (Livestock and Fishery Sciences). Myanmar Academy of Agricultural, Forestry, Livestock and Fishery Sciences. May, 2006, Yangon, Myanmar (On press).

Khin San Mu, Aung Aung, Mar Mar Kyi, Tin Ngwe and Ni Ni Maw. 2002. Studies on the physiological responses of growing bulls fed on urea-treated rice straw with untreated or heat-treated sesame meal and two rates of chickpea (*Cicer Arietinum*) husk. Proceedings of the annual research conference held in Yangon on June 28–30, 2002. (Livestock and Fishery Sciences). Myanmar Academy of Agricultural, Forestry, Livestock and Fishery Sciences. August, 2002, Yangon, Myanmar.

Mar Mar Kyi, Tin Ngwe, Zaw Win Maung and Ni Ni Maw.1998. Some physiological responses of growing bulls to rice straw diet supplemented with groundnut meal and sesame meal with or without chickpea (*Cicer Arietinum*) husk.. Proceedings of 7th Veterinary Conference, Yangon University Diamond Jubilee hall. 24 th –25 th October 1998. Myanmar Veterinary Association, Myanmar.

Menke,K.H., Steingass,H.,1988. Estimation of the energetic feed value obtained from chemical analysis and in vitro gas production using rumen fluid. Ani.Res.Dev.28, 7 – 55.

Ni Ni Maw, Khin San Mu, Aung Aung and Moe Thida Htun.2002. Preliminary Report on Nutritive Value of Tree Foliages Locally available in Yezin Area . Proceedings of the annual research conference held in Yangon on June 28– 30, 2002. (Livestock and Fishery Sciences). Myanmar Academy of Agricultural, Forestry, Livestock and Fishery Sciences. August, 2002, Yangon, Myanmar

Ørskov E.R., 1985. Evaluation of crop residues and agro-industrial by-products using the nylon bag method. Res. Dev. Agric. 4(2), 59 – 65.

Pearse, S.C., Clarke,G.M, Dyke,G.V and Kempson, R.E., 1988. A manual of Crop experimentation, Charles Griffin & Company Ltd., London.

Tin Maung Soe, Khin San Mu, Aung Aung, Nwe Nwe Htin and Tin Ngwe.2007. The study on the milk production in cross-bred Holstein Friesian lactating cows with the special reference of nutritional requirement in Myanmar. Proceedings of Annual Meeting of Myanmar Veterinary Association, 2007, Convocation Hall, University of Veterinary Science, Nay Pyi Taw, November 25th – 26th , 2007 (On Press).

Tin Ngwe , Y. Nukui , Y. Kobayashi , H. Nakatsuji , S. Kondo and T. Kato.2004. Effects of chickpea (*Cicer arietinum*) husk with or without polyethylene glycol and detannined chickpea husk on *in vitro* fibre digestion of rice straw diet. Journal of Myanmar Veterinary Association Conference, Yangon University Diamond Jubilee hall. 20-21, November, 2004. Myanmar Veterinary Association, Myanmar.

Tin Ngwe, M. Sugimoto, T. Ichinohe, T. Tamura, H. Nakatsuji, T. Moroka, M. Okubo and Y. Asahida.1990. Effect of different sources of protein on the digestibility and nitrogen retention of rice straw based diet in castrated calves. Report of The Hokkaido Branch, Japanese Society of Zootechnical Science. Volume 33 (No. 1), August, 1990.

Tin Ngwe, Mar Mar Kyi, Cho Cho Thein and Zaw Win Maung .1993a. Study on utilization of rice straw by ruminants supplemented with Agricultural by-products available in Myanmar. 1. Effect of level of rice bran on voluntary intake of rice straw and digestibility of rice straw diet in growing bulls. Myanmar J. Agric. Sci. 5(1): 65-75.

Tin Ngwe, Mar Mar Kyi, Cho Cho Thein and Zaw Win Maung. 1993b. Study on utilization of rice straw by ruminants supplemented with Agricultural by-products available in Myanmar. 2. Effect of groundnut meal or sesame meal with or without chickpea (*Cicer Arietinum*) husk on voluntary intake of rice straw and digestibility of rice straw diet in growing bulls.. Myanmar J. Agric. Sci. 5(2): 83-9

Tin Ngwe, T. Ichinohe, T. Tamura, H. Nakatsuji, T. Moroka, M. Okubo and Y. Asahida. 1989. Effect of rice bran and soya bean meal on the digestibility and nitrogen retention of rice straw based diet in castrated calves. Report of The Hokkaido Branch, Japanese Society of Zootechnical Science. Volume 32 (No. 1) November, 1989.

Tin Ngwe, Ye Tun Win, Khin San Mu and Ni Ni Maw.2005. Preliminary survey on the dairy production in Tapei village, Kyauk Sei District, with special reference to the nutritional requirement. Proceedings of 14th Myanmar Veterinary Association Conference, Myanmar Livestock Federation hall, 17-18, December 2005. Myanmar Veterinary Association, Myanmar.

Vadiveloo.J.,1995. Factors contributing to varietal differences in the nutritive value of rice straw. Animal Food Science and Technology.54 (1995) 45 – 53.

Whiteman, P.C.,1980. Tropical Pasture Science. Oxford University Press.

Yan Naing Soe. 2001. Effects of sunflower seed cake and cotton seed cake fed with untreated and urea-treated rice straw for growing bulls. M.V.Sc. Thesis submitted to Department of Physiology and Biochemistry, University of Veterinary Science, Yezin.

ဆွေးနွေးချက် (၈)

Dr. ရန်နိုင်စိုး

- Abstract line 6 တွင် Sowing အစား Harvesting ဖြစ်နိုင်ပါသလား။
- Two months after sowing တွင် Cutting လုပ်၍ ကျွေးပါကCrude protein ပိုရနိုင်ခြင်း Digestibility နှင့် Annual yield ပိုရနိုင်ပါသလား၊

ဖြေကြားချက်

- Sowing သာ အမှန်ဖြစ်သည်။
- တစ်လအကြာတွင် Crude protein % အကောင်းဆုံးဖြစ်၍ Yield အရ (၆)လသားတွင် အကောင်းဆုံး ဖြစ်ပါသည်။
- Digestibility ကို လေ့လာခြင်း မရှိပါ။ (၆)သားတွင် Gas production ပိုကောင်းပါသည်။
- Annual yield သည် (၆)လသားတွင် ပို၍ ရနိုင်ပါသည်။

The Study on Quality and Safety Production of Some Value-added Seafood

Khin Maung Win[1]

ABSTRACT

Fish and shrimp meat balls and sausages were manufactured in good manufacturing practice, GMP and good hygienic practice, GHP. In addition to these, other pre-requisite programmes, PRP(s), such as sanitation standard operating procedures, SSOP was also applied in the production of better and wholesome quality. For safety purpose, the potential health risk hazards of physical, chemical and biological natures were prevented, and it was also screened down to the critical limits of acceptability. On-line processing steps were monitored and corrective action taken on spot at each defective point(s), i.e. critical control point(s), CCP(s). Discussion and suggestion were presented, with some hints for future improvement of production, packaging, labeling, marketing and preparation for serving of the products.

Introduction

People's Pearl and Fishery Corporation, has produced fish balls and sausages for the first time in Myanmar in 1974. In small pilot scale, these were produced the ready-to-eat RTE, products and introduced to public during that time. Based on the technology and experience, a group of research workers of Institute of Fisheries Technology, headed by the Instructor himself, was again produced the value-added products with advanced formulation in 1995. From that time onwards, similar products of foreign joint-ventured origins were gradually appeared in mini markets and supermarkets.

Approximately, eight to ten brands of ball and sausage of pork, beef, chicken, fish and shrimp are available in Yangon markets. Though the *Ready to Eat* products have increasingly accepted by the lifestyle of citizens, but there are not known report of consumption in volume and price structures.

Imitation of crab stick, fish cake, patties, battered and breaded fish stick may be made from surimi as base materials. (a kind of fish sausage) and however, value-added fishery products has more promising market access at present.

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Institute of Fisheries Technology, Department of Fisheries

Objectives

- To produce wholesome value-added products, VAPs according to good manufacturing practice
- To increase nutrition value and palatability
- To prevent health hazard contaminants to food
- To ensure food safety in value-added product : VAPs
- To introduce food directives to producers
- To initiate Hazard Analysis and Critical Control Point: HACCP plan in value added products: VAPs production
- To promote export trade for VAPs.

Materials and Methods

Raw material selection

- Low-cost-commercial marine fish / shrimp species
- Freshwater food fish / shrimp
- Surimi, ready-made white fresh meat

Selection of raw material of fish shrimp species are shown in Table 1

Extraction of meat and yields

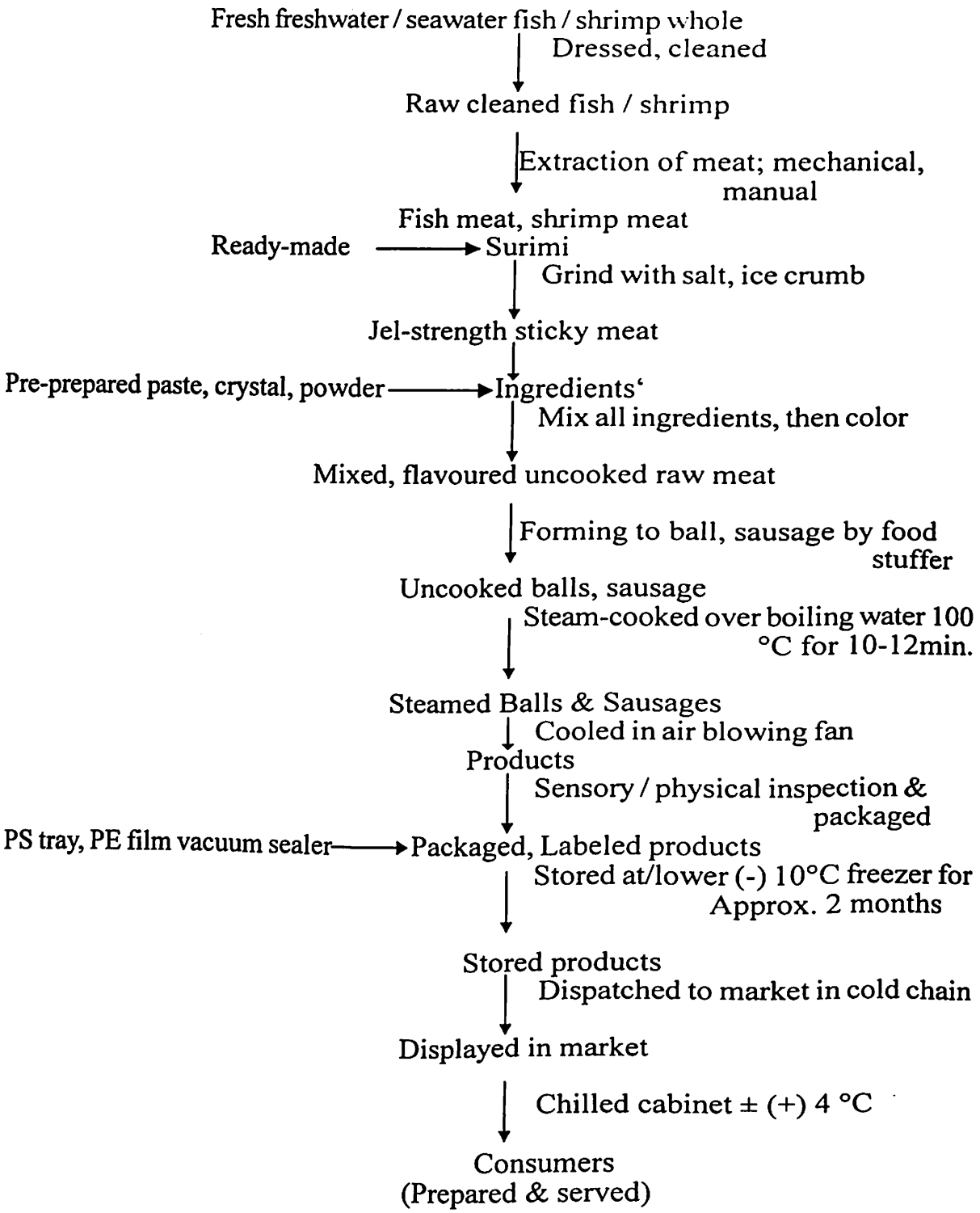
- Mechanical deboner for small marine fish species
- Yield approx. 30 ~ 35% weight, gm
- Hand scrap meat, big-size fish
- Yield approx. 35 ~ 45% weight, gm
- Peeled, deveined cleaned marine / freshwater shrimp species
- Yield appropx. 30 ~ 50% weights, gm

Ingredients

The followings ingredients were used for the production of fish and shrimp balls:

- Tapioca starch / flour, powder
- Edible oil, liquid
- Household salt, NaCl, crystal
- Sugar, crystal
- MSG, Monosodium Glutamate /Ajinomoto, crystal
- Curry powder
- Pepper powder
- Garlic
- Ginger
- Ice crumbs
- Color, food grade, syrup

Generic manufacturing flow diagram for value-added seafood (Balls &Sausages)



Raw / ingredients	Mixed % by weight	Value-added seafood			
		FB	SB	FS	SS
• Raw meat fish	100	100	-	100	-
• Raw fish / shrimp	100	-	100	-	100
• Ingredients					
• Tapioca flour	%	15	15	20	20
• Edible oil	%	2.0	2.0	1.5	1.5
• Salt, NaCl	%	1.75	1.75	1.75	1.75
• Sugar	%	0.1	0.1	0.1	0.1
• M.S.G	%	0.1	0.1	0.1	0.1
• Pepper					
• Ginger	paste	——— to taste ———			
• Garlic					
• Curry powder					
• Food color		———desirable———			
• Ice crumbs	%	——— 25~35 ———			

Machinery, equipment and packaging materials of production line

- Meat machinery
- Meat / Fish deboner
- Meat grinder / mincer
- Meat mixer
- Meat stuffer
- Equipments
- Electronic oven
- Vacuum sealer
- Heat sealer
- Freezer / refrigerator
- Laminating machine
- Air blow fan
- Test equipments / instruments
- Incubator, bacteriological
- Oven, hot air
- Test meter, pH, brine, petri-film, scale, timer
- Nutrition lab (protein, fat, ash, moisture etc.)
- Cooking utensils, pot, metal sieves, knives, cups, bowls
- Packaging materials, PE wrap film, PS Foam tray
- Label paper, mfd. / exp. dt., product name

Machinery and equipment used in the preparation of the value-added products of fish and shrimp ball and sausage are shown in Plate I and II.

Product processing

Raw fish and shrimp meat was collected by hand extraction or peeling and deveining((removal of intestine). Meat deboner (bone remover) was used for fish meat. Salt and ice crumbs was introduced to meat grinder and ground for 5-8 minutes till the meat became sticky, resilient or in other word smooth, homogenous and yielding high jel-strength.

All ingredients except color syrup added to meat in meat mixer and blended to attain desirable color of meat. Balls and sausages were formed by passing through food stuffer. Then, placing these over boiling water for 10-12 minutes. The VAPs in metal sieves were steamed and cooked, then was air cooled by air blowing fan.

Packaging was made with PS foam tray and PE wrap film, label, mentioning product name, in addition to these, manufactured and expiry date, instruction for storage, preparation and serving instruction were printed.

Product description of value-added seafood (balls and sausages)

- Product name : Fish / shrimp balls / sausages
- Product types : Semi-processed immediate product, snack, fast-food moisture content > 65%, moist solid balls Ø 2.5cm sausages Ø2cm x L 10-20 cm
- Raw material : Freshwater / marine fish / shrimp species
- Ingredients : Starch (flour), salt, sugar, edible oil food color, herbal indigenous plant spice (pepper, garlic, ginger & leaves)
- Processing steps : 12 no. steps
- Packaging : PE / PVDC synthetic casing (skin) or natural meat origin collagen casing PE wrap film, PS tray, PP cup, outer insulated PS Foam box, Label-paper / PE Laminate, vacuum / heat sealer
- Storage : Chilled temp. Refrigerator + (+) 4 °C freezer ± (-) 10 °C
- Shelflife : 1-2 wks in refrigerator, chilled cabinet 2 months in freezer
- Transport : Insulated / refrigerated truck, insulated PS Foam box or HDPE box
- Distribution : Individual packet 200 ~ 220 gm approx. in cold chain

- Intended user : General public, institutional, holiday makers, picnic fast-food
- Label requirement : No use of harmful health risk preservatives nutritional value, instruction for storage warning to remove PE film when eaten (if used)
- Regulatory application: Production with GMP practice or HACCP, ISO system, Myanmar DoF specification
- Risk grading : Low health risk hazard food (heating essential)
- Preparation / serving : Apply heating / boil, fry, roast, bake, smoke, grill

Results and discussion

Results

- Nutritional value, proximate of value-added seafood were analyzed at Thaketa Central Fish Inspection Laboratory, Department of Fisheries and the results was shown in Table 2.
- Processing data of fish and shrimp balls and sausages with regard to type of products, ingredients and yields are shown in Table 3.
- Sensory evaluation has shown with some results these are: The taste test was conducted by specially trained panelists using a nine point Hedonic scale, Hedonic scale1, point means extremely dislike and 9, extremely like and 5, border line score. Average score of each product, these are shown in Table 4.
- Physical inspection

  It was usually carried out at the end of production before being packaged for marketing. Some representative sample of 5% weight was inspected, in these inspections,such as appearance, texture, odour and flavour were assessed. Table
- Bacteriological analysis

  Regarding these, the bacteria content to the products and type of the bacteria were analyzed and checked the safe limit. Table 6.
- HACCP plan for value-added seafood.

  Hazard Analysis and Critical Control Point: HACCP, plans were used for the product at every step from raw material of fish/shrimp, ingredients, step of production and correction actions were taken when necessary. Table 7

- Consumer acceptance

In order to know public reaction to the products, A Consumers Acceptance Survey was conducted at Myanmar Fisheries Federation: MFF, Compound at Fisheries Trade Fair, Yangon, during Dec.2007 to Jan. 2008. The survey lasted for five days. Four Consumers groups were categorized with age group and economic status. It was found that younger generation age >15 and housewives were very much favourable to the products. Table 8

- Shelflife of valued-added Products: VAPs

Quality of food is also very much depends on its shelflife. So, an experiment was conducted to assess the shelflife of fish / shrimp balls / sausages in a few years ago. The products were kept under different conditions, such as room temperature, ice condition and freezer. At room temperature it was good only for two days. When the products were stored in refrigerator, it could last for 14 days, however, there was mild changed and quality has some deterioration.

Similarly, when these were in freezer with under -15° C, it could store over 2 weeks, however, frost might appear and quality deteriorated. The shelflife might be extended with the use of suitable preservatives. Details regarding stored conditions, quality description and shelflife are shown in Table 9.

Discussion

Discussions in briefs are as follows:

- Products of fish and shrimp balls and sausages were good demand in Myanmar in markets.
- The product of high valued food fishes such as Nge gyin, Mrigal, Nga myit chin, Rohu and Nga-phae Featherback give better flavour and palatability.
- By mixing with low value commercial fish, production cost could be lower.
- By product from trimmings of fillet fish such as snapper, sea bass and catfish (nga dan) may be used as a good source of raw meat for balls and sausages.
- The application of Hazard Analysis and Critical Control Point: HACCP plan and Prerequisite Program: PRPs will ensure food safety and quality wholesomeness.
- The use of surimi (a kind of fish sausage)as raw material will cost more than local raw fishes.

- The product will improved with the blending of traditional herbal spices such as pepper, garlic, clove, ginger, lemon grass and bale leaves. In addition to these, steam-cooking would make the product safer.
- These experiment products used less jel-strength than those of other commercial brands, these products utilized surimi as raw material.
- Both neither chemicals, additives nor preservative was used in the products.

Suggestion for future works

- All the products of such types should be manufactured without use of food retaining skin called PE or PVDC casings.(Plastic casing)
- The longer shelflife could be achieved with use of the common casing.
- Since no casing is used in sausage manufacturing and thus, they were exposed and naked; meat was sticky and will cause more dehydration and color faded.
- By using PVDC casing and healthy laminated outer packaging with vacuum seal which will improve food quality without chilled medium.

Acknowledgements

I am greatly indebted to Professor Dr. Maung Maung Gyi, Head of Zoology Department, Yangon University for his encouragement and supervision. I wish to offer my gratitude to U Khin Maung Aye, Director-General, Department of Fisheries for his permission and support.

Table 1 Selection of species of raw fish and shrimp

Local name of fish / Shrimp	Common name	Scientific name	Size range (gm)
Shwe nga			
Nga pa lway	Sea bream	*Nemipterus japonicus*	50 ~ 120
Ka ka dit	Lizard fish	*Saurida tumbil*	80 ~ 150
Nga myitchin	Sea bass	*Lates calcarifer*	1000 ~ 1800
	Rohu	*Labeo rohita*	1000 ~ 2500
Ye cho pazun tote	Freshwater giant prawn	*Macrobrachium rosenbergii*	60-180
Khun gyan pazun	Pink shrimp	*Metapenaeus spp.*	20-30

Table 2 Nutritional values of raw material of fish and shrimp

Name of products	Nutritional value (%)				
	Moisture	Crude protein	Fat	Carbohydrate	Mineral
Fish ball, FB	69.5	18.9	2.5	7.0	2.1
Fish sausage, FS	68.1	19.9	2.3	7.7	2.0
Shrimp ball, SB	64.8	21.8	2.7	8.9	1.8
Shrimp sausage, SS	65.2	22.0	3.0	7.9	1.9

Table 3 Product composition of balls and sausages

Name of products	Meat of fish and shrimp (gm)	Ingredients (gm)	Cooked meat (gm)	Yield (%)	Approximate waste (%)
Fish ball: FB	12,000	43,600	15,000	125	2.0
Fish sausage: FS	12,000	42,000	15,500	130	2.1
Shrimp ball: SB	10,000	3,000	12,500	125	2.2
Shrimp sausage: SS	10,000	3,500	12,725	127	2.6

Table 4 Products sensory evaluation

Products	Quality attributes and score				Overall acceptance
	Appearance	Odour	Texture	Flavour	
Fish ball: FB	7.1	6.9	7.3	6.6	6.9
Fish sausage: FS	6.8	7.3	7.0	6.9	7.0
Shrimp ball: SB	7.4	6.6	6.4	7.6	7.0
Shrimp sausage: SS	6.9	7.4	7.1	6.9	7.1

Table 5 Physical inspections of the value-added products.

Products	gm/ Package	pH	Size & mode of package (cm)	Appearance	Texture	Odor	Flavour	Some defects. (occasional)
Fish ball: FB	160 ± 10	5.8	PS tray & label PE film L13xB7	White-milky	Soft & granular	Fishy, spicy	Fishy, spicy	Trace of spine scale, herbal spices
F. sausage: FS		5.6	L15xB9	Chocolate-Orange-red	"	"	"	"
Shrimp bal: SB	150 ± 10							
S. sausage: SS		5.9	L13xB7	"	"	Shrimp, spicy	Sweet, spicy	" & shell
	155 ± 10	5.4	L15xB9	"	"	"	"	"
	175 ± 10							

Table 6 Bacteriological analyses the products

Products	Total plate count (gm)	Coliform/ *Escherichia coli* (gm)	*Staphylococcus aureus* (gm)	*Salmonella* MPN, 25gm	*Vibrios* MPN, 25gm	Mould (gm)
Fish ball, FB	$3.5x10^1$	4/1	3	Nil	Nil	Nil
Fish sausage, FS	$2.5x10^1$	6/0	2	"	"	"
Shrimp ball, SB	$4.0x10^1$	8/2	6	"	"	"
Shrimp sausage. SS	$3.9x10^1$	2/0	6	"	"	"

Table 7 HACCP plan used for value-added seafood

Critical control point, CCP	Hazards	Critical limit	Monitoring				Corrective action	Record	Verification
			Who	What	How	When			
Raw materials receipt fish/ shrimp	Phy: -spine, scale, metal, water, dye, taint Chem: toxic, histamine, lube oil Bio: - pathogens parasite	Acceptable	In charge	Hazards	-Visual -Physical check	Each batch	Reject raw chilled at 0 °C	Raw receipt	Lab tests
Ingredient collection	Phy: -foreign matter Chem.: - - Bio: -mold	"	Store purchase IC	"	"	"	-Branded ingredients -Follow instruction	Ingredient store	"
Production -Grinding -Mixing -Forming -Cooking -Packaging	Phy: - - Chem: - detergents sanitizers contaminants	No time delayed cook product at 100 °C	Production IC	-Time control -Temp. control -Job sequential control -PRPs program	- Temperature Time -GMP GHP SOP SSOP	"	Check ½ hourly	Production	Inspection
Storage dispatch / delivery market display	Bio: - pathogens	-Max. 2wks -Minimal temperature 0 °C	-Market manager	"	-Visual - Temperature -Time	"	No delay	-Market -Recall	-Inspection -Sensory test
Preparation/ serving	Bio: - pathogens	Cook, fry at +160 °C	Lab staff	- contamination	Taste test	"	Max 160 °C oil	Lab-test	Lab test (Sensory)

Table 8 Consumer acceptance of the value-added products with reference to scale

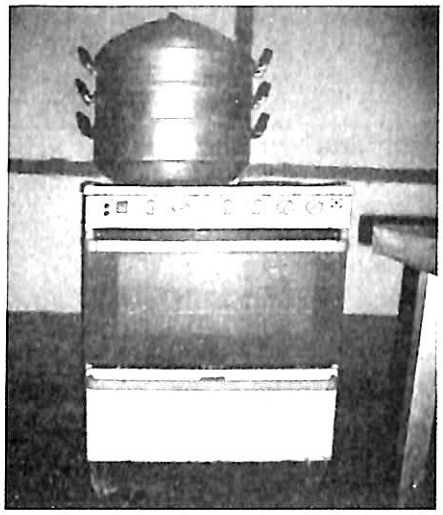
Consumer group		Acceptance: Hedonic scale : 1-9 point								
		Strongly dislike				Border line		Strongly like		
		1	2	3	4	5	6	7	8	9
Age: years	< 15 year						x	x	x	x
	16-45				x	x	x	x		
	> 45				x	x	x			
Economic group										
Low -middle						x	x	x		
Wealthy					x	x	x			
Works of life										
Schooling age						x	x	x	x	
Office workers					x	x	x			
House wives							x	x	x	
Relished as: Snack					x	x	x	x		
Prepared curry							x	x	x	

9 Shelflife of value-added products with different stored conditions (VAPs)

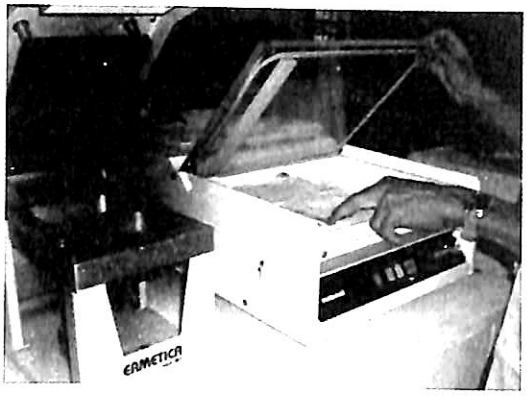
		Shelflife, days			
		0-2	3-7	7-14	>14
a. Just manufactured	-Product characteristics: fishy, shrimp-meaty, spicy, resilient texture	x	-	-	-
b. At room temp. ± 30 °C	-Gradual loss of balls/sausages quality attributes: appearance, fla–vour, odour, texture, mold sets in	x	-	-	-
c. Iced condition wet, moist (+) 0 ~ (+) 5 °C	-Moist condition encourages bacteriological growth. -mouldy & slimy, off-flavour, unpleasant smell appears.	-	x	-	-
d. Refrigerated storage chilled cabinet; show case temp. ± 4°C	-Appearance of product altered-colour faded. -Dehydration proceeds, quality attributes shows mild changes, deterioration set-in.	-	-	x	-
e. In freezer store -15 °C	-No alteration in quality attribute -Dehydration and oxidation may occur if poorly packaged.	-	-	-	x
f. During transport to consumers, markets products temp. -15 °C to room temp. ± 30 °C	-Frost may appear inside the Package. -The time, condition of insulation of box, ambient temp. may cause erious quality loss	x	x	-	-

Plate I Machinery and equipment used in the production of value-added products

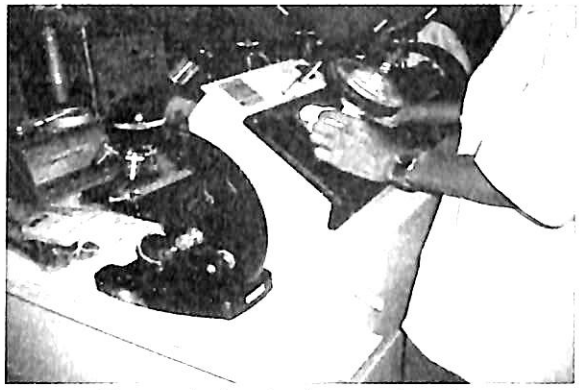
Bacterial work chamber



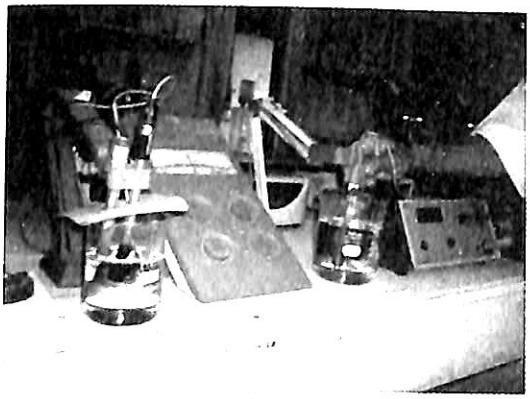
Oven & steam-cooker



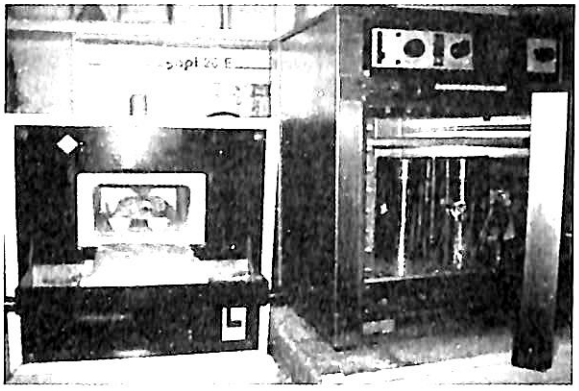
Vacuum sealer & some sausages



Bacteriological examination



Physical inspection of the products



Oven & furnace

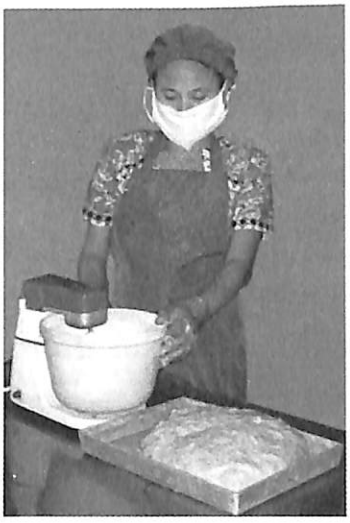
Plate II. Machinery and equipment used in the preparation of value-added products

Ingredients to be mixed

Meat grinder

Packaging of VAPs

Meat and some ingredients



Meat mixer

References

Anonymous.1993. Hazard Analysis Critical Control Point. Division of Food and Nutrition Food Safety Unit.

Anonymous, 1992. Laboratory Manual on Analytical Methods and Procedure for fish and Fishery Product No. 8. Marine Fishery Department. SEAFDEC, Singapore.

Khin Maung Win.1974. Sausage and other Valued added Seafood Project. Departmental Report, People Pearl's and Fishery Corporation, Yangon. (Manuscript)

Kyu Kyu Myint.2005. Safe food production from some marine product. M. Res. Department of Zoology, University of Yangon, Yangon.

Min Min E, and Win K.S, 1985. A study on Fish Sausage Processing Diploma Term Paper. D. F. T, Yangon.

Sann Aung. 2003. Commercial Fishes of Myanmar Seas, Myanmar Academy of Agricultural, Forestry, Livestock and Fishery Sciences, Yangon.
Savic. I. V.1985. Small scale sausage production. F.A.O Technical Paper No. 52. FAO Rome.

Tan San Min, Konagawa.S, Ng Mui Chang and Kwang. L. 1998 25th Regional Training Course in Fish Processing and Packaging. 8-20 June, SEAFDEC,

ဆွေးနွေးချက်

Dr. စန်းအောင် - Consumer acceptance တွင် အသက်ငယ်ငယ် ပရိသတ် ၂-၁၅ နှစ်များ က Seafood ကို ပိုကြိုက်ပြီး သက်ကြီး ၄၅ နှစ် အရွယ်များက သိတ်မ ကြိုက်ကြောင်း လေ့လာတွေ့ရှိရပါသည်။ အသက် (၂)နှစ်အောက် အရွယ် များသည် အကောင်းအဆိုး သိတ်မသိသေး၍ ၄င်းကို ပယ်၍ (၁၅)နှစ် အောက် Group ဟု သတ်မှတ်လျှင် လုံလောက်ပါသလား၊

အကြံပြုချက် - Table 8 တွင် ရေခဲသေတ္တာတွင် ထားသော်လည်း Shelf life (၂)ပတ်သည် နည်းပါသည်။ ခွင့်ပြုချက် Dose ဖြင့် Preservative ကို အသုံး ပြုပါက Shelf life ကို တိုးနိုင်မည်ဟု ယူဆပါသည်။ ၄င်းကို စမ်းသပ် စေလိုပါသည်။

ဖြေကြားချက် - အသက် (၁၅)နှစ်အောက် စားသုံးသူများက အသက်ကြီး သူများထက် ပို၍ ကြိုက်နှစ်သက်ပါသည်။ စားသုံးသူများက ငါးအူချောင်းကို မေးပြီး တန်းတန်း မတ်မတ် ဝယ်သွားလေ့ရှိပါသည်။

- ဈေးပွဲတော်တွင် ရရှိသော အတွေ့အကြုံအရ ပထမနေ့တွင် မေးစမ်း၍ အမြည်း အစမ်းသဘောဖြင့် ဝယ်သွားပြီး ဒုတိယ-တတိယနေ့များတွင် လာရောက် ဝယ်ယူသွားလေ့ရှိပါသည်။

ဖြေကြားချက် - Food preservatives ကို သုံး၍ Shelf life ပိုကောင်းရန် အကြံပြုချက်ကို သိရှိပါ၍ Permissible dosage limit အသုံးပြုသွားမည် ဖြစ်ပါသည်။ ယခုအခါ Small scale production ဖြစ်ပါ၍ ရေခဲသေတ္တာ အပူ ချိန်ဖြင့်သာ ထိန်း၍ ဈေးကွက်ဘေးကင်းမှုကို အာမခံပေးပါသည်။ Commercial producton လုပ်သည့်အခါတွင် GMP အကျင့်စဉ်ဖြင့် ထိန်း၍ သုံးသွားပါမည်။

Dr. စောပလယ်စော - ဆရာရဲ့ Fish silage မှ အသုံးပြုတဲ့ PVDC ဟာ တိရစ္ဆာန်များ၊ လူများရဲ့ အူလမ်းကြောင်းထဲမှာ Digest မလုပ်နိုင်တဲ့အတွက် အစားများခဲ့ပါလျှင် အူလမ်းကြောင်း ပိတ်စေနိုင်ပါတယ်။ ကျွန်တော်တို့ တိရစ္ဆာန်များမှာ အူလမ်းကြောင်း ပိတ်ဆို့၍ သေဆုံးဒါ မကြာခဏ တွေ့ကြုံရပါတယ်။

- PVDC ကို ဝက်အူချောင်း၊ ကြက်အူချောင်း၊ ငါးအူချောင်းမှာ သုံးတဲ့အ တွက် FDA ရဲ့ကန့်ကွက်မှု ရှိပါသလား၊

ဖြေကြားချက် - ဆရာကြီး၏ Polyvinyl dichloride: PVDC သားရေတုခဲ့သို့သော Casing (အခွံ)ကို ကျွန်တော်၏ VAPs လုပ်ငန်းတွင် မသုံးထားပါ၊ ရှေ့လုပ်ငန်းစဉ် အကြံပြုချက်တွင် PVDC ကို သုံးလျှင် Commercial sterilization အခြေအနေကို လုံးဝမပျက်စီးစေဘဲ Ambient တွင် သယ်ပိုးရောင်းချသွားရန် အစီအစဉ် ရှိပါသည်။

- Adequate packaging material (casing) ဖြစ်သောကြောင့် Spoilage ကို Maximum protection ပေးနိုင်မည် ယုံကြည်ကြောင်း အကြံပြု လိုခြင်းသာ ဖြစ်သည်။

- ကျွန်တော်၏ VAPs တွင် တိရစ္ဆာန်အူသော်လည်းကောင်း၊ ပလပ်စတစ် PE casing သော်လည်းကောင်း၊ လုံးဝ မသုံးသေးပါ၊ အသားတောင့် ချည်း သက်သက်ဖြစ်ပါသည်။

ဦးတင့်ဝေ - ငါးအူချောင်း ထုတ်လုပ်ပုံတွင် HACCP plan တစ်ဆင့်ခြင်း ဖော်ပြပေးပါ။

ဖြေကြားချက် - ငါးအူချောင်းထုတ်လုပ်ရာတွင် HACCP plan ကို Step အလိုက်ဖော်ပြ ပေးရန် အကြံပြုသည်ကို လက်ခံပါသည်။ ယခုစာတမ်းတွင် Seafood (၄)မျိုးဖြစ်နေပါ၍ Ph.D dissertation တွင် Frozen, Fermented VAPs (၃)မျိုး ဖြစ်နေပြန်သဖြင့် Quality and safety (Quality Assurance on Food Security) Aspect များဖြင့် တင်ပြရန် ရည်ရွယ်ထားပါသဖြင့် ဆရာ၏အကြံ ပြုချက်ကို နားလည် သဘောပေါက်ပေးစေလိုပါသည်။

ဖြေကြားချက် - အကြံပြုချက်၌ Risk သတ်မှတ်ရာတွင် Medium သို့မဟုတ် High risk production အဖြစ် သတ်မှတ်သင့်ပါသည်။

- Risk သတ်မှတ်ရာတွင် Medium/ High ကို သတ်မှတ်သင့်ကြောင်း အကြံပြုသည်ကို ရှင်းပြလိုပါသည်။ VAPs များသည် Acid water activities, pH များမြင့်သဖြင့် Risk မြင့်နိုင်ပါသည်။ သို့သော် Production flow တွင် Live steam cooking, product core temp. >85 °C ရအောင် ပေါင်းထားရခြင်း Serving မလုပ်မီ Boiling, drying, washing and grilling လုပ်ရမည်ဖြစ်ခြင်း Vacuum sealing လုပ်ခြင်း၊ Cool chain (+4) –(-14 °C) တွင် သိုလှောင်ထားရခြင်းကြောင့် စားသုံးမည့်သူကို ဥပါဒ်အနည်းဆုံးပေးမည်ဟု ယုံကြည်ပါသည်။

အကြံပြုချက် - အန္တရာယ် အနေဖြင့် Biological hazard အရ *Staphylococcus aureus* သတ်မှတ်ရန်နှင့် Bone အား Hazard အဖြစ် သတ်မှတ်ရန် အကြံပြုပါသည်။

ဖြေကြားချက် - *Staphylococcus aureus* ကို တစ်ကောင်မျှသာ Accidentally, personal hygiene အခြေအနေအရ Surveillance လုပ်ကြည့်ရာမှ တွေ့ရပါသည်။ အရိုးသည် 0.2 - 0.3 ဟာ or 2.0-3.0 mm အရွယ်ပါတတ်သော်လည်း Physical hazard ဟု သတ်မှတ်နိုင်လောက်အောင် မရှည်ပါ။ စားသုံးသူ များထံမှ အရိုးစူးခြင်း တစ်ခါမျှ Complaint တစ်ခါမျှ ပြန်မကြားခဲ့ပါ။

Effects of Groundnut and Black Gram Residues on *In Situ* Degradation of Rice Straw and Wheat Straw Based Diets

Tin Maung Soe[1], Khin San Mu[2] and Tin Ngwe[2]

ABSTRACT

The nutrient constraints in most crop residues are of low nitrogen content, high proportion of cell wall constituents, poor digestibility and low voluntary intake. The supplementation of groundnut and black gram residues to the rice straw-based diet did not increase the nutrient digestibility of diets. It might be due to inclusion of readily fermentable carbohydrate (RFC) in the rice bran and sesame meal used as supplements to provide the energy and protein in the rice straw-based diet. A rumen-fistulated bull, 262 kg body weight was used to investigate the degradation effects of rice straw and wheat straw, and added with groundnut residue and black gram residue by *in situ* nylon bag method. Six treatments used in this study were rice straw only (RS), wheat straw only (WS), 65% rice straw + 35% groundnut residue (RSGN), 65% rice straw + 35% black gram residue (RSBG), 65% wheat straw + 35% groundnut residue (WSGN) and 65% wheat straw + 35% black gram residue (WSBG). The organic matter (OM) disappearance of RSBG treatment was higher than that of RS treatment at 1, 3, 6, 24, 48 and 96 h incubation times and significant difference ($P<0.05$) was observed at 24 h. The OM disappearance of RSGN treatment at 1, 3, 6 and 24 h was higher than that of RS treatment and significant differences were found at 3 ($P<0.05$), 6 ($P<0.01$) and 24 h ($P<0.05$). At 48, 72 and 96 h, OM disappearance of RS treatment was higher than that of WS treatment. The OM disappearance of WSGN treatment was higher than that of WS treatment throughout incubation times and the values were significantly different at 12 ($P<0.01$), 72 ($P<0.01$) and 96 h ($P<0.05$), respectively. The degradation rate of rice straw in the rumen of fistulated bull was found to be higher than that of wheat straw. The supplementation of 35% of groundnut or black gram residue to either rice straw or wheat straw resulted in higher ruminal OM degradation in compared with rice straw or wheat straw which was excluded of concentrate, respectively.

Key words: Degradation rate, nylon bag, readily fermentable carbohydrate, rumen-fistulated bull, supplements.

Introduction

Myanmar which is an agricultural-based country, cereal crops such as rice, maize and various kinds of legume are cultivated widely in all parts of the country. These crop residues are used as animal feed during the dry period of feed shortage. As expansion of crop areas due to population growth has reduced grazing lands, pastoralists have started to grow crops. As a result, the two specialized activities (pastoralism and arable cropping) are both developing towards mixed crop-livestock systems (Winrock International, 1992 and De Grandi, 1996). To alleviate feed shortage in the dry season, farmers collect crop residues and store them for later use in stall feeding (Songué, 1997).

The crop residues that are rich in fibre and low in protein are abundantly utilized as effective feed for ruminants in Myanmar. The nutrient constraints in most crop residues (rice straw, wheat straw, groundnut, black gram, green gram, red gram, lablab bean etc.) are of low nitrogen content, high proportion of cell wall constituents, poor digestibility and low voluntary intake.

Tin Maung Soe *et al.* (2007) reported that the supplementation of groundnut and black gram residues to the rice straw-based diet did not increase the nutrient digestibility of diets although the proportion of nitrogen retention to nitrogen intake of RSGN and RSBG diets tended to increase in compared with that of RS diet. It might be due to inclusion of readily fermentable carbohydrate (RFC) in the rice bran and sesame meal used as supplements to provide the energy and protein in the rice straw-based diet. Therefore, RSGN and RSBG diets were similar to the RS diet, although they are supplemented with the groundnut and black gram residues, respectively.

In the review (Durand, 1987), it was stated that the inclusion of starchy concentrates in mixed diets has long been found to reduce fibre digestion and a stimulatory effect of low amounts of RFC (5-10% for the substrates) on cellulose has been reported. However, only few *in vivo* experiments support these observations. Some researchers have recently shown that addition of 15% sugar beet pulp in an untreated straw diet could increase straw dry matter disappearance from the nylon bags by about 6-10%. Degradable ß glucans present in the pulp might be more effective than starch or molasses. However, degradation of ammonia-treated straw was not improved by beet pulp addition.

In this experiment, if the control diet (rice straw diet) is excluded of rice bran and sesame meal, further investigation is to be carried out on the effect of groundnut and black gram residues, and to study these effects on other straw such as wheat straw. Therefore, this experiment is conducted to evaluate the effect of groundnut and black gram residues when they are supplemented to rice straw and wheat straw *in situ* nylon bag method.

Materials and Methods

A rumen-fistulated bull, 262 kg body weight was used to investigate the degradation effects of rice straw and wheat straw, and added with groundnut residue and black gram residue. Six treatments used in this study were as follows:

1. Rice straw (RS)
2. Wheat straw (WS)
3. 65% Rice straw + 35% Groundnut residue (RSGN)
4. 65% Rice straw + 35% Black gram residue (RSBG)
5. 65% Wheat straw + 35% Groundnut residue. (WSGN)
6. 65% Wheat straw + 35% Black gram residue (WSBG)

Before the commencement of this study, the maintenance ration containing rice straw 6 kg and groundnut meal 500 g was fed to the experimental animal for 14 days, and that maintenance ration was continually fed in the experimental period for the same ruminal condition. The experimental period lasted 4 days for each treatment and 24 days for six treatments.

Experimental procedure

The dry matter and organic matter degradation of each diet was measured by the nylon bag method in the rumen of bull (Ørskov and McDonald, 1979).

$$P = a+b\ (1 - e^{-kdt})$$

Rice straw, wheat straw, groundnut residue and black gram residue by nylon bag measurement were ground to pass through a 2 mm sieve. A bag size of 13.5 cm and 8.5 cm, with pore size of 50 microns was used in this study. Eight incubation times were taken for each diet. For each incubation time, triplicates of nylon bag were introduced into the rumen. Thus twenty four bags were required to complete incubation of one diet. The bags were dried in a hot air oven at 100°C for four hours and placed in a room for one day to get air dried weight. About 5 g of ground sample was weighed into the bag and then three bags for each incubation time were closed with a plastic tie and tied with plastic string. The bags were then suspended in the rumen by tying the string to the bamboo stick which was placed outside the cannular. The nylon bag containing ground sample for each diet was incubated in the rumen for 1, 3, 6, 12, 24, 48, 72 and 96 h. Three bags for each incubation time from the rumen withdrawn after 1, 3, 6, 12, 24, 48, 72 and 96 h, washed immediately and stored at 4°C. At the end of incubation period, all bags were washed

with cold water for about one hour under running tap water while rubbing gently between thumb and fingers until the water runs clear and then dried under sunlight for one day. Then the bags were dried in a hot air oven at 60°C for 48 h and then spread on a table at room temperature for 48 h. The weights of bags with dried residue were recorded. The residues were then taken out from each bags and placed to the plastic bag, and stored for the chemical analysis.

Chemical analysis

Dried residues were analyzed for dry matter and organic matter by the method described by AOAC (1970). All of the chemical analyses were carried out at the Laboratory of Department of Physiology and Biochemistry, University of Veterinary Science, Yezin.

Statistical analysis

Data were statistically analysed and means were compared by the Student's t test.

Results

Chemical composition of treatments

Chemical compositions of treatments are presented in Table 1. All values except dry matter were expressed in DM basis. The DM contents of RS, WS, RSGN, RSBG, WSGN, and WSBG treatments were 93.49, 93.32, 92.89, 92.72, 92.78 and 92.61%, respectively. The CP contents of these experimental treatments were 4.96, 3.25, 7.41, 6.46, 6.29 and 5.34%, respectively. The percentages of NDF contents of these treatments were 69.97, 72.39, 66.35, 68.07, 67.92 and 69.65, and ADF contents of these treatments were 42.30, 41.71, 43.07, 44.34, 42.68 and 43.95, respectively.

Organic matter disappearance

The OM disappearances of treatments are shown in figure 1, figure 2, figure 3, figure 4 and figure 5. At 1, 3, 6, 24 ($P<0.05$), 48 and 96 h, OM disappearance of RSBG treatment was higher than that of RS treatment. The OM disappearance of RSGN treatment at 1, 3 ($P<0.05$), 6 ($P<0.01$) and 24 h ($P<0.05$) were higher than that of RS treatment. At 48, 72 and 96 h, OM disappearance of RS treatment was higher than that of WS

treatment. The OM disappearance of WS treatment at 48 and 72 h was slightly lower than that of WSBG treatment. At 1, 3, 6, 12 ($P<0.01$), 48, 72 ($P<0.01$) and 96 h ($P<0.05$), OM disappearance of WSGN treatment was higher than that of WS treatment.

The OM disappearances (%) of RS and WS were nearly the same from 0 to 12 h and then the disappearance (%) of rice straw was gradually higher than that of wheat straw. The disappearance of RS was the lowest, and that of RSGN and RSBG were the same before the incubation time 12 h and then RSGN degradation was higher than RSBG. The OM disappearance of WS was lower than that of WSBG and OM disappearance of WSGN was higher than that of WSBG. The comparative OM degradation of RSGN and WSGN was nearly the same in the rumen of fistulated bull. Black gram residue supplementation to the rice straw showed higher OM disappearance (%) compared with wheat straw supplemented with black gram residue.

Discussion

The *in situ* organic matter disappearances of RSGN and RSBG were highly degraded in the rumen followed by RS at 1, 3, 6, 12 and 24 h incubation. This would indicate that supplementation of groundnut and black gram to rice straw increased organic matter degradation in the rumen. The degradation rates (c) of dry matter and organic matter for RS, RSGN and RSBG were relatively similar to each other (Table 2). However the values of (a) and (a + b) for RSGN and RSBG were found to be higher than that of RS. This would indicate that the supplementation of groundnut and black gram residues to rice straw increase dry matter and organic matter degradation in the rumen compared to those of rice straw alone.

In the rumen, the organic matter disappearances (%) of rice straw and wheat straw were not significantly different from 0 to 12 h and after then the disappearance (%) of rice straw was gradually higher than that of wheat straw. That might be due to the different content of hemicellulose in rice straw and wheat straw. The NDF content of wheat straw was higher than that of rice straw although the ADF content of wheat straw and rice straw were the same (Table 1). Beever, Coelho da Silva, Prescott and Armstrong (1972) stated that hemicellulose is more digestible in the hind gut than is cellulose. Weston and Hogan (1968) stated that a higher digestion rate for NDF in the intestine than in the rumen. Rice straw contains much more silica (12-16%) and less lignin (6-7%) than wheat straw which contains 3-5% silica and 10-12% lignin (Jackson, 1978). Bailey (1973) reported that lignin is associated with the hemicellulose via covalent and non covalent interaction. A high lignin to hemicellulose suggests that a large proportion of hemicellulose was interacting with lignin and therefore was less digestible than hemicellulose from a feed with a low lignin to hemicellulose (Weiss, Fisher and Erickson, 1989).

The organic matter disappearance of RS was higher than that of WS. The rumen degradation of groundnut residue was higher than that of black gram residue (Tin Ngwe *et al.*, 2006, unpublished). Although the organic matter disappearance of WSBG was lower than that of WSGN, organic matter disappearance of RSBG was higher than that of RSGN. That might be due to, inclusion of some nutrients in the black gram residue, which were deficient in rice straw and not able to be supplied by groundnut residue. This was in line with the study of Williams, Innes and Moor (1984) that it was possible that fish meal contained some nutrients which were not supplied by soybean meal for the stimulation of straw degradation.

The organic matter disappearance of RSGN was relatively lower than that of WSGN. This effect might be due to inclusion of easily digestible fibre in the groundnut residue which stimulates the fibre degradation in the rumen. Tin Ngwe *et al.* (1993) reported that supplementation of sesame meal showed higher digestibility in compared with straw based diet supplemented with groundnut meal. However, the digestibility of straw based diet supplemented with groundnut meal was higher than that of straw-based diet supplemented with sesame meal when chick pea husk were added to diets.

Conclusion

In accordance with the results mentioned above, the following conclusions were elaborated.

(1) The OM disappearance of rice straw in the rumen *in situ* nylon bag method was found to be higher than that of wheat straw.

(2) The supplementation of 35% of groundnut or black gram residue to either rice straw or wheat straw resulted in higher ruminal OM degradation in compared with rice straw or wheat straw which was excluded of concentrate, respectively.

Table 1 Chemical composition of treatments

Description[1)]	DM[2)]	OM	CP	NDF	ADF
RS	93.49	81.16	4.96	69.97	42.30
WS	93.32	85.84	3.25	72.39	41.71
RSGN	92.89	84.20	7.41	66.35	43.07
RSBG	92.72	84.36	6.46	68.07	44.34
WSGN	92.78	87.27	6.29	67.92	42.68
WSBG	92.61	87.43	5.34	69.65	43.95

[1)] DM: Dry matter, OM: Organic matter, CP: Crude protein,

NDF: Neutral detergent fibre, ADF: Acid detergent fibre,

2) All values except DM are on DM basis

Table 2 Degradation constants of respective diets in the rumen of fistulated bull

Description	RS	WS	RSGN	WSGN	RSBG	WSBG
DM						
a, %	3.0	7.0	11.5	12.0	10.0	7.0
b, %	48.5	37.5	42.5	42.5	47.5	41.5
c, % h^{-1}	1.24	1.37	1.26	1.31	1.22	1.28
a+b, %	51.5	44.5	54.0	54.5	57.5	48.5
OM						
a, %	0.0	5.0	5.0	7.0	5.0	5.0
b, %	51.5	39.0	47.0	46.0	49.0	42.0
c, % h^{-1}	1.20	1.22	1.29	1.30	1.25	1.25
a+b, %	51.5	44.0	52.0	53.0	54.0	47.0

a: Rapidly degradable fraction,
b: Slowly degradable fraction,
a+b: Potentially degradable fraction,
c: Rate of degradation,
h^{-1}: per hour

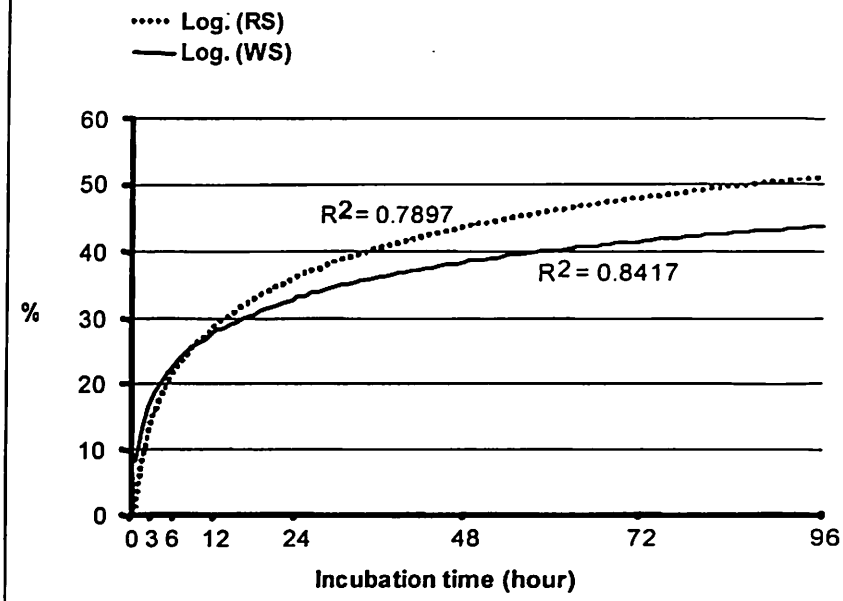


Fig.1 Organic matter disappearances (%) of rice straw and wheat straw in the rumen of fistulated bull

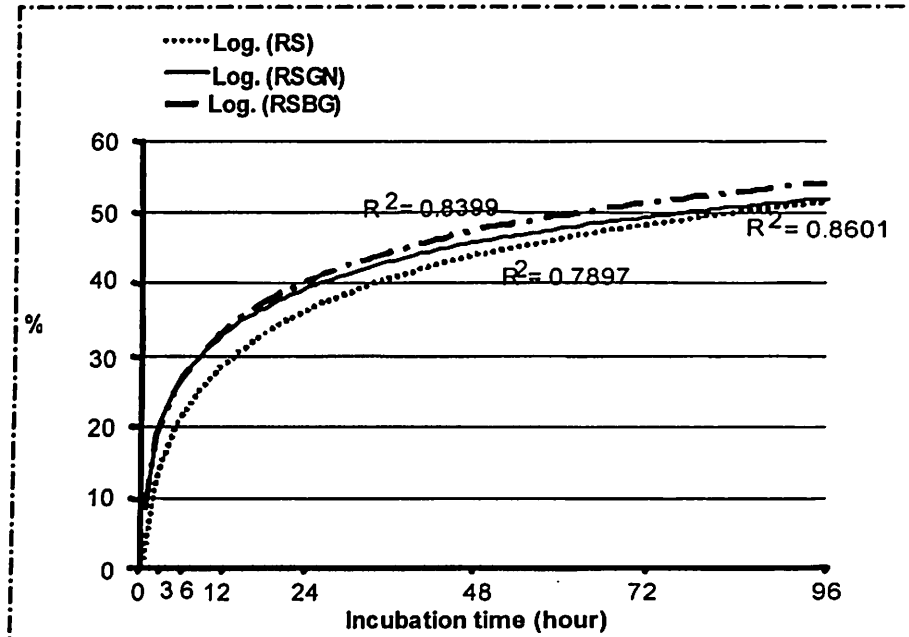


Fig.2 Organic matter disappearances (%) of respective diets in the rumen of fistulated bull

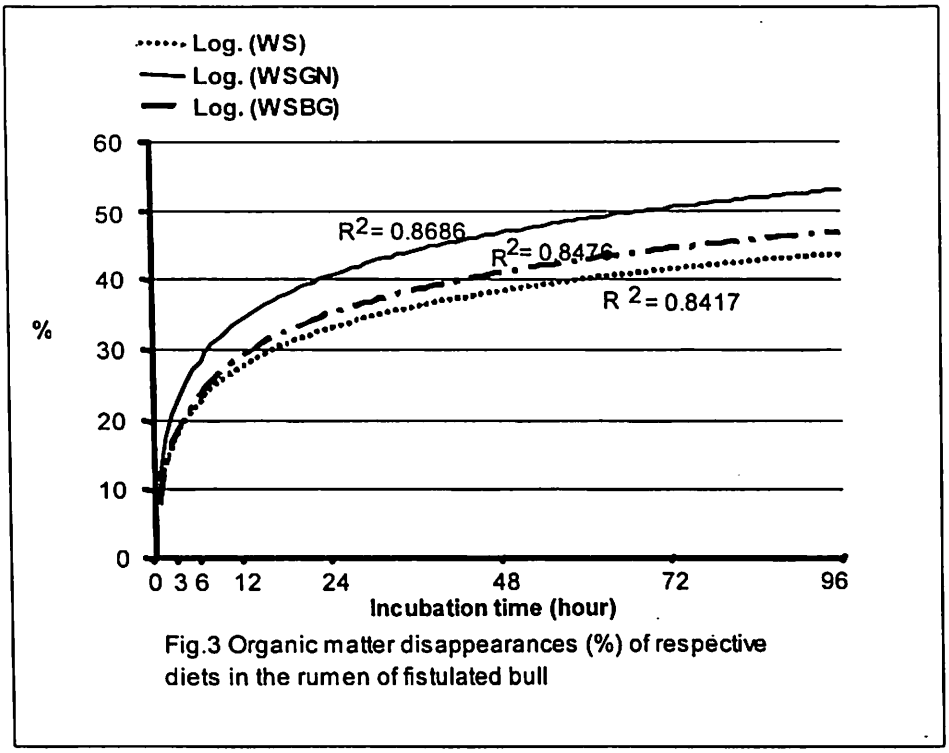


Fig.3 Organic matter disappearances (%) of respective diets in the rumen of fistulated bull

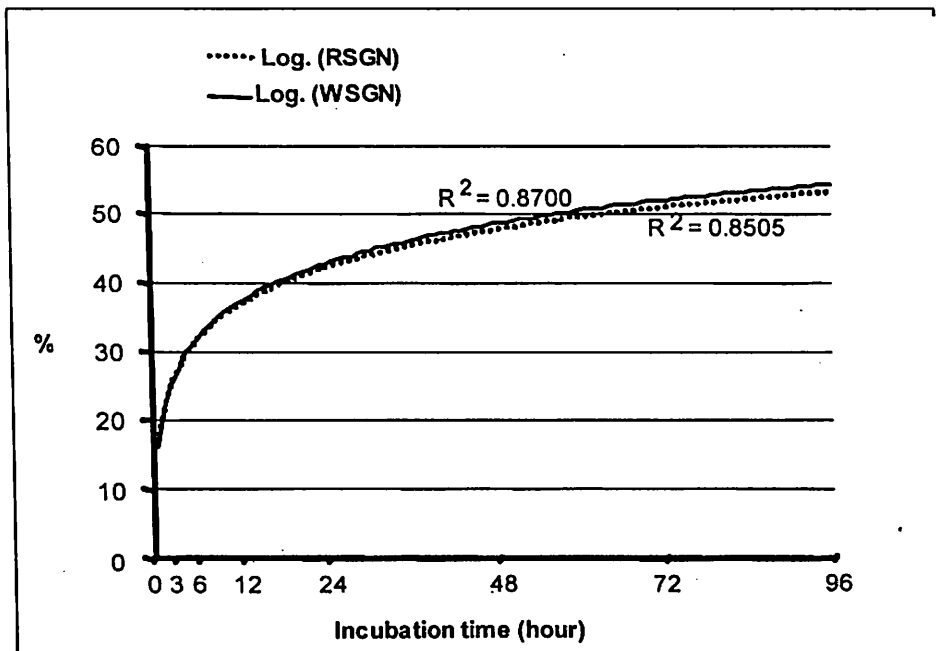


Fig.4 Organic matter disappearances (%) of respective diets in the rumen of fistulated bull

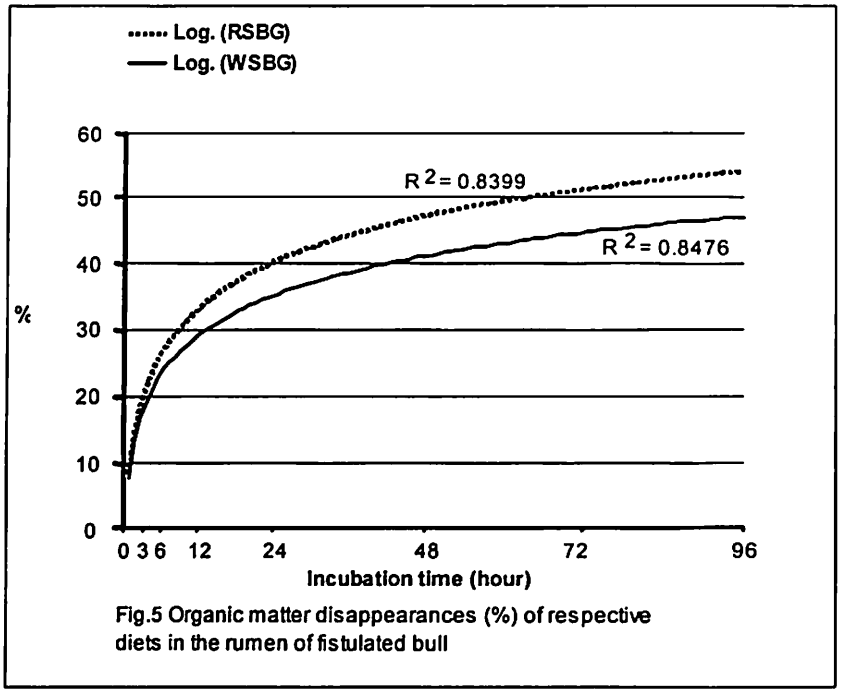


Fig.5 Organic matter disappearances (%) of respective diets in the rumen of fistulated bull

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References

A.O.A.C. 1970. Official Methods of Analysis, 11th edn., A.O.A.C., Washington D.C. p.122-131.

Bailey, R.W. 1973. Structural carbohydrates. In: Chemistry and biochemistry of herbage. Vol.1.157. Butler, G.W. and Bailey, R.W. ed., Academic Press, London, UK. Cited by Weiss *et al.* 1989.

Beever, D.E., Coelho da Silva, J.F., Prescott, J.H.D. and Armstrong, D.G. 1972. The effect on sheep of physical form and stage of growth on the sites of digestion of a dried grass. 1. Sites of digestion of organic matter, energy and carbohydrate. Br. J. Nutr. 28.347.

De Grandi, J.C. 1996. L'évolution des systèmes de production agropastorale par rapport au dévelopment rural durable dans les pays d'Afrique Soudano Sahélienne. Collection FAO: Gestion des Exploitations Agricoles No.11, Rome, Italy. p.161.

Durand, M. 1987. Conditions for optimizing cellulolytic activity in the rumen. In: Chenost, M. and Reiniger, P. Evaluation of straws in ruminant feeding. Comm. Eur. Comm. p.5.

Jackson, M.G. 1978. Rice straw as livestock feed. Old. Anim. Rev. 23.34-40. F.A.O. Animal production and health paper 12.

Ørskov, E.R. and McDonald, I. 1979. The estimation of protein degradability in the rumen from incubation measurements weighted according to rate of passage. J. Agric. Sci. Cambridge. 92.499-503.

Songué, Y. 1997. Les mutations socio-économiques du système agricole: un modèle d'intégration culture-élevage. Doctorat 3ème Cycle, Université de Ouagadougou, Burkina Faso.p.206.

Tin Ngwe, Mar Mar Kyi, Cho Cho Thein and Zaw Win Maung. 1993. Effect of groundnut meal or sesame meal with or without chickpea husk on voluntary intake of rice straw and digestibility of rice straw diet in growing bulls. Myanmar J. Agri. Sci. 2.83-95.

Tin Maung Soe, Khin San Mu and Tin Ngwe. 2007. Effect of groundnut, black gram and green gram residues on intake, digestibility and nitrogen utilization as supplements in goat fed on rice straw. J. Myanmar Vet. Asso. p.9-18.

Weiss, W.P., Fisher, G.R. and Erickson, G.M.1989. Effect of source of neutral detergent fiber and starch on nutrient utilization by diary cows. J. Dairy Sci. 72.2308-2315.

Weston, R.H. and Hogan J.P. 1968. The digestion of pasture plants by sheep. II. The digestion of ryegrass at different stages of maturity. Australian J. Agr. Res. 19. 963.

Williams, P.E.V., Innes, G.M. and Moor, P.J. 1984. Supplementation of a diet of straw with starch or fish meal: effects on the degradability and rate of outflow of straw from the rumen. Anim. Prod. 38.551.

Winrock International, 1992. Assessment of Animal Agriculture in Africa. Winrock International, Morrilton, AR. p.125.

ဆွေးနွေးချက်

Dr.သက်ခိုင် - Nylon bag \ Pore size အရွယ်အစားကို သိလိုပါသည်။

ဖြေကြားချက် - 50μ ဖြစ်ပါသည်။

Dr. သန်းကျော် - Sample တစ်မျိုးစီအတွက် Nylon bag replicate အရေအတွက် မည်မျှ ထားပါသနည်း။

- Nylon bag များ Rumen ထဲထည့်သောအခါ သံကြိုး (သို့) အလားတူ အလေးမျိုးကို သုံးပါသလား၊

- မသုံးလျှင် Nylon bag များ Flood ဖြစ်နိုင်၍ Digestibility (Degradability) တန်ဖိုးအမှန် မရနိုင်ဟု ထင်ပါသည်။

ဖြေကြားချက် - (၃)အိတ်ထားပါသည်။

- မသုံးပါ။

Dr. ရဲထွဋ်အောင် - Degradation of nutrients သည် အသက်အရွယ်အထိုး အပေါ်တွင် မူ တည်၍ ပြောင်းလဲမှု ရှိနိုင်ပါသလား။

- Rumen ထဲရှိ Microorganism အရေအတွက် မတူညီသော ကြောင့် တစ် ကောင်ချင်း ကွဲပြားခြားနားမှု ရှိနိုင်ပါသလား။

- တစ်ကောင်ချင်း ကွဲပြားခြားနားမှုရှိပါက နွားကောင်ရေ (၄)ကောင်နှင့် စမ်း သပ်ပါက ကောင်းမွန်သော Data ကို ရရှိနိုင်မည်လား။

Dr. တင်ငွေ
ရှင်းလင်းချက်

- Nylon bag တွင် ပါဝင်သည့် Pore ထဲသို့ Microorganism များ လွတ် လပ်စွာဝင်ထွက်နိုင်ပြီး Bag ထဲရှိ Sample များ အပြင်သို့ မထွက်နိုင်ပါ။
- Ruminants အတွက် အဓိကလိုအပ်သော Roughage များ၏ Fibre digestion ကို လေ့လာနေသည့်အတွက် Flavour နှင့် ပတ်သက်ပြီးမလုပ် နိုင်ပါ။
- Ruminants ၏ Species, sex and age အပေါ်မူတည်၍ အစာတစ်၏ Degradation အနည်းအများဖြစ်နိုင်သော်လည်း ၄င်းအစာ၏ Degradation pattern ပြောင်းလဲမှု မရှိပါ။
- Nylon bag ကို Net ထဲထည့်၍ Rumen ထဲ ထည့်ထားသည့် အတွက် Nylon bag များ Floating မဖြစ်နိုင်ဘဲ၍ Digester ထဲတွင် နစ်မြုပ်နေပါသည်။

CHERRY EYE

Surgical Correction of Prolapsed Membrana Nictitan Glands

Dr. Myint Wynn

ABSTRACT

Cherry eye is one of the eye diseases encountered in small animal practice. Definition, possible causes, clincal symptoms, diagnosis, surgical anatomy and correction methods are discussed.

1. **Introduction**

* Cherry eye is a disease of lower lacrimal gland which is often seen in small animal practice. The third eye lid (nictitating membrane) consists of mobile cartilage covered by conjunctiva. Behind the cartilage, on the eyeball side, is the lower lacrimal gland, which is properly called the "nictitating membrane gland" or "nictitans gland".

  For reasons that are poorly understood, this gland sometimes swells to five or more time (that of) its normal thickness. As it does so, it lifts the nictitating membrane away from the surface of the eye. Once this problem occurs, the continued swelling of the nictitating membrane couses the third eyelid to flip over. The gland appears as a round, glistening pink mass at the inner corner of the eye (medial canthus), for this reason, the condition is called "cherry eye".

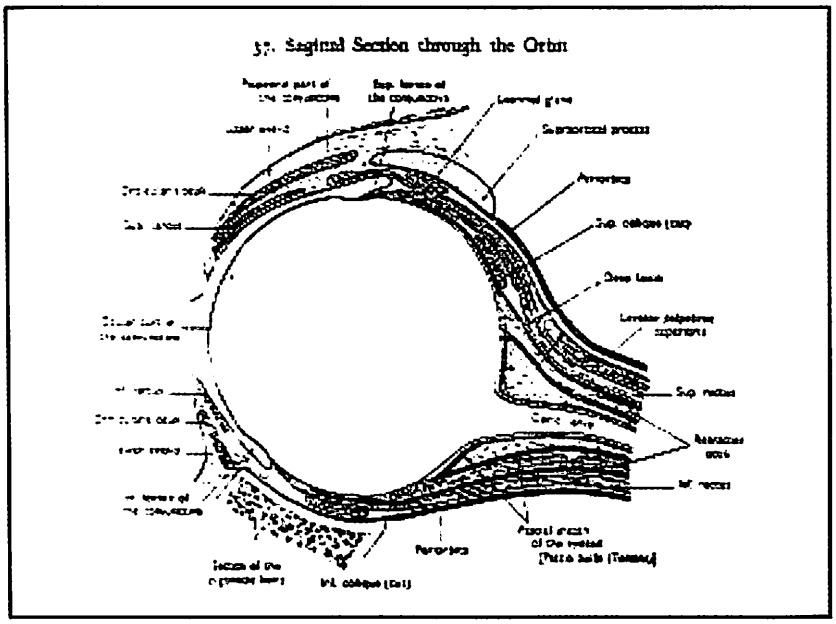
* Once exposed by swelling, the gland can irritate the cornea, causing conjunctivitis until the cherry eye is treated. Therefore, epiphora or mucoid discharges and mild to severe conjunctivitis are usually concurrent. Protrusion of the gland can affect one or both eyes.

* Cherry eye is a hereditary disease and sometimes it can be seen in both parent and its offsprings of the some group. There is no age limitation and cherry eye can be seen in yound puppies as well as in the older ones. Beagle, Boxer, Bull dog, Blood hound, Boston Terrier, Cocker Spaniel, Lhasa Apso and SharPei are the breeds at risk for cherry eye.

* Surgical removal of the exposed portion of the gland is the treatment of choice in the past seventies to eighties. But because of the gland is responsible for production of a portion of aqueous tear film, sacrificing valuable glandular tissue may cause Keratoconjunctivitis Sicca (KCS) or Dry Eye at a later time. For this reason, replacement without excision and with presservation of entire gland offers an advantage over the alternative method for partial total gland resection.

2. Materials and Methods

2.1 Anatomy and Physiology of Lacrimal Glands"



* There are two lacrimal glands in cats and dogs: the nictitans gland and the orbital lacrinal gland. They each produce approximately one-half of the tear volume.
* The nictitans gland is the lacrimal gland of the nictitating membrane and it is wrapped around the vertial cartilage of the third eyelid.
* The orbital lacrimal gland lies internal to the lateral orbital ligament, directly below the zygomatic process of the frontal bone.
* Parasympathetic innervation of the lacrimal gland originates with the trigeminal nerve, courses through the inner ear with the facial nerve, and distributes superficially as divisions of the facial nerve
* Blood supply is by the capillaries of orbital, auricular and auriculo-palpebral vessels.

2.2 **Case Reports**

2.2.1 Lay lay

o[7] Terrier

4½ m.o, 12lbs

Bi-lateral, neticed for 2 weeks.

Tumor size = 7.5mm in length

Pre-med?- over night fasting (9.30 hrs)

- Inj: Atr opine : 0.5 mg $S/_C$
- Inj: Ketamine 50 mg zim

Gir A - Thiopentone sodium

Calculated dosage 20-35 mg/kg

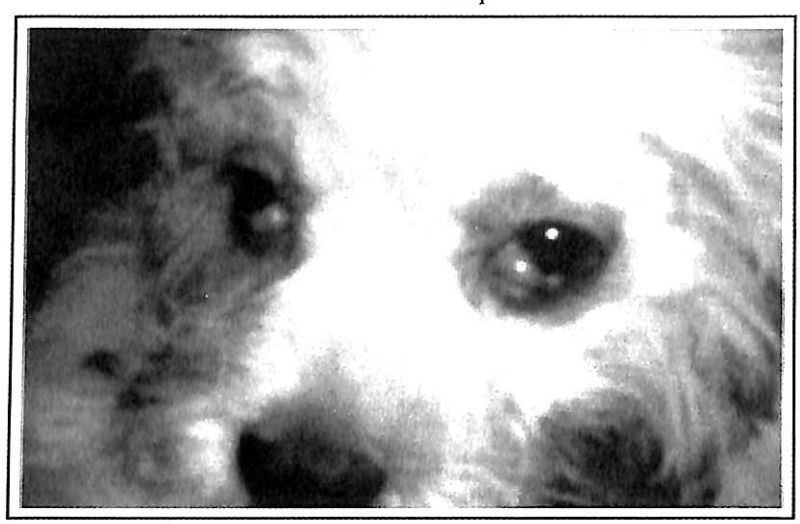
$\frac{1.2 \times 20}{2.2}$ = 109.09mg

$\frac{1.2 \times 35}{2.2}$ = 190.90mg

Given dose = 200 mg

Case 2.2.1 Lay Lay

Pre.Op



Post -op

Case Report 2.2.2 TORRY

Ó, Shi-Tzux Terrier cross

6m.o, 14 lbs

Uni-lateral cherry eye,

Noticed for 2 weeks by owners with signs of conjunctivitis and epiphora

Tumor size = 8 mm in length

Pre-medication + overnight fasting (10 hrs)

- Inj: Atropine 0.5 mg S/c

- Inj: Ketamine 50 mg 1/M

G.A Thiopentone sodium

Calculated dose ~20-35mg/kg

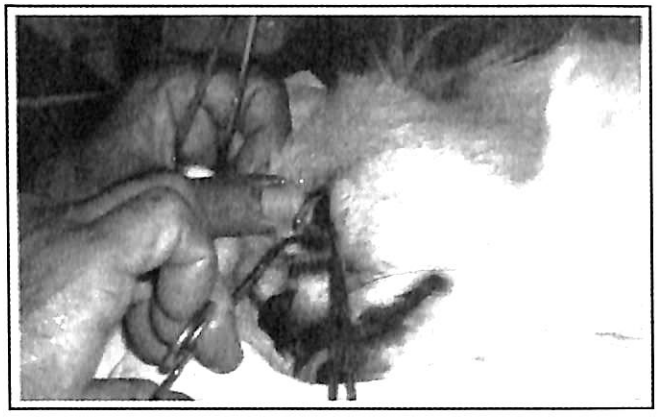
$\frac{14 \times 20}{2.2} = 127.27\text{mg}$

$\frac{14 \times 35}{2.2} = 222.72\text{mg}$

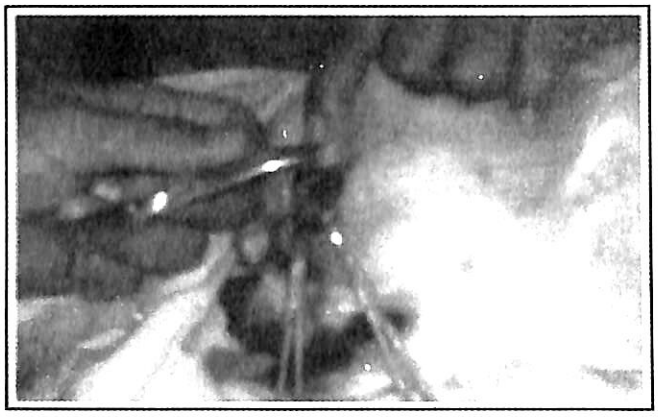
Given dose = 175 mg

Case 2.2.2

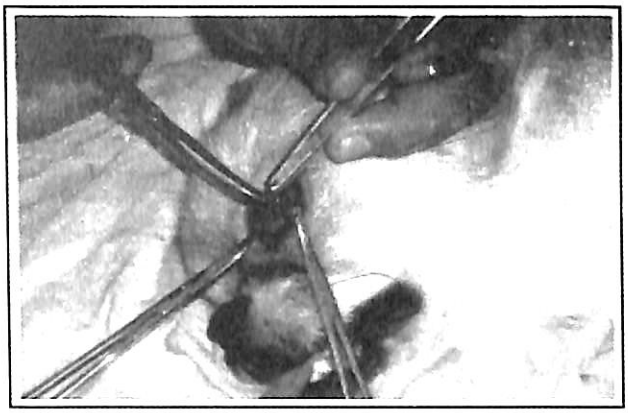
TORRY Pre.Op



Clamping the blood vesels



Ligation of blood vessels by 5/0 chromic catgut



Excision of the gland

3. Discussion

3.1. Common disorders of lacrimal apparatus include insufficient tearing (i.e kerato con junctivitis sicca, kcs), prolapse of the gland of the nictitating membrane (cherry eye), and over flow tearing (i.e epiphora)

Keratoconjunctivitis sicca (KCS) occurs when tear secretion is deficient and the cornea and conjunctiva become desiccated. Aqueous tear deficiency leads to excessive mucus build up; corneal pigmentation, vasularisation and keratinization; and dense corneal scars. KCS is a dif ficult disorder to manage and one of the most frequent causes of canine visual loss. Introduction of topical cyclosporine has greatly reduced the morbidity of KCS and increased the convenience of treatment.

Epiphora or overflow tearing, can be a cosmetic problem or an indication of occular pain necessitation diagnosis. Irritation of the eye, distichiasis (eyelashes touching the eye), trichiasis (misdirected facial hairs touching the eye), entropion, and dacryocystitis (inflam-matory block age of the naso-lacrinal drainage duct) cause eplphore.

Prolapse of the nictitating membrane gland is a cosmetic problem. Hypertrophy and prolapse of the mictitating membracem gland , i.e gland of the third eyelid, presents unattracted appearance often accompanied by recurrent conjunctivitis.

Although the exact cause of the condition is unceratain, glandular hyperplasia and improper development of the connective tissue at the base of the gland perhaps allow the protrusion to occur. And this condition has been referred as " Cheery Eye".

3.2 Protrusion of the hypertrophied superficialgland is the common clinical symptom of the cherry eye. The enlarged gland becomes approximately (8x5 mm) in size, and protrudes from behind the third eyelid. Epiphora or mucoid discharge and mild to severe conjunctivitis are usually seen. Development of cherry eye is very quick in some animals and the size of (4x2 mm) growth may reach within two weeks.

3.3 In Myanmar, Terrier, Shi-Tzu, Pekingese and cross-breds of these breeds are frequently found with defect of cherry eye. Incidence of uni-lateral and bilateral are nearly the same. Most cases are seen in younger age, but some cases are found in older dogs. Occurrence of cherry eye, one after another in the same dog is seen in some cases. But, it takes some time to develop.

4. Treatment options

Surgical removal of the prolapsed gland was the treatment of choice in the 70's and 80's. The opreation was done under local anasthesia or general anasthesia.

But, the choice for surgical excision became controversial among the practitioners in the 90's. Some surgeons believed that keratoconjunctivitis sicca (KCS) may develop at a later time after removal of gland which is responsible for the production of half of the tear film. So, they avoid surgical removal and recommend to choose "the replacement therapy."

But replacement therapy is suitable for the early stage of glandular development or small sized cherry eye and if the gland continues to develop, irritation to eyeball may occur and it has to do surgical correction as the last attempt.

Besides, KCS is not found in all cases after surgery, therefore some srugeons preferred to use surgical method for the treatment of cherry eye.

According to the experience of surgical cases, there were no complications of KCS, found post.operation. But, protective bandaging to the eyes should be applied on the operation day to prevent bleeding by self-trauma.

4.1 "Surgical Excision Method"

The animal is given general anaesthesia and all the aseptic preparations are made for surgery.

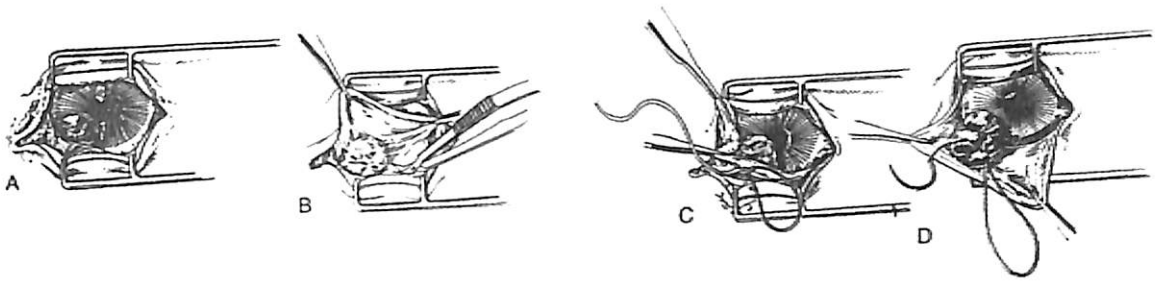
The thin conjunctival covering is clamped with small mosquito forceps at the medial and lateral free edge extremilies, thus exposing the prolapsed gland. Then, small blood vessels supplied to the gland are clamped and ligated with 4/0 or 5/0 chromic catgut. After this, exposed gland is dissected free with a small, blunt-tipped scissors. The cartilage of the third eyelid can be removed, but it is better to omit the cartilage.

Some of the small vessels located at the base of the gland may have to be coagulated or ligated to control haemorrhage. Spraying with adrenaline and nomal saline solution can also be used in controlling haemorrhage.

As the third eyelid is thin in its center, it may be perforated during removal of the gland. Such a defect should be repaired with 4/0 or 5/0 surgical gut, tying the knots on the extermal surface of the 3rd eyelid.

4.2 "Replacement therapy"

Replacement therapy can be used instead of surgical excision, so as the gland can be replaced / repositioned and can restore and preserve its normal nictitans fuction.



Surgical Technique (Saunders', 2000)

i) Expose the globe for repostioning of nictitating membrane and nictitans gland. (A)

ii) Extend the nictitating membrane and incise the palebral conjuctiva of the fornix. (B)

iii) With 3/0 nonabsorbable monofilament suture, take a long bite of periosteum along the orbital rim. The needle should traverse medially to laterally through the rim and not perpendicularly (towards the eyeball). Pass the suture back through incision, the dorsally through the prolapsed gland, exiting on the dorsal bulbar face (C)

iv) Reflect the nictitating membrane downward.

* Pass the suture back through the exit hole in the apex of the gland taking a horizontal bite through the dorsal prominence of the gland.

* The final pass of suture begins again at the previous exit hole and passes ventrally through the gland, exiting through the conjuctival incision, within which both suture ends are securely tied (D)

5. **Post operative care and Complications**

* Administer topical broad-speetrum antibiotic 3~4 times daily for 7 days. Parenteral antibiotic and anti-inflammatory drugs can be given 4~5 consecutive days.

* Complications are uncommon, but include reprolapse of the gland and infection of the surgical site.

* Epiphora may be noticeably relieved on the morning often surgery; the full effects of operation

can best be evaluated 10 days after suigery.

* Post-op bleeding may be found in some cases because of self-trauma (rubbing the head against the wall or scratching) therefore thorough, protective bandaging to the eyes should be applied on the operation day.

6. **Acknowledgements**

The paper is dedicated to my late parents whose love and encouragement for education made me a competent veterinary surgeon.

Reference

1. Archibald. L. 1974, Canine Medicine, American veterinary Publication Lnc, Santa Barbra, Californnia. 2nd Archibald Ed: 216~218.

2. Birchard S.I.et.al 2000, Saunders Manual of small Animal Practice Diseases of the Lacrimal apparatus W.B Saunders Company, The curtis center Independence Square West, Philadelphia, Pennsylvania.19106, 2nd Ed;1369-1373

3. Bojrab M.I.et.al 1990, Current Techniques in Small Animal Surgery Replacement Technique for Prolapsed Gland Lea & Febiger, 600 Washington Square, Philadelphia. PA 19106-4198, USA, 3nd Ed; 85-86

4. Fogle. B.2002, Caring for your dog Cherry Eye Dorling Kindersley Limited 80 strand, London WC 2R ORL A Penguin Company 1st Publlishing, 214-215

5. H.Preston Hoskins, VMD et-al Canine Medicine Ameriean Vet. Publications, 7nc 114 North west st, Wheaton, Illinois Drawer KK, Santa Barbara, California, USA.

ဆွေးနွေးချက်

Dr. မင်းစိုး

- General anesthetic အနေဖြင့် Thiopentone သည် ရှေးနှစ်ပေါင်း (၄၀) ကျော်ကတည်းက သုံးစွဲခဲ့သော မေ့ဆေး ဖြစ်ပြီး နောက်ပိုင်း Ketamine မေ့ဆေးကို တိရစ္ဆာန်ဆေးကုခန်း အများစုတွင် မေ့ဆေးအဖြစ် သုံးစွဲနေပါ သည်။ Thiopentone သည် Manage လုပ်ရန် ခက်ခဲသော ခွေးကြောင် များတွင် I / V ထိုးရန် ခက်ခဲပြီး Ketamine မှာအလွယ်တကူ I/ M ထိုးပြီး သုံးနိုင်သော်လည်း မည့်သည့်အတွက်ကြောင့် Thiopentone ကို ရွေးချယ် သုံးစွဲပါသနည်း။
- Post operative treatment တွင် Antibiotics အနေဖြင့် မည်သည့် Antibiotic ကို သုံး၍မည်သည့် Dosage သုံးကြောင်း ရှင်းပြစေလိုပါသည်။

ဖြေကြားချက်

- သုံးနေကျမေ့ဆေးကို သုံးခြင်းဖြင့် Nature ကို သိနေပါသည်။ Ketamine က Theory အရ Reflex ပေးနိုင်သော်လည်း Overdose အလွယ်တကူ ဖြစ်နိုင်ပါသည်။ တစ်ဦးတည်း လုပ်ကိုင်ရသည့်အတွက် Minimum dosage နှင့် Reflex ကုန်က စတင်၍ ခွဲပါသည်။
- Glass syringe ကို Indicator အတွက် သုံး၍ Plastic syringe ကို Maintenance အတွက် သုံးသည်။
- Small animal တွင် 5% ပေးက Respiratory arrest ဖြစ်နိုင်သည်။ ထိုကြောင့် ခွေးတွင် 2.5-5.0%. ကြောင်တွင် (1.25-2.5%) သုံးပါသည်။
- Pen-strep depending on body weight ကို သုံးပါသည်။

Verification of Studies of Food Safety of Hazards in Dried Snakehead Fish Products

Tint Wai [1]

ABSTRACT

This paper presents a verification study into the levels of nitrite found in dry snake head fish. Dried snakehead fish were purchased and collected from various markets and manufacturing sites during December 2004 to March 2006. The dried fish were analyzed for nitrite at the quality control laboratory located at Thaketa. A mixture of sodium nitrite (*Yann seinn)* and salt are used as preservatives while imparting the pink colour associated with the product. Sodium nitrite can be extremely toxic to human body. Nitrite has been implicated in a variety of long term health effects and its toxicity has been evaluated on a number of occasions. The most recent study was conducted by the joint FAO/WHO expert committee on food additives. The study recommends as Acceptable Daily Intake (ADI) of 0.07 mg/kg/bodyweight/day (as nitrite ion). Nitrite can combine with secondary or tertiary amines to form N-nitroso derivatives. Certain N-nitroso compounds have been shown to produce cancers in a wide range of laboratory animals (Codex 1988). When combined with saliva and digestive enzymes, sodium nitrite technically has the potential to create a cancer-causing compound known as nitrosamine. Results of the present study detected levels of nitrite above the international standard. Inaccurate measurement and mixing of sodium nitrite in the dry form and a lack of process control during manufacture were found to be the primary causes of excess levels in finished product. The application of Good Manufacturing Practices and HACCP concept in the production of dry snake head fish are also discussed.

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[1] Staff Officer, Export and Quality Control Laboratory, Department of Fisheries.

Introduction

Myanmar, one of the developing countries in South East Asia, is richly endowed with an abundance of natural resources. The fisheries sector is of considerable importance to the national economy as a major source of nutrition for the local population, and from foreign exchange contributions from exports.

Currently there are 140 fish processing establishments in Myanmar. The annual production of fish products has increased on a yearly basis of 2004-05, total reaching 255 780.14 metric tons. Exports were worth US$ 346.921million for the same year and the major markets being China, Japan, EU, Middle East and ASEAN member countries.

There are many species of fresh water and marine fish which are processed as traditional fish products. These are broadly classified as dried and salted, fermented pastes and sauces, minced fish meal, smoked, canned and cured fish products. There is a significant requirement for the adoption of food safety practices throughout the supply chain in the production and handling of these products.

The Department of Fisheries is the Government agency tasked with the responsibility for the inspection, licensing of all export oriented and domestic fish processing plants in Myanmar. One of the departments' primary roles is to ensure public health by implementing and monitoring the compliance with domestic and importing country food legislation.

Justification

Dried snakehead fish is a popular fresh water species occasionally consumed by the general public of Myanmar. Current processing methods suggest potential of a significant hazard due to excessive levels of sodium nitrite used as a preservative /antibacterial agent. Associated with the consumption levels is the potential for conversion of sodium nitrite to nitrosamine a recognized carcinogenic chemical. This popular product is prepared in many ways such as by shallow frying, with curry and tomato syrup or grilled before serving. Dried snakehead fish is produced in Ayeyawady, Yangon and Bago Divisions and is an important product for local consumption.

Currently under Myanmar food legislation there is no regulatory limit for sodium nitrite in fish and fish products. Given the potential toxic nature of derivatives from sodium nitrite and the resultant potential for adverse health effects, this screening study will prove valuable in determining potential exposure levels from snakehead fish consumption.

The aim of this study is to assess the levels of sodium nitrite in dried snake head and determine if current application methods result in product safe for public consumption.

Materials and Methods

Dry snake head fish were collected from the markets and production sites of Pantanaw, Pegu and Twante from December 2004 to March 2006. The samples were analyzed for:

Moisture content
Protein
Salt
Ash
Total Volatile Basic Nitrogen: TVBN
Mould

Nitrite according to SEAFDEC (MFRD) Laboratory manual on Analytical Methods and Procedures for fish and fishery products 2nd Edition ,1992.

The method for nitrite analysis uses sulphalilamide which combines with the nitrite under acid conditions to become a diazotized salt. The diazotized salt then combines with naphthyl ethylene diamine to form the reddish-violet color of azo dye. The intensity of the colour is proportional to the concentration of nitrite present. The azo dye is measured by spectrophotometer for absorbance at a wavelength of 540 nm.

Recommended limits and guidelines

Currently in Myanmar there is no national regulatory limit for sodium nitrite in dry fish products. Singaporean food regulations (1988) set the residue limit of 10 ppm for sodium nitrite in fish sausage and fish ham. The Australian standard for residue in meats is 125 mg per kilogram maximum permissible limit.

According to the Japanese Food Sanitation Law (2001), sodium nitrite is a permissible food additive and permitted for use in fish sausage, fish ham, fish roe and smoked fish to prevent the growth of the bacteria *Clostridium botulinum*. The most recent study conducted by the joint FAO/WHO expert committee on food additives recommends an Acceptable Daily Intake (ADI) of 0.07 mg/kg/bodyweight/day (as nitrite ion). The U.S. Department of Agriculture (USDA) in Meat Inspection Regulations cites the use of nitrites, nitrates, or combinations of them cannot result in more than 200 parts per million (ppm), calculated as sodium nitrite, in the finished product.

Result and Discussion

Results summary

- The nitrite results varied significantly between manufacturers and batches of product from the same manufacturer. The range was 10.9 to 89 mg/kg.
- Nitrite residues were in excess of recommendations for fish products but significantly less than those applied to meat products. Conclusion to be drawn from this result is given the risk from pathogenic bacteria to consumers and the inconclusive case against nitrite the residue levels found during the study do not pose a significant risk to consumers.
- Moisture levels ranged from 17-34%
- Salt levels ranged from 1-10%

Moisture

Moisture is a key requirement for bacterial growth. The removal of moisture is a primary preservation method for dried products. The moisture content of dried snakehead fish ranges from 17 to 38 % (Table 1). The results indicate moisture contents from the same production site differ significantly during the sampling period.

The variable moisture contents may be attributed to a number of factors. These include the uncontrolled condition of drying the products and the absorption of atmospheric moisture during the wet season due to a lack of packaging.

The high variability of the results has a number of potential undesirable outcomes from a food safety perspective. Higher levels of moisture may lead to potential food hazards including allowing the growth of pathogenic bacteria likely to be present as a result of open air drying, the presence of no protective packaging and poor personal hygiene practices of processors. Moisture levels while not sufficient to allow bacterial growth may allow the growth of moulds which may have adverse health effects.

Salt

Salt content varied from 1 to 10 % in the samples (Table 1). Salt is frequently used in dried products to inhibit bacterial growth. The combination of salt and drying reduces water activity (available moisture) which has a preservative effect by creating an environment in which insufficient water is available to sustain bacterial growth. The variability in salt levels from the same producer at different sampling times again indicates

lack of a consistent manufacturing process. Levels of less than 4% salt are considered to have little or no inhibitory effect on bacteria. Given the variable salt and moisture results it would be difficult to determine the safety of this product from bacteria.

Nitrite

The results of the nitrite residues are shown in Table 2. The results indicate that although the nitrite content for all samples exceeds the Singaporean limit they are significantly less than both from the Australian limit for processed meats (125 mg/kg) and the US limits for processed meats (200 mg/kg). This would indicate that the levels of nitrite in dried snakehead fish do not represent a significant hazard to consumers. The high variability in residue levels between samples indicates the need for national production guidelines for producers and appropriate facilities and equipment to be used including scales to measure salt and sodium nitrite.

The results are insufficient to give an indication as to the significance of moulds in this product. Given high variability in moisture levels between samples combined with a lack of moisture proof packaging it may be assumed that the potential for mould growth is significant. In future monitoring activities water activity (AW) should be measured. This will give an indication as to the potential for mould growth.

Moulds in dried fish products have not been extensively studied and the potential health implications from consumption are not widely appreciated. Often National regulations do not include limits or guidelines for moulds.

Recommendations

- Need to develop a guide and education program for producers and the supply chain on appropriate production and handling methods
- Need to for regulators to promote accurate measuring practices when mixing ingredients
- Development of a national limit for nitrite supported by training and educations programs
- Measure water activity (AW) as part of product monitoring by a competent authority
- Encourage the use of moisture proof packaging for finished product
- Promotion of GMP, GHP and HACCP practices in manufacturing

- Education and training for workers and processors on GMP, GHP
- National or ASEAN standard for dried fish products including nitrite residues and moulds based on risk based approach
- Need for clear documented guidelines (specification) to provide guidance on manufacturing methods

Acknowledgement

The author would like to express his deepest gratitude to U Khin Maung Aye, Director General, U Than Tun, former Director General and U Khin Ko Lay Deputy Director General of the Department of Fisheries for their kind permissions to present this paper and supportive suggestion on verification studies. And also to all laboratory staff of Quality Control Laboratory, Thaketa and Divisional and Township Fishery Officers from Ayeyawady Division.

Table 1. Nutritional values of dry snakehead fish

	Place	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	*TVBN g/kg	Salt (%)
1	Ayeyawady	19.05	67.81	2.1	9.5	338.91	1.3
2	Bago	35.78	50.17	2.5	11.5	278.50	4.49
3	Twante	30.32	56.40	1.5	11.0	278.55	4.33
4	Ayeyawady	33.65	50.39	2.5	13.0	375.60	2.7
5	Bago	38.13	48.08	2.3	11.5	462.70	3.6
6	Twante	30.25	54.32	2.1	12.0	419.16	4.0
7	Ayeyawady	19.84	55.77	6.0	13.1	204.40	6.8
8	Bago	17.32	60.7	6.5	15.5	251.71	7.01
9	Twante	18.5	59.18	7.0	17.5	295.71	10.08
10	MOH*	20.5	66.14	7.0	6.2	-	-

*Ministry of Health * Total volactile basic nitrogen

Table 2. Nitrite content in dry snake head fish

Sr. No	Markets and manufacturing sites	Nitrite content mg/kg
1.	Than zay /Chinese market (Yangon)	36.3
2.	Thein gyi zay (Yangon)	55.4
3.	Pantanow(Ayeyawady Division)	27.4
4.	Phayagyi Village (Bago Division)	55.8
5.	Kyone pyaw Township (Ayeyawady)	27.8
6.	Waw (Bago Division)	88.6
7.	Thar paung	10.9
8.	Maubin	27.6
9.	Thanat pin	35.4
10.	Wakhema	46.6
11.	Twante	12.8
12.	Kyone pyaw	27.8
13.	Eaime	66.3
14.	Inm ma	23.9

Table 3. Mould colony per gram

Products	Purchase area	Mould Contents/mg (Range)	Species identified
Dry snake -head fish	Yangon	10-350	Aspergillus
Dry snake -head fish	Bago	50-60	Penicillin

Appendix 1. Process flow diagram of dry snake head fish production

1.Rawfish receiving

2. Beheading

3. Slicing and butterfly

Mixing with salt and nitrite

⇩

4.Soaking with salt and nitrite (5:1)

⇩

5. Leave overnight in cement jar

⇩

6. Washing with water

⇩

7. Sun dry for 3days

⇩

8. Finished products

References

Anonymous. 1992. Laboratory Manual on Analytical Methods and procedure for Fish and Fishery Products. 2nd edn. SEAFDEC (MFRD)

Anonymous. 2001. Specifications and Standards for Foods, Food Additives, etc. under the Food Sanitation Law. JETRO.

Shank,R.C. 1975.Toxicologyof N-nitroso Compounds in Foods Toxicol. Appl. Pharma-co.31:361-8.

ဆွေးနွေးချက်

Dr. တင်တင်မြင့်	-	Aspergillus နှင့် Clostridium ပါဝင်မှုကို တိုင်းတာစစ်ဆေးခဲ့ပါသလား။
	-	ယမ်းစိမ်းပါဝင်မှုကို Public level သိရှိရန် ထည့်ရမည်သည့် Amount ကို Official ထုတ်ပေးသင့်သနည်း။
ဖြေကြားချက်	-	Dry product ဖြစ်၍ Bacteria ကို မတိုင်းပါ။ မှိုပါဝင်မှု ရှိ/မရှိကို တိုင်းတာခဲ့ပါသည်။
	-	National standard ထုတ်ပြန်ရန် လိုအပ်ကြောင်း သိပ္ပံနှင့် နည်းပညာ ဝန်ကြီးဌာနမှ ဆောင်ရွက်ရမည်ဖြစ်ကြောင်း ကြေငြာခဲ့ပါသည်။
Dr. ခင်မမ	-	မီးဖုတ်ပြီး ဆီဆမ်းထားသော ငါးရံ့ခြောက် (အသင့်စားသုံးနိုင်) တွင် အမှန်တကယ်ပါဝင်သော ယမ်းစိမ်း (Nitrite) ပမာဏကို တိုင်းတာစစ်ဆေးဘူးလျှင် သိလိုပါသည်။
ဖြေကြားချက်	-	တိုင်းတာစစ်ဆေးဘူးပါသည်။
ဦးခင်ကိုလေး	-	ငါးပိ၊ ငါးခြောက်၊ ငါးဆားနယ်စသော အသေးစားလုပ်ငန်း
အကြံပြုချက်		Small, Medium Enterprise(SME) များအား GMP, SSOP စနစ်ဖြင့် ဆောင် ရွက်ရန် ASEAN Road Map, Measure 42 စနစ်ဖြင့် ဆောင်ရွက် လျက်ရှိပါသည်။
	-	ငါးရံ့ခြောက်လုပ်ငန်းများအား မှတ်ပုံတင်ခြင်း၊ သင်တန်းပေးခြင်း၊ Guide lines များရေးဆွဲခြင်းဖြင့် Food safety နှင့် ညီညွတ်ရန် GMP စနစ်ကျင့် သုံးရန် ငါးလုပ်ငန်းဦးစီးဌာနမှ ဆောင်ရွက်လျက်ရှိပါသည်။
	-	ASEAN နှင့် Inline ဖြစ်အောင် ဆောင်ရွက်သွားမည် ဖြစ်ပါသည်။

Dr. စန်းအောင် - Table 1 နှင့် 2 ကို Details ရှင်းပြရန် လိုအပ်ပါသည်။

အကြံပြုချက် - Protein content သည် 50-70% ဖြစ်နေ၍ ၄င်းသည် Moisture content အနည်း အများကြောင့် ဖြစ်နိုင်ပါသည်။ ဖြစ်သင့်သည့်မှာ water 60-65% များလျှင် protin range သည် နည်းရမည်သာဖြစ်သည်။

- ယမ်းစိမ်း Content သည် 10-87mg/kg ရှိနေ၍ Range အလွန်များ သည်။ ဥမာ- ဝေမြို့နယ်တွင် 87mg/kg သည် အလွန်များပါသည်။ သို့ဖြစ်ပါ၍ မည့်သည့်ဒေသမှ ငါးခြောက်ကို မစားရန် (သို့)ရှောင်ရန် ပညာပေးသင့်သည်။

Studies on the Effective Components in Silkworm Pupa Meal as Feed Ingredients for Common Carp (*Cyprinus carpio*)

Aung Naing Oo[1] and Shuichi Satoh[2]

ABSTRACT

Silkworm pupa (*Bombyx mori*) meal is a by-product available from silk industry that is rich in protein and lipid. In the first experiment, the availability of silkworm pupa products for carp feeds was investigated. Four isonitrogenous (crude protein: 42.0%) and isocaloric (gross energy: 5.1 kcal/g) diets were formulated: a control fishmeal based diet with 9% oil (3% Pollock liver oil and 6% soybean oil), three test diets with raw dried silkworm pupa meal replacing 26% of the fish meal of the diet (SPM), defatted pupa meal replacing 20% fishmeal of the diet (dSPM) and silkworm pupa oil replacing 6% of the oil mix used in the control diet (SPO). Each diet was offered to duplicate groups of 20 common carp (initial mean weight 7.4g) maintained in 60L aquaria for 12 weeks. The incorporation of silkworm pupa products in the diets resulted in a slight decrease in growth for the dSPM group compared to the control group. A distinct reduction of the α-tocopherol level in hepatopancreas tissue of the SPM fish indicated the poor lipid quality of dried silkworm pupa meal. The second experiment was an elaboration of the first, and intended to test the efficacy of the components from silkworm meal at different levels in carp diet. Besides, the same control diet used in the first study, this trial employed four other test diets (isocaloric, 5.1 kcal/g); two diets with pupa oil replacing the oil mix either partially (6%; diet PO1) or wholly (9%; PO2) and two other diets with defatted pupae meal replacing fish meal either at 20% (DP1) or at 10% (DP2). The diets were fed to common carp (initial mean weight 5 g) in duplicate groups for 12 weeks. The fish receiving the pupae oil diets (PO1 & PO2) showed growth comparable to the control group, while those fed on the diets containing defatted pupae meal (DP1 & DP2) gave inferior responses. This study has demonstrated that although the dried silkworm pupa meal could partially substitute the fish meal in carp diet, ill-effects of the oxidized oil portion from the ingredient has to be taken care of. On the other hand, the oil from silkworm pupae after filtration with celite could effectively replace fish oil in total, whereas the defatted pupa meal could substitute partially the fishmeal in carp diets in combination with other protein sources.

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Introduction

Development of cost-effective fish feed is an important aspect of aquaculture research considering the availability of ingredients and the requirements of the culture species. Fishmeal (as protein source) and fish oil (as lipid source) are the conventional ingredients in all types of fish feed. The cost of these ingredients is high due to their increasing demand worldwide. Therefore, for over the last decade, the research emphasis has been to find proper substitutes for the two ingredients. Alternative feed ingredients would be more cost effective for incorporation in diets, especially those destined for warm water fish species such as carp, tilapia, and catfish (Rumsey, 1993). A number of published reports are available regarding the efficacy of plant feedstuffs and ingredients of animal origin as alternative protein sources in fish feeds (Watanabe *et al.*, 1991; Abdel-Warith *et al.*, 2001). Again, the challenge of finding environmentally and economically sustainable ingredients raises questions about the future suitability and availability of fish oil. As the demand for fish oil increases relative to supply, the price increases, making other lipid sources economically competitive. The combination of fish oil and other lipids would be useful in reducing dietary unsaturation levels and prolonging lipid stability by lowering lipid peroxidation during feed storage. Many researchers have also looked into the animal oil sources in the diets of various fish species for replacing the fish oil (Chou & Shiau, 1999; Martino *et al.*, 2002). Ingredients from terrestrial animal origin such as meat meal or meat and bone meal may contain a recently discovered pathogen; the prion, responsible for bovine spongiform encephalopathy (BSE). That is the reason why these raw materials are not allowed to be used in animal feeds in the European Community although fish are not suspectible to prions (Métailler and Guillaume, 2001). Recently, in Japan, use of meat meal or meat and bone meal in animal feeds including fish feeds were prohibited. Therefore, the present nutritional research intended to look for other locally available animal waste by-products for developing a cost-effective fish feed.

One such alternative is silkworm pupae, which is available as a by-product from silk industry and is rich in protein and lipid contents. Silkworm pupae meal has been tested as a partial fish meal replacement in diets of carp *Cyprinus carpio* (Takeuchi *et al.*, 1989) and fish fed on 12% silkworm pupae meal showed almost the same growth and feed efficiency as those on other diets containing the same levels of protein and lipid. Silkworm pupae meal has been evaluated in diets for carp, *Cyprinus carpio* (Nandeesha *et al.*, 1990), and catfish species like *Heteropneustes fossilis* (Hossain *et al.*, 1993), and *Clarias batrachus* (Habib *et al.*, 1994) and it has been suggested that a high percent of silkworm pupae meal could replace fishmeal without affecting the growth. Not only in freshwater fish feed, but also in marine fish feed for Japanese flounder (*Paralichthys olivaceus*), silkworm pupae meal could replace 20% of protein of dietary fish meal, and where amino acid supplementation was not required at the crude protein levels of

45-48% in test diets (Kikuchi and Takeuchi, 2002). Therefore, silkworm pupae meal can generally be accepted for replacement of fishmeal up to a considerable level to develop cost-effective fish feed. In recent years, oil is often extracted from pupa and two products *viz.*, defatted pupa meal and pupa oil are commercially available. The efficacy of pupa oil in comparison with sardine oil asan additional energy source in the diet of common carp has investigated by Nandeesha *et al.* (1999). With this background knowledge, it is possible to include silkworm pupae meal and oil as cost-effective ingredients in aquatic feed.

The objective of the present study was to determine the efficacy of lipid and protein components from silkworm pupa meal as sources in common carp diets. The first study was on the availability of silkworm pupae products (dried silkworm pupae meal, defatted silkworm pupae meal, and filtered silkworm pupae oil) for carps. Based on this information, the second trial was designed to substitute fishmeal and oil with defatted pupa meal and pupa oil to clearly examine the effect of the lipid and protein components from pupa meal as sources in carp diets.

Materials and Methods

Silkworm Pupae Products

Silkworm pupae products used in this experiment were produced by the following procedures (Fig.1). The oil was extracted (thrice) from the raw dried silkworm pupae meal using hexane at the temperature of 65-67°C, filtered and evaporated at 60°C. This was followed by additional filtration using Celite to reduce the oxidized fractions in the oil used in the experiments. The oil-extracted wet pupa meal was dried at 82-95°C for 24 h to obtain the defatted pupa meal. The raw dry silkworm pupae meal contained crude protein 59.2%, crude lipid 26.5% and the acid value of the lipid was 33.4. Defatted silkworm pupae meal had a crude protein of 82.3% and residual lipid of 3.0%. The silkworm pupae oil filtered by Celite consists of crude lipid 98% and had an acid value 5.4. The main fatty acids of silkworm pupa oil are palmitic acid (16:0), oleic acid (18:1n-9) and α-linolenic acid (18:3n-3) (Table 1).

Two experiments were conducted by the use of above mentioned silkworm pupae products.

Feed Preparing

Expt. I : Four isonitrogenous and isocaloric diets were prepared. The control diet (C) contained 50% fishmeal as protein source and 9% of an oil mix (3% pollock liver oil & 6% soybean oil) as lipid source. Three test diets were formulated: dry silkworm pupae meal replaced 26% of the fishmeal in SPM diet and it also contained 5% of oil mix (3% Pollock liver oil & 2% soybean oil); In dSPM diet fish meal was substituted by 20% defatted silkworm pupae meal and it also included 12% of oil mix (6% pollock liver oil & 6% soybean oil). The SPO diet was a 50% fish meal diet, similar to the control diet, but the lipid sources were silkworm pupae oil 6% and pollock liver oil 3% (Table 2). Dry silkworm pupa and defatted silkworm pupae meal was ground (ZM 1, Retch grinder, Germany) to get a fine power before mixing with other ingredients. All ingredients were mixed well and pelletized. Pellets were dried in vacuum freeze dryer (REL-206, Kyowa

Vacuum Tech. Co. Ltd., Tokyo, Japan) and stored at 5°C until used. The proximate composition and major fatty acids content of the experimental diets are shown in Tables 2 and 3 respectively.

Expt. II: The same quality of silkworm pupae oil and defatted silkworm pupae meal used in the previous experiment was employed in this study. Five isocaloric diets were prepared. The control diet contained 50 % fishmeal and 9% oils (3% Pollock liver oil and 6% soybean oil) as protein and lipid sources, respectively. Among the four test diets, two contained 50% fish meal and silkworm pupae oil replacing the oil mix either partially (6% of the oil mix; PO1) or wholly (9% of the oil mix; PO2) and another two diets contained about 11% oil mix (pollock liver oil and pupae oil) and defatted pupae meal replacing fish meal either at 20% (DP1) or at 10% (DP2). The DP2 diet also combined 15% defatted soybean as a protein source. The diet preparation was as per the description in Expt. I. The proximate composition and fatty acid profile of the experimental diets are shown in Tables 2 and 3.

Fish and feeding methods

Both of the feeding trials were conducted using juvenile common carp *Cyprinus carpio* purchased from Sankyo Suisan Co. Ltd. (Tokyo, Japan). Prior to the trials, fish were kept on a commercial diet (Nippon Formula Feed Mfg. Co. Ltd., Yokohama, Japan) in 60L indoor tanks for about 5 months. At the start of the feeding trials, fish weighing about 7g (20 fish per tank) and 5g (25 fish per tank) were randomly allotted to eight and ten 60L glass tanks in Expt. I and II, respectively. Another 20 fish (Expt.I) and 25 fish (Expt.II) were sampled and kept frozen at -20°C for initial whole body proximate composition analysis. The tanks were set up in a flow through city-water system that was

passed through activated carbon filters for de-chlorinization and the flow rate was maintained at 500ml/min. The tanks were continuously aerated and duplicate groups of fish were fed each of the experimental diets three times per day, six days a week to near satiation. Both of the feeding trials were 12 weeks long and the water temperature was 24.3 ± 1.5°C in Expt. I and 23.3 ± 2.3°C in Expt. II. during the culture period.

Analytical methods

Fish were weighed every 3 weeks to calculate the live weight gain and feed performance. Prior to every biometric assessment the fish were starved for 24 h, lightly anaesthetized with ethylene glycol monophenyl ether (300 p.p.m) and weighed individually. At the end of the experiment, 10 fish from each diet group were sampled for whole body analysis. The fish were minced with a centrifugal mill (ZM 1, Retch) fitted with a 0.5mm screen. The homogenate was stored at -28°C until analysis. Another 10 fish from each group were sampled for blood and hepatopancreas. Anti-coagulated whole blood was drawn from the caudal vein of the fish with heparinized syringes and transferred to hematocrit tubes for measuring the hematocrit value. The hepatopancreas collected from the fish and preserved at -28°C for further lipid and vitamin E analyses. The sampling regimes were almost same in experiment I and II.

Sample of the experimental diets and whole body samples were analyzed for proximate composition (AOAC., 1990) and gross energy by auto calculating bomb calorimeter (CA-4P, Shimadzu, Japan). Total phosphorus content of the diets wasmeasured spectrophotometrically (UV 265 FW, Shimadzu, Japan) using the methods described by Satoh *et al.* (1984). Total lipid from carp hepatopancreas were separated to neutral lipid and phospholipids fractions by using silica gel cartridges (Sep-Pack, Waters, Milford, MA, USA). Fatty acid methyl esters were prepared from the total lipids of diets and the polar lipids of tissue by saponification and methylesterification (A. O. C. S., 1990). Alpha-tocopherol was extracted from hepatopancreas tissue samples using the saponification method of Buttriss and Diplock (1984) as described by Akhtar (1999). Hematocrit (Hct) values were determined by centrifugation (MC-150, Tomy Tech., USA) at 4500 rpm for 5 min at room temperature.

Statistical analysis

For statistical comparisons, data from the different treatments were assessed by analysis of variance (ANOVA; SYSTAT 8.0 software, SPSS Inc., Chicago, USA). Differences among means were considered significant at $P < 0.05$. *Post hoc* analyses were performed using Tukey test (P level 0.05) to resolve the differences among means of duplicate groups.

Results

The experimental diets in experiment I contained crude protein in the range 41.5 - 42.4% and crude lipid between 15.1 and 17.1%. As expected, the gross energy content of the experimental diets maintained an almost identical level between 5.0 to 5.2 kcal/g of diet (Table 2). The total saturated and n-3 PUFA fatty acids levels were higher in silkworm pupa oil containing diets – SPM & SPO, compared to control & dSPM. The later two diets, which also contained soybean oil, were rich in n-6 PUFA (Table 3). In experiment II, the crude protein content of the diets ranged from 41.1% to 43.1% and lipid content ranged from 15.2 to 15.6%. The experimental diets were resulted in isocaloric (5.1 ± 0.1 kcal/g diet) and met the fatty acid requirement of common carp. However there were some differences in individual fatty acids and their major groups. The fatty acids profiles of the diets matched the dietary oil sources and their proportions. The silkworm pupae oil-containing test diets were rich in saturates, monoenes, and n-3 PUFAs while the soybean oil containing control diet was rich in n-6 PUFAs. The test diets were rich with palmitic, oleic, and α-linolenic acids.

The fish growth and feed performance are presented in Table 4. In the experiment I, the final average body weights of the fish were not significantly different ($P>0.05$). Compared to the control group, the fish from the SPM diet were significantly inferior in feed gain ratio whereas the dSPM and SPO groups were not markedly different. The control group was significantly higher than the test groups, excluding dSPM fish, in protein efficiency ratio. The survival rate (%) in the treatment groups were not markedly different, nevertheless the percentage was lowest for the SPM group. In the experiment II, the difference in average body weight of fish from PO1 and DP2 was significant ($P<0.05$). The growth rate of the fish fed on pupa oil replaced PO1 and PO2 were comparable to that of the control fish. Besides, compared to the control group, there were no significant differences in growth of fish fed on defatted silkworm pupae meal substituted DP1 and DP2 diets. Survival rate (%) was not significantly different among the treatment groups.

While the moisture content and crude ash were lower crude protein, crude lipid and gross energy were higher among the final fish compared to their initial counterparts in experiment I and II (Table 5). In the experiment I, the whole body crude protein of the fish fed SPO was significantly higher than that of the control and dSPM fish, but the content of SPM and dSPM groups were not significantly different compared to the control group. In the experiment II, carp fed DP1 had slightly lower whole body lipid content and higher moisture content compared to other groups, but there were no statistically significant differences among the treatment groups. The crude protein content and crude ash content in the whole body of the fish were also not affected by the treatments.

Fatty acid composition of the carp's hepatopancreas polar lipid is shown in table 6. The pattern was typical of fatty acid polar lipid fractions, with high saturated and polyunsaturated fatty acids, and clearly reflected the composition of the dietary lipid. In the experiment I, except for the n-6 PUFA, differences were not found in total saturates, monoenes, n-3 PUFA and total PUFA level among the treatment groups. Although, there is no statistically significant difference in the PUFA content among the treatment groups, the PUFA content of SPM fish was slightly lower than the other fish. The main fatty acid DHA also followed the pattern of PUFA levels and the content in SPM fish was slightly lower than the other fish. In the experiment II, the fatty acids composition of the polar lipid fraction of the hepatopancreas were resulted the differences in total saturates, n-6 PUFA, and total PUFA level among the treatments groups.

Hematocrit values of the fish in experiment I were not statistically significant difference among the treatment groups. All of the experiment fish had hematocrit values above the mean percent 31.3% reported for healthy common carps (Klontz, 1994). In the experiment II, the hematocrit value was highest for the fish fed PO2 and it was significantly different from the control and DP1 groups. However, rest of the values was similar to the control (Table 7).

Vitamin E content of the hepatopancreas and muscle of carp in both experiments is shown in table 7. In the experiment I, accumulation of vitamin E in hepatopancreatic tissue was least in SPM fish (157.1 ± 16.0 μg/g) and highest in SPO fish. There was no marked difference between SPM fish and the control fish. The content in dSPM fish was not significantly different from SPO fish. The content of vitamin E in SPM and control fish was significantly lower than that of dSPM and SPO fish. The vitamin E content was determined in the hepatopancreas and muscle of carp from the different dietary groups in the experiment II. Its content in the tissues did not indicate any changes to suspect the oxidative stability of the pupa oil.

Discussion

With regard to growth performance in carp, no significant difference was observed between the silkworm pupae products containing test diets and the fishmeal based control diet. Though the growth of fish fed the diet containing 26 % silkworm pupa was comparable to the control group, its feed utilization was significantly inferior as indicated by the feed gain ratio. The dried meal was high in lipid and linolenic acid content. When supplemented as protein and lipid sources at 12% level in the carp diet, it gave growth and feed efficiency almost similar to those on other diets containing the same levels of protein and lipid (Takeuchi *et al.*, 1989). Again it replaced fishmeal partially or

completely in carp and other fish diets, a similar performance was observed (Nandeesha *et al.*, 1990, Hossain *et al.*, 1991, Habib *et al.*, 1994). Nandeesha *et al.* (1990) reported that non-defatted silkworm pupa meal could replace up to 27% of the dietary protein without hampering the fish growth. Partial replacement studies with the defatted product have been reported in carp and Deccan mahseer, *Tor khudree* (Nandeesha *et al.*, 1990, Shyama and Keshavanath, 1993). Although Nandeesha *et al.* (1990) reported that the growth performance deteriorated upon inclusion of 20% defatted meal, in the present study we did not observed any such change deemed to be statistically significant. In earlier studies on carp the same group had shown that the non-defatted pupa meal was superior to defatted product (Nandeesha *et al.*, 1990), the reason being the loss of attractants and appetite stimulants due to oil extraction.

In the experiment I of present study the defatted pupae meal treated group is comparable to control group in feed gain ratio and protein efficiency ratio. The filtered silkworm pupa oil when incorporated at 6% in the diet gave specific growth rate and feed gain ratio comparable to control fish while protein efficiency ratio was lower. The present experiment revealed that silkworm pupa oil combined with the Pollock liver oil could be successfully used in carp feed. After the 12-week culture period, even though the survival rate of fish among the treatment groups was not statistically different, it was lower for the SPM diet-group compared to the rest. It is suspected that this may have been due to the oxidized lipid in dried silkworm pupa meal although the diet contained 50mg/g diet of the antioxidant vitamin E. Silkworm pupa meal is considered as conventional feedstuff and an appropriate processing method can improve its availability to fish. The first experiment demonstrated this; the silkworm pupa oil extracted from pupa meal and filtered by Celite, as well as the residual defatted pupa meal could replace the fishmeal and fish oil in carp diet. With adequate supplementation of vitamin E, the silkworm pupa oil filtered by Celite could replace the fish oil, and defatted pupa meal could substitute 10% of fish meal in carp diet. In the experiment II, carp fed the silkworm pupa oil partially and wholly replaced diets (PO1 and PO2) showed growth performance comparable to control fish while the fish fed the defatted pupa meal DP1 (20% of diet) and DP2 (10% of diet) gave inferior response compared to control group (Table 4). Different oils can produce similar growth of fish, provided the qualitative and quantitative requirements for essential fatty acids are met (Steffens, 1995). In this study too, when silkworm pupa oil replaced fish oil partially and wholly, growth performance, and feed gain ratio was comparable to that of control fish.

Considering the defatted pupa meal substituted diets, a similar response in growth performance and feed utilization has been also reported when defatted pupa meal was employed in carp diets (Nandeesha *et al.*, 1990). They suggested that inclusion of defatted pupa meal beyond 10% might not be good for growth. On the contrary, Shyama

and Keshavanath (1993) observed good growth when 50% defatted silkworm pupa meal replaced fish meal in diet for *Tor khudree*. On the basis of our results and other similar reports it seems that large amounts of the defatted meal cannot be employed in diets due to its poor protein quality, besides the lack of the fat fraction. Though the protein content of the defatted pupa meal (82.3%) was higher than that of the raw silkworm pupa meal (59.2%), the former appears to have a different amino acid profile compared to latter. Takeuchi (1999) reported that over heating of a protein can cause losses of amino acids by oxidation and ultimately decrease the availability of some of them such as lysine. The oil extraction from the pupa meal and the subsequent drying (82-95°C) may have led to a decrease in the availability of amino acid to carp from ingredient, apart from the loss of appetite stimulants. Information on animal feed resources describes that silkworm pupa meal contains the exoskeleton and contents of the body cavity. Chitin, a component of the exoskeleton, contains approximately 25% of the crude protein content, which is not composed of amino acids and is indigestible. This is probably why we observed that defatted pupa meal could replace fish meal only up to 10% of diet. However, when combined with soybean meal in carp diet there was no negative effect on fish growth.

In the study of Takeuchi *et al.* (1989), 12% pupa meal containing diet did not have any distinct effect on the proximate composition of the whole body tissue. Higher deposition of fat and protein in fish treated with pupa oil as well as sardine oil compared to control fish fed on oil-excluded diet has been reported by Nandeesha *et al.* (1999). Common carp in the present study receiving the dried silkworm pupae meal (SPM) and filtered pupae oil (SPO) had slightly greater fat deposition but it was not statistically different compared to control and defatted pupae meal fish. The replacement of silkworm pupa oil as well as pupa meal did not result in any significant difference in the whole body composition of carp in the experiment II. In this study, different dietary protein ingredient combinations in carp diets did not affect the protein levels of the whole body. However the DP1 group with the lowest growth had relatively less amounts of lipid and greater moisture content in whole body tissue, but these differences were not statistically different from the rest. The two levels of pupa oil employed in the experimental diets did not produce any significant changes in fish whole body composition, similar to reports with Chinook salmon (Dosanjh *et al.*, 1988), with palm oil in African catfish (Ng *et al.*, 2003). The different oils employed in the diets, did not affect the whole body composition of the fish, and provided their fatty acid requirement is met by the particular oil.

The fatty acid compositions of the body lipids basically match that of the dietary lipids. Satoh (1991) has indicated that dietary lipids affect the fatty acid composition of phospholipids to a greater degree than those in the neutral lipids. The significant decrease of linoleic (18:2n-6) and linolenic (18:3n-3) acid in phospholipid of hepatopancreas tissue

in Expt. I and in Expt. II suggested that carp converted the dietary 18:2n-6 to 20:4n-6 and 22:5n-6 and 18:3n-3 to 22:6n-3 in phospholipid fraction (Farkas *et al.*, 1980). It has been reported that the oxidized lipid destroys the α-tocopherol originally present in the diet, causing its deficiency (Watanabe *et al.*, 1982) that may lead to a decrease in 18:2n-6, 20:4n-6, 20:5n-3 and 22:6n-3 in the hepatopancreas polar lipid fraction of young carp (Watanabe *et al.*, 1977) and adult carp (Watanabe and Takashima, 1977). Klaus Eder (1999) reported in rat, that the presence of oxidized oil in dietary lipid would lower the 20:4n-6 and 22:6n-3 level in liver polar lipid fatty acid. In this study, the suspected dietary oxidized oil portion in SPM diet led to lower levels of 20:4n-6 and 22:6n-3 in hepatopancreas polar lipid fraction, though statistically insignificant. Various levels of pupa oil substitution in test diets did not significantly affect the polar lipid fatty acidcomposition in hepatopancreas in the experiment II. In this study, the polar lipid fatty acid compositions clearly reflected those of the dietary lipids. A decrease in 22:6n-3 in carp hepatopancreas polar lipid that can be caused by feeding oxidized oil was not observed in the experiment II. Thus, it appears that the pupae oil filtered by Celite can safely be incorporated into carp feeds as an effective alternate to fish oil.

Silkworm pupa products incorporated in carp diets did not have any significant impact on hematocrit values. Murai and Andrews (1974) reported that the high levels of oxidized menhaden oil and low levels of α-tocopherol in channel catfish diet resulted in reduced hematocrit levels. Rainbow trout fed highly or extremely oxidized oils without DL-α-tocopherol acetate supplementation, exhibited lower haematocrit value but the fish fed diet containing highly oxidized oil supplied with DL-α-tocopherol acetate (33mg/kg of diet), and showed the same level of hematocrit value compared to fresh oil-diet fed fish (Moccia, *et al.*, 1984). In the present study no significant decrease in the haematocrit values were observed despite the possibility of inclusion of oxidized oils from the silkworm pupae meal. The fish receiving the greater amount of pupae oil (PO2) had the highest hematocrit value (40.2%), while the values for the rest of the fish was in the range (35.1 to 38.1%), quite similar to that of healthy common carp (26 to 39%; Klontz, 1994). It is interesting that fish fed on diets with pupa oil alone had higher hematocrit value than that of the control diet and diet with a lower proportion of pupae oil. The replacement of fish meal with defatted pupa meal did not influence the hematocrit value.

Differences were noted for the vitamin E content of carp hepatopancreas among fish from the various treatments, although all the diets contained vitamin E 50mg/100g of diet. Watanabe *et al.* (1981) reported that feeding diets containing 15 to 20% of pollock liver oil resulted in an increased requirement for α-tocopherol in carp. Again Satoh *et al.*, (1986) reported that the elevation of the dietary lipid levels from 5 to 15% in the tilapia diet containing 50mg of α-tocopherol reduced the concentration of α-tocopherol in the whole body. Sakai *et al.* (1992) also reported that the yellow tail fed on brown fish meal

diets supplemented with 40 mg α-tocopherol/100g and 9% of sardine oils of high and low POVs (100 and 4.7 respectively) exhibited clear differences in the α-tocopherol content of liver tissue. Potentially negative health effect associated with dietary lipids can be attributed to their rancidity. Many fish diets contain relatively high levels of polyunsaturated fatty acids, which are particularly susceptible to oxidation. Various products of lipid oxidation may react with proteins, vitamins, and other dietary components to limit their nutritional value. This result is in good agreement with that of Satoh (1991), where he assumed that the oxidized lipids were destroyed by the α-tocopherol originally present in the diet. As far as the decrease in α-tocopherol in hepatopancreas of the fish from the control group, it could be due to the high amount of the lipid contained in their diets (15%). In the experiment II, employing pupa oil filtered by celite at various level in carp diets, did not affect the vitamin E level in hepatopancreas and muscle tissues, as in the case of oxidized lipid. Dietary oil status significantly influences the vitamin E content in liver and muscle tissue. At identical vitamin E inclusion levels, when dietary fresh oils were compared to oxidized oils, the latter caused a decrease in the tocopherol concentration in tissues of rainbow trout (Hung *et al.*, 1981), and African catfish (Baker and Davies, 1997). Confirming the observations based on fatty acid profiles, the tissue vitamin levels recorded in this study leaves no doubt about the good quality of filtered pupae oil.

Conclusion

In the first trial investigation of the availability silkworm pupae meal products in carp diets, it was known that the dried silkworm pupae meal (27% of diet) replaced diet group showed comparable growth performance to that of control fish, but the oxidative oil effect of the significantly decreasing of vitamin E content in hepatopancreas tissue was observed in this treatment group. Thus dried silkworm pupae meal replacing level should be reduced and/or vitamin E adding level should be adjusted to optimum level at high dietary lipid level (15% of diet) of carp diets were seen in this experiment. From the first and second trials of this study, silkworm pupae oil extracted by hexane from silkworm pupae meal and filtrated by Celite to reduce the oxidative contents in this oil, had effectively replaced oil mix either partially or wholly in carp diets.

Poor quality of protein component in the silkworm pupae meal was clearly observed in this study. In the first trial, defatted pupae meal 20% substitution in carp diet showed slightly inferior response of growth performance and feed utilization. In the second trial, when we again confirmed the protein quality of pupae meal, diet contained defatted pupae meal 20% and oil mix (fish oil 2.8% + pupae oil 8%) showed significantly lower growth response compared to control diet group. However, defatted pupae meal 10% replaced fish meal and combined with soybean meal supplied with oil mix (fish oil

2% + pupae oil 9%) diet treatment group could be comparable to control group fish. It was clearly known that significantly inferior growth response of defatted pupae meal 20% replaced diets group was the effect of the poor protein quality of defatted pupae meal. The efficacy of growth stimulant of the protein and lipid component from silkworm pupae meal in carp diets determined in this study.

Table 1. Crude protein, lipid content of the silkworm pupae products and main fatty acid composition of the filtered silkworm pupa oil used in the formulated diets.

Ingredients	Crude protein (%)	Crude protein (%)
Silkworm pupae meal	59.2	26.5 (AV: 33.4)*
Defatted silkworm pupae meal	82.3	3.0
Silkworm pupae oil	-	98.0 (AV: 5.4)*
Fatty acid		% Area
16:0		22.2
16:1n-7		1.2
18:0		6.8
18:1n		32.4
18:2n-6		5.5
18:3n-3		31.0
Others		0.9

* Acid value

Table 2. Composition of the experimental diets in experiment I and II

Experiment No.	I				II				
Ingredients (%)	Diet code				Diet code				
	C	SPM	dSPM	SPO	C	PO1	PO2	DP1	DP2
Jack mackerel meal	50	27	26	50	50	50	50	26	26
Silk worm pupae meal	-	26	-	-	-	-	-	-	-
Defatted silk worm Pupae meal	-	-	20	-	-	-	-	20	10
Defatted soybean meal	-	-	-	-	-	-	-	-	15
Pollock liver oil	3	3	6	3	3	3	-	2.8	2
Soybean oil	6	2	6	0	6	-	-	-	-
Silk worm pupae oil[1]	-	-	-	6	-	6	9	8	9
Wheat flour	25	25	25	25	25	25	25	25	25
Mineral premixture[2]	1	1	1	1	1	1	1	1	1
Vitamin premixture	1.5	1.5	1.5	1.5	3	3	3	3	3
Others[3]	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Cellulose	4.9	5.9	5.9	4.9	3.4	3.4	3.4	5.6	0.4
Nutrient contents (dry basis)									
Crude protein (%)	41.5	41.8	42.2	42.4	43.1	42.9	42.8	41.8	41.1
Crude lipid (%)	16.1	17.1	16.4	15.1	15.2	15.4	15.3	15.6	15.3
Crude ash (%)	11.3	9.3	9.4	11.8	10.9	11.0	10.9	8.7	8.8
Moisture (%)	4.7	3.8	2.4	2.4	4.0	3.3	3.4	2.5	2.1
Gross energy (kcal/g)	5.1	5.2	5.2	5.0	5.1	5.1	5.1	5.1	5.2
Phosphorous (mg/g)	24.8	19.2	19.8	27.1	22.4	22.3	22.6	18.9	18.4

[1]Silkworm pupae oil filtered by Celite, Nippon Chemical feed Co. Ltd., Yokohama, Japan.
[2]Composition (g 100^{-1}g): NaCl (5), $MgSO_4.7H_2O$ (74.5), $FeC_6H_5O_7.nH_2O$ (12.5), $ZnSO_4.7H_2O$ (1.77), $MnSO_4.5H_2O$ (0.81), $CuSO_4.5H_2O$ (0.16), $AlCl_3.6H_2O$ (0.05), $CoCl_3.6H_2O$ (0.015), KIO_3 (0.005), Cellulose (5.2).
[3]Others: Pregelatinized starch, 5%; Choline chloride, 0.5%; Vitamin E (50%), 0.1%; $Ca(H_2PO_4)_2$, 3%,

Table 3. The main fatty acids composition of the diets in experiment I and II.

Expt. no.	I				II				
Fatty acids (% area)	Diet code				Diet code				
	C	SPM	dSPM	SPO	C	PO1	PO2	DP1	DP2
16:0	13.1	16.6	12.5	19.0	14.1	19.3	21.5	20.0	20.9
16:1n-7	3.2	2.4	3.9	3.9	3.0	3.8	2.1	2.6	2.5
18:0	3.4	4.7	3.4	4.4	3.2	4.3	5.1	5.2	5.0
18:1	21.9	24.3	21.9	25.3	22.1	25.4	28.4	27.9	28.5
18:2n-6	31.3	15.2	28.3	7.3	30.4	6.7	7.7	7.8	8.1
18:3n-3	3.1	21.1	4.1	15.1	2.8	15.2	22.0	20.5	22.0
20:1	3.5	2.6	4.9	3.1	2.6	2.6	0.5	2.1	0.8
20:4n-6	0.3	0.2	0.3	0.3	0.4	0.4	0.3	0.2	0.2
20:5n-3	4.8	3.1	5.4	5.6	4.9	5.1	2.6	3.4	2.7
22:1	3.5	2.2	3.8	2.6	2.0	1.9	0.3	1.8	1.4
22:5n-3	0.8	0.4	0.6	0.9	0.9	0.9	0.8	0.5	0.5
22:6n-3	4.5	2.4	3.7	5.1	6.8	8.3	5.4	3.7	3.2
Total									
Saturates	19.3	23.2	18.7	26.4	19.9	26.2	28.3	27.0	27.5
Monoenes	32.0	31.6	34.5	34.9	29.7	33.6	31.3	34.3	33.1
n-3 PUFA	13.9	27.6	14.9	27.6	16.6	30.6	31.0	28.9	29.2
n-6 PUFA	31.8	15.4	28.7	7.9	31.0	7.4	8.9	8.2	8.5
PUFA	45.7	43.0	43.6	35.5	47.6	38.0	39.2	37.1	37.7

Table 4. Growth performance, feed utilization and survival rate of carp in experiment I and II.

Diet no.	Av. body wt. (g) ±SD		SGR (%/day)	FGR	PER	TGC	Survival (%)
	Initial	Final					
Expt. I:							
C	7.4±0.5	125.9±32.2	3.38	0.84^{a}	3.01^{b}	0.0015	97.5
SPM	7.4±0.6	123.3±32.1	3.35	1.05^{b}	2.38^{a}	0.0015	77.5
dSPM	7.4±0.6	103.7±23.3	3.15	0.92^{ab}	2.64^{ab}	0.0014	92.5
SPO	7.4±0.5	121.6±24.1	3.34	0.96^{ab}	2.52^{a}	0.0015	92.5
Expt. II:							
C	5.02±0.1	107.9 ± 3.1^{ab}	3.65^{b}	0.81^{a}	3.00^{b}	0.0016^{b}	98
PO1	5.10±0.1	111.3 ± 8.5^{b}	3.67^{b}	0.82^{a}	2.94^{b}	0.0016^{b}	100
PO2	5.01±0.1	108.2 ± 3.3^{ab}	3.66^{b}	0.83^{a}	2.89^{ab}	0.0016^{b}	100
DP1	5.02±0.0	91.6 ± 0.4^{a}	3.46^{a}	0.92^{b}	2.68^{a}	0.0014^{a}	100
DP2	4.97±0.1	99.8 ± 0.7^{ab}	3.57^{ab}	0.91^{b}	2.72^{ab}	0.0015^{ab}	100

SGR; Specific growth rate (%/day), FGR; Feed gain ratio, PER; Protein efficiency ratio, TGC; Thermal unit growth coefficient

Values within the same column not sharing the same letters are statistically different ($P<0.05$)

Table 5. Proximate composition of fish whole body before and after the feeding trials in experiment I and II.

Diet no.	Crude protein (%)	Crude lipid (%)	Moisture (%)	Crude ash (%)
Expt. I:				
Initial fish	13.0	1.8	81.6	3.2
C	14.9[a]	6.9	74.9	2.6
SPM	15.1[ab]	7.4	74.6	2.6
dSPM	14.7[a]	7.0	75.4	2.7
SPO	15.4[b]	7.4	74.3	2.8
Expt. II:				
Initial fish	14.3	2.6	80.1	3.3
C	15.4	7.7	74.3	2.9
PO1	15.7	7.6	74.2	3.0
PO2	15.6	7.9	74.3	2.8
DP1	15.5	6.9	75.2	3.0
DP2	15.7	7.3	74.6	2.8

Values within the same column not sharing the same letters are statistically different ($P<0.05$)

Table 6. Fatty acid compositions of polar lipid from carp hepatopancreas in experiment I and II

Expt. no.	I				II				
Fatty acids (% area)	Diet code				Diet code				
	C	SPM	dSPM	SPO	C	PO1	PO2	DP1	DP2
16:0	23.8	24.7	23.3	24.1	21.0^{a}	22.4^{b}	22.8^{b}	22.6^{b}	22.8^{b}
18:0	8.6	9.4	9.2	9.4	7.3	7.3	8.2	8.2	8.4
18:1	10.9	13.0	11.6	10.9	8.6^{a}	10.1^{b}	10.6^{b}	9.7^{ab}	9.3^{ab}
18:2n-6	7.7^{c}	5.5^{b}	7.8^{c}	2.8^{a}	7.3^{c}	2.3^{a}	3.1^{b}	3.0^{b}	3.1^{b}
18:3n-3	0.3^{a}	1.7^{b}	0.5^{a}	1.5^{b}	0.2^{a}	1.4^{b}	1.9^{b}	1.9^{b}	1.4^{b}
20:1	3.3	3.5	3.5	3.0	1.5	1.7	1.0	2.2	1.7
20:4n-6	2.8	2.6	2.7	3.5	4.3^{bc}	3.8^{b}	3.6^{ab}	3.1^{a}	3.3^{ab}
20:5n-3	2.3	2.8	3.2	3.9	2.8^{ab}	3.4^{b}	2.3^{a}	3.5^{b}	3.6^{b}
22:5n-3	1.3^{ab}	1.2^{a}	1.6^{b}	1.7^{b}	1.4^{ab}	1.4^{ab}	1.2^{a}	1.4^{ab}	1.7^{b}
22:6n-3	29.0	25.2	27.4	29.8	37.4	37.9	37.3	36.8	37.1
Total									
Saturates	33.6	35.0	33.4	35.0	29.1^{a}	30.4^{ab}	31.5^{ab}	31.5^{ab}	31.9^{b}
Monoenes	16.1	18.2	17.2	15.7	11.5	13.4	13.2	13.2	12.4
n-3 PUFA	33.2	31.2	33.1	37.2	42.4	45.4	44.8	45.4	45.4
n-6 PUFA	13.0^{b}	9.7^{a}	12.3^{b}	7.5^{a}	14.4^{b}	7.8^{a}	8.1^{a}	7.3^{a}	7.6^{a}
PUFA	46.2	40.9	45.4	44.7	56.9^{b}	53.2^{a}	52.9^{a}	52.7^{a}	53.0^{a}

Values within the same row not sharing the same letters are statistically different ($P<0.05$).

PUFA, polyunsaturated fatty acids.

Table 7. Hematocrit value and vitamin E content in carp after 12 weeks in experiment I and II.

Diet no.	Hematocrit[1]	Vitamin E[2]	
		Hepatopanctreas	Muscle
Expt. I			
C	49.8 ± 3.4	247.7 ± 2.7[a]	-
SPM	41.4 ± 1.8	157.1 ± 16.0[a]	-
dSPM	41.4 ± 2.9	451.3 ± 35.4[b]	-
SPO	46.0 ± 1.2	586.8 ± 98.6[b]	-
Expt. II			
C	35.6 ± 1.3[a]	537.5 ± 32.4	12.8 ± 1.9
PO1	37.6 ± 0.4[ab]	548.5 ± 0.3	12.1 ± 0.1
PO2	40.2 ± 2.1[b]	573.2 ± 26.1	12.5 ± 1.3
DP1	38.1 ± 0.4[ab]	633.7 ± 108.2	13.8 ± 0.2
DP2	35.1 ± 1.1[a]	570.6 ± 89.4	13.3 ± 1.4

Values within the same column not sharing the same letters are statistically different ($P<0.05$).
[1] (%, n=10)
[2] (μg/g, n=10)

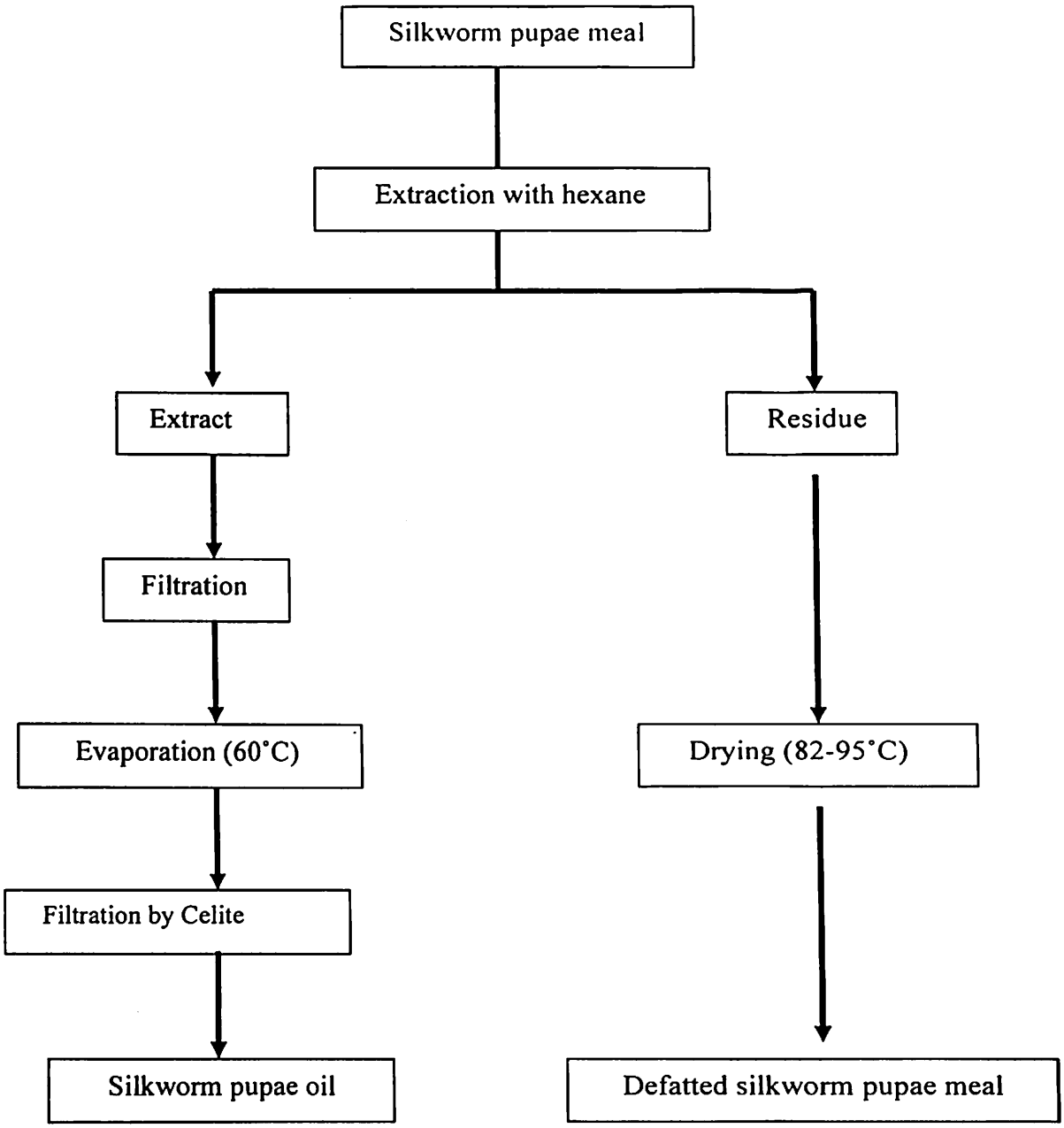

Fig. 1. A simplified schematic diagram showing the procedures of oil extraction from silkworm pupa meal, refining process of pupa oil and production of defatted pupa meal.

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References

A.O. C. S. 1990. Official methods and recommended practices, 4th Edition. Method Ce1b-89, American Oil Chemist's Society, Chicago.

Abdel-Warith A.A., Russell, P.M. & Davies S.J., 2001. Inclusion of commercial poultry by-product meal as a protein replacement of fish meal in practical diets for African catfish *Clarias gariepinus* (Burchell 1822). *Aquaculture Research*, **32**(Suppl. 1), 296-305.

Akhtar, P., Gray, J. I., Cooper, T. H., Garling, D. L. & Booren, A. M. 1999. Dietary pigmentation and deposition of α-tocopherol and carotenoids in rainbow trout muscle and liver tissue. *Journal of Food Science* **64**, 234-279.

AOAC. 1990. Official Methods of Analysis, 2nd Edition. Helrich, K. (ed.). Association of Official Analytical Chemists, Arlington, V.A. 1289 pp.

Baker R.T. M. & Davies S. J. 1997. Modulation of tissue α-tocopherol in African catfish, *Clarias gariepinus* (Burchell), fed oxidized oils, and the compensatory effect of supplemental dietary vitamin E. Aquaculture Nutrition **3**; 91-97.

Buttriss, G. & Diplock, A. T. 1984. High performance liquid chromatography methods for vitamin E in tissues. *Methods in Enzymology* **105**, 131-138.

Chou, B. S., Shiau, S. Y., 1999. Both n-6 and n-3 fatty acids are required for maximal growth of juvenile hybrid tilapia. *North American Journal of Aquaculture*, **61**: 13-20.

Dosanjh, B.S., Higgs, D.A., Plotnikoff, M.D., McBride, J.R. and Buckley, J.T., 1984. Efficacy of canola oil, pork lard and marine oil singly and in combination as supplemental dietary lipid sources for juvenile coho salmon (*Oncorhynchus kisutch*). *Aquaculture*, **36**:333-345.

Farkas T., Cenger I., Majoros F., and Olah J., 1980. Metabolism of fatty acids in fish. III. Biosynthesis of fatty acids in relation to diet in the carp, *Cyprinus carpio*

Linnaeus 1758. *Aquaculture* **20**, 29.

Habib, M.A.B., Hasan, M.R., Akand, A.M. & Siddiqua, A. 1994. Evaluation of silkworm pupae meal as a dietary protein source for *Clarias batrachus* fingerlings. Abstract/ Aquaculture **124**, 61-66.

Hossain M.A., Islam M.N. and Alim M.A. 1991. Evaluation of silkworm pupae meal as dietary protein source for catfish (*Heteropneutes fossilis* Bloch). Fish Nutrition in Practice, Biarritz (France) June 24-27, 1991 Ed. INRA, Paris 1993 (Les Collo-ques, n°61) 785-791.

Hung S.S.O., Cho C.Y. & Slinger S.J. 1981. Effect of oxidized fish oil, dl-α-tocopherol acetate and ethoxyquin supplementation on the vitamin E nutrition of rainbow trout (Salmo gairdneri) fed practical diets. *Journal of Nutrition* **111**, 648-657.

Kiuchi K. and Takeuchi T., 2002. Japanese flounder (*Paralichthy olivaceus*) In:

Webster C. D., Lim C., (eds) "*Nutrient requirements and feeding of finfish for aquaculture*" CAB international.

Klaus Eder 1999. The effect of dietary oxidized oil on lipid metabolism in rats. Lipids, Vol. **34** no.7 pp 717-725.

Klontz, G.W. 1994. Fish Hematology: In " Techniques in Fish Immunology-3" (Stolen, J.S., Fletcher, T.C., Rowley, A.F., Zelikoff, J.T., Kaattari, S.L., and Smith, S.A. eds) pp. 121-130. SOS Publications, Fair Haven, NJ 07704-3303, USA.

Martino, R.C., Cyrino, J. E. P., Portz, L., Trugo, L. C., 2002. Performance and fatty acid composition of surubim (*Pseudoplatystoma coruscans*) fed diets with animal and plant lipids. *Aquaculture*, **209**: 233-246.

Métailler, R. and Guillaume, J., 2001. Raw materials and additives used in fish foods In "*In Nutrition and Feeding of Fish and Crustaceans*" (Guillaume, J., Kaushik, S., Bergot, P. and Métailler R. eds) pp. 281-295. Springer, New York.

Moccia, R. D., Hung, S. S. O., Slinger, S. J. & Ferguson, H. W. 1984. Effects of oxidized fish oil, vitamin E and ethoxiquin on the histopathology and hematology of rainbow trout, *Salmo gairdneri* Richardson. Journal of Fish Diseases **7**, 269-282.

Murai, T. & Andrews, J. W. 1974. Interactions of dietary α-tocopherol, oxidized menhaden oil and ethoxyquin on channel catfish (*Ictalurus punctatus*). Journal of Nutrition **104**, 1416-1431.

Nandeesha, M.C., Gangadhara, B. and Manissery, J.K. 1999. Silkworm pupa oil and sardine oil as an additional energy source in the diet of common carp, *Cyprinus carpio*. Asian Fisheries Science **12** 207-215.

Nandeesha, M.C., Srikanth, G.K., Keshavanath, P., Varghese, T.J., Basavaraja, N.and Das, S.K. 1990. Effects of non- defatted silkworm-pupae in diets on the growth of common carp, *Cyprinus carpio*. Biological wastes **33** 17- 23.

Ng, W.K., Lim, P.K. and Boey, P.L., 2003. Dietary lipid and palm oil source affects growth, fatty acid composition and muscle α-tocopherol concentration of African catfish *Clarias gariepinus*. *Aquaculture*, **215**: 229-243.

Rumsey G.L., 1993. Fish meal and alternate sources of protein in fish feeds update 1993. *Fisheries*, Vol. **18**, No.7, pp.14-19.

Sakai, T., Murata, H., Yamauchi, K., Sekiya, T., and Ukawa, M. 1992. Effects of dietary lipid peroxides contents on *In Vivo* lipid peroxidation, α-tocopherol contents, and superoxide dismutase and glutathione peroxidase activities in the liver of yellowtail. Nippon Suisan Gakkaishi **58** (8), 1483-1486.

Satoh, S., 1991. Common carp, Cyprinus carpio, in "Handbook of nutrient requirements of finfish" (ed. by R. P. Wilson), CRC Press, pp. 55-67.

Satoh S., Takeuchi T., and Watanabe T. 1986. Requirement of Tilapia for α-tocopherol. *Nippon Suisan Gakkaishi* Vol. **53**(1), 119-124.

Satoh, S., Takeuchi, T., Watanabe, T., Hoshi, M. and Toyama, K., 1984. Nutritional evaluation of scrap meal as a protein sources in diets for rainbow trout and carp. Bulletin of the Japanese Society of Scientific Fisheries. Vol. **50**(12), 2077-2083.

Shyama, S. and Keshavanath, P. 1991. Growth response of *Tor khudree* to silkworm pupa incorporated diets. Fish Nutrition in Practice, Biarritz (France) June 24-27,1991 Ed. INRA, Paris 1993 (Les Colloques, n°61) 779-783.

Steffens W., Wirth M. and Rennert B., 1995. Effects of adding various oils to the diet on growth, feed conversion and chemical composition of carp (*Cyprinus carpio*). *Arch. Anim. Nutr.*, Vol. **47**, pp. 381-389.

Takeuchi, T. 1999. Feeding the common carp in Japan. International Aquafeed, Issue **4**, 27- 32.

Takeuchi T., Watanabe T., Satoh S., Martino R C., Ida T., and Yaguchi M. 1989. Suitable levels of protein and digestible energy in practical carp diets. *Nippon Suisan Gakkaishi* **55**(3), 521-527.

Watanabe T. 1982. Lipid nutrition in Fish. *Comp.Biochem. Physiol.*, 73A No. 1, pp3

Watanabe T. and Takashima F. 1977. Effect of α-tocopherol deficiency on carp-VI. Deficiency symptoms and changes of fatty acid and triglyceride distribution in adult carp. Bulletin of the Japanese Society of Scientific Fisheries. Vol. **43**(7) 819-830.

Watanabe T. and Pongmaneerat J. 1991. Quality evaluation of some animal protein sources for rainbow trout *Oncorhynchus mykiss*. *Nippon Suisan Gakkaishi*, **57**: 495-501.

Watanabe T., Matsui M., Kawabata T., and Ogino C. 1977. Effect of α-tocopherol deficiency on carp—V. The composition of triglycerides and cholesteryl esters in lipids of young carp. Bulletin of the Japanese Society of Scientific Fisheries. Vol. **43**(7) 813-817.

Watanabe T., Takeuchi T., and Wada M. 1981. Dietary lipids level and α-tocopherol requirement of carp. Bulletin of the Japanese Society of Scientific Fisheries. Vol. **47**(12) 1585-1590.

ဆွေးနွေးချက်

Dr. နွဲ့နွဲ့ထင်
အကြံပြုချက်

- Silk worm pupae meal သည် New ingredient as an animal feed (Fish) ဖြစ်ပါသည် Crude protein% 59 ထက် ကျော်ကြောင်း မှတ်သားမိပါသည်။ သို့ရာတွင် ၄င်း Crude protein ငါးအတွက် Digestible ဖြစ် မဖြစ် လေ့လာပြီးမှ တစ်နိုင်ငံလုံး အတိုင်းအတာနှင့် ကျွေးမယ်ဆိုရင် ကောင်းမယ်လို့ အကြံပေးလိုပါတယ်။
- (Linolente) 18:3n-3 (33%) ကျော် 18:2n-6(Linoleic) ပါဝင်တဲ့ အတွက် Immune response ကိုလည်း ကောင်းစေ နိုင်ပါသည်။ 18:3n-3 နှင့် 18:2n-6 ပါဝင်မှုများတဲ့ ငါးတွေ Silk worm pupae meal ကို လူတွေက စားသုံးခြင်းဖြင့် လူတွေမှာလည်း Immune response ကောင်းစေမှာ ဖြစ်တဲ့အတွက် ဒီ Research ကို Commercially apply လုပ်နိုင်အောင် ကြိုးစားဖို့ အကြံပြုလိုပါတယ်။

Dr. မြင့်သိန်း

- Crude protein, crude lipid, defatted meal ရှိသည့်အတွက် ငါးကို ကျွေးသည်မှာ (၃)မျိုးစလုံး ကျွေးပါသလား။
- By product ပမာဏဟာ ဘယ်လောက်ရှိပါသလဲ။

Dr. ထွန်းစိန်
အကြံပြုချက်

- ငါးအစာစျေးနှုန်း ကြီးမြင့်နေချိန်မှာ ယခုလိုအသားဓါတ် ကြွယ်ဝစွာ ပါဝင် တဲ့ပိုးချည်လုပ်ငန်း၏ ဘေးထွက်ပစ္စည်း ဖြစ်သော ပိုးတုံးလုံး Silk worm pupae ဖြင့် ရွှေဝါငါးကြင်း အစာထဲတွင် ထည့်သွင်းဖော်စပ် ထားခြင်းဖြင့် ငါးကြီးထွားနှုန်း ကို ရှာဖွေခြင်းသည် ငါးစာစျေးနှုန်း ကျဆင်းစေရန် ရည် ရွယ်၍ Least cost formula ပြုလုပ်သည့် အတွက် ငါးမွေးမြူရေး လုပ်ငန်း အတွက် အလွန်အကျိုးရှိပါသည်။
- Pupae oil diets ကျွေးသည့် Experiment မှာ Crude fat 15% ပါဝင်နေတာတွေ့ရပါတဲ့အတွက် အစာထဲမှာ Energy ပိုများလာ ပေမယ့် အစာကြေ ညက်မှု (Digestion) လျော့ကျနိုင်တယ်လို့ ယူဆပါတယ်။ Digestibility လျော့ကျ နိုင်တဲ့ အခြေအနေကြောင့် နောင်အခါတွင် အခြေအနေပေး ပါက Digestibility ပက်သက်တဲ့ Experiment လည်း ဆက်လုပ်ဆောင် ရွက်သင့်ကြောင်း အကြံပြု ပါသည်။

အသားတိုးဘဲမျိုးရိုးမြှင့်တင်ခြင်းလုပ်ငန်း

ဒေါက်တာတင်နွယ်ရီ

စာတမ်းအကျဉ်းချုပ်

အသားတိုးဘဲမျိုးရိုးမြှင့်တင်ခြင်းလုပ်ငန်း၏ ရည်ရွယ်ချက်မှာ အသားထုတ်လုပ်မှုမြင့်မားသော မျိုးဘဲများ၏ အရည်အသွေးအား ထိန်းသိမ်းထားနိုင်ရန် နှင့် အာရှတိုက် အတွင်းကြက်ဥက်တုပ်ကွေးရောဂါကြောင့် မျိုးဘဲများထပ်မံတင်သွင်းနိုင်မှု မရှိမီကာလအတွင်း လက်ရှိမျိုး၏ထုတ်လုပ်မှု အရည်အသွေး ကျဆင်းမှု မရှိစေရန် ဖြစ်ပါသည်။ အသားတိုးဘဲများတွင် အသားတက်နှုန်းမှာ မျိုးဘဲထီး အပေါ်တွင် မူတည်ပါသည်။ ၎င်းမျိုးဘဲထီးများအား မျိုးမြှင့်မျိုးထိန်းရွေးချယ်ဖော်ထုတ်နိုင်ရန် (၂၁-၇-၂၀၀၅) ရက်နေ့မှ (၁၅-၂-၂၀၀၈) ရက်နေ့အထိ အသားတိုးဘဲ မျိုးရိုးမြှင့်တင်ခြင်း လုပ်ငန်းအား လုပ်ဆောင်ခဲ့ပါသည်။ လုပ်ဆောင်ရာတွင် ရွာသာကြီးဘဲမွေးမြူရေးခြံတွင် လက်ရှိထုတ်လုပ်မှုပေးနေသော မျိုးဘဲများမှ မျိုးဘဲထီး (၂၀) ကောင်၊ မျိုးဘဲမ (၁၀၀) ကောင်ရွေးချယ်၍ မျိုးဘဲဥထုတ်လုပ်ခြင်းနှင့် မှတ်တမ်းကောက်ယူခြင်း၊ ဗဟိုဖောက်စက်တွင် မျိုးဥများမှ အသားတိုးဘဲပေါက်များအား စမ်းသပ်မှုပြုလုပ်ခြင်း၊ စမ်းသပ်မှုရလဒ်များမှ အကောင်းဆုံးမျိုးဘဲထီးများအား ရွေးချယ်ပါသည်။ မျိုးဘဲထီးရွေးချယ်ရာတွင် မျိုးအောင်နှုန်း ကောင်းမွန်မှု၊ ဘဲပေါက်နှုန်းကောင်းမွန်မှု၊ ထွက်ရှိဘဲပေါက်များ၏ Meat Test Result အကောင်းဆုံး ရရှိမှုတို့အပေါ် အခြေခံထား၍ ရွေးချယ်ပါသည်။ အသားတိုးဘဲပေါက်မွေးမြူသည့် ကာလ (၇) ပတ်တွင် ရှင်သန်နှုန်း (၈၈%)၊ ကိုယ်အလေးချိန် (၂. ၂) ကီလိုဂရမ်၊ အစာမှအသားပြောင်းနှုန်း ၁း၂. ၅ ရရှိရန် မျှော်မှန်း၍ လုပ်ဆောင်ခဲ့ပါသည်။

ရွေးချယ်ထားသော မျိုးဘဲထီး (၂၀) ကောင် နှင့် မျိုးဘဲမ (၁၀၀) ကောင် တို့အား Random (၁၀) ခန်း ခွဲ၍ ၎င်းတို့မှ ထွက်ရှိဘဲပေါက်များ နှင့် Commercial ဘဲပေါက်အား Control ထားကာ Meat Test (၂)ကြိမ်ပြုလုပ်ခဲ့ပြီး ၎င်းအတွက် Result များမှအုပ်စု (၃) စုအား ရွေးချယ်ခဲ့ပြီး ၎င်းအုပ်စုများအား မျိုးယူကာ မျိုးဘဲထီး (၂၀) ကောင် နှင့် မျိုးဘဲမ (၁၀၀) ကောင် တို့အား ထပ်မံရွေးချယ်ပြီး ၎င်းမှ ထွက်ရှိ ဘဲပေါက်များ နှင့် Commercial ဘဲပေါက်အား Control ထားကာ Meat Test (၂) ကြိမ် ပြုလုပ်ကာ ထပ်မံ၍ မျိုးထီးရွေးချယ်ပြီး မျိုးမြှင့်ခြင်းလုပ်ဆောင်ခဲ့ပါသည်။ ဤကဲ့သို့ အကြိမ်ကြိမ် စမ်းသပ် မျိုးမြှင့်ခဲ့ခြင်းကြောင့် အသားတိုးဘဲများ၏ အရည်အသွေးအား ထိန်းထားနိုင်ခဲ့ပါသည်။

နိဒါန်း

မွေးမြူရေးနှင့် ရေလုပ်ငန်းဝန်ကြီးဌာန၊ အသားကဏ္ဍ ဖွံ့ဖြိုးစေရေးအတွက် ဆောင်ရွက်ရာတွင် ထုတ်လုပ်မှု မြန်ဆန်သော အသားတိုးဘဲ မွေးမြူရေးလုပ်ငန်းကို ပိုမို တိုးတက်အောင်ဆောင်ရွက်ရန် မွေးမြူရေး၊ အစားအစာ နှင့် နို့ထွက်ပစ္စည်းလုပ်ငန်း သို့ တာဝန်ပေးအပ်ခဲ့ပါသည်။ အဆိုပါ တာဝန် ပေးအပ်မှုအား အကောင်အထည်ဖော် ဆောင်ရွက်ရန် အသားတိုးဘဲ မျိုးရိုး မြှင့်တင်ခြင်း လုပ်ငန်းကို လုပ်ဆောင်ခဲ့ခြင်း ဖြစ်ပါသည်။

မြန်မာနိုင်ငံ၏ဘဲသားထုတ်လုပ်မှုမှာ ၂၀၀၅-၂၀၀၆ ခု ဘဏ္ဍာရေးနှစ် စာရင်းများအရ ဘဲသား (၃၇၃၅) ပိဿာ နှင့် ဘဲကောင်ရေ (၉၇၈၀၀၀) ကောင် ထုတ်လုပ်နိုင်ခဲ့ပါသည်။ ၂၀၀၆-၂၀၀၇ ခုဘဏ္ဍာရေးနှစ် စာရင်းများအရ ဘဲသား (၄၁၈၈၆) ပိဿာ နှင့် ဘဲကောင်ရေ (၁၀၁၂၀၀၀) ကောင် ထုတ်လုပ်နိုင်၍ လျာထားချက်ထက် ကျော်လွန်အောင် ထုတ်လုပ်နိုင်ခဲ့ပါသည်။ ၂၀၀၇-၂၀၀၈ ခု ဘဏ္ဍာရေးနှစ်စာရင်းများအရ ဘဲသား (၄၅၁၈၃) ပိဿာ နှင့် ဘဲကောင်ရေ (၁၀၄၂၀၀၀) ကောင် ထုတ်လုပ်ရန် လျာထားခဲ့ပါသည်။

မြန်မာနိုင်ငံ၏ဘဲမွေးမြူရေးမှာ ၂၀၀၆-၂၀၀၇ ခု ဘဏ္ဍာရေးနှစ် စာရင်းများအရ ဘဲကောင်ရေ (၁၁၁) သိန်းကျော် ရှိသည့်အနက် မွေးမြူရေး၊ အစားအစာနှင့် နို့ထွက်ပစ္စည်းလုပ်ငန်းမှ မွေးမြူထားရှိမှုမှာ (၄၅၃၇၃) ကောင် ဖြစ်ပြီး ဘဲသား (၂၈၉၂၇၉) ပိဿာ၊ မျိုးဘဲဥ (၅၇၉၆၁၉) လုံး၊ ဘဲပေါက်ကောင်ရေ (၃၆၄၃၈၈) ကောင် ထုတ်လုပ်ပေးနိုင်ခဲ့ပါသည်။ ၂၀၀၇-၂၀၀၈ ခု၊ ဘဏ္ဍာရေးနှစ် စာရင်းများအရ လူတစ်ဦးချင်း၏ တစ်နှစ်အသားစားသုံးမှု (၂၂. ၅) ကီလိုဂရမ်ရှိပြီး အနာဂတ်တွင် အသားစားသုံးမှုမြင့်တက်လာနိုင်စေရေး အတွက် အသားကို အဓိကထုတ်လုပ်ပေးသော အသားတိုးဘဲများ၏ အရည်အသွေး မြှင့်တင်နိုင်ရန် အသားတိုးဘဲ မျိုးရိုးမြှင့်တင်ခြင်း လုပ်ငန်းကို အကောင်အထည် ဖော်ခဲ့ရခြင်းဖြစ်ပါသည်။

အသားတိုးဘဲ မျိုးရိုးမြှင့်တင်ခြင်းလုပ်ငန်း၏ ရည်ရွယ်ချက်မှာ အောက်ပါအတိုင်း ဖြစ်ပါသည်-

(က) အသားထုတ်လုပ်မှု မြင့်မားသော မျိုးဘဲများ၏ အရည်အသွေးအား ထိန်းသိမ်းထား နိုင်ရန်၊

(ခ) အာရှတိုက်အတွင်း ကြက်ငှက်တုပ်ကွေးရောဂါကြောင့် မျိုးဘဲများ ထပ်မံတင်သွင်း နိုင်မှုမရှိမီကာလအတွင်း လက်ရှိမျိုး၏ ထုတ်လုပ်မှုအရည် အသွေးကျဆင်းမှု မရှိစေရန်၊

ဆောင်ရွက်သည့် နည်းလမ်း

ရွာသာကြီးဘဲမွေးမြူရေးခြံမှ လက်ရှိ မျိုးဥ ထုတ်လုပ်လျက်ရှိသော မျိုးဘဲ အုပ်စုထဲမှ Phenotypical Performance (မျက်မြင်အခြေအနေအရ ပုံသဏ္ဌာန်ကျနသော ထုတ်လုပ်မှု) ကောင်းမွန်သည့် အသက် (၃၂) ပတ် အရွယ်ရှိ မျိုးဘဲမကြီး (၁၀၀) ကောင်အား (၂၁-၇-၂၀၀၅) ရက်နေ့တွင် ရွေးချယ်ပြီး (၁၀) ကောင်စီ (၁၀) အုပ်စုဖွဲ့၍ တစ်ကောင်ချင်း Leg band များတပ်ဆင်ပြီး အခန်း(၁၀) ခန်းတွင် Random ခွဲခြားပြီး နေရာချထားပါသည်။ စမ်းသပ်မှုကာလတစ်လျောက်လုံး မျိုးဘဲများအား -ညင်းကုန်း စက်ရုံမှထွက်ရှိသော မျိုးဘဲကြီးစာကို ပုံမှန်စံနှုန်းအတိုင်း ကျွေးမွေးပါသည်။ အထက်ပါအတိုင်း မျိုးဘဲထီး (၂၀) ကောင်စီ ခွဲခြမ်း၍ (၂) ကောင်စီ အား မျိုးဘဲမ (၁၀) ကောင်စီ ထည့်သွင်းထားသော (၁၀' × ၁၂') အခန်း (၁) ခန်းစီ သို့ ကျပန်း ထည့်သွင်းမျိုးစပ်ပါသည်။ ၎င်းစမ်းသပ်ခန်း (၁၀)ခန်းအား တူညီသော အစာ၊ ဆေး နှင့် Management ပေး၍ စမ်းသပ်မှုတစ်ပတ်ပြည့်သော (၂၈-၇-၂၀၀၅) ရက်နေ့တွင် စတင် မျိုးဥကောက်ပြီး(၇)ရက်စုပါသည်။ အုပ်စုတစ်စုချင်းအလိုက် ရောနှောမှုမရှိစေရန် အဖုံးပါ ဖောက်ဗန်းဖြင့် သီးခြားစီခွဲ၍ (၂-၉-၂၀၀၅) ရက်နေ့တွင် ထွက်ရှိလာသော အသားတိုး ဘဲပေါက်များအား အုပ်စု တစ်ခုချင်းအလိုက် ပေါက်နှုန်း၊ မျိုးအောင်နှုန်း၊ Body Weight တို့အား Record ပြုလုပ်ပြီး၊ အုပ်စု တစ်စုချင်းမှ ထွက်ရှိ ဘဲပေါက်များအား ပူးတွဲ(၁)ပါအတိုင်း Web Cutting ပြုလုပ်၍ မှတ်သားထားပါသည်။ အုပ်စု(၁၀)စုမှ ထွက်ရှိ ဘဲပေါက်များ နှင့် တစ်ချိန်တည်းထွက်ရှိလာသော Commercial ဘဲပေါက် (၃၀)ကောင်အား Control အနေဖြင့် (၁၀'×၁၀')ခန်း (၁၁)ခန်းတွင် (၁)ခန်းစီ ကျပန်းရွေးချယ်၍ အခင်းထူစနစ်(ကောက်ရိုး)ဖြင့် အနွေးပေးပါသည်။

ဘဲပေါက်များ အနွေးပေးရုံသို့ ရောက်ရှိလျှင်ရောက်ရှိခြင်း အမျိုးအစားအလိုက် တစ်မျိုးချင်း ကိုယ်အလေးချိန် ချိန်ခြင်း၊ နေ့စဉ်သေဆုံးမှု နှင့် တွေ့ရှိရောဂါများအား မှတ်တမ်းတင်ခြင်း၊ အပတ်စဉ် ကိုယ်အလေးချိန် ချိန်ခြင်း၊ အစာ စားသုံးမှု မှတ်တမ်းထားရှိခြင်း၊ အခန်းအပူချိန် နှင့် ထူးခြားဖြစ်စဉ် များအား မှတ်တမ်းထားရှိခြင်း တို့ ပြုလုပ်ခဲ့ပါသည်။

ရက်သား မှ (၃)ပတ်သားအထိ အသားတိုးဘဲငယ်စာ၊ (၃)ပတ်သား မှ (၇)ပတ်သား အထိ အသားတိုးဘဲလတ်စာတို့အား -ညင်းကုန်းအစာစပ်စက်ရုံမှ အစာတောင့် အနေအထား ဖြင့် ကျွေးမွေးပါသည်။ အစာ Formula အား **ပူးတွဲ(၂)** ဖြင့် တင်ပြအပ်ပါသည်။

ဘဲပေါက် Meat Test ကာလအား (၇)ပတ် သတ်မှတ်ပြီး စမ်းသပ်မှု ပြီးဆုံးသောအခါ (၂၁-၁၀-၂၀၀၅) နေ့တွင် အမျိုးအစား တစ်မျိုးချင်းအလိုက်၊ ကိုယ်အလေးချိန်၊ အစာစားနှုန်း၊ သေနှုန်း? FCR? အသား အရည်အသွေး စစ်ဆေးခြင်းပြုလုပ်ပြီး၊ Data များအား မှတ်တမ်းထားရှိပြီး **ပူးတွဲ (၃)** ပါ အတိုင်း တင်ပြအပ်ပါသည်။

(၂-၉-၂၀၀၅) ရက်နေ့တွင် ဒုတိယအကြိမ် မျိုးဘဲဥစတင်ကောက်ယူပြီး (၉-၉-၂၀၀၅) ရက်နေ့တွင် ဖောက်စက်အတွင်းထည့်ကာ (၇-၁၀-၂၀၀၅) ရက်နေ့တွင် ဘဲပေါက်ထွက်ရှိပြီး (၂၅-၁၁-၂၀၀၅) ရက်နေ့တွင် Meat Test ပြီးဆုံးခဲ့ပါသည်။ ရရှိလာသော Data များအား **ပူးတွဲ(၄)**ပါအတိုင်း တင်ပြအပ်ပါသည်။

ရရှိလာသော Meat Test Result (၂) ခု အပေါ် အခြေခံ၍ အုပ်စု (၃) ခု A,B,C အား မျိုးရွေးချယ်ခဲ့ပါသည်။ ၎င်းမျိုးဘဲထီးများမှ Commercial အသားတိုးဘဲများအား ထုတ်လုပ်ခဲ့ပါသည်။ **ပူးတွဲ (၅)** ပါ Data များအရ ရွေးချယ်ထားသော မျိုးဘဲထီးများသည် မှန်ကန်ကြောင်း အတည်ပြုနိုင်ခဲ့ပါသည်။

၎င်းအုပ်စု A,B,C မှထွက်ရှိ ဘဲပေါက်များမှ မျိုးဘဲများအားထပ်မံရွေးချယ်၍ ၃၂-ပတ်သား အရွယ်တွင် အုပ်စု(၁၀)စုဖြင့် ပထမအကြိမ်အတိုင်း (၄-၁၀-၂၀၀၆) ရက်နေ့တွင် မျိုးဥကောက်ယူပြီး (၁၁-၁၀-၂၀၀၆) ရက်နေ့တွင် ဖောက်စက်တွင် ထည့်ကာ (၈-၁၁-၂၀၀၆) ရက်နေ့တွင် ဘဲပေါက်ထွက်ရှိပြီး (၂၆-၁-၂၀၀၇) ရက်နေ့တွင် ရရှိခဲ့သည့် Meat Test Result ကို **ပူးတွဲ(၆)**ပါအတိုင်းတင်ပြပါသည်။ ၎င်း Result အရအုပ်စု F, D, G အားမျိုးရွေးချယ်၍ အသားတိုး ဘဲပေါက်များအား ထုတ်လုပ်ပါသည်။ ၎င်းဘဲပေါက်များမှ မျိုးဘဲထီးအား ထပ်မံရွေးချယ်ပြီး ၎င်းမှ Commercial အသားတိုး ဘဲပေါက်များ ထုတ်လုပ်လျက်ရှိပါသည်။ **ပူးတွဲ(၇)**ပါ Data များအရ ရွေးချယ်ထားသော မျိုးဘဲထီး များသည် မှန်ကန်ကြောင်း အတည်ပြုနိုင်ခဲ့ပါသည်။

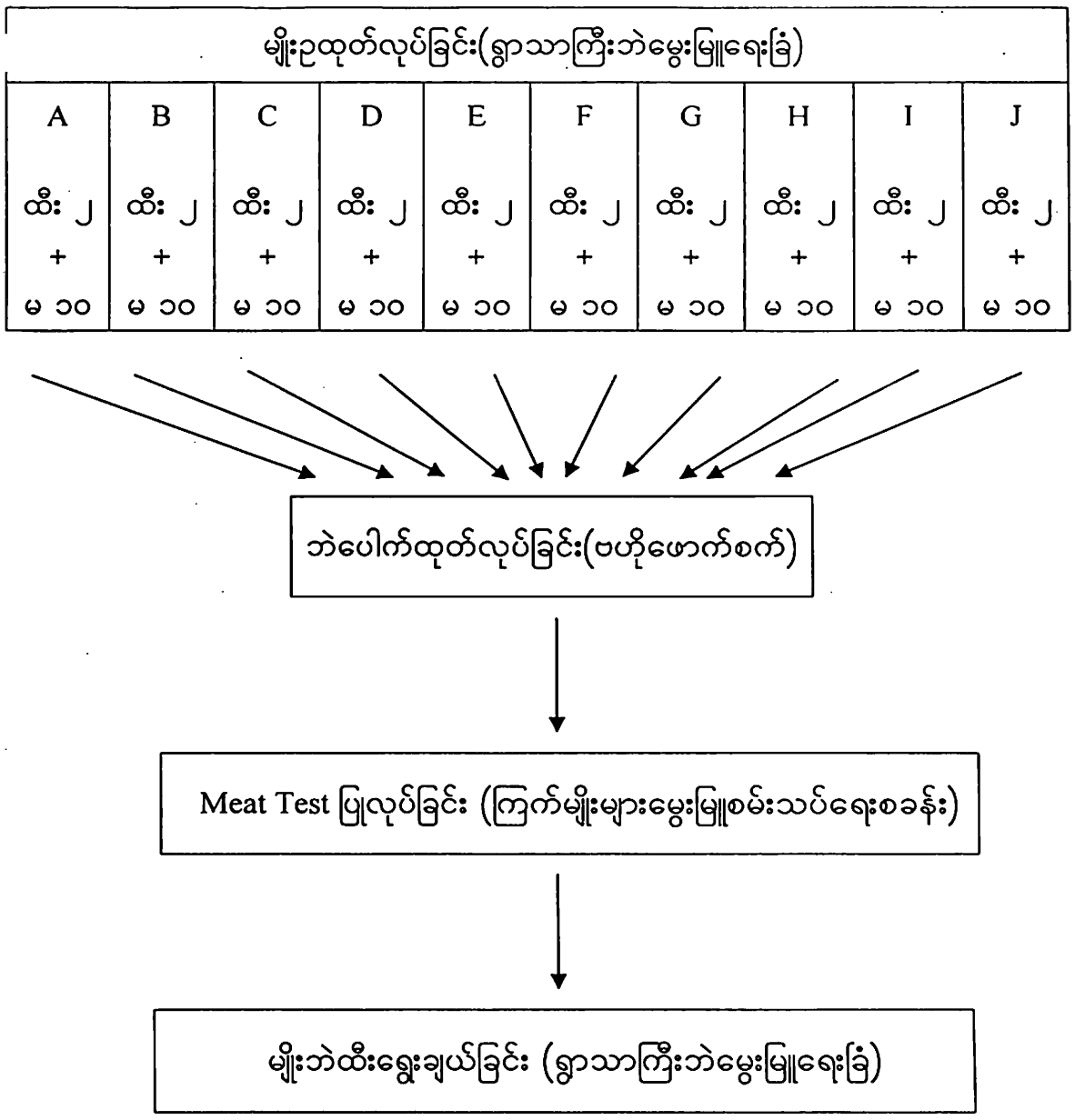
ၵင်းအုပ်စု F,D,G မ့ထွက်ရှိ ဘဲပေါက်များမ့ မျိုးဘဲများအား ထပ်မံရွေးချယ်၍ (၃၂) ပတ်သားအရွယ်တွင် အုပ်စု(၁၀)စုဖြင့် ပထမအကြိမ်အတိုင်း (၂၃-၁၀-၂၀၀၇) ရက်နေ့တွင် မျိုးဥ ကောက်ယူပြီး (၃၀-၁၀-၂၀၀၇) ရက်နေ့တွင်ဖောက်စက်တွင် ထည့်ကာ (၂၈-၁၂-၂၀၀၇) ရက်နေ့တွင် ဘဲပေါက်ထွက်ရှိပြီး (၁၅-၂-၂၀၀၈) ရက်နေ့တွင် ရရှိခဲ့သည့် Meat Test Result ကို ပူးတွဲ(၈)ပါ အတိုင်းတင်ပြပါသည်။ ၵင်း Result အရ အုပ်စု A, H, B အား မျိုးရွေးချယ်၍ အသားတိုး ဘဲပေါက်များအား ထုတ်လုပ် ပါသည်။ ၵင်းဘဲပေါက်များမ့ မျိုးဘဲထီးအား ထပ်မံရွေးချယ်ပြီး ၵင်းမ့ Commercial အသားတိုး ဘဲပေါက်များထုတ်လုပ်လျက်ရှိပါသည်။

နိဂုံးချုပ်

အစာစျေးနှုန်းမြင့်မားမ့ကြောင့် ထုတ်လုပ်မ့စရိတ် မြင့်တက်နေသော ယနေ့ခေတ် မွေးမြူရေးလောကတွင် မျိုးကောင်းမျိုးသန့် ရရှိရေးသည် အလွန် အရေးကြီးပါသည်။ အချိန်တိုအတွင်း အသားတက်နှုန်း မြန်ဆန်သော အသားတိုးဘဲအတွက် အသားတိုးဘဲ မျိုးရိုး မြှင့်တင်ခြင်းလုပ်ငန်းကို အကောင်အထည် ဖော်ခြင်းဖြင့် မျိုးဘဲထီးများ၏ အရည်အသွေးကို မြှင့်တင်ပေးနိုင်၍ နိုင်ငံတော်၏ အသားကဏ္ဍထုတ်လုပ်မ့ု တိုးတက်အောင်ဆောင်ရွက်ရာတွင် တစ်ဖက်တစ်လမ်းမ့ ပါဝင်ဆောင်ရွက် နိုင်မည့်အပြင် ကြက်ဥက်တုပ်ကွေးရောဂါကြောင့် မျိုးဘဲများ ထပ်မံတင်သွင်းနိုင်မ့ု မရှိမီကာလအတွင်း လက်ရှိမျိုး၏ထုတ်လုပ်မ့ု အရည်အသွေး ကျဆင်းမ့ု မရှိစေရန်ထိန်းထားနိုင်မည်ဖြစ်ပါကြောင်း တင်ပြအပ်ပါသည်။

ကျေးဇူးတင်ရှိခြင်း

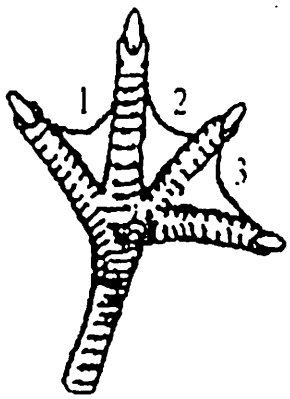
ဤစာတမ်းဖြစ်မြောက်ရေးအတွက် အဖက်ဖက်မ့ အကူအညီပေးခဲ့ကြသော မွေးမြူရေး၊ အစားအစာနှင့်နို့ထွက်ပစ္စည်းလုပ်ငန်းမ့ ဦးဆောင်ညွှန်ကြားရေးမ့ုး၊ အထွေထွေမန်နေဂျာ၊ ဘဲမွေးမြူရေး စီမံကိန်း မန်နေဂျာ၊ မျိုးကြက်ထုတ်လုပ်ရေး မန်နေဂျာတို့အား ကျေးဇူးတင် စကားပြောကြားရင်း စာတမ်းတင်ပြမ့ုအား နိဂုံးချုပ်အပ်ပါသည်။



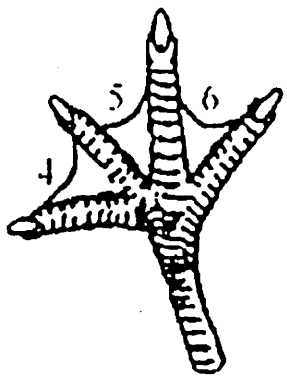
မျိုးဘဲထီးရွေးချယ်ခြင်းအဆင့်ဆင့်ပြပုံ

ပူးတွဲ (၁)

Web-Cutting ပြုလုပ်ခြင်း



Left



Right

1.	A အုပ်စုမှထွက်ရှိသော ဘဲပေါက်အား	1	Web Cutting
2.	B အုပ်စုမှထွက်ရှိသော ဘဲပေါက်အား	2	Web Cutting
3.	C အုပ်စုမှထွက်ရှိသော ဘဲပေါက်အား	3	Web Cutting
4.	D အုပ်စုမှထွက်ရှိသော ဘဲပေါက်အား	4	Web Cutting
5.	E အုပ်စုမှထွက်ရှိသော ဘဲပေါက်အား	5	Web Cutting
6.	F အုပ်စုမှထွက်ရှိသော ဘဲပေါက်အား	6	Web Cutting
7.	G အုပ်စုမှထွက်ရှိသော ဘဲပေါက်အား	1,4	Web Cutting
8.	H အုပ်စုမှထွက်ရှိသော ဘဲပေါက်အား	2,5	Web Cutting
9.	I အုပ်စုမှထွက်ရှိသော ဘဲပေါက်အား	3,6	Web Cutting
10.	J အုပ်စုမှထွက်ရှိသော ဘဲပေါက်အား	1,3	Web Cutting
11.	Control (CS) ဘဲပေါက်အား		No Cutting

ပူးတွဲ (၂)

မျိုးဘဲကြီးစာ	ဆန်ကွဲ	၅၀ %
	ဖွဲနု	၁၀ %
	နှမ်းဖတ်	၁၉ %
	ငါးခြောက်	၁၄ %
	ခရု	၇ %
	ပရိုတင်းပါဝင်မှု	၁၉ %
အသားတိုးဘဲငယ်စာ	ဆန်ကွဲ	၅၂ %
	ဖွဲနု	၁၁ %
	နှမ်းဖတ်	၂၃ %
	ငါးခြောက်	၁၂ %
	ခရု	၂ %
	ပရိုတင်းပါဝင်မှု	၂၀ %
အသားတိုးဘဲလတ်စာ	ဆန်ကွဲ	၅၄ %
	ဖွဲနု	၁၁ %
	နှမ်းဖတ်	၂၁ %
	ငါးခြောက်	၁၂ %
	ခရု	၂ %
	ပရိုတင်းပါဝင်မှု	၁၇ %

ပူးတွဲ (၃-က)

DOC -7 Week Meat Test Result (2-9-2005 – 21-10-2005)

စဉ်	အုပ်စု အမှတ်	ဝိုင်း အမှတ်	စက်သွင်း မျိုး ဥ	ပေါက်ကောင်ရေ	ပေါက်နှုန်း	ဘဲပေါက်အလေးချိန်	သေကောင်ရေ	သေနှုန်း	Avg ကိုယ်အလေးချိန် (kg)	Avg အစာစားနှုန်း (kg)	FCR
၁။	Control	၁	၃၆	၂၅	၆၉	၅၃	-	-	၂.၄၁	၆.၄၀	၂.၆
၂။	H	၂	၄၅	၂၉	၆၄	၅၃	၁	၃	၂	၆.၄၃	၅
၃။	A	၃	၄၄	၂၂	၅၀	၅၀	-	-	၂.၅၀	၆.၃၆	၂.၅
၄။	D	၄	၄၃	၂၉	၆၇	၅၀	-	-	၂	၆.၂၀	၆
၅။	E	၅	၃၁	၂၂	၆၈	၄၉	၁	၄	၂.၅၅	၆.၄၁	၂.၄
၆။	G	၆	၄၂	၂၃	၃၃	၄၆	၂	၉	၅	၆.၆၀	၉
၇။	J	၇	၃၈	၂၆	၆၈	၅၅	-	-	၂.၅၀	၆.၃၅	၂.၄
၈။	C	၈	၃၄	၁၇	၅၀	၅၀	၁	၄	၃	၆.၂၂	၁
၉။	I	၉	၄၄	၁၅	၃၄	၅၃	-	-	၂.၄၅	၆.၂၇	၂.၆
၁၀	B	၁၀	၂၆	၁၅	၅၈	၅၃	-	-	၂.၄၅		၉
။	F	၁၁							၀		
၁၁									၂.၅၄		၂.၅
။									၀		၀
									၂.၅၂		၂.၅
									၀		၁
									၂.၄၇		၂.၅
									၀		၂
									၂.၆၃		၂.၄
									၃		၀
									၂.၄၆		၂.၅
									၃		၄
	Test Avg:	၁	၄၁၆	၂၄၆	၆၀	၅၁	၅	၂	၂.၅၁	၆.၄၆	၂.၅
									၂		၂

ပူးတွဲ (၃-ခ)

DOC -7 Week Meat Test Result (2-9-2005 – 21-10-2005)

စဉ်	အုပ်စုအမှတ်	ဝိုင်းအမှတ်	ဘဲမအလေးချိန် (kg)	ဘဲမကောင်ရေ	ဘဲထီးအလေးချိန် (kg)	ဘဲထီးကောင်ရေ	စုစုပေါင်းကောင်ရေ	စုစုပေါင်းကိုယ်အလေးချိန် (kg)	Avg ကိုယ်အလေးချိန် (kg)	Avg အစာစားနှုန်း (kg)	FCR
၁.	Control	၁.	၃၅. ၄	၁၅	၂၅. ၈	၁၀	၂၅	၆၁. ၂	၂. ၄၁၂	၆. ၄၀	၂. ၆၅
၂.	H	၂.	၅၁. ၄	၂၀	၁၈. ၈	၈	၂၈	၇၀. ၂	၂. ၅၀၇	၆. ၄၃	၂. ၅၆
၃.	A	၃.	၃၇. ၈	၁၅	၁၈. ၄	၇	၂၂	၅၆. ၂	၂. ၅၅၅	၆. ၃၆	၂. ၄၉
၄.	D	၄.	၃၅. ၆	၁၅	၃၇	၁၄	၂၉	၇၂. ၆	၂. ၅၀၃	၆. ၂၁	၂. ၄၈
၅.	E	၅.	၃၄. ၆	၁၄	၂၁. ၆	၈	၂၂	၅၆. ၂	၂. ၅၅၅	၆. ၄၁	၂. ၅၁
၆.	G	၆.	၃၁. ၂	၁၃	၁၇. ၈	၇	၂၀	၄၉	၂. ၄၅၀	၆. ၆၀	၂. ၆၉
၇.	J	၇.	၂၆. ၂	၁၁	၃၂. ၂	၁၂	၂၃	၅၈. ၄	၂. ၅၄၀	၆. ၃၅	၂. ၅၀
၈.	C	၈.	၂၉. ၂	၁၂	၃၃. ၈	၁၃	၂၅	၆၃	၂. ၅၂၀	၆. ၃၂	၂. ၅၁
၉.	I	၉.	၂၃. ၂	၁၀	၁၈. ၈	၇	၁၇	၄၂	၂. ၄၇၀	၆. ၂၄	၂. ၅၃
၁၀.	B	၁၀.	၁၁. ၅	၅	၂၈	၁၀	၁၅	၃၉. ၅	၂. ၆၃၃	၆. ၃၃	၂. ၄၀
၁၁.	F	၁၁.	၁၆	၇	၂၁	၈	၁၅	၃၇	၂. ၄၆၇	၆. ၂၇	၂. ၅၄
၊	Test Avg		၃၃၂. ၁	၁၃၇	၂၇၃. ၂	၁၀၄	၂၄၁	၆၀၅. ၃	၂. ၅၁ ၂	၆. ၃၆	၂. ၅ ၃

ပူးတွဲ (၃-၃)

Carcass Evaluation Data

No	Entry	No	Avg Live wt (kg)	Avg Dress wt (kg)	Avg Dress wt %	Leg wt (kg)	% dre; wt	Leg Meat (kg)	Leg Meat %	Breast wt (kg)	% dre; wt	Breast Meat (kg)	Breast Meat %	Wing (kg)
1.	Control	X	2.80	1.90	68.0	0.43	22.6	0.23	12.1	0.34	17.9	0.19	10.0	0.22
		x	2.30	1.60	70.0	0.38	23.8	0.21	13.1	0.33	20.6	0.20	12.5	0.19
		Avg	2.60	1.75	69.0	0.41	23.2	0.22	12.6	0.34	19.3	0.20	11.3	0.21
2.	H	X	3.00	2.12	71.0	0.46	22.0	0.23	10.9	0.49	23.1	0.27	12.7	0.24
		x	2.80	1.96	70.0	0.41	20.9	0.23	11.7	0.36	18.4	0.24	12.3	0.24
		Avg	2.90	2.04	70.5	0.44	21.5	0.23	11.3	0.43	20.8	0.26	12.5	0.24
3.	A	X	2.80	1.94	69.3	0.40	20.6	0.20	10.3	0.42	21.7	0.26	13.4	0.22
		x	2.50	1.75	70.0	0.38	21.7	0.22	12.6	0.42	24.0	0.22	12.6	0.20
		Avg	2.65	1.85	69.7	0.39	21.2	0.21	11.4	0.42	22.8	0.24	13.0	0.21
4.	D	X	2.90	2.10	72.4	0.43	20.5	0.21	10.0	0.43	20.5	0.24	11.4	0.24
		x	2.40	1.50	62.5	0.32	21.3	0.20	13.3	0.40	26.7	0.22	14.7	0.21
		Avg	2.70	1.80	67.5	0.38	20.9	0.21	11.7	0.42	23.6	0.23	13.1	0.23
5.	E	X	3.10	2.35	75.8	0.50	21.3	0.24	10.2	0.60	25.5	0.32	13.6	0.26
		x	2.80	2.00	71.4	0.44	22.0	0.21	10.5	0.42	21.0	0.25	12.5	0.22
		Avg	3.00	2.18	73.6	0.47	21.7	0.23	10.4	0.51	23.3	0.29	13.1	0.24
6.	G	X	2.70	1.94	71.9	0.40	20.6	0.20	10.3	0.44	22.7	0.24	12.4	0.26
		x	2.40	1.72	71.9	0.28	16.3	0.18	10.5	0.38	22.0	0.22	12.8	0.22
		Avg	2.55	1.86	72.9	0.34	18.5	0.19	10.4	0.36	22.4	0.23	12.6	0.24
7.	J	X	2.80	2.00	71.4	0.42	21.0	0.22	11.0	0.44	22.0	0.25	12.5	0.22
		x	2.50	1.80	72.0	0.32	17.8	0.20	11.1	0.40	22.2	0.20	11.1	0.22
		Avg	2.65	1.90	71.7	0.37	19.4	0.21	11.1	0.42	22.1	0.23	11.8	0.22
8.	C	X	2.80	2.14	76.4	0.48	22.4	0.27	12.6	0.48	22.4	0.27	12.6	0.26
		x	2.40	1.80	75.0	0.38	21.1	0.19	10.6	0.42	23.3	0.21	11.7	0.22
		Avg	2.60	1.97	75.7	0.43	21.8	0.23	11.6	0.45	22.9	0.24	12.2	0.24
9.	I	X	2.60	1.95	75.0	0.42	21.5	0.24	12.3	0.36	18.5	0.24	12.3	0.23
		x	2.40	1.74	72.5	0.38	21.8	0.20	11.5	0.38	21.8	0.20	11.5	0.22
		Avg	2.50	1.85	73.8	0.40	21.7	0.22	11.9	0.37	20.2	0.22	11.9	0.23
10.	B	X	2.80	2.15	76.8	0.42	19.5	0.23	10.7	0.50	23.3	0.26	12.1	0.24
		x	2.30	1.76	76.5	0.39	22.2	0.22	12.5	0.36	20.5	0.22	12.5	0.20
		Avg	2.55	1.96	76.7	0.41	20.9	0.23	11.6	0.43	21.9	0.24	12.3	0.22
11.	F	X	2.60	1.90	73.1	0.37	19.5	0.24	12.6	0.36	19.0	0.20	10.5	0.26
		x	2.40	1.75	72.9	0.34	19.4	0.23	13.1	0.36	20.6	0.20	11.4	0.24
		Avg	2.50	1.83	73.0	0.36	19.5	0.24	12.9	0.36	19.8	0.20	11.0	0.25
	Test	Avg	2.66	1.91	72.2	0.40	20.9	0.22	11.53	0.41	21.7	0.23	12.3	0.23

ပူးတွဲ (၄-က)

DOC (7)Week Meat Test Result (7-10-2005 TO 25-11-2005)

စဉ်	အုပ်စု အမှတ်	ဝိုင်း အ မှတ်	စက် သွင်း မျိုး ဥ	ပေါက် ကောင် ရေ	ပေါက် နှုန်း	ဘဲ ပေါက် အလေး ချိန်	သေ ကောင် ရေ	သေ နှုန်း	Avg ကိုယ် အလေး ချိန် (kg)	Avg အစာ စားနှုန်း (kg)	F C R
၁။	Control	၁	၃၈	၂၆	၆၈	၅၄	-	-	၂. ၆၁	၆. ၃၉	၂. ၆၀
၂။	H	၂	၄၃	၂၅	၆၈	၆၀	-	-	၂. ၆၈	၆. ၈၉	၂. ၅၃
၃။	A	၃	၄၆	၂၅	၅၄	၅၃	-	-	၂. ၃၆၈	၆. ၆၅	၂. ၄၀
၄။	D	၄	၄၆	၃၀	၆၅	၅၂	၁	၃	၂. ၃၂	၆. ၆၉	၂. ၄၆
၅။	E	၅	၄၂	၃၁	၃၄	၅၅	၂	၃	၂. ၃၄	၆. ၈၈	၂. ၅၂
၆။	G	၆	၄၅	၂၀	၅၃	၅၆	-	-	၂. ၆၁	၆. ၈၆	၂. ၆၃
၇။	J	၇	၃၉	၂၂	၅၆	၅၉	-	-	၂. ၆၉	၆. ၃၀	၂. ၄၉
၈။	C	၈	၄၄	၃၁	၃၀	၅၆	-	-	၂. ၃၃	၆. ၆၆	၂. ၄၀
၉။	I	၉	၄၂	၂၂	၅၂	၅၆	-	-	၂. ၃၀	၆. ၈၉	၂. ၅၅
၁၀။	B	၁၀	၄၅	၂၂	၄၉	၅၆	၂	၉	၂. ၃၈	၆. ၉၂	၂. ၄၉
၁၁။	F	၁၁	၂၉	၂၁	၃၂	၅၈	-	-	၂. ၆၄	၆. ၆၉	၂. ၅၃
	Test Avg:	၊	၄၄၃	၂၃၅	၆၂. ၁	၅၆	၅	၁. ၈	၂. ၃၀	၆. ၃၈	၂. ၅၁

ပူးတွဲ (၄-ခ)

DOC (7)WEEK MEAT TEST RESULT(7-10-2005 TO 25-11-2005)

စဉ်	အုပ်စုအမှတ်	ဝိုင်းအမှတ်	ဘဲမအလေးချိန် (kg)	ဘဲမကောင်ရေ	ဘဲထီးအလေးချိန် (kg)	ဘဲထီးကောင်ရေ	စုစုပေါင်းကောင်ရေ	စုစုပေါင်းကိုယ်အလေးချိန် (kg)	ပျမ်းမျှကိုယ်အလေးချိန် (kg)	Avg အစာစားနှုန်း (kg)	FCR
၁.	Control	၁.	၃၅. ၂	၁၄	၃၂. ၆	၁၂	၂၆	၆၇. ၈	၂. ၆၁	၆. ၇၉	၂. ၆၀
၂.	H	၂.	၂၂. ၈	၉	၄၄. ၂	၁၆	၂၅	၆၇. ၀	၂. ၆၈	၆. ၈၉	၂. ၅၇
၃.	A	၃.	၃၉. ၆	၁၅	၂၉. ၆	၁၀	၂၅	၆၉. ၂	၂. ၇၇	၆. ၆၅	၂. ၄၀
၄.	D	၄.	၃၁. ၀	၁၂	၄၇. ၈	၁၇	၂၉	၇၈. ၈	၂. ၇၂	၆. ၆၉	၂. ၄၆
၅.	E	၅.	၃၉. ၂	၁၅	၄၀. ၀	၁၄	၂၉	၇၉. ၂	၂. ၇၃	၆. ၈၈	၂. ၅၂
၆.	G	၆.	၂၈. ၃	၁၁	၂၃. ၈	၉	၂၀	၅၂. ၁	၂. ၆၁	၆. ၈၆	၂. ၆၃
၇.	J	၇.	၂၀. ၈	၈	၃၈. ၄	၁၄	၂၂	၅၉. ၂	၂. ၆၉	၆. ၇၀	၂. ၄၉
၈.	C	၈.	၂၆. ၀	၁၀	၆၀. ၀	၂၁	၃၁	၈၆. ၀	၂. ၇၇	၆. ၆၆	၂. ၄၀
၉.	I	၉.	၂၈. ၄	၁၁	၃၁. ၀	၁၁	၂၂	၅၉. ၄	၂. ၇၀	၆. ၈၉	၂. ၅၅
၁၀.	B	၁၀.	၁၈. ၀	၇	၃၇. ၆	၁၃	၂၀	၅၅. ၆	၂. ၇၈	၆. ၉၂	၂. ၄၉
၁၁.	F	၁၁.	၂၄. ၄	၁၀	၃၁. ၀	၁၁	၂၁	၅၅. ၄	၂. ၆၄	၆. ၆၉	၂. ၅၃
၁	Test Avg		၃၁၃. ၇	၁၂၂	၄၁၆. ၀	၁၄၈	၂၇၀	၇၂၉. ၇	၂. ၇၀	၆. ၇၈	၂. ၅၁

ပူးတွဲ (၄-ဂ)

Carcass Evaluation Data

No	Entry	No	Avg Live wt (kg)	Avg Dress wt (kg)	Avg Dress wt %	Leg wt (kg)	% dre; wt	Leg Meat (kg)	Leg Meat %	Breast wt (kg)	% dre; wt	Breast Meat (kg)	Breast Meat %	Wing (kg)
1.	Control	X	2.60	2.00	76.9	0.32	16.0	0.19	9.5	0.41	20.5	0.28	14.0	0.26
		x	2.90	1.88	64.8	0.41	21.8	0.20	10.6	0.45	23.9	0.29	15.4	0.22
		Avg	2.75	1.94	70.9	0.37	19.1	0.20	10.3	0.43	22.2	0.29	15.0	0.24
2.	H	X	3.20	2.30	71.9	0.49	21.3	0.28	12.2	0.60	26.0	0.33	14.4	0.25
		x	2.60	1.94	74.6	0.42	21.7	0.24	12.4	0.49	25.3	0.31	16.0	0.24
		Avg	2.90	2.12	73.1	0.46	21.7	0.26	12.3	0.55	25.9	0.32	15.1	0.25
3.	A	X	3.2	2.44	76.3	0.53	21.7	0.27	11.1	0.49	20.1	0.33	13.5	0.24
		x	2.7	2.15	79.6	0.35	16.3	0.22	10.2	0.52	24.2	0.29	13.5	0.25
		Avg	3.0	2.30	76.7	0.44	19.1	0.25	10.9	0.51	22.2	0.31	13.5	0.25
4.	D	X	3.1	2.17	70.0	0.47	21.7	0.23	10.6	0.51	23.5	0.31	14.3	0.25
		x	2.6	1.85	71.2	0.37	20.0	0.19	10.3	0.46	24.9	0.29	15.7	0.21
		Avg	2.9	2.01	69.3	0.42	20.9	0.21	10.4	0.49	24.4	0.30	14.9	0.23
5.	E	X	2.9	2.17	74.8	0.50	23.0	0.26	12.0	0.51	23.5	0.35	16.1	0.24
		x	2.9	2.10	72.4	0.45	21.4	0.22	10.5	0.55	26.2	0.31	14.8	0.23
		Avg	2.9	2.14	73.8	0.48	22.4	0.24	11.2	0.53	24.8	0.33	15.4	0.24
6.	G	X	2.9	2.07	71.4	0.42	20.3	0.21	10.1	0.44	21.3	0.30	14.5	0.22
		x	2.9	1.96	67.6	0.38	19.4	0.20	10.2	0.50	25.5	0.32	16.3	0.22
		Avg	2.9	2.02	69.7	0.40	19.8	0.21	10.4	0.47	23.3	0.31	15.3	0.22
		X	3.2	2.20	68.8	0.50	22.7	0.27	12.3	0.50	22.7	0.30	13.6	0.25
7.	J	x	2.6	1.88	72.3	0.36	19.2	0.19	10.1	0.45	23.9	0.28	14.9	0.21
		Avg	2.9	2.04	70.4	0.43	21.1	0.23	11.3	0.48	23.5	0.29	14.2	0.23
		X	2.9	2.09	72.1	0.45	21.5	0.24	11.8	0.50	23.9	0.33	15.8	0.24
8.	C	x	2.8	2.12	75.7	0.44	20.8	0.24	11.3	0.44	20.8	0.35	16.5	0.26
		Avg	2.9	2.11	72.8	0.45	21.3	0.24	11.4	0.47	22.3	0.34	16.1	0.25
		X	3.0	2.22	74.0	0.50	22.5	0.26	11.7	0.51	23.0	0.32	14.4	0.24
9.	I	x	2.4	1.74	72.5	0.38	21.8	0.22	12.6	0.45	25.3	0.28	16.1	0.20
		Avg	2.7	1.98	73.3	0.44	22.2	0.24	12.1	0.48	24.2	0.30	15.2	0.22
		X	3.2	2.32	72.5	0.50	21.6	0.26	11.2	0.59	25.4	0.37	16.0	0.24
10.	B	x	2.4	1.77	73.8	0.35	19.8	0.19	10.7	0.44	24.9	0.29	16.4	0.22
		Avg	2.8	2.05	73.2	0.43	21.0	0.23	11.2	0.52	25.4	0.33	16.1	0.23
		X	2.7	1.82	67.4	0.36	19.8	0.20	11.0	0.45	24.7	0.29	15.9	0.21
11.	F	x	2.7	1.88	69.6	0.40	21.3	0.20	10.6	0.46	24.5	0.29	15.4	0.21
		Avg	2.7	1.85	68.5	0.38	20.5	0.20	10.8	0.46	24.9	0.29	15.7	0.21
	Test	Avg	2.8	2.06	73.6	0.42	20.4	0.23	11.2	0.49	23.8	0.31	15.1	0.24

ပူးတွဲ (၅)

အကြောင်းအရာ	၂၀၀၅-၂၀၀၆ ဘဏ္ဍာရေးနှစ်		၂၀၀၆-၂၀၀၇ ဘဏ္ဍာရေးနှစ်	
	ရုံအမှတ်(၆)	ရုံအမှတ်(၇)	ရုံအမှတ်(၆)	ရုံအမှတ်(၁၁)
စတင်ထည့်သွင်းရက်	၁၆. ၉. ၀၅	၁၁. ၁၁. ၀၅	၁၅. ၁၂. ၀၆	၂၉. ၁၂. ၀၆
ထည့်သွင်းကောင်ရေ	၉၀၀	၉၀၀	၉၀၀	၉၀၀
သေကောင်ရေ	၇၃	၅၈	၅၅	၆၄
ရောင်းချကောင်ရေ	၈၂၇	၈၄၂	၈၄၆	၈၃၆
ပိသာချိန်	၁၁၁၀	၁၁၂၀	၁၁၅၁	၁၁၄၄
စတင်ရောင်းနေ့စွဲ	၃၀. ၁၀. ၀၅	၂၆. ၁၂. ၀၅	၂၉. ၁. ၀၇	၁၂. ၂. ၀၇
နောက်ဆုံးရောင်းနေ့စွဲ	၇. ၁၁. ၀၅	၃၀. ၁၂. ၀၅	၂. ၂. ၀၇	၁၆. ၂. ၀၇
ကုန်ကျအစာပိသာ	၂၆၄၂	၂၉၈၀	၂၈၇၇. ၅	၂၈၄၈. ၅
ပျမ်းမျှကိုယ်အလေးချိန်	၁. ၃၄	၁. ၃၃	၁. ၃၆	၁. ၃၇
F C R	၂. ၆၅	၂. ၆၆	၂. ၅၀	၂. ၄၉

ပူးတွဲ (၆-က)

DOC -7 Week Meat Test Result (8-11-2005 — 26-1-2007)

စဉ်	အုပ်စုအမှတ်	ဝိုင်းအမှတ်	စက်သွင်းမျိုးဘဲဥ	ဘဲပေါက်ကောင်ရေ	ပေါက်နှုန်း %	ဘဲပေါက်အလေးချိန်	သေ/ပယ်ကောင်ရေ	သေ/ပယ် %	(၇) ပတ်သား Body wt (kg)	အစာစားနှုန်း (kg)	FCR
၁။	Control	၁	၄၃	၂၅	၅၈	၅၂	၁	၄	၂.၄၈	၆.၂၆	၂.၃၂
၂။	F	၂	၃၂	၂၅	၈၈	၅၃	၁	၄	၃	၆.၈၆	၂.၅၉
၃။	A	၃	၄၀	၂၄	၆၀	၅၀	-	-	၂.၃၄	၅.၈၈	၂.၃၀
၄။	E	၄	၃၂	၂၁	၆၆	၅၅	၁	၅	၂	၆.၃၄	၂.၆၆
၅။	D	၅	၂၃	၁၇	၆၃	၅၃	-	-	၂.၅၅	၆.၃၃	၂.၃၈
၆။	C	၆	၂၂	၁၆	၆၈	၅၆	-	-	၈	၆.၉၈	၂.၆၃
၇။	I	၇	၂၄	၂၂	၆၃	၅၆	-	-	၂.၅၃	၆.၆၆	၂.၅၅
၈။	B	၈	၃၅	၁၈	၆၃	၅၀	-	-	၀	၆.၈၉	၂.၆၀
၉။	G	၉	၃၀	၂၉	၆၃	၅၂	-	-	၂.၆၈	၆.၆၃	၂.၄၃
၁၀။	H	၁၀	၂၃					၉	၂	၆.၃၂	၂.၅၅
၁၁။	J	၁၁	၄၃						၂.၄၅	၃	
									၂.၆၃	၆	
									၂.၃၀	၅	
									၂.၆၀	၁	
									၂.၆၀	၃	
၊	Test Avg:		၃၅၆	၂၃၄	၆၆	၅၃	၃	၁	၂.၆၀	၆.၃၀	၂.၅၈

ပူးတွဲ (၆-ခ)

DOC -7 Week Meat Test Result (8-11-2005 — 26-1-2007)

စဉ်	အုပ်စုအမှတ်	ဝိုင်းအမှတ်	ဘဲမအလေးချိန် (kg)	ဘဲမကောင်ရေ	ဘဲထီးအလေးချိန် (kg)	ဘဲထီးကောင်ရေ	စုစုပေါင်းကောင်ရေ	စုစုပေါင်းကိုယ်အလေးချိန် (kg)	Avg ကိုယ်အလေးချိန် (kg)	Avg အစာစားနှုန်း (kg)	FCR
၁.	Control	၁.	၃၅. ၄	၁၅	၂၅. ၈	၁၀	၂၅	၆၁. ၂	၂. ၄၁၂	၆. ၄၀	၂. ၆၅
၂.	H	၂.	၅၁. ၄	၂၀	၁၈. ၈	၈	၂၈	၇၀. ၂	၂. ၅၀၇	၆. ၄၃	၂. ၅၆
၃.	A	၃.	၃၇. ၈	၁၅	၁၈. ၄	၇	၂၂	၅၆. ၂	၂. ၅၅၅	၆. ၃၆	၂. ၄၉
၄.	D	၄.	၃၅. ၆	၁၅	၃၇	၁၄	၂၉	၇၂. ၆	၂. ၅၀၃	၆. ၂၁	၂. ၄၈
၅.	E	၅.	၃၄. ၆	၁၄	၂၁. ၆	၈	၂၂	၅၆. ၂	၂. ၅၅၅	၆. ၄၁	၂. ၅၁
၆.	G	၆.	၃၁. ၂	၁၃	၁၇. ၈	၇	၂၀	၄၉	၂. ၄၅၀	၆. ၆၀	၂. ၆၉
၇.	J	၇.	၂၆. ၂	၁၁	၃၂. ၂	၁၂	၂၃	၅၈. ၄	၂. ၅၄၀	၆. ၃၅	၂. ၅၀
၈.	C	၈.	၂၉. ၂	၁၂	၃၃. ၈	၁၃	၂၅	၆၃	၂. ၅၂၀	၆. ၃၂	၂. ၅၁
၉.	I	၉.	၂၃. ၂	၁၀	၁၈. ၈	၇	၁၇	၄၂	၂. ၄၇၀	၆. ၂၄	၂. ၅၃
၁၀.	B	၁၀.	၁၁. ၅	၅	၂၈	၁၀	၁၅	၃၉. ၅	၂. ၆၃၃	၆. ၃၃	၂. ၄၀
၁၁.	F	၁၁.	၁၆	၇	၂၁	၈	၁၅	၃၇	၂. ၄၆၇	၆. ၂၇	၂. ၅၄
၊	Test Avg		၃၃၂. ၁	၁၃၇	၂၇၃. ၂	၁၀၄	၂၄၁	၆၀၅. ၃	၂. ၅၁၂	၆. ၃၆	၂. ၅၃

ပူးတွဲ (၆-၀)

Carcass Evaluation Data

No	Entry	No	Avg Live wt (kg)	Avg Dress wt (kg)	Avg Dress wt %	Leg wt (kg)	% dre; wt	Leg Meat (kg)	Leg Meat %	Breast wt (kg)	% dre; wt	Breast Meat (kg)	Breast Meat %	Wing (kg)
1.	Control	X	2.6	1.98	76	0.39	20	0.28	14	0.41	21	0.22	11	0.21
		x	3.0	2.3	77	0.47	20	0.26	11	0.55	24	0.33	14	0.26
		Avg	2.8	2.14	76	0.43	20	0.27	13	0.48	22	0.28	13	0.24
2.	F	X	3.1	2.32	75	0.43	19	0.23	10	0.44	19	0.30	13	0.26
		x	2.8	2.22	79	0.50	23	0.24	11	0.52	23	0.29	13	0.22
		Avg	3.0	2.29	78	0.47	21	0.25	11	0.48	21	0.30	13	0.24
3.	A	X	2.9	2.10	72	0.48	23	0.27	13	0.44	21	0.24	11	0.23
		x	2.6	2.00	77	0.44	22	0.25	13	0.43	22	0.24	12	0.22
		Avg	2.8	2.05	75	0.46	22	0.26	13	0.44	22	0.22	12	0.23
4.	E	X	2.7	2.00	74	0.43	22	0.22	11	0.42	21	0.26	11	0.22
		x	2.6	2.10	71	0.45	21	0.24	11	0.49	23	0.24	12	0.22
		Avg	2.7	2.05	77	0.44	22	0.23	11	0.46	22	0.21	12	0.22
5.	D	X	2.6	1.90	73	0.39	21	0.22	12	0.41	22	0.25	11	0.21
		x	2.7	2.00	74	0.45	23	0.23	12	0.45	23	0.23	13	0.20
		Avg	2.7	1.95	74	0.42	22	0.28	14	0.43	22	0.26	12	0.21
6.	C	X	2.9	2.12	73	0.46	22	0.24	11	0.46	22	0.24	12	0.24
		x	2.7	1.98	73	0.42	21	0.22	11	0.46	23	0.25	12	0.23
		Avg	2.8	2.05	73	0.44	22	0.23	11	0.46	22	0.22	12	0.24
7.	I	X	2.9	2.20	76	0.48	22	0.24	11	0.48	22	0.25	10	0.23
		x	2.7	1.98	73	0.40	20	0.22	11	0.46	23	0.24	13	0.21
		Avg	2.8	2.09	75	0.44	21	0.23	11	0.47	23	0.24	12	0.22
8.	B	X	3.0	2.20	73	0.56	26	0.32	15	0.46	21	0.30	11	0.24
		x	2.8	2.10	75	0.42	20	0.22	11	0.50	24	0.27	14	0.25
		Avg	2.9	2.14	74	0.49	43	0.27	13	0.48	22	0.34	13	0.25
9.	G	X	3.2	2.42	76	0.50	21	0.29	12	0.56	23	0.30	14	0.28
		x	3.1	2.40	77	0.50	21	0.23	10	0.58	24	0.32	13	0.22
		Avg	3.2	2.41	77	0.50	21	0.26	11	0.57	24	0.24	13	0.25
10.	H	X	2.6	2.00	77	0.42	21	0.20	10	0.48	24	0.25	12	0.22
		x	2.8	2.15	77	0.42	20	0.20	9	0.40	19	0.25	12	0.22
		Avg	2.7	2.10	78	0.42	20	0.20	10	0.44	21	0.25	12	0.22
11.	J	X	3.0	2.28	76	0.44	19	0.24	11	0.50	22	0.23	10	0.26
		x	2.6	2.1	81	0.42	20	0.24	11	0.46	22	0.24	11	0.24
		Avg	2.8	2.2	79	0.43	20	0.24	11	0.48	22	0.24	11	0.25
	Test	Avg	2.8	2.13	76	0.45	21	0.24	11	0.47	22	0.26	12	0.24

ပူးတွဲ (၇)

အကြောင်းအရာ	၂၀၀၆-၂၀၀၇ဘဏ္ဍာရေးနှစ်		၂၀၀၇-၂၀၀၈ဘဏ္ဍာရေးနှစ်	
	ရုံအမှတ်(၆)	ရုံအမှတ်(၁၁)	ရုံအမှတ်(၇)	ရုံအမှတ်(၃)
စတင်ထည့်သွင်းရက်	၁၅. ၁၂. ၀၆	၂၉. ၁၂. ၀၆	၂. ၃. ၀၇	၂၉. ၆. ၀၇
ထည့်သွင်းကောင်ရေ	၉၀၀	၉၀၀	၉၀၀	၉၀၀
သေကောင်ရေ	၅၄	၆၄	၅၀	၆၈
ရောင်းချကောင်ရေ	၈၄၆	၈၃၆	၈၅၀	၈၃၂
ပိသာချိန်	၁၁၅၁	၁၁၄၄	၁၁၆၈. ၇	၁၁၄၀. ၇
စတင်ရောင်းနေ့စွဲ	၂၉. ၁. ၀၇	၁၂. ၂. ၀၇	၁၆. ၄. ၀၇	၁၂. ၈. ၀၇
နောက်ဆုံးရောင်းနေ့စွဲ	၂. ၂. ၀၇	၁၆. ၂. ၀၇	၂၂. ၄. ၀၇	၁၇. ၈. ၀၇
ကုန်ကျအစာပိသာ	၂၈၇၇. ၅	၂၈၄၈. ၅	၂၈၉၈. ၅	၂၈၃၅. ၀
ပျမ်းမျှကိုယ်အလေးချိန်	၁. ၃၆	၁. ၃၇	၁. ၃၈	၁. ၃၇
F C R	၂. ၅၀	၂. ၄၉	၂. ၄၈	၂. ၄၉

ပူးတွဲ (၈-က)

DOC -7 Week Meat Test Result (28-12-2007 — 15-2-2008)

စဉ်	အုပ်စုအမှတ်	ဝိုင်းအမှတ်	စက်သွင်းမျိုးဘဲဥ	ဘဲပေါက်ကောင်ရေ	ပေါက်နှုန်း %	ဘဲပေါက်အလေးချိန်	သေ/ပယ်ကောင်ရေ	သေ/ပယ် %	(၇) ပတ်သား Body wt (kg)	အစာစားနှုန်း (kg)	FCR
၁။	Control	၄	၄၁	၂၉	၉၁	၅၆	-	-	၂. ၆၀	၆. ၃၉၃	၂. ၄၆
၂။	H	၃	၃၃	၂၉	၈၃	၄၉	-	-	၄	၆. ၃၉၀	၂. ၄၁
၃။	A	၅	၂၅	၂၂	၈၈	၅၀	၁	၅	၂. ၈၁	၆. ၄၁၀	၂. ၃၁
၄။	D	၁၀	၃၈	၃၀	၃၄	၄၃	၁	၃	၆	၆. ၄၅၅	၂. ၄၅
၅။	E	၁	၂၄	၂၁	၈၈	၄၉	-	-	၂. ၃၆	၆. ၅၆၃	၂. ၄၃
၆။	G	၃	၂၃	၂၀	၈၆	၅၀	-	-	၉	၆. ၅၈၀	၂. ၅၀
၇။	J	၂	၂၃	၂၀	၈၆	၅၀	-	-	၂. ၆၃	၆. ၄၆၀	၂. ၄၀
၈။	C	၁၁	၃၁	၂၅	၈၁	၄၉	-	-	၅	၆. ၄၈၈	၂. ၄၃
၉။	I	၉	၂၆	၂၁	၈၁	၄၈	-	-	၂. ၆၆	၆. ၃၉၁	၂. ၄၅
၁၀။	B	၈	၃၆	၃၀	၈၃	၄၈	၁	၃	၁	၆. ၅၉၃	၂. ၄၁
၁၁။	F	၆	၃၀	၂၃	၉၀	၄၈	၁	၄	၂. ၆၂ ၀ ၂. ၆၉ ၁ ၂. ၆၃ ၂ ၂. ၃၃ ၀ ၂. ၃၄ ၃ ၂. ၅၅ ၃	၆. ၂၀၀	၂. ၄၂
၊	Test Avg:		၃၃၀	၂၃၄	၈၃	၅၀	၀. ၄	၁. ၅	၂. ၆၈ ၅	၆. ၅၂၁	၂. ၄၃

ပူးတွဲ (၈-ခ)

DOC -7 Week Meat Test Result (28-12-2007 — 15-2-2008)

စဉ်	အုပ်စုအမှတ်	ဝိုင်းအမှတ်	ဘဲမအလေးချိန် (kg)	ဘဲမကောင်ရေ	ဘဲထီးအလေးချိန် (kg)	ဘဲထီးကောင်ရေ	စုစုပေါင်းကောင်ရေ	စုစုပေါင်းကိုယ်အလေးချိန် (kg)	Avg ကိုယ်အလေးချိန် (kg)	Avg အစာစားနှုန်း (kg)	FCR
၁. ၂. ၃. ၄. ၅. ၆. ၇. ၈. ၉. ၁၀. ၁၁.	Control H A D E G J C I B F	၄ ၇ ၅ ၁၀ ၁ ၃ ၂ ၁၁ ၉ ၈ ၆	၃၄. ၈၄ ၄၂. ၉၄ ၅. ၁၈ ၁၇. ၁၆ ၃၀. ၉၈ ၂. ၅၂ ၂၆. ၂၄ ၃၂. ၄၄ ၃၀. ၄၄ ၂၂. ၀၀	၁၄ ၁၆ ၂ ၁၉ ၇ ၁၂ ၁၀ ၁၄ ၁၂ ၁၂ ၁၃	၄၀. ၆၈ ၃၈. ၇၂ ၅၂. ၉၆ ၂၇. ၅၈ ၃၈. ၇၂ ၁၀. ၄၂ ၂၅. ၄၂ ၂၅. ၅၆ ၂၀. ၅၆ ၄၉. ၁၂ ၃၄. ၄၈	၁၅ ၁၃ ၁၉ ၁၀ ၁၄ ၈ ၉ ၁၀ ၉ ၁၃ ၁၃	၂၉ ၂၉ ၂၁ ၂၉ ၂၁ ၂၀ ၂၀ ၂၅ ၂၁ ၂၇ ၂၆	၂၅. ၅၂ ၈၁. ၆၆ ၁၈. ၁၄ ၇၆. ၄၁ ၅၅. ၈၈ ၅၀. ၃၂ ၆၆. ၈၀ ၁၈. ၁၈ ၂၉. ၅၆ ၆၆. ၄၈	၂. ၆၀၄ ၂. ၈၁၆ ၂. ၇၆၉ ၂. ၆၃၅ ၂. ၆၆၁ ၂. ၆၂၀ ၂. ၆၉၁ ၂. ၆၇၂ ၂. ၇၇၀ ၂. ၃၄၃	၆. ၃၉ ၃ ၆. ၇၉ ၀ ၆. ၄၁ ၀ ၆. ၄၅ ၀ ၆. ၅၆ ၀ ၆. ၅၈ ၈ ၆. ၇၉ ၁ ၆. ၇၉ ၇ ၆. ၂၀ ၀	၂. ၄၆ ၂. ၄၁ ၂. ၃၁ ၂. ၄၅ ၂. ၄၇ ၂. ၄၃ ၂. ၅၁ ၂. ၅၀ ၂. ၄၃ ၂. ၄၃ ၂. ၄၂ ၂. ၄၂ ၂. ၄၁ ၂. ၄၀ ၂. ၄၂
၊	Test Avg		၃၃၉. ၅၇	၁၃၂	၃၈၅. ၂	၁၃၈	၂၅၀	၇၂၄. ၈	၂. ၆၈၅	၆. ၅၂	၂. ၄၃

ပူးတွဲ (၈-၀)

Carcass Evaluation Data

No	Entry	No	Avg Live wt (kg)	Avg Dress wt (kg)	Avg Dress wt %	Leg wt (kg)	% Dres: wt	Leg Meat (kg)	Leg Meat %	Breast wt (kg)	% Dres: wt	Breast Meat (kg)	Breast Meat %	Wing (kg)
1.	E	X	2.90	2.12	73	0.500	24	0.315	15	0.490	23	0.280	13	0.221
		x	2.60	1.88	72	0.430	23	0.240	13	0.450	24	0.235	13	0.210
		Avg	2.75	2.00	73	0.465	23	0.278	14	0.470	24	0.258	13	0.216
2.	J	X	2.90	2.11	73	0.415	20	0.268	13	0.490	23	0.260	12	0.235
		x	3.00	2.19	73	0.490	22	0.270	12	0.510	23	0.270	12	0.220
		Avg	2.95	2.15	73	0.453	21	0.269	13	0.500	23	0.265	12	0.228
3.	G	X	2.90	2.12	73	0.470	22	0.280	13	0.440	21	0.235	11	0.220
		x	2.80	2.01	72	0.440	22	0.260	13	0.440	22	0.250	12	0.225
		Avg	2.85	2.07	72	0.455	22	0.270	13	0.440	21	0.243	12	0.223
4.	Control	X	2.90	2.05	71	0.480	23	0.270	13	0.490	24	0.270	13	0.235
		x	2.70	1.88	70	0.440	23	0.250	13	0.390	21	0.220	12	0.210
		Avg	2.80	1.97	70	0.460	23	0.260	13	0.440	22	0.245	12	0.223
5.	A	X	3.00	2.20	73	0.480	22	0.280	13	0.500	23	0.280	13	0.230
		x	2.30	1.64	71	0.400	24	0.235	14	0.410	25	0.240	15	0.210
		Avg	2.65	1.92	72	0.440	23	0.258	13	0.455	24	0.260	14	0.220
6.	F	X	2.70	1.92	71	0.420	22	0.260	14	0.400	21	0.210	11	0.235
		x	2.50	1.85	74	0.450	24	0.260	14	0.450	24	0.270	15	0.210
		Avg	2.60	1.89	73	0.435	23	0.260	14	0.425	23	0.240	13	0.223
7.	H	X	2.90	2.10	72	0.500	24	0.300	14	0.540	26	0.310	15	0.240
		x	2.60	1.90	73	0.440	23	0.250	13	0.500	26	0.290	15	0.240
		Avg	2.75	2.00	73	0.470	24	0.275	14	0.520	26	0.300	15	0.240
8.	B	X	2.90	2.12	73	0.460	22	0.265	13	0.520	25	0.300	14	0.260
		x	2.40	1.75	73	0.430	25	0.240	14	0.460	26	0.250	14	0.200
		Avg	2.65	1.94	73	0.445	23	0.253	13	0.490	25	0.275	14	0.230
9.	I	X	3.10	2.16	70	0.460	21	0.270	13	0.510	25	0.300	14	0.240
		x	3.10	2.14	69	0.520	24	0.280	13	0.470	22	0.260	12	0.220
		Avg												
10.	D	X	3.10	2.15	69	0.490	23	0.275	13	0.500	23	0.280	13	0.230
		x	2.70	1.86	69	0.415	22	0.240	13	0.470	25	0.275	15	0.200
		Avg	2.60	1.81	70	0.360	20	0.210	12	0.440	24	0.260	14	0.210
11.	C	X	2.65	1.84	69	0.388	21	0.225	12	0.455	25	0.268	15	0.205
		x	2.50	1.85	74	0.440	24	0.260	14	0.440	24	0.290	16	0.230
		Avg	2.50	1.83	73	0.400	22	0.220	12	0.510	28	0.310	17	0.215
			2.50	1.84	74	0.420	23	0.240	13	0.475	26	0.300	16	0.223
	Test	Avg	2.75	1.98	72	0.447	23	0.260	13	0.470	24	0.267	13	0.223

REFERENCES

1. Atkare. SS, JK Bhardwaj, Salmakhan & RP Nema. Growth performance of meat and dual type chicks under hot & cold climate fed variable protein & energy level.

2. Atkare. SS, R.P Nema & NG paradkar. Effect of genotype, protein, Energy and climate on mortality pattern of meat & dual type chicken.

3. Damerow. Gail ; Darrell L.Salsbury, Nancy, Searle, Paula Simmons, Healther Smith Thomas. Barnyard in your Backyard

4. Dinesh Prasado singh. Dr., Development of naked neck Broiler for Hot climate.

5. Conference Proceedings 2001. South Asian Regional Poultry Conference & Exhibition 24-26 September 2001 Pune, India.

6. National Institute of Industrial Research Board 2003. The Complete Technology Book on Dairy & Poultry Industries With Farming and Processing.

ဆွေးနွေးချက်

Dr. မောင်မောင်စံ	-	Upgrading လုပ်ဒါလား Selection လုပ်ဒါလား။
အကြံပြုချက်	-	ကိန်းဂဏန်းများတင်ပြရာတွင် X, SD, SE နှင့် P (Probability) များ ထည့်သွင်းပေးမှ ဂျာနယ်အတွက် ဆောင်းပါးကောင်း ဖြစ်နိုင်ပါသည်။
	-	Selection, Selection pressure နှင့် Response to selection ကို Formula များသုံး၍ တွက်ပြသင့်ပါသည်။
ဖြေကြားချက်	-	Upgrading လုပ်ခြင်းမဟုတ်ပါ Selection မျှသာ ဖြစ်ပါသည်။
Dr. နွဲ့နွဲ့ထင်	-	ဘဲစာတွင် ပါဝင်သည့် Protein တစ်ခုကိုသာ ဖော်ပြပြီး ME/CE ratio ဖော်ပြထားခြင်း မတွေ့ပါ။ Performance ကောင်းကောင်းဆိုရာမှာ ME အပေါ်မူတည်သလို CP ပေါ်မှာ မူတည်ပါတယ်။ ME/CP ratio တိကျမှ Maximum performance ကို ရနိုင်ပါတယ်။ ခေတ်မီ တိကျစေရန် ME, ME/CP ratio ကိုပါ ကြက်စာတွင် ထည့်သွင်းဖော်ပြစေလိုပါသည်။
Dr. ရဲထွဋ်အောင်	-	ဖြစ်လေ့ ဖြစ်ထရှိသော ရောဂါရှိသလား။
	-	၄င်းရောဂါ ထိန်းချုပ်မှု၊ ကာကွယ်ဆေး အသုံးပြုမှု ရှိပါသလား။
	-	လက်တွေ့ ကာကွယ်ဆေးအသုံးပြုမှု အစီအစဉ်ရှိပါကသိလိုပါသည်။
ဖြေကြားချက်	-	မရှိပါ။
	-	မရှိပါ။
	-	မရှိပါ။
Dr. အောင်ထွန်းခိုင် အကြံပြုချက်	-	DVE, DVH စသည့် Vaccine များ ထိုးနှံ ပေးသင့်သည်။

Dr. စန်းအောင် အကြံပြုချက် - ဘဲထီးသည် အသားတိုးကောင်းသဖြင့် အထီးဖြစ်အောင် Tilapia ငါးများ ကဲ့သို့ Hormone ကျွေး၍ အထီးဖြစ်အောင်ပြုလုပ်သောနည်းကို ရှာဖွေ သင့်ကြောင်း အကြံပြုအပ်ပါသည်။

- ငါး Selection မွေးမြူနည်းတွင်
- 1st generation ကို 100% မွေးမြူပါသည်။
- 2nd generation တွင် သက်တူအကြီးဆုံးငါးကို 50% မွေးမြူပါသည်။
- 3rd generation တွင် သက်တူအကြီးဆုံးငါးကို 25% မွေးမြူပါသည်။
- 4th generation တွင် သက်တူအကြီးဆုံးငါးကို 10% မွေးမြူ၍ မျိုးပွါးသည်။ ဘဲကိုလည်း ဤနည်းအတိုင်း လုပ်သင့်ကြောင်း အကြံ ပြုပါသည်။

Dr. စောပလယ်စော အကြံပြုဆွေးနွေးချက်

- ယခုစာတမ်းကို အနည်းသယ် ဖြည့်စွက် ဆွေးနွေးလိုပါသည်။ ယခုစာတမ်း ကို ဝန်ကြီးမှ ဦးသန်းရွှေကို တာဝန်ပေးခဲ့ကြောင်း လည်း သိရပါသည်။ ကျွန်တော်က ဦးသန်းရွှေနဲ့ နီးစပ်သူ တစ်ဦး ဖြစ်သောကြောင့် သူရဲ့ဆောင် ရွက်ချက်များကို အနည်းနှင့်အများ သိခွင့်ရခဲ့ပါသည်။ ယခု Selection ပြုလုပ်ခြင်းသည် Upgrading လုပ်ရန်အတွက် မဟုတ်ပါ။ ၂၀၀၃ခုနှစ်မှ စတင်၍ အာရှတစ်ခွင်တွင် ကြက်ငှက်တုတ်ကွေး ရောဂါ ဖြစ်ခဲ့တဲ့အတွက် Parent stock: PS မျိုးများတင်သွင်းခွင့် မရမီကာလအတွက် လက်ရှိခြံ တွေမှာရှိတဲ့ ဘဲများ အရည်အသွေး ကျဆင်းမှု မရှိစေရန် Selection ပြုလုပ် မွေးမြူခဲ့ခြင်းဖြစ်ပါသည်။ Dr. သန်းရွှေ ကိုယ်တိုင် အနီးကပ် ကြပ်မတ်တဲ့ Experiment ဖြစ်ပါသည်၊ သူက Index

selection ဆောင်ရွက်ပြီး Data တစ်ချို့နဲ့ တွက်ချက်မှု အသေးစိတ်ကို ဒေါက်တာတင်နွယ်ရီက အချိန်ကန့်သတ်မှု ကြောင့် ဖော်ပြခြင်း မရှိဟု ယူဆပါတယ်။

- ဒေါက်တာအောင်ထွန်းခိုင် အကြံပြုသွားတဲ့ Vaccine အသုံးပြုရန်အတွက် Commercial duck များအတွက် မလိုအပ်သော်လည်း Breeder stock များအတွက် အသုံးပြုရန် စဉ်းစားသင့်ပါသည်။ ဒေါက်တာစန်းအောင် အကြံပြုသွားတဲ့ အသားပိုမိုထွက်ရှိရေးအတွက် ငါးအမကိုအထီးဖြစ်အောင် ဆောင်ရွက်နိုင်သော်လည်း ဘဲအမကို အထီးဖြစ်အောင် ဆောင်ရွက်နိုင်ရန် နည်းလမ်းမရှိကြောင်း ဖြည့်စွက် ဆွေးနွေး အပ်ပါသည်။

ပျားနို့ အမြောက်အများ ထုတ်ယူနည်းများနှင့် အသုံးဝင်ပုံများကို လေ့လာခြင်း စာတမ်း

ဦးထွန်းမြင့်[၁] ဦးစောအောင်မြင့်[၂]

စာတမ်းအကျဉ်း

ပျားနို့ (Royal jelly) သည် ပျားမွေးမြူရေးလုပ်ငန်းမှ ထုတ်ယူရရှိနိုင်သော ပျားထွက်ပစ္စည်းတစ်မျိုးဖြစ်ပါသည်။ ပျားနို့သည် ပျားဘုရင်မနှင့်ပျားသားလောင်းများဖြစ်သော လုပ်သားပျား (Worker larvae) ၊ ပျားထီး (Drone larvae) များနှင့် ဘုရင်မ သားလောင်း (Queen larvae) များတို့၏ အထူးအစားအစာဖြစ်ပါသည်။ ထိုအထူးအစာကို (၅)ရက်မှ (၁၅)ရက်သား လုပ်သား ပျားငယ် (Nurse bees) များမှ ထုတ်လုပ်ပေးသည်။ သို့ရာတွင် ၄င်းအစာကို ပျားငယ်များမှ ထုတ်လုပ်ပေးသော ကာလသည်(၃)ရက်မှ (၆)၇က်သားတွင် အမြင့်မားဆုံးအချိန်ဖြစ်သည်။ ပျားနို့သည် ဖြူဝါရောင် ပျစ်နှစ်ရည်တစ်မျိုးဖြစ်ပြီး အနည်းငယ်ခါးသက်လျက် ဒိန်ချဉ်ခဲကဲ့သို ချဉ်ဖြုံးဖြုံးအရသာလည်းရှိသည်။ ပျားနို့ကို သက်တမ်းတစ်လျှော်လုံး စားသုံးခွင့်ရရှိ သော ပျားဘုရင်မ (Queen bee) သည် အခြား လုပ်သားပျား (Worker bees) နှင့် မတူတမူထူးခြားသည်။ အရောင်အသွေးမှာ လှပသည်။ ခန္ဓာကိုယ်မှာ တစ်ဆမှတစ်ဆခွဲခန့်အထိ ပိုမိုကြီးထွားသည်။ သက်တမ်းမှာ အဆ(၅၀)ခန့် ပိုမို ရှည်သည်။ နေ့စဉ်ဥပေါင်း ၂,၀၀၀ ခန့်ဥချနိုင်သည် ပရိုတိန်းဓါတ်များ၊ ဗိုက်တာမင်ဓါတ်များ၊ အမိုင်နိုအစ်ဆက်ဓါတ်များ၊ သတ္တုဓါတ်များ၊ ဟော်မုန်းများ၊ ဖက်တီးအက်စစ်များအပြင် ဘက်တီးရီး ယား မပေါက်ပွါးနိုင်သော (Anti-bacterial) ဓါတ်များ၊ မှိုမပေါက်ပွါးနိုင်သော (Anti-mold) ဓါတ်များ ပါရှိပါသည်။ ပျားနို့သည် ပျားများတွင် သာမက လူတို့ကိုပင် အလားတူ အကျိုးပြုလျက်ရှိပါသည်။ ရသာယန (ခေါ်) အသက်ရှည်ဆေး ထုတ်လုပ်ခြင်းလုပ်ငန်း၊ အလှကုန်လုပ်ငန်း၊ လူသုံးကုန်လုပ်ငန်း၊ အာဟာရဖြစ် အစားအစာထုတ်လုပ်ခြင်းလုပ်ငန်းနှင့် အဖျော်ယမကာ လုပ်ငန်းတွင် ဖြည့်စွက်ပစ္စည်းတစ်ခု အနေဖြင့်လည်းကောင်း အဓိကပစ္စည်း တစ်ခုအနေဖြင့်လည်းကောင်း၊ ကျယ်ပြန့်စွာ အသုံးပြုနိုင်ပါသောကြောင့် ဤစာတမ်းကို လေ့လာရေးသား၍ တင်ပြအပ်ပါသည်။

၁။ ဦးထွန်းမြင့်
ညွှန်ကြားရေးမ-း
၂။ ဦးစောအောင်မြင့်
ညွှန်ကြားရေးမ-း (အငြိမ်းစား)

နိဒါန်း

ပျားနို့ (Bee milk) ခေါ် Brood Food) ကို ပျားမွေးမြူရေးလုပ်ငန်းမှ ထုတ်ယူရရှိပါသည်။ (၅) ရက်သားမှ (၁၅)ရက်သား လုပ်သားပျားငယ် (Nurse bee) တို့သည် ပန်းဝတ်မှုန်နှင့် ပျားရည်ရောထားသော ပျားကိတ် (Bee cake) ခေါ် (Bee bread) ၊ ဒေသအခေါ် ပျားချေးကို စားသုံးကြသည်။ ပန်းဝတ်မှုန် (Pollen) မှ ပရိုတိန်းဓါတ်နှင့် အဟာရဓါတ် (Nutrient) ကိုရရှိပြီး၊ ဦးခေါင်းခွံရှိသော Hypopharygeal gland (Brood food gland) နှင့် မေးရိုးဂလင်း (Mandibular gland) တို့ကို ဖွံ့ဖြိုးလာစေပါသည်။ ထိုဂလင်း(၂)ခုနှင့် ပျားရည်သယ်အိတ် (Honey stomach) ခေါ် (Honeysac) မှ ထွက်လာသော စစ်ထွက်ရည်တို့ ပေါင်းပြီး၊ ဖြူဝါရောင်ပြစ်နှစ်ရည် တစ်မျိုးဖြစ်သည့် ပျားနို့ကိုခံတွင်းမှ တဆင့် စစ်ထုတ်ပေးသည်။ သားလောင်းများ (Bee milk) မှ Royal jelly ဟူသော ဝေါဟာရသို့ ၁၉၇၂ ခုနှစ်တွင် ပြင်သစ်လူမျိုး Franchois Huber က စတင်ဖော်ထုတ်အမည်ပေးခဲ့သည်။ ပျားထွက်ပစ္စည်း တစ်မျိုး အဖြစ်နှင့် ၁၉၅၀ ခုနှစ်တည်းက စတင်ထုတ်လုပ်ခဲ့ကြပါသည်။

ပျားနို့ကို သက်တမ်းတစ်လျှောက်လုံး စားသုံးခွင့်ရသောပျားဘုရင်မသည် အခြားပျားများနှင့် မတူတမူခြား ပါသည်။ အရောင်အသွေးမှာ လှပသည်။ လုပ်သားပျားတို့ထက် ခန္ဓာကိုယ်သည် တစ်ဆမှ တစ်ဆခွဲခန့်အထိ ပိုမိုကြီးထွားသည်။ သက်တမ်းမှာ ၅၀ အဆခန့် ပိုမိုရှည်သည်။ နေ့စဉ် ဥပေါင်း (၂၀၀၀)ခန့် ဥချနိုင်သည်။ ပျားနို့သည်ပျားအထွက်သာမ ကလူသားတို့ကိုလည်းအလားတူ အကျိုးပြုလိမ့်မည်ဟု ရှေးယခင်ကတည်းက အနောက်နိုင်ငံသားများမှ အယူအဆရှိခဲ့သည်။ ၁၉၅၀ ခုနှစ်မှစ၍ ဆေးဝါးများ၊ အလှကုန်ပစ္စည်းများ၊ လူသုံးကုန်ပစ္စည်းများ၊ အာဟာရဖြစ် အစာအစာနှင့် အဖျော်ယမကာများ ထုတ်လုပ်သည့် လုပ်ငန်းများတွင် တွင်ကျယ်စွာ အသုံးပြုခဲ့ကြသည်။ ထိုအချိန်မှစ၍ တန်ဖိုးရှိ ပျားထွက်ပစ္စည်းတစ်ခုဖြစ်လာခဲ့ပါသည်။ အစိုတစ်ကီလိုဂရမ်လျှင် အမေရိကန်ဒေါ်လာ (၁၀၀)မျှ တန်ဘိုးရခဲ့သည်။ ပြင်သစ်၊ ကျူးဘား၊ ဂျာမန်၊ ကနေဒါ၊ အစ္စရေးလ်၊ ထိုင်ဝမ်၊ ကိုရီးယား၊ ချက်ကိုစလိုဗက်ကီးယား၊ အီတလီ၊ ရုရှား၊ အမေရိကန်၊ ယူဂိုစလားဗီးယား (၁၂)နိုင်ငံတို့သည် တစ်နှစ်လျှင် တန် ၅၀ မှ ၅၀ အထိ ထုတ်လုပ်နိုင်ခဲ့ပါသည်။ ၁၉၈၄ ခုနှစ်မှစ၍ တရုတ်နိုင်ငံသည် ကမ္ဘာပေါ်တွင် ပျားနို့အများဆုံး ထုတ်လုပ်သည့်နိုင်ငံ ဖြစ် လာခဲ့သည်။ ၄င်းသည် ပျားရည်ကို တန် (၄၀၀) အထိ ထုတ်လုပ်သည်။ ယိုးဒယားမှ (၁၂) တန်၊ ဂျပန်၊ ဥရုဂွေး၊ ဗီယက်နမ်နိုင်ငံတို့မှ (၁)တန်စီ ထုတ်လုပ်ခဲ့ကြသည်။

ထို့ကြောင့် ပျားမွေးမြူသူများမှ ဝင်ငွေများစွာ ရရှိနိုင်မည့် ပျားနို့အမြောက်အများ ထုတ်ယူနည်းများနှင့် တန်ဖိုးမြှင့် ပျားနို့ပစ္စည်းထုတ်လုပ်ရေးလုပ်ငန်းများ လုပ်ကိုင်နိုင်ရန် ဤစာတမ်းကို ပြုစုတင်ပြအပ်ပါသည်။

ရည်ရွယ်ချက်

ဤစာတမ်းကို ပြုစုရခြင်းရည်ရွယ်ချက်မှာ -

(၁) သန့်ရှင်းစင်ကြယ်သော ပျားနို့အမြောက်အများ ထုတ်ယူရရှိနိုင်ရန်၊

(၂) ပျားနို့ကိုကျယ်ပြန့်စွာအသုံးချနိုင်သော နည်းလမ်းကောင်းများ ရှာဖွေဖော်ထုတ်နိုင်ရန်

(၃) ပြည်သူ့ကျန်းမာရေးကို အထောက်အကူပြုရန်၊

(၄) ဝင်ငွေအမြောက်အများ ရရှိစေရန် တို့ဖြစ်ပါသည်။

ပါဝင်သောပစ္စည်းများနှင့် ဆောင်ရွက်ပုံနည်းလမ်းများပျားနို့ထုတ်ယူနည်း

ပျားနို့အမြောက်အများထုတ်ယူနိုင်သည့် မည်သည့်နည်းလမ်းမဆို Doolittle method စနစ်ကို အခြေခံပြီး သာထုတ်လုပ်ရပါသည်။ ပျားနို့တစ်အောင်စရရန်အတွက် (၃)ရက်သား ပျားဘုရင်မ (Queen cell) (၁၂၀)ခန့်မှ စုယူရရှိနိုင်သည်။ ပျားရည်ကို ပျမ်းမျှထုတ်လုပ်သူ တစ်ဦးအနေဖြင့် ရိုးရိုးတစ်ထပ်ပျားအုံပေါင်း (၄-၅) အုံမှ တစ်ရက်တည်းနှင့် ပျားနို့ (၄-၅) အောင်စကို ရရှိနိုင်သည်။ ပျားအုံတစ်အုံမှ ပျားနို့တစ်ပေါင်ကို တစ်ရာသီ (၃) လအတွင်းထုတ်ယူရရှိနိုင်သည်။ သို့ရာတွင် ပျားစာရရှိမှု၊ ရာသီဥတု၊ အပူချိန်၊ လေတိုက်နှုန်းစသော အချက်များအပေါ်တွင်လည်း မူတည်ပါသည်။ ဂျပန်နိုင်ငံတွင် နေ့စဉ် မိသားစု(၃)ဦးဖြင့် ပျားအုံ(၅၀)မှ ပျားနို့အမြောက်အများ ထုတ်ယူနိုင်သည်ကို လေ့လာသိရှိရသည်။ မြန်မာနိုင်ငံ၌ နှမ်းပျားစာနှင့်ပန်းနှမ်းပျားစာသည် အကောင်းဆုံး ပျားစာဖြစ်သောကြောင့် ပျားရည်ထွက်ရာသီများသည့် ရာသီနှင့်လည်း တိုက်ဆိုင်နေပါသောကြောင့် ပျားနို့ထုတ်ရန် အကောင်းဆုံး အချိန်များ ဖြစ်ပါသည်။

ပျားနို့အမြောက်အများ ထုတ်ယူနိုင်သည့် နည်းလမ်းများစွာရှိသည့်အနက် နည်းလမ်း (၃) ခု ကို တင်ပြပါမည်။ ပျားနို့ကို ထုတ်လုပ်ရန်အတွက် ပထမဦးစွာ ပျားနို့ထုတ်လုပ်မည့်ပျားအုံများ၏ လိုအပ်ချက် များ ပြင်ဆင်ပေး ရသည်။ ၄င်းတို့တွင် -

(၁) ပျားကောင်ရေ အင်အားကောင်အောင် ဆောင်ရွက်ပေးရမည်။ တစ်ထပ်ပျားအုံ ဖြစ်ပါက ပျားသလက်ချပ် ၈ချပ်၊ ၉ချပ်၊ ၁၀ ချပ် ၊ နှစ်ထပ်ပျား ဖြစ်ပါက အပေါ်၁၀ ချပ်၊ အောက် ၁၀ ချပ်၊ သုံးထပ်ပျားဖြစ်ပါက အပေါ် ၁၀ ချပ်၊ အလယ် ၁၀ ချပ်၊ အောက် ၁၀ ချပ်၊ (ပျားသလက်တစ်ချပ်လျှင် ပျားကောင်ရေ ၂၀၀၀ နှုန်းခန့်ရှိပါသည်။)

(၂) ပျားအုံတွင်း လုံလောက်သော ပျားစာရှိရန် ဆောင်ရွက်ပေးရမည်။

(၃) သင့်လျော်သည့် အပူအအေးမျှတမှုလည်း ရှိရမည်။

(၄) သက်ငယ်ပျား (Nurse bee) များလုံးလောက်မှုရှိအောင် ဆောင်ရွက်ရမည်။

(၅) သားလောင်းကော်ဇွန်း (Grafting tool)၊ ပျားနို့ထည့်ရန် အရောင်ပါသည့် ပုလင်း (သို့မဟုတ်) ပလပ်စတစ်ဘူး၊ ရေခဲဘူး၊ ပျားနို့ဘောင် (Cell bar frame)၊ ဘုရင်မထားဇကာ (Queen excluders)၊ ဘုရင်မဆဲလ်ကပ် (Plastic queen cell rups) အရံသင့်ရှိရမည်။

နည်းလမ်း (၁)

ရိုးရိုးတစ်ထပ်ပျားအုံနှင့် ပျားနို့ထုတ်လုပ်ခြင်း

၁။ ရိုးရိုးတစ်ထပ်ပျားအုံပုံစံကို အသုံးပြုထုတ်လုပ်မည်ဆိုပါက ပျားအင်အားမှာ ၈ ချပ်၊ ၁၀ ချပ်နှင့် ညီမျှသော ပျားကောင်ရေ အနည်းဆုံး ၅၀၀၀၀ ခန့်ရှိရမည်။

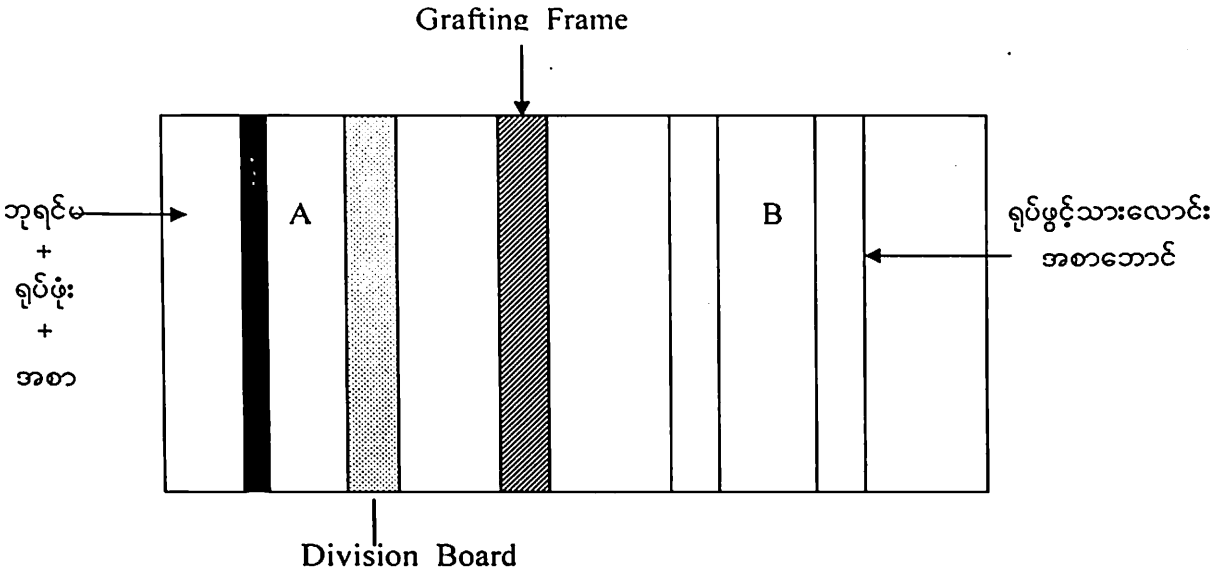


Fig. 1 - Single hive မှ ပျားနို့ထုတ်လုပ်ပုံနည်းစနစ်

A ခြမ်းတွင် ပျားဘုရင်မ + ရုပ်ဖုံးသားလောင်း + အစာဘောင်၊ B ခြမ်းတွင် ရုပ်ဖွင့်သားလောင်း + အစာဘောင်၊ ကြားတွင် Division board နှင့် ခြားထားရမည်။ Prepare frame (၂)ခုအသုံး ပြုနိုင်သည်။ Prepare frame တစ်ခု တွင် ဘုရင်မဆဲလ်ခွက်ပါသော သစ်တန်း (Queen cell bar) (၂) ခု ပါရှိပြီး၊ Bar တန်းတစ်ခုတွင် ဆဲလ်ခွက် (၂၅-၃၄) ခုအသုံးပြုသည်။ ထိုဆဲလ်ခွက်များ အတွင်းသို့ Royal Jelly သီးသန့် (သို့) ရေနှင့်ရောထား သော Royal jelly (၁း၁) တစ်စက်စီ ထည့်ကာ (၁၈-၂၀) နာရီ အသက်အရွယ်ရှိ လုပ်သားပျားသားလောင်း (Larvae) တစ်ကောင်စီ ရွှေ့ပြောင်း (Graft) ထည့်ပေးရမည်။ Fig.3, Fig.4, Fig.5. Fig.6, Fig7 နှင့် Fig. 9, ပျားအုံ၏ B ဘက်ခြမ်း အလယ်တည့်တည့်တွင် ထည့်ရမည်။ ဘေးတစ်ဖက်တစ်ချက်တွင် ရုပ်ဖွင့်သားလောင်း ဘောင်များကပ်ပေးရမည်။ ထိုပျားအုံအား ဖြည့်စွက်စာ (၁) သကြားရည်၊ ဖြည့်စွက်စာ (၂) ဝတ်မှုန်ဖြည့်စွက်စာများကို ညအချိန်ကတည်းက ကြိုတင် တိုက်ကျွေးထားရမည်။ (၃) နာရီ ကြာပြီးနောက်တွင် ၄၄်းတို့ကို ပြန်လည်စစ်ဆေးရမည်။ လက်မခံသော ဆဲလ်ခွက်များထဲသို့ သားလောင်း တဖန် ကော်ထည့် ပေးရမည်။ (၃) ရက်မြောက်နေ့တွင် ဆဲလ် များအတွင်း Royal jelly အများဆုံး ရှိနေမည် ဖြစ်သည်။ Fig.10, Fig.11, Fig.12။ ၄၄်း Cell bar များကို ဓါတ်ခွဲခန်း (သို့) သန့်ရှင်းသော အခန်းသို့ ယူဆောင်ပြီး၊ ဆဲလ်အတွင်း Royall jelly နှင့် မျက်နှာပြင်ညီအတိုင်း အပူပေးထားသော

ဘလိတ်ခါးဖြင့် ဖြတ်ပစ်ရမည်။ Fig. 13, သားလောင်းကို ညှပ်ဖြင့် သို့မဟုတ် ကော်ခပ်ကာ စုဆောင်းရသည်။ ဆေးထိုးပြွန်ကဲ့သို့ ဆိုင်ဖွန်နည်းဖြင့်လည်း ဆုဆောင်းယူနိုင်ပါသည်။ ပုံ-၁၄၊ ပျမ်းမျှ ပျားအုံ တစ်အုံလျှင် တစ်နှစ်လျှင် အကြိမ် (၃၀) မျှ ဆောင်ရွက်နိုင်သည်။ တစ်ကြိမ် လျှင် ပျမ်းမျှ Cell cups (၁၃၆) ခု အနက် ပျမ်းမျှလက်ခံရရှိမှု (၁၂၀)ရရှိနိုင်၍ တစ်နှစ်လျှင် Cell cups (၃၆၀၀) ရရှိနိုင်သည်။ Cell (၁၂၀) လျှင် ၁ အောင်စရရှိသဖြင့် တစ်နှစ်လျှင် ပျားအုံတစ် အုံမှ ပျားနို့ (၂) ပေါင်ခန့် ထုတ်လုပ်နိုင်မည် ဖြစ်ပါသည်။

နည်းလမ်း(၂)

နှစ်ထပ် ပျားအုံနှင့် ပျားနို့ထုတ်လုပ်ခြင်း

နှစ်ထပ်ပျားအုံကို အသုံးပြုမည်ဆိုပါက အောက်ထပ်တွင် ဘုရင်မနှင့် ရုပ်ဖုံးသားလောင်းများ (Pupae) ထားရှိရမည်။ အပေါ်ဆုံးထပ်တွင် အစာဘောင်နှင့် ရုပ်ပွင့်သားလောင်းများ (Larvae) ထားရှိရမည်။ အလယ်တွင် ဘုရင်မတားဆန်ခါ (ဇကာ) (Queen excluders) ခြားထားပေးရမည်။ Prepared frame (၃) ခုအသုံးပြုနိုင်သည်။ Prepared frame တစ်ခုလျှင် Queen cell cups (၂၅-၃၄) ခုပါ Bar တန်း (၂) ခုအသုံးပြုနိုင်သည်။ ပျားအင်အားမှာ (၁၈)ချပ်၊ (၂၀)ချပ်နှင့် ညီမျှသော ပျားဦးရေအနည်း ဆုံး ၈၀,၀၀၀ ရှိရမည်။

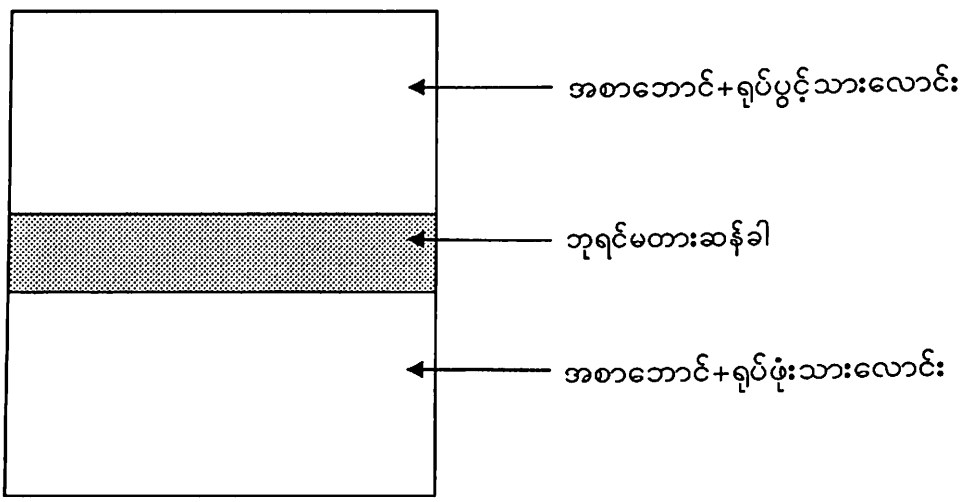


Fig.2 - နှစ်ထပ်ပျားအုံမှ ပျားနို့ထုတ်လုပ်ပုံနည်းစနစ်

Grafted Frame ကို အပေါ်ဆုံးထပ်အလယ်တည့်တည့်တွင် ထည့်ပေးရမည်။ ထို Grafted frame ကို Open brood cone နှင့် ကပ်လျက်ထားရမည်။ (၃) နာရီကြာပြီးနောက် ပြန်လည်စစ်ဆေးပြီး လက်မခံသောဆဲလ်များထဲသို့ သားလောင်းတစ်ဖန် ပြန်ကော်ထည့်ပေးရမည်။ ၄င်းနောက် (၃) ရက်မြောက်သောနေ့တွင် ဆဲလ်များအတွင်း Royally jelly အများဆုံးရှိနေပြီးဖြစ်၍ ထိုဘားတန်းများအားထုတ်ယူနိုင်သည်။ တစ်အုံလျှင် ပျမ်းမျှလက်ခံရရှိမှုသည် (၂၀၄) ခုဖြစ်၍ တစ်နှစ်လျှင် Cell cups ပေါင်း (၆,၁၂၀) ရရှိမည်။ ပျားနို့ (၅၁) အောင်စ ရရှိနိုင်ပါသည်။ ထို့နောက် ဓါတ်ခွဲခန်း (သို့မဟုတ်) သီးသန့် အခန်းထဲသို့ ယူဆောင်သွားရမည်။ ထို့နောက် ပျားနို့မျက်နှာပြင်နှင့်အညီ ဘရိတ်ဒါးပါးပါးကလေးနှင့် လှီးဖြတ်ပါ။ ဘုရင်မသားလောင်းများကို ညှပ်ဖြင့် ဆွဲထုတ်ပါ။ ပျားနို့ကို ကော်ခပ်ယူကာ စုဆောင်းနိုင်သည်။ ဆေးထိုးအပ်ပြွန်ကဲ့သို့ ဆိုင်ဖွန်နည်းဖြင့်လည်း စုဆောင်းနိုင်သည်။ ၄င်းတို့ကို Fig.13 နှင့် Fig. 14 ဖြင့် ဖော်ပြထားပါသည်။ ၄င်းပြွန်သည် (၂) ဖက်ပွင့်ပြွန်ဖြစ်ပြီး၊ အချင်းအားဖြင့် ၁ လက်မ၊ အလျား ၆-၈ လက်မ ရှိပါသည်။ ပြွန်အောက် ဖက်အဝှဲ့ ဖော့ဆို့ပိတ်ဆို့ထားသည်။ ပြွန်တစ်ဖက်တွင် ဖန်ချောင်းငယ် (၂) ချောင်းပါရှိသော ဖော့ဆို့တစ်ခုဖြင့် ဆို့ထားသည်။ ပြွန်တစ်ခုကို လေဟာနယ်၊ တစ်ခုကို ပျားနို့ရှိ ဆဲလ်ခွက်ဖြင့် ဆက်သွယ်ရသည်။ လေဟာနယ်ရှိ ပြွန်မှ စုတ်ပေးပါက တစ်ဖက်ပြွန်မှတဆင့် ဆဲလ်ခွက်အတွင်းရှိ ပျားနို့များ ပြွန်အတွင်း ဝင်ရောက်လာမည်။

ထို့နောက် ပြွန်ဝထိပ်ဖက်ရှိဖော့ဆို့ကို ဖယ်ပစ်ပြီး (၄-၅)လက်မခန့်ရှိ (၁၀၀ ပိုက်ကွက်) နိုင်လွန်စဖြင့် ဖန်ပြွန်ဝကိုအုပ်ကာ လက်တစ်ဖက်ဖြင့် ခိုင်မြဲစွာကိုင်ပြီး ပြွန်အောက်ဖက်ရှိ ဖော့ဆို့ကို တုတ်တံငယ်ဖြင့် တွန်းတင် ပေးပြီးစစ်ယူနိုင်သည်။

နည်းလမ်း (၃)

ထပ်ဆင့်သုံးထပ် ပျားအုံနှင့် ပျားနို့ထုတ်ယူနည်း

ပျားဘုရင်မရှိသော သုံးထပ်ထပ်ပျားအုံကို အသုံးပြုပါက အပေါ်ဆုံးထပ်တွင် ရုပ်ဖွင့်သားလောင်းနှင့် အစာဘောင်၊ အလယ်ထပ်တွင် ပျားရည်ဘောင်များ၊ အောက်ဆုံးအလယ်ထပ်ကြားတွင် ဘုရင်မ ထားဇကာ၊ အောက်ဆုံးထပ်တွင် ဘုရင်မနှင့် ရုပ်ဖုံးသားလောင်းများထားရှိရမည်။ ပျားအင်အားမှာ ၃၀ ချပ်နှင့် ညီမျှသော ပျားဦးရေအနည်းဆုံး ၁၂၀၀၀၀ ခန့် ရှိရမည်။

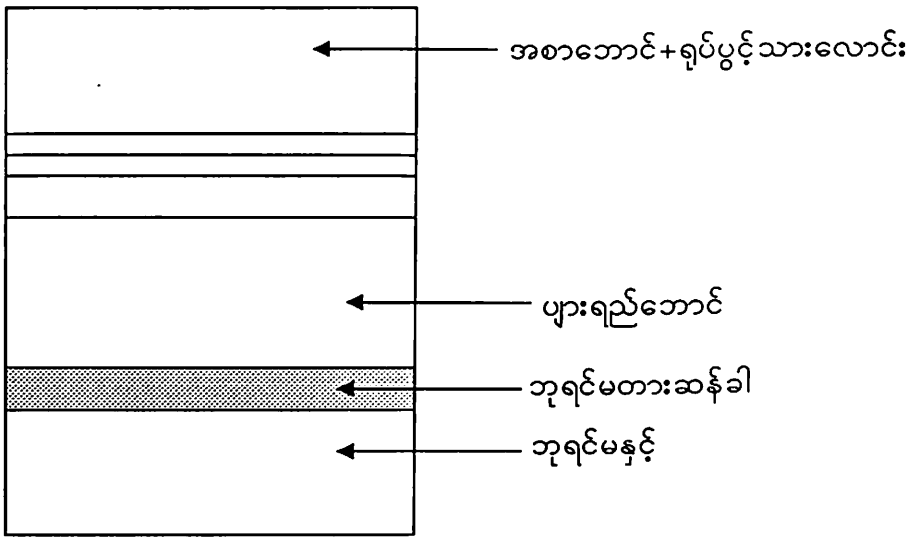


Fig.3 (၃) ထပ်ပျားအုံမှ ပျားနို့ထုတ်လုပ်ပုံနည်းစနစ်

ဤတွင် Prepare Frame ၅-ခု အသုံးပြုနိုင်သည်။ Prepare တစ်ခုလျှင် Bar တန်း ၂ တန်းပါရှိသည်။ Bar တန်း တစ်ခုလျှင် Queen cell cup (၂၅-၃၄)ခု ပါရှိသည်။ ပျမ်းမျှပျားတစ်အုံလျှင် Queen cell cup (၃၀၀) ရရှိသည်။ တစ်နှစ်လျှင် Queen cell cup (၉၀၀၀) ရရှိမည်ဖြစ်၍ ၇၅ အောင်စရရှိ နိုင်မည်။ Grafted frame ကို အပေါ်ဆုံးထပ် အလည်တည့်တည့်တွင် ဥစနည ဘမသသိ ခသာဘ နှင့် ကပ် လျက်ထည့်ရမည်။ (၃)နာရီကြာလျှင် ပြန်စစ်ဆေးရမည်။ (၃)ရက် မြောက်နေ့တွင် ဆဲလ်များအတွင်း Royal jelly အများဆုံး ရှိနေပြီဖြစ်၍ အထက်ပါအတိုင်း ဓါတ်ခွဲခန်း (သို့မဟုတ်) သန့်ရှင်းသော အခန်းအတွင်းသို့ ပို့ကာ စုဆောင်းခြင်း၊ စစ်ယူခြင်းပြုလုပ်ရပါမည်။

တွေ့ရှိချက်များ

(၁) ပျားနို့တစ်အောင်စရရန် ဘုရင်မဆဲလ် (၁၂၀) ခန့်မှ စုဆောင်းရပါသည်။

(၃) ရက်သား ပျား ဘုရင်မဆဲလ်တစ်ခုလျှင် ပျားနို့ (၁၄၈-၂၈၁) မီလီဂရမ် ပါရှိပါသည်။ ပျားအုံတစ်အုံမှ တစ်နှစ်လျှင် တစ်ထပ်အုံသုံးပါက အနည်းဆုံး (၂)ပေါင်၊ နှစ်ထပ်အုံသုံးပါက အနည်းဆုံး(၃) ပေါင်၊ သုံးထပ်အုံအသုံးပြုပါက အနည်းဆုံး(၄)ပေါင် ရရှိနိုင်ပါသည်။ သို့သော်လည်း ပျားစာအပေါ်မူတည်သည်။ မြန်မာနိုင်ငံ၌ နှမ်းပျားစာနှင့် ပန်းနှမ်းပျားစာရသည့် ရာသီသည်ပျားနို့ထုတ်ရန် အကောင်းဆုံးဖြစ်သည်။

(၂) လုပ်သားပျားများနှင့် ပျားထီးတို့သည် ပျားကိတ်(သို့) Bee bread ကို စားသုံးသည်။ သက် တမ်းမှာလုပ်သားပျားက (၁)လနှင့်(၁)လခွဲ၊ ပျားထီးက (၅၉)ရက် အသက်ရှည်သည်။ ပျား ဘုရင်မ ဖြစ်လာမည့်ဥနှင့် လုပ်သားပျား၊ ပျားထီးဖြစ်လာမည့်ဥမှာ အတူတူဖြစ်သော်လည်း နေရာချထားခြင်းခံရသော အခန်းငယ် (cell) နှင့် ပျားနို့အမြောက်အများ ကျွေးမွေးခြင်းခံရ သည့် အပေါ်မူတည်၍ပျားဘုရင်မ၊ လုပ်သားပျား၊ ပျားထီးဟူ၍ ကွဲပြားစေခြင်းသည် ထူးခြားလှပါသည်။

(၃) ထိုဥကလေးမှာ စင်တီမီတာတစ်ဝက်ခန့်သာရှိပါသည်။ ပျားထီးနှင့် လုပ်သားပျား ဖြစ်မည့်သားလောင်းသည် ပျားနို့ကို (၄)ရက်မြောက်နေ့အထိသာ စားသုံးခွင့်ရရှိသည်။ (၂၁)ရက်ကြာလျှင် လုပ်သားပျားငယ်များ ပေါက်ထွက်လာသည်။ (၂၄)ရက်ကြာလျှင်ပျားထီးငယ်များပေါက် ထွက်လာပါသည်။

(၄) ပျားဘုရင်မဖြစ်မည့် သားလောင်း၊ ပျားဘုရင်မတို့သည် ပျားနို့ကိုသာ စားသုံးခွင့်ရကြသည်။ (၃)ရက်သား ရုပ်ဖွင့်သားလောင်းသည် ပျားနို့အများဆုံးကျွေးမွေးခံရသည်။ (၁၆)ရက်ကြာလျှင် ပျားဘုရင်မ ပေါက်ထွက်လာသည်။ သက်တမ်းမှာ (၅)နှစ်မှ(၉)နှစ်အထိ အသက်ရှည်သည်ကို တွေ့ရခြင်းသည်လည်း ထူးခြားလှသည်။ ၄င်းအပြင် ပျားဘုရင်မသည် နေ့စဉ် ဥ ပေါင်း (၂၀၀၀) ခန့် ဥချနိုင်သည်။ ထို့ကြောင့် ပျားနို့သည် ပျားဘုရင်မတွက် အထူးအစာ ဖြစ်သည်ဟူလည်း ဆိုနိုင်ပါသည်။

(၅) ပျားဖယောင်းဖြင့် ပြုလုပ်သော ဘုရင်မဆဲလ်ခွက်များ အစား ပလက်စတစ်ဆဲလ်ခွက်များကို သုံးခြင်းဖြင့်လည်း ပျားနို့ထုတ်လုပ်မှု (၂၀%) တိုးစေနိုင်ပါသည်။

ပျားနို့ကို သိုလှောင်နည်း

(၁) ပျားနို့တွင်ပါဝင်သော 10- Hydroxyl decanoic acid ၏ ဂုဏ်သတ္တိကြောင့် ဘက်တီးရီးယားကပ်ညိခြင်း၊ မှိုတက်ခြင်း၊ တဆေးပေါက်ဖွားခြင်း မဖြစ်သည်ကို တွေ့ရှိရသည်။

(၂) ပျားနို့ကို သိုလှောင်သိမ်းဆည်းမည်ဆိုလျှင် ပုလင်းဘူးဆို့ကို လေလုံစွာပိတ်ရန်လို သည်။ ၃၅ ဒီဂရီဖာရင်ဟိုက် အအေးခန်းအတွင်း၌ တစ်နှစ်အထိ သိုလှောင်ထားနိုင် သည်။ ရေခဲအမှတ်အအေးခန်း၌ သိုလှောင်ပါက နှစ်ကြာ ရှည်စွာထားနိုင်ပါသည်။

(၃) ဆေးလုံး၊ ဆေးပြား (Tablet) အတွင်းသို့ ထည့်သုံးလျှင် အာနိသင်မပျောက်ပျယ် စေရန် Lyophilization ခေါ် အအေးခန်း လေဟာနယ်တွင် အခြောက်ခံ၍ အမှုန့်ပြုသော နည်းကို အသုံးပြုရန်လိုပါသည်။

(၄) သာမန်အခန်းအတွင်း အပူချိန်တွင် သိုလှောင်ထားပါက အရည်အသွေးသည် လျင်မြန်စွာ ဆုတ်ယုတ် ညံ့ဖျင်းသွား နိုင်ပါသည်။

ပျားနို့၏ အရောင်၊ အနံ့၊ အရသာ

ပျားနို့သည် ဖြူဝါရောင် ပျစ်နှစ်ရည်ဖြစ်ပြီး၊ ဒိန်ချဉ်ခဲ အရသာကဲ့သို့ အလွန်ချဉ်ကာ (Creamy, milk white, strongly acid) သားလောင်းအနံ့နှင့် ဖယောင်းနံ့များလည်း ရတတ်ပါပါသည်။ (Slightly pungent odor and a somewhat bitter taste) အနံ့မှာစူးရှ၍ အရသာမှာ အနည်းငယ် ခါးသက်သည်။

ပျားနို့တွင် ပါဝင်သောဓာတုပစ္စည်းများ

ပျားနို့သည် ရေတွင်တဖြည်းဖြည်း ပျော်ဝင်နိုင်သည်။ pH မှာ ၃. ၆-၄. ၂အကြား ရှိသည်။ သိပ်သည်းဆ ရေထက်အနည်းငယ်များပြီး ၁. ၁ရှိသည်။၄င်းတွင် ပါဝင်သော ပစ္စည်းများကို Table 1. ဖြင့် ဖော်ပြထားပါသည်။

(၁) ပျားနို့တွင် အဓိကပါဝင်သော ပစ္စည်းမှာ ရေ၊ ပရိုတိန်း၊ သကြား၊ Lipids mineral salt တို့ဖြစ်သည်။ ထူးခြားချက်မှာ ပျားအုံ၊ ပျားမျိုးစိတ်၊ အချိန်နေရာ များကွာခြားသော်လည်း ပျားနို့နှင့်ဆက်နွယ်နေလျက် ပါဝင်ပစ္စည်းများမှာ အမြဲတမ်း (Constant) ဖြစ် လျက် ပြောင်းလဲခြင်းမရှိကြောင်း တွေ့ရှိရပါသည်။

(၂) ရေသုံးပုံနှစ်ပုံပါရှိပါသည်၊ ပရိုတိန်း ၇၃. ၉ % (အဓိက ၆မျိုး)၊ 4 glycoprotein တို့ပါဝင်ပါသည်။ N_2 မှာ Free Amino Acid သည် ၂. ၃% ပါရှိသည်။ Peptides 0.16 % နှင့်လူတို့လိုအပ်သည့် Amino Acid ဓါတ်(၂၉) မျိုးပါရှိပါ သည်။ အထူးသဖြင့် အရေးကြီး၍ လိုအပ်တဲ့ Aspartic acid နှင့် Glutamic acid တို့လည်း ပါရှိပါသည်။

(၃) ၄င်းအပြင် အင်ဇိုင်းများလည်းပါရှိပါသည်။ Glucose oxidize, phosphatase, cholinesterase တို့ပါရှိသည်။ ၄င်းတို့သည် Insulin-likesubstance များဖြစ်သည်။

(၄) သကြား၌ Fructose နှင့် Glucose တို့ပါရှိပါသည်။ Fructose ကိုနေရာတိုင်း၌ တွေ့ရှိပါသည်။ Total sugar တွင် ၄င်းဓါတ်နှစ်မျိုးသည် ၉၀% အထိပါရှိပါသည်။ Sucrose content အမျိုးမျိုးပါရှိသည်။ သို့သော်လည်း တစ်ခုနှင့်တစ်ခုမတူဘဲ အနည်ငယ်သာ ကွာခြားခြင်း ပါရှိပါသည်။ Maltose, trehalose, melibiose, ribose and Erlose ဆိုသည့် သကြားများလည်း အနည်းငယ် သာပါသည်ကို တွေ့ရှိ ရပါသည်။

(၅) Lipids content မှာ အမျိုးအစားတစ်မျိုးတည်း ပါရှိသည်။ Free fatty acid ၌ Lipid သည် ၈၀-၉၀%ထိ ပါဝင်ပါသည်။ တိရစ္ဆာန်နှင့် သစ်ပင်တွေများတွင် တွေ့ရသည့် 14-20 carbon atoms ပါရှိသည့် Fatty acid များလည်း ပါရှိပါသည်။ ၄င်းတို့သည် ဇီဝဖြစ်ပျက်ပစ္စည်း (Biological properties) အာနိသင်များ ပါရှိပါသည်။

(၆) Total ash (ပြာဓါတ်) သည် ပျားနို့အစိုတွင် ၁% ၊ အခြောက်တွင် ၃%ပါရှိသည်။ အဓိကပါဝင်သောဓါတ်ဆားများ မှာ K, Ca, Na, Zn, fe, Cu, Mn တို့ဖြစ်ပါသည်။ ပျားနို့တွင် ပါဝင်သော အပစ္စည်းများတွင် တွေ့ရသည်မှာ P ဖြစ်ပါသည်။

(၇) ဗိုက်တာမင်အနေဖြင့် ထူးကဲစွာ ပါရှိပါသည်။ အထူးသဖြင့် ရေတွင် ပျော်ဝင်နိုင်သည့် ဗိုက်တာမင်များနှင့် အဆီတွင်ပျော်ဝင်နိုင်သည့် ဗိုက်တာမင် E တို့ပါဝင်ပါသည်။ ဗိုက်တာမင် E သည် ဘုရင်မ၏ မျိုးအောင်စေရန် ဆောင်ရွက်ပေးပါသည်။ ဗိုက်တာမင် A,D,K တို့ မပါရှိပါကြောင်း တွေ့ရှိရသည်။

ပျားနို့၏အာနိသင်ကို တိရစ္ဆာန်များ အပေါ်စမ်းသပ်ခြင်း

ကြက်အစာအတွင်းသို့ ပျားနို့ 5mg/kg of weight ထည့်ကျွေးရာ ဥနှုန်း တက်လာသည်ကို တွေ့ရပါသည်။ (Bonomit1983) ၊ နွားပေါက်ကလေးများကို စမ်းသပ်ကျွေးမွေးရာ ရောဂါဒါဏ်ခံနိုင်ရည်ရှိပြီး၊ သေနှုန်းကျဆင်းကြောင်း တွေ့ရှိရသည်ဟု ဆိုပါသည်။ (Radu-Todurache 1978) Guinea pig ကို 100-300 mg/kg of weight ဆေးထိုးပေးရာ အလေးချိန်တိုးလာကြောင်းတွေ့ရသည်ဟု ဆိုပါသည်။ (Afifi.etal 1989) သွေးအတွင်း၌ Cholesterol level မြင့်မားစွာရှိသော တိရိစ္ဆာန် ကိုအစာများသို့ ပျားနို့ထည့်ကျွေးမွေးကြည့်ရာ Cholesterol level သည် ကျသွားသည်ဟု ဆိုပါသည်။ (Carli et al 1975, Nakajinet al 1982). ကင်ဆာရောဂါပြန့် ပွါးလျက် (Rapid-growth cancer) ရှိသော ကြွက်ဖြူကလေးကို ပျားနို့ 20 mg/kg body weight ကျွေးကြည့်သည့်အခါတွင် ကင်ဆာ (Cancer) အဖုအကြိတ်သည် ကြီးထွားနှုန်း နှေးသွားကြောင်း (Slow-growing) နှင့် Solid tumour ဖြစ်သွားသည်ဟု ဆိုပါသည်။ (Ehrlich and Sarcoma Strains 1987).

လူများ အပေါ်စမ်းသပ်ခြင်း

အာဟာရချို့တဲ့ပြီး Premature babies ဖြစ်နေသောကလေးများကို ပျားနို့ 8-100 mg/kg of weight ကျွေး ကြည့်သည့်အခါ အလေးချိန်တိုးလာခြင်း အစားစာခြင်စိတ်ရှိလာခြင်း၊ Red blood cells နှင့် Haemoglobin များ တိုးပွားလာပါသည်။ (Prosperi et la 1956)

နာတာရှည်နှင့် မကြာမကြာပြန်ဖြစ်လေ့ရှိသည့် ရောဂါသည်ကို ပျားနို့ကို စမ်းသပ်ကျွေး မွေးသည့်အခါ ကျန်းမာရွှင်လန်းလာပါသည်။ အထွေထွေကျန်းမာရွှင်လန်းခြင်း အရသာခံစားနိုင်လာပါ သည်။ ပျားနို့စားလျှင် အရွယ်တင်နုပျိုး၍ ပင်ပန်းနွမ်းနယ်မှုလျော့နည်းစေပါသည်။ ထို့အပြင် အထွေထွေ အားကြွဆေးဖြစ်သည့်အပြင် မှတ်ဉာဏ်ကောင်းခြင်း၊ ခံနိုင်ရည်အား တိုးတက်လာနိုင်ပါသည်။

သွေးအားနည်းခြင်း၊ အစာ စားချင်စိတ်နည်းခြင်းနှင့် စိတ်အားငယ်နေသော အသက်အရွယ် ၇၀-၇၅ နှစ်ရှိ လူကြီးတို့ကို 20 mg/kg of weight ဖြင့် တစ်ရက်ခြား ဆေးထိုးပေးခြင်းနှင့် ကျွေးမွေး ခြင်းသည် တိုးတက်မှုများကောင်းကြောင်း မှတ်တမ်းတင် နိုင်ခဲ့ပါသည်။

ထိုအတူ နာတာရှည် အဆုတ်ရောဂါသမားကို ပျားနို့+ပျားရည်+ဂျင်ဆင်းတို့ စုပေါင်းဖော်စပ်ထားသော ဆေးကို စမ်းသပ်ကျွေးမွေးသည့်အခါ အလေးချိန်တိုးလာခြင်း၊ စိတ်ပိုင်း ဆိုင်ရာဆိုးတက်လာခြင်း၊ သွေးအား ကောင်းမွန်လာကြောင်းတွေ့ရှိရပါသည်။ (Borgia 1984)

မီးလောင် အရည်ကြည်ဖုများကို ပျားနို့ 5-30 mg/ml ပါဆေးရည်နှင့် စမ်းသပ်၍ ဆေးထည့်ကြည့်ရာ အရေပြား ပြန်ပြည့်သွားကြောင်း တွေ့ရှိပါသည်။ (Gembel 1962)

အသုံးပြုခြင်း

ပျားနို့ကို သဘာဝအခြေအနေနှင့်လည်ကောင်း၊ အဟာရဖြည့်စွက်စာ အနေနှင့် လည်းကောင်း၊ ပျားရည်+ သကြား (သို့) ရေရောရွက်လည်းကောင်း၊ A tiny plastic spatula အနေနှင့်လည်းကောင်း ရောင်းချသည် ကိုတွေ့ရှိရပါသည်။

ဆေးဝါးဒ္ဍအသုံးပြုခြင်း

ပျားနို့အမှုန့်ကို ပျော်ဝင်ပစ္စည်းအနေနှင့်အပြင်၊ ဆေးပြား၊ ဆေးတောင့်၊ သောက်ဆေး၊ ထိုးဆေး အနေဖြင့်လည်း ထုတ်လုပ်ရောင်းချသည်ကို တွေ့ရှိရပါသည်။ နောက်တစ်မျိုးတွင် ဂျင်ဆင်း ဆီ+တဆေး+ ဝတ်မှုန်ဆီ+ပျားနို့တို့ကိုရောစပ်ပြီး ထုတ်လုပ်ရောင်းချပါသည်။

လက်တင်အမေရိက၊ အမေရိကန်နှင့် ဥရောပနိုင်ငံများတွင် အရက်အနည်းငယ်၊ ပျားကော်အဆီ၊ ပျားနို့တို့ကိုရောပြီးရောဂါကာကွယ်ရန်၊ ရောဂါပိုးမွှားများ မပေါက်ပွားလာရန် အတွက် စားသုံးကြပါသည်။ ပျားရည်၊ ပျားနို့၊ ဂျင်ဆင်းအဆီတို့ကို ရောစပ်ပြီး ဆေးဝါးတစ်မျိုး အဖြစ်သော်လည်းကောင်းနှင့် အစား အစာအဖြစ်သော်လည်းကောင်း ရောင်းချကြပါသည်။

တရုတ်ပြည်တွင် Shangi Ginseng Royal Jelly အမည်နှင့် Ginaeng 250 mg နှင့် ပျားနို့ 300mg ရောပြီး အစက်ချသောက်ဆေးအနေဖြင့် ရောင်းချပါသည်။ ပျားလုပ်ငန်းဦးစီးအနေဖြင့် 250 mg capsule နှင့် 500 mg capsule ? Royal Jelly+ Ginseng capsule အနေဖြင့် ထုတ်လုပ်ရောင်းချပါသည်။ အင်အားချို့တဲ့ခြင်း၊ အသက်ရှူမဝခြင်း၊ အဟာရချို့တဲ့ခြင်း၊ အာရုံကြော အားနည်းခြင်း၊ အသည်းရောင် အသားဝါရောဂါ၊ ဆီးချိုရောဂါ၊ ချောင်းဆိုးပန်းနာရောဂါ၊ ဆဲပင်ကျွတ်၊ အဆစ်အမြစ်ရောင်၊ သွေးအားနည်း၊ အစာအိမ်ရောဂါတို့ ပျောက်ကင်းစေနိုင်သည်။ ၎င်းသည်အသက်ရှည် ကျန်းမာစေသည့်အပြင် ကလေးများတွင် ဉာဏ်ရည်ဖွံ့ဖြိုးခြင်း၊ ကိုယ်ခန္ဓာဖွံ့ဖြိုးကြီးထွား လာစေနိုင်ပါသည်။

Yitapropol အမည်ဖြင့် သောက်ဆေးကို ပျားရည် 450 gm ၊ ဝတ်မှုန် 45 gm ၊ ပျားနို့ 2 gm ၊ ပျားကော် 3 gm ရောပြီး ရောဂါပိုးကာ ကွယ်ဆေးအနေဖြင့်လည်း ထုတ်လုပ်ရောင်းချပါသည်။ Melbrosin Super D အမည်နှင့် ပျားနို့ ၁. ၂၅%၊ ဝတ်မှုန် ၂၅%၊ Fructose 250 gm တို့ရောစပ်ပြီး သောက်ဆေးအနေဖြင့် ထုတ်လုပ်ရောင်း ချပါသည်။ ဤဆေးသည် ဆီးချိုရောဂါနှင့် အသည်းရောဂါ တို့ကို ပျောက်ကင်းစေနိုင်ပြီ၊ ခွန်အားဗလနှင့်လည်း ပြည့်ဝစေပါသည်။

အလှကုန်ပစ္စည်းများ၌ အသုံးပြုခြင်း

(၁) အရေပြား ပြုပြင်သည့်လုပ်ငန်း၌လည်းကောင်း၊ ရေပြားသန့်ရှင်းလတ်ဆတ်ရန်နှင့် အရေပြား အသားနုအမြန်တက်ရန် ပျားနို့ကို လိမ်းနိုင်ပါသည်။ မီးလောင်၊ ထိခိုက်ဒါဏ်ရာတို့၌ ပျားနို့လိမ်း၍ ပျောက်ကင်းစေနိုင်ပါသည်။

(၂) ခေါင်းလိမ်းဆီ၊ ဆံပင်သန်ဆေးတွေမှာလည်း ထည့်သုံးနိုင်သည်။ ခေါင်းလျှော်ရည်၊ ဆပ်ပြာ၊ သွားတိုက်ဆေး၊ ခံတွင်းသန့်ဆေး၊ မျက်နှာလိမ်းပေါင်ဒါ၊ မိတ်ကပ်၊ နှုတ်ခမ်းနီ တို့၌လည်း ပါဝင်သော ပစ္စည်းတစ်ခုအနေဖြင့် အသုံးပြုနိုင်ပါသည်။

(၃) တရုတ်နှင့် ယူဂိုဆလားဗီးယားနိုင်ငံတို့သည် မျက်နှာလိမ်း ခရင်ဆီတွင် ပျားနို့ ၀. ၂% ထည့်သွင်းပြီး၊ အသားအရေစိုပြေ ချောမွတ်စေရန်နှင့် အရေတွန့်ခြင်း၊ ကာကွယ်ရန် အထူးဖော်စပ် ထုတ်လုပ်ရောင်းချသည်ကို တွေ့ရှိရပါသည်။

စားသောက်ကုန်၌အသုံးပြုခြင်း

(၁) တရုတ်နိုင်ငံတွင် ရေခဲချောင်း၊ ရေခဲမုန့်များတွင် ပျားနို့ထည့်သွင်း ထုတ်လုပ်ရောင်းချပါသည်။ သစ်သီးများတွင်လည်း ထည့်သွင်းစားသောက်ကြပါသည်။

(၂) ဥရောပနိုင်ငံများတွင် ပျားနို့ကို ဒိန်ချဉ် (Yogurt) ၏နှင့် ရောစပ်၍ စားသုံးကြသည်။ ဗိုက်တာမင်အားဆေးများနှင့် သစ်သီးရည်များတွင် ပျားနို့နှင့်ရောစပ်ပြီး ပြီးစားသုံးသည်။

အဖျော်ယမကာ၌အသုံးပြုခြင်း

အာရှတိုက်တွင် ပျားနို့ကို အဖျော်ယမကာနှင့် ရောစပ်ပြီးကျယ်ပြန့်စွာ အသုံးပြုသည်။ အခြားတစ်မျိုးတွင် နို့နှင့် ပျားရည်၊ သကြား၊ သစ်သီးယို၊ Pectin များထည့်ပြီး Jelly ကဲ့သို့ ပြုပြင်၍ ရောင်းချသည်ကို တွေ့ရှိရသည်။

ဆွေးနွေးချက်နှင့် အကြံပြုချက်များ

(၁) နှမ်းစိုက်ပျိုးရေးတွင် ရေသွင်းရာသီမရောက်မီ ရောဂါကုခြင်းလုပ်ငန်းကို စတင်လုပ်ကိုင် ရပါမည်။ ရေသွင်းနှမ်းအချိန်ဖြစ်သော ဧပြီနှင့်မေလများတွင် ပျားအင်အားကို ပြုစုပျိုး ထောင်ခြင်း (Building up) ပြုလုပ်ရမည်။

(၂) မိုးနှမ်းအချိန်ဖြစ်သော ဇူလိုင်နှင့်သြဂုတ်လများ၊ ပန်းနှမ်းအချိန်ဖြစ်သည့် နိုဝင်ဘာ၊ ဒီဇင်ဘာနှင့် ဆောင်းနေကြာရာသီများဖြစ်သော ဇန်နဝါရီ၊ ဖေဖော်ဝါရီတွင် ပျားနို့များကို အမြောက်အများ ထုတ်ယူသင့်သည်။ ပန်းနှမ်းပျားစာသည် ပျားသားလောင်း ပေါက်ပွားနှုန်း မြင့်မားသဖြင့် ပျားနို့အမြောက်အများ ထုတ်ရန် အားထားရသော ပျားစာများဖြစ်သည်။ လိမ္မော်ပျားစာသည် ဂျပန်နိုင်ငံတွင် ပျားနို့အမြောက်အများထုတ်လုပ်သော ပျားစာဖြစ်သည်။ ၄င်းအခြေအနေကို မိမိနိုင်ငံအနေဖြင့် လေ့လာသင့်သည်။

(၃) မိုးရေချိန်လက်မ (၅၀-၁၀၀) အထိရှိသော ဒေသမျိုး၊ လေတိုက်နှုန်း တစ်နာရီ (၁၀)မိုင် အောက်ရှိသော နေရာမျိုးနှင့် အပူချိန် > 100°F ရှိသော နေရာမျိုးတို့ကို ရွေးချယ်သင့်သည်။

(၄) ရိုးရိုးတစ်ထပ်ပျားအုံဖြင့် ပျားနို့ထုတ်လုပ်ခြင်းထက် နှစ်ထပ်ပျားအုံသည်လည်းကောင်း၊ နှစ်ထပ်ပျားအုံနှင့် သုံးထပ်ပျားအုံသည်လည်းကောင်း ပျားနို့များကို ပိုမို၍ များစွာထုတ်ပေး နိုင်ကြောင်း လေ့လာတွေ့ရှိပါသည်။

(၅) ဖြည့်စွက်စာ(၁)နှင့် ဖြည့်စွက်စာ(၂)တို့ကို ပျားနို့မထုတ်မီ ညမှစ၍ တိုက်ကျွေးရမည်။

(၆) နှစ်ထပ်၊ သုံးထပ် ပျားအုံများကို တစ်ပတ် (သို့မဟုတ်) ၁၀ ရက်လျှင် တစ်ကြိမ်၊ အပေါ် အောက် Sealed brood, Open brood လဲလှယ်ပေးသင့်သည်။

(၇) ပျားနို့ထည့်သည့် ပုလင်းသည် အရောင်ဝါပုလင်းဖြစ်ရမည်။

(၈) ဖြည့်စွက်စာ(၁)၊ ဖြည့်စွက်စာ(၂)များကို လုံလောက်စွာကျွေး၍ ပျားနို့ကို တစ်နှစ်ပတ်လုံး ထုတ်လုပ်နိုင်ပါသည်။ အကောင်းဆုံးဖြည့်စွက်စာ (၁)သည် ပျားရည်ဖြစ်သည်။

(၉) ပျားနို့ထုတ်လုပ်ရာတွင်အဆင့်မြင့်သော ပျားမျိုးကိုသာ ရွေးချယ်၍ မွေးမြူသင့်ပါသည်။

(၁၀) Cell bar frame ကို အမှတ်အသား (သို့မဟုတ်) ရက်စွဲကိုလည်း မှတ်သားထားသင့်သည်။

(၁၁) Grafted Frame ကို Open brood နှင့် ကပ်လျက်ထားရမည်။ (၁၂) ပျားနို့တွင် အာဟာရဓါတ်များ ပေါကြွယ်ဝစွာပါရှိသဖြင့် အထူးအားဆေး၊ အစားအစာ၊ လူသုံးကုန်၊ စားသုံးကုန်၊ အဖျော်ယမကာ၊ အလှကုန်လုပ်ငန်းများတွင် ထည့်သွင်းအသုံးပြုနိုင်သည်။

(၁၂) ကင်ဆာအကြိတ်ရှိသော ကြွက်ကိုပျားနို့ (20mg/kg) ကျွေးသည့်အခါ အကြိတ်သည် တဖြည်းဖြည်း သေးသွားသည်ကို တွေ့ရှိရပါသည်။ (Tamura 1987) ထို့ကြောင့် Cancer ဖြစ်နေသူများစားသုံးသင့်သည်။

(၁၃) ပျားနို့တွင် Glucose oxidase, phosphatase, cholinesterase များပါရှိသဖြင့် ၄င်းတို့မှ Insulin like substance များထုတ်နိုင်သဖြင့် ဆီးချိုရောဂါရှိသူများ စားသုံးသင့်ပါသည်။

နိဂုံး

ပျားနို့အမြောက်အများ ထုတ်လုပ်သည့် လုပ်ငန်းသည် ပျားရည်ထုတ်လုပ်ငန်းမတိုင်မီ၊ အဖိုးထိုက်တန်သော ပျားထွက်ပစ္စည်းတစ်ခုကို အချိန်တိုတိုအတွင်း ထုတ်ယူရရှိနိုင်သည့် လုပ်ငန်းတစ်ရပ်ဖြစ်ပါသည်။ ပျားနို့ကို အသုံးပြုပြီး၊ မြန်မာ့ဆေးပညာနယ်ပယ်တွင် ထိရောက်သော အားဆေးတစ်လက် ပေါ်ထွက် လာစေနိုင်ပါသည်။ ထိုအပြင် လူသုံးကုန်၊ အလှကုန်၊ အာဟာရ အစားအစာ၊ အဖျော် ယမကာတို့တွင်လည်း ပါဝင်သော ပစ္စည်းတစ်ခု အဖြစ် တွင်ကျယ်စွာ အသုံးပြုလာနိုင်ပါသည်။ ပျား မွေးမြူသူများအတွက်လည်း အပိုဝင်ငွေများ တိုးတက်လာနိုင်ပါသဖြင့် အကျိုးပြုနိုင်သော စာတမ်းတစ်စောင်ဖြစ်လိမ့်မည်ဟု မျှော်လင့်မိပါသည်။

ကျေးဇူးတင်ရှိခြင်း

ဤစာတမ်းဖြစ်မြောက်ရန် အတွက် အားပေးကူညီခဲ့ပါသော ဗိုလ်မှူးချုပ် မောင်မောင်သိမ်း၊ ဝန်ကြီး မွေးမြူရေးနှင့်ရေလုပ်ငန်းဝန်ကြီးဌာနအား အထူးကျေးဇူးတင်ရှိပါသည်။ ထိုနည်းတူစွာ ဦးမြင့်ရွှေ၊ ညွှန်ကြားရေးမှူးချုပ်၊ မွေးမြူရေးနှင့်ရေလုပ်ငန်း ညွှန်ကြားမှုဦးစီးဌာန၊ ဒေါက်တာမင်းစိုး၊ ဒုတိယဥက္ကဋ္ဌ၊ မြန်မာ နိုင်ငံစိုက်ပျိုးရေး၊ သစ်တော၊ မွေးမြူရေးနှင့်ရေလုပ်ငန်းပညာရှင်အဖွဲ့၊ ဦးမောင်မောင်စိန်၊ ဒုတိယညွှန်ကြားရေးမှူးချုပ်၊ ပျားလုပ်ငန်းဌာနတို့အား များစွာ ကျေးဇူးတင်ရှိပါသည်။

နောက်ဆုံးတွင် ဤစာတမ်းရေးသားရာတွင် ကူညီခဲ့ကြသော ဒေါ်စန်းစန်းလှ၊ ဒေါ်တင်မိုးခိုင်၊ ဦးကျော်စည်သူ၊ ဒေါ်အိသဇင်မြင့်၊ ဒေါ်သူဇာအေးတို့အားလည်း ကျေးဇူးတင်ရှိပါသည်။

Table 1. A list of properties of Royal jelly for internal and external uses

Internal uses	External uses
Tonic	Skin conditioning
Stimulant – physical performance,	Epithelial stimulation and re-growth
Better memory, learning	Anti-wrinkle
Capacity and self-confidence	Sebaceous secretion (fat secretions of skin glands)
General health improvement	Normalized
Anorexia	
Increased appetite	
Skin conditioning	
Sexual desire and performance	
Influenza	
Increased resistance to vital infections	
Good for high blood pressure	
Anaemia	
Arteriosclerosis	
Lower cholesterol levels	
Good for chronic and incurable disorders	

Table 2. Composition of Royal jelly (From Lercker et al., 1984 and 1992)

Composition	Minimum	Maximum
Water	57%	70%
Protein (N x 6.25)	17% of dry wt.	45% of dry wt.
Sugar	18% of dry "	52% of dry "
Lipid	3.5% of dry "	19% of dry "
Minerals	2% of dry "	3% of dry "

Table 3. Vitamin content of Royal jelly in sugar/gram of fresh weight (Vecchi et at, 1988)

Range	Thiamine	Riboflavin	Pantothenic acid	Pyridoxine	Niacin	Folic acid	Inositol	Biotin
Minimum	1.44	5	159	1.0	48	0.130	80	1.1
Maximum	6.70	25	265	48.0	88	0.530	350	19.8

Table .4. A list of some effects of Royal jelly on human

Applications	Description	References
ıature babies and those nutritional deficiencies ırious origins	8-100 mg orally, improvement of general condition; increase in weight and appetite, red blood cells a haemglobin	Malossi & Grand , 1956 Prasper and Ragazirti,1956 Prosperi, et al., 1956 Quadric, 1956
rly(70-75years)anorexic ɜssed and low blood ɜure patients	20mg injected every second day improvements on all accounts	Destrem,1956
	20 mg taken orally every second day, improvements as above	Destrem, 1956
hiatry	Improvements of asthenia, nervous breakdown, emotional problems and counteraction of side effects of psychoactive drugs	Telatin, 1956
ınic tuberculosis	Mixture of Royal jelly, honey and ginseng, improvements in weight a gain and psychological conditions, but changes of blood characteristics.	Borgia et al., 1984
ulation metabolism	Stimulating effect comparable to that by proteins, effect assumed to be due to activity of enzymatic complexes	Martinetti and Caracisti 1956
nd healing	5-30 mg/ml injected into burn blisters, improved re-growth of skin	Gimble et al., 1962

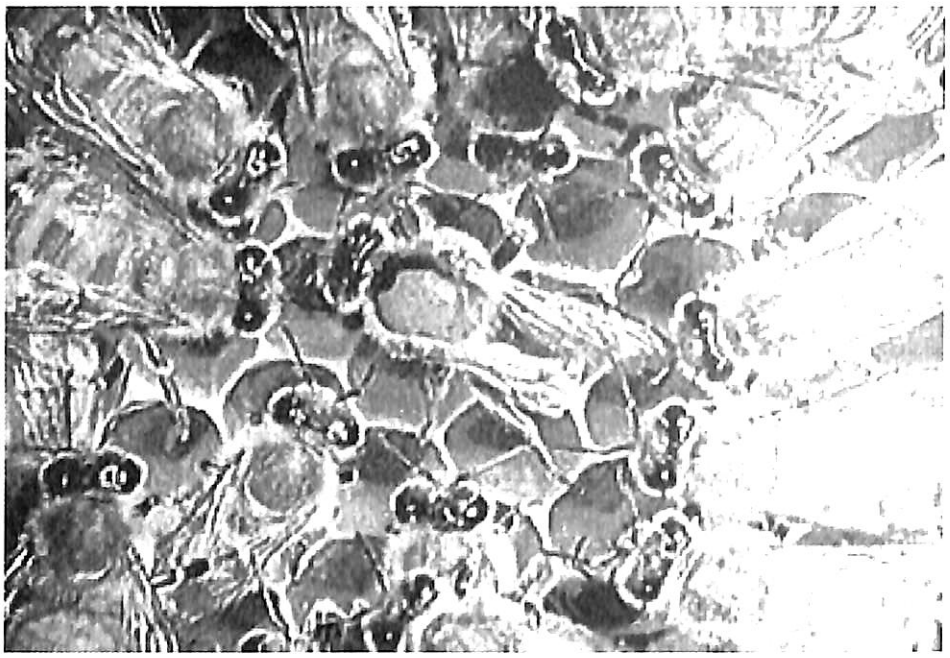
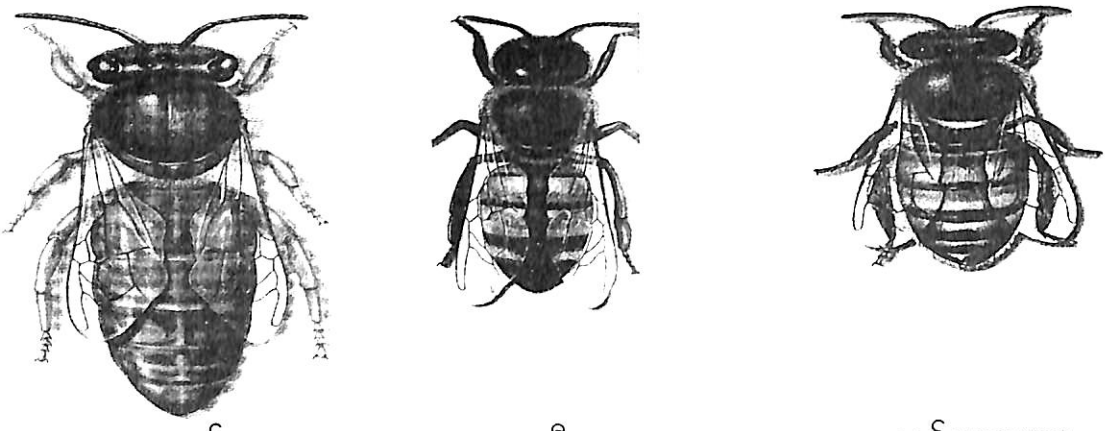


Fig. 1. ပျားဘုရင်မ၊ ပျားထီးနှင့်လုပ်သားပျားများပါဝင်သောပျားအုံပုံ



ပျားဘုရင်မ ပျားထီး လုပ်သားပျား

Fig.2 ပျားဘုရင်မ၊ ပျားထီး နှင့်လုပ်သားပျား

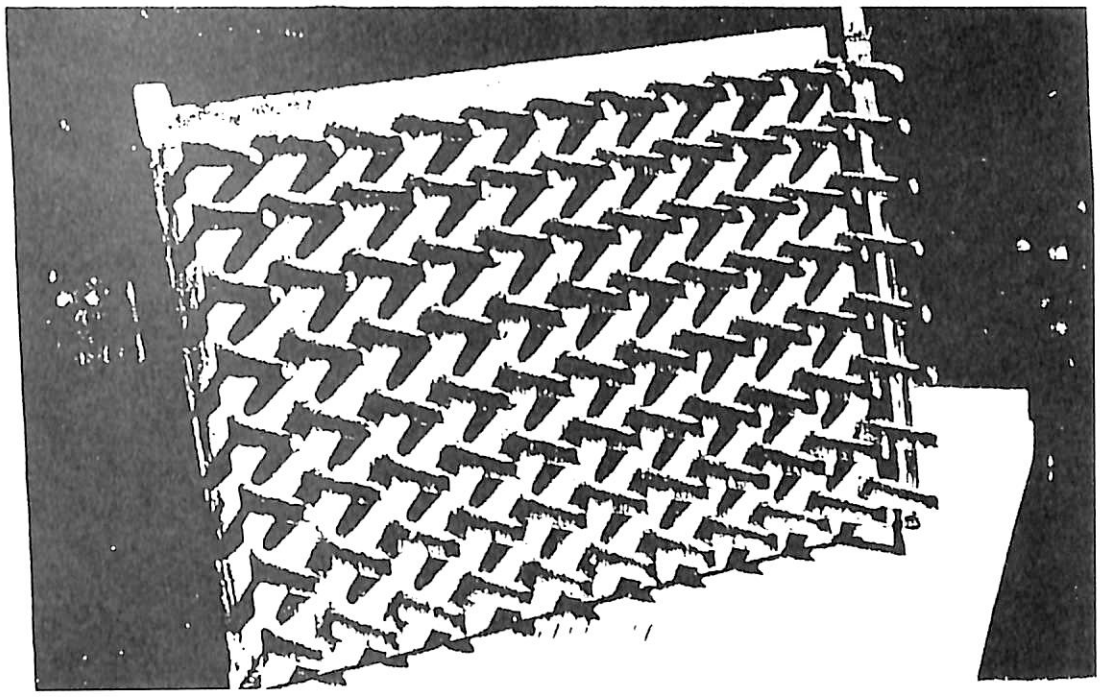


Fig.3 - ပျားအုံနှင့်ပျားရည်ပျား Queen cell ပုံဖော်ကိရိယာပုံ

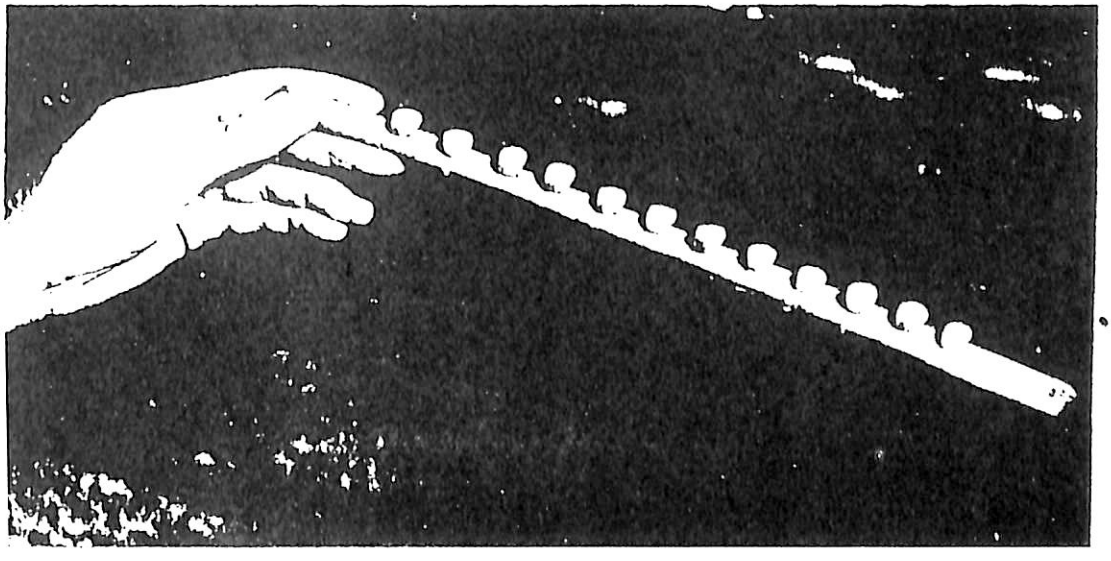


Fig. 4 Queen cell များကြိုတင်ပြင်ဆင်ထားသော Bar ပုံ

Fig. 5 Queen cell များကြိုတင်ပြင်ဆင်ထားသော Bar ပုံ

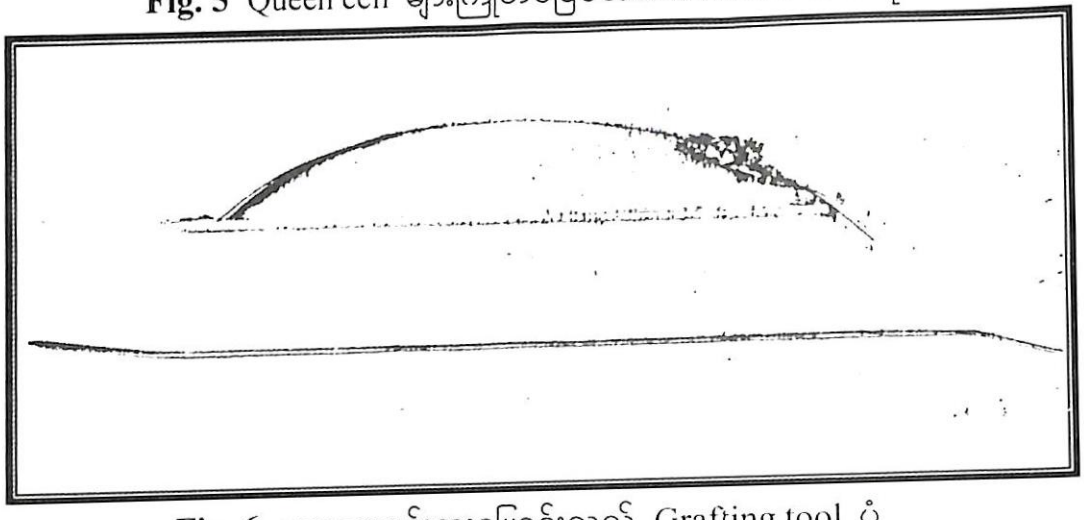


Fig. 6 သားလောင်းကူးပြောင်းသည့် Grafting tool ပုံ

The grafting needle is simply a small nod with a book on the end. Shown above
Arc the straight needle (Lower) and the pierce or Macy automatic needle (Upper).

Fig.7. A close up view of transferring or grafting a very young larva into a wax-cell cup which has previously been attached to the cell bat.

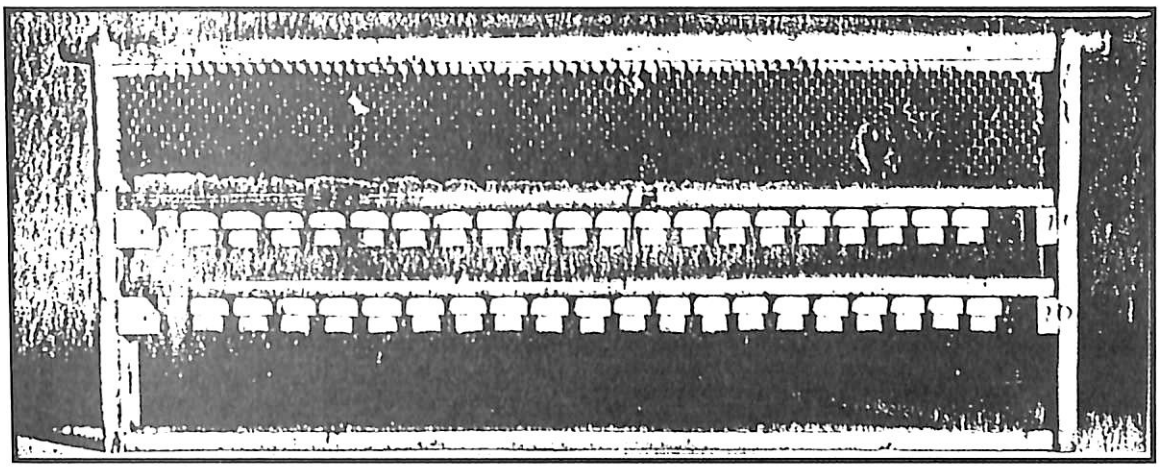
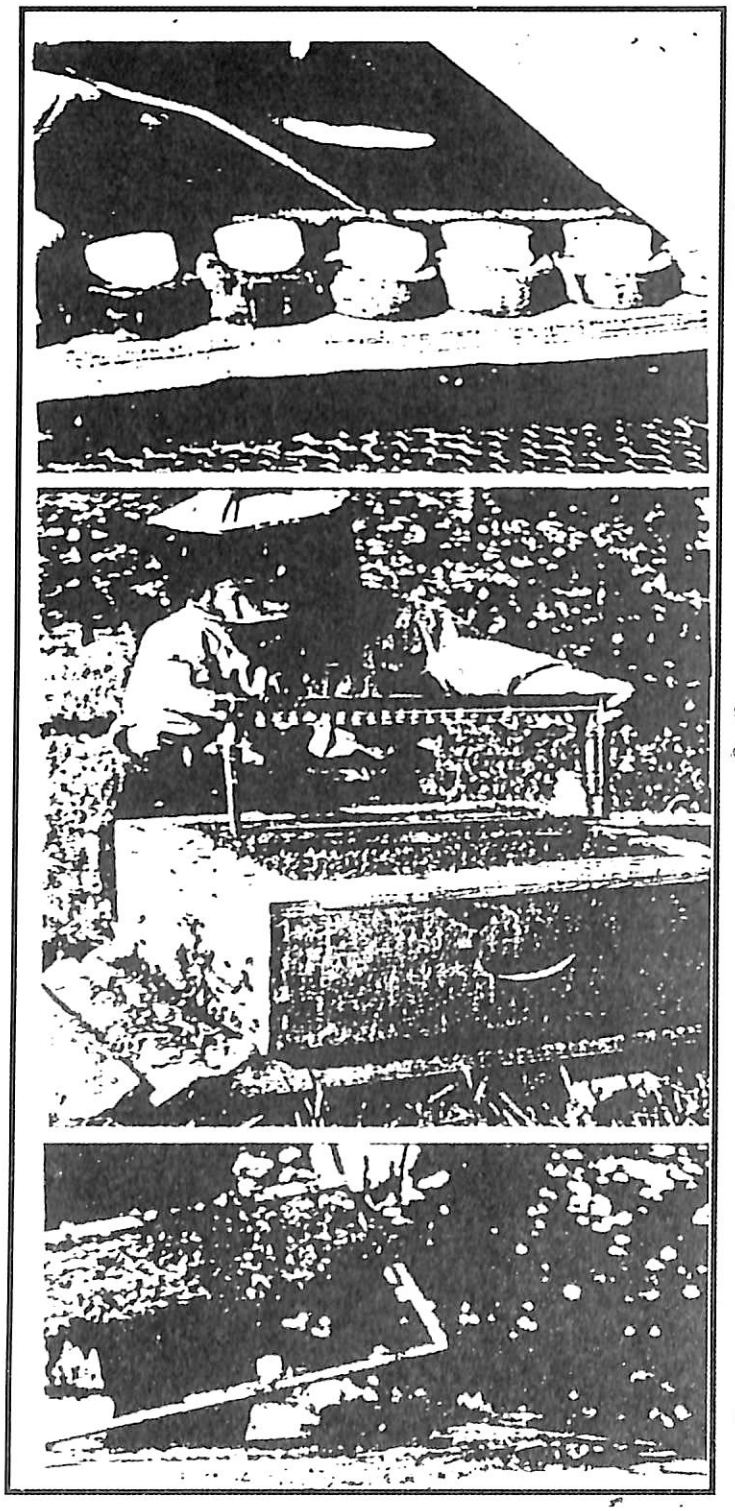


Fig. 8. A cell-bar frame containing two cell bars each with twenty wax-cell cups is ready to be placed in the swarm box.



ပျားကောင်ကော်ခပ်ရွေ့ပြောင်းပုံ

အစပို့းအုံထဲသို့ Grafted frame
ထည့်သွင်းသည့်ပုံ

Fig. 9 Grafted frame အား
လက်ခံ/လက်မခံ စစ်ဆေးသည့်ပုံ

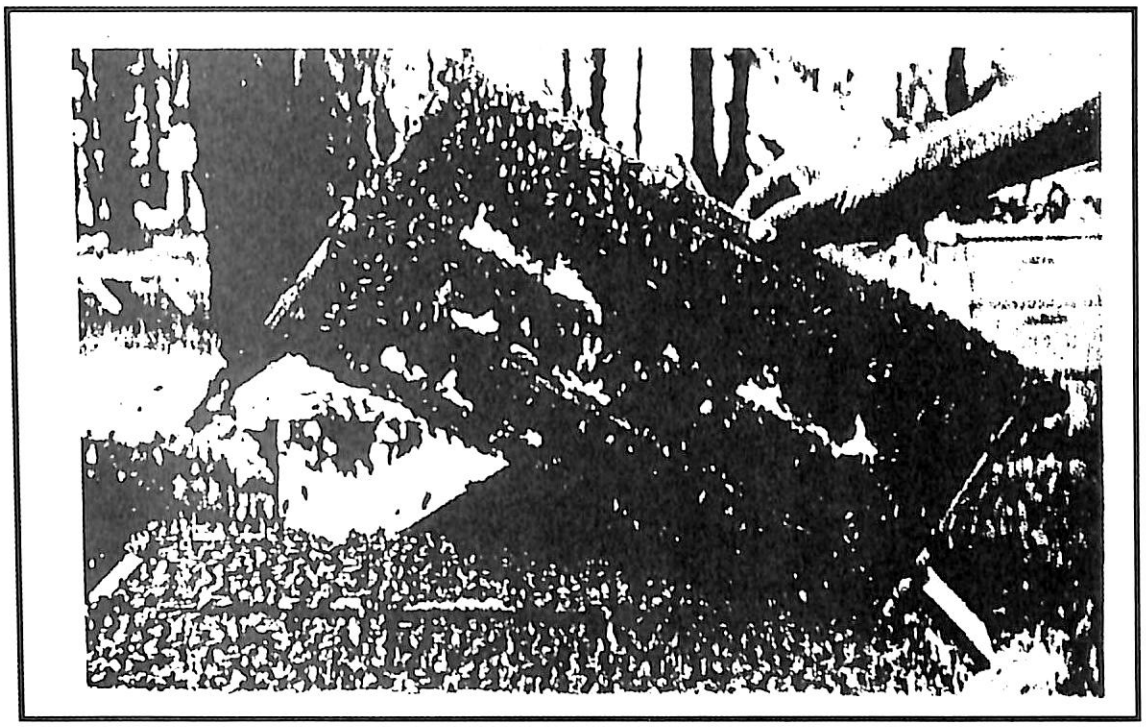
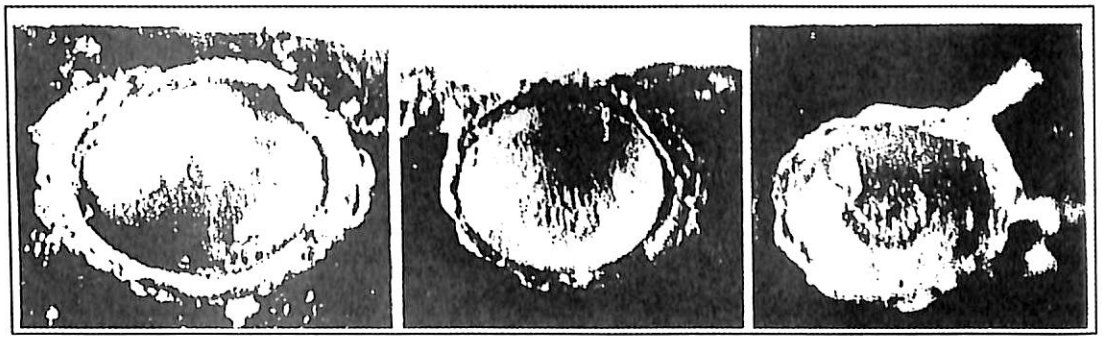
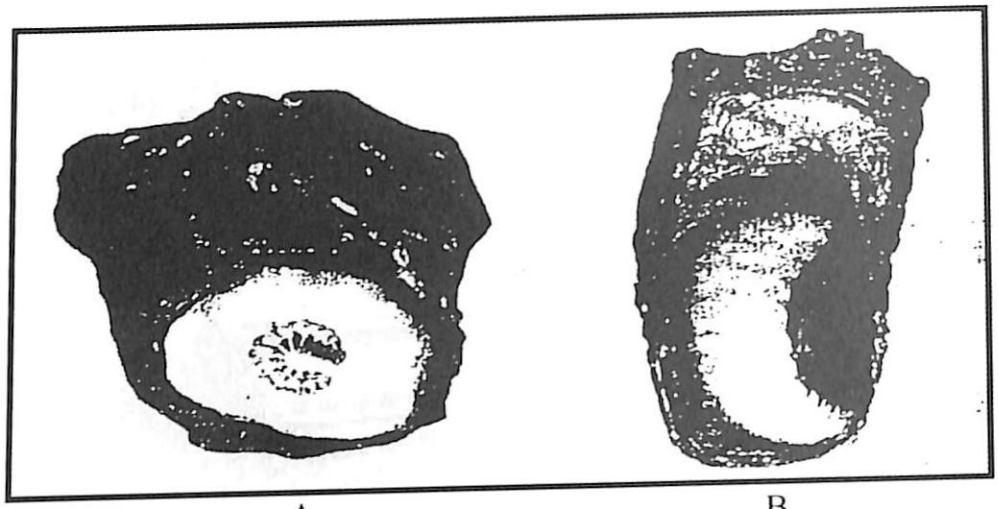


Fig. 10. Removing a cell-bar frame from a cell-builder (Photo courtesy of H.York)



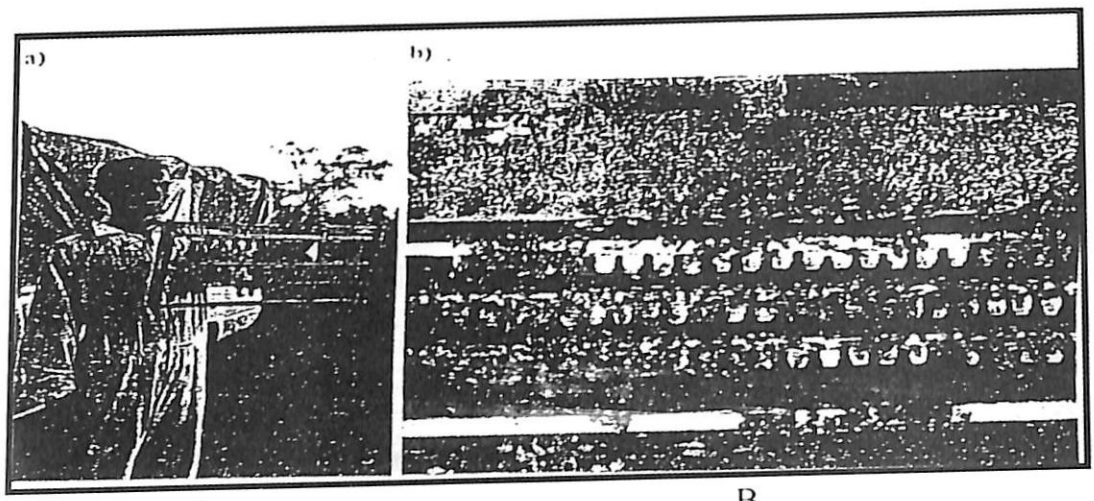
A B C

Fig. 11. Growth of larvae in queen cells. A. One day after grafting; B. Two days after grafting. C. Three days after grafting. (Photos courtesy of J.E. Eckert)



A B

Fig. 12 A. Three day old queen larva floating in Royal jelly. The cell is almost ready for harvest. B. Five day old queen larva in a newly sealed cell just before pupation. A good quantity of Royal jelly is left.



A B

Fig. 13 A .Special frame with queen cells for queen tearing or Royal jelly for harvesting. These cells have already been sealed and are too old for collection of Royal jelly. However, queens may be raised from these cells if they are introduced into queen-less hives. B Queen cells of the right age for Royal jelly harvesting.

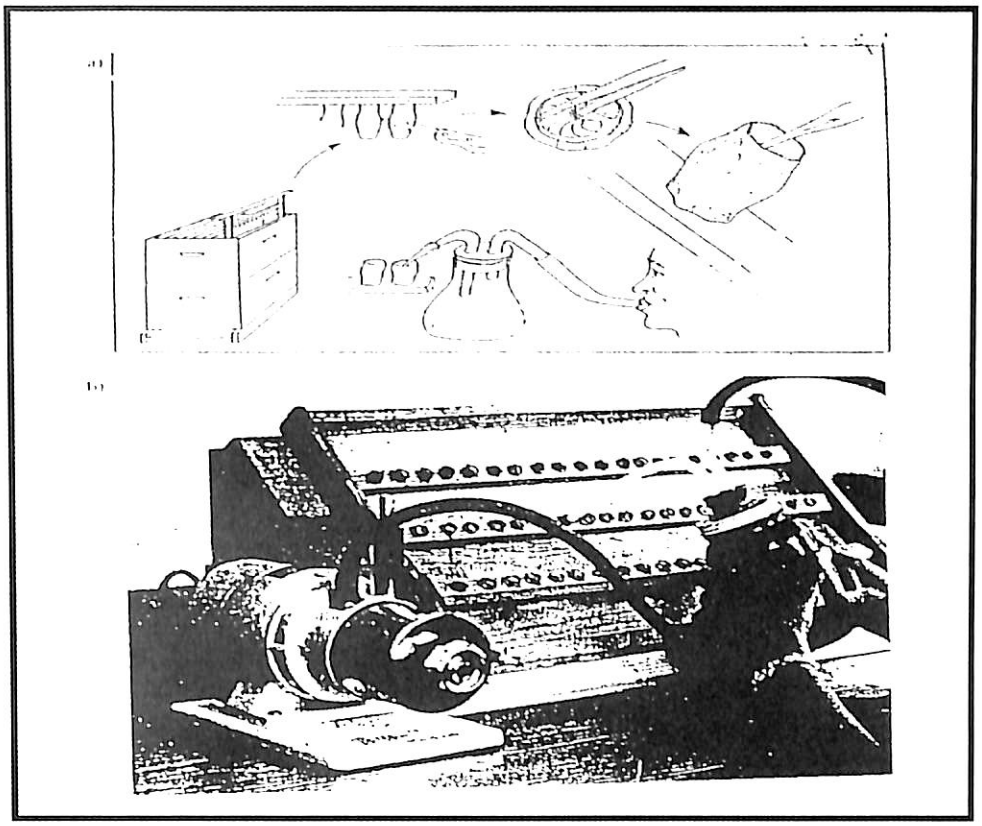


Fig. 14 Upper. The steps for removing Royal jelly from a queen cell and a diagram of a simple suction device for the collection of Royal jelly from queen cups. Lower. A small vacuum pump can be adapted for the collection of larger quantities of Royal jelly. Note that all the queen cells have been cut down in size to facilitate removal of the larvae and the Royal jelly.

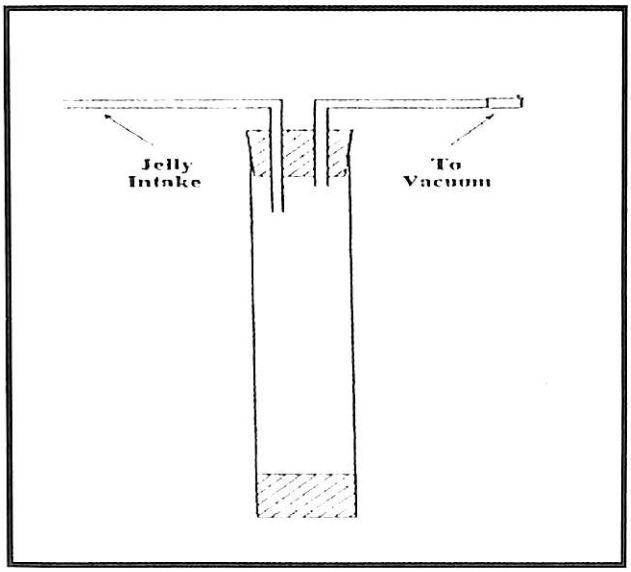


Fig. 15 Royal jelly collecting tube

References

Anonymous. 1996. Value added product from beekeeping. FAO publication.

Anonymous. - The hive and honey bee.

Crane, E. V. - Beekeeping.

Harry, H. L Jr. and J. E . Eikerk. - Queen bee rearing.

Lersky, A M . Y.- Bee products, properties, application and apitherapy.

Root, A. I. - A. B. C and X. Y. Z of bee culture.

ဆွေးနွေးချက်

Dr. မင်းစိုး - Phosphatase enzyme သည် Liver glycogen ကဲ့သို့ Glucose ပြောင်းပြီး သွေးကြောထဲတွင် Blood glucose များစွာ ပါပြီးဖြစ်ပါသည်။ ထို့ကြောင့် Insulin like substance ဟု ရေးသားထားခြင်းသည် မည့်သည် အခြား Biochemical process များကြောင့် ဖြစ်ပေါ်လာသည်ကို ရှင်းလင်းပေးပါက ပိုမိုပြည့်စုံမည်ဟု တင်ပြပါသည်။

Effect of Equilibration Period on Viability of Frozen-thawed Striped Catfish (*Pangasius hypophthalmus*) Spermatozoa

Myint Wai[1], Myint Thein[2], Than Kyaw[3] and Maung Chit[4]

ABSTRACT

Success of semen cryopreservation in each species has been determined by many factors such as extender, cryoprotectant, equilibrium time, freezing procedure, thawing temperature etc. Among these, determination of appropriate equilibrium period was a key factor for viability of frozen- thawed fish spermatozoa. Four equilibrium periods (0, 10, 20 and 30 minutes) were tested for their effect for post thawed mobility of striped catfish spermatozoa. Of these, 0 minute was suggested as control. Milt (semen) from three adult males of striped catfish was collected by striping method. Collected milt was thoroughly mixed with honey in Ringer extender (one part milt with three parts extender) and stored at 4°C before use. Glycerol 10%, DMSO 10% and Propylene Glycol 15% used as cryoprotective agents. One ml each of extended milt was dispensed into three sets cryo-vials. Each set included 12 units of 1.5 ml cryo-vials (Costar, USA). A total of 36 cryo-vials were used. After equilibrium all vials were cryopreserved in liquid nitrogen for 3-5 days by using two steps freezing methods. After keeping in liquid nitrogen for 3-5 days, vials were thawed and examined their motility under stereomicroscope. Viability of spermatozoa was determined by their post-thawed motility. Post thawed motility percent in all treatment groups were not differed greatly. In conclusion effective equilibrium period ranged between 0 - 30 minutes in semen cryopreservation of striped catfish. Better post thawed viability of striped catfish spermatozoa could be obtained when the equilibrium period of 10 minutes is used.

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Introduction

Success of semen cryopreservation in each fish species has been determined by many specific factors such as extender, cryoprotectant, equilibration period, freezing procedure, thawing temperature, etc. Consequently, no common method of semen cryopreservation for all fish species could be established. Each species had its own procedures and equipments for successful cryopreservation protocol. Among these, determination of appropriate equilibration time was a key factor for viability of frozen-thawed fish spermatozoa.

When the cells are placed in the solution containing CPAs, they shrink because water rapidly leaves the cell to dilute the high concentration of extra cellular CPAs. But, with time, CPAs enter the cells so that the intracellular concentration gradually about the same as that of extra cellular. Under these circumstances, water re-enters the cells and the cell size is about the same as it was before CPAs was added (Ferguson, 1984). The time needed to regain the cell size to its normal is the equilibration period. In other word, the period of time between mixing the cryoprotectant with the cell suspension and the beginning of the cooling process is called the equilibration period (Mazur, 1984).

Equilibration, which should take place at ambient temperature, allows time for the cryoprotective agent to penetrate the cells, with larger and less permeable cells require a longer equilibration period. During this period the cell suspension may be dispensed into vials and otherwise manipulated in preparation for freezing. The optimal equilibration time should be determined empirically for the cells being cryopreserved to maximize later recovery (Simione, 1998).

For most cells, Mazur (1984) reported that equilibration should occur for at least 15 minutes but no longer than 45-60 minutes. Chao (1991) also reported that equilibration time never exceed one hour for many fish species. If the equilibration time is too long, the CPAs will toxic to the cells. However, Dong *et al.* (2005) reported that the equilibration time of 60 min was beneficial for the cryopreservation of shipped sperm samples of diploid Pacific Oysters, *Crassostrea gigas*. Differently, Jamieson (1991) reported that fish spermatozoa, unlike those of mammals, did not require an equilibration period because spermatozoa are small and the penetration of cryoprotectants is rapid. The need of equilibration time for fish sperm cryopreservation is obviously controversial among investigators. However, there is a general concept that the equilibration time is a key factor for cell survival in any conventional cryopreservation. Therefore, it is needed to investigate the effect of different equilibration time on the viability of frozen-thawed spermatozoa of striped catfish.

Materials and Methods

Milt (semen) from three adult males of striped catfish was collected during the middle of spawning season (the end of July) by stripping method (gently massage of the lower part of abdomen). Collected Milt was thoroughly mixed and suspended in the honey in Ringer extender (one part milt with three parts extender) and stored at 4°C before use. According to the previous experiment, three CPAs at their appropriate concentrations (Glycerol 10%, DMSO 10% and Propylene Glycol 15%) and four different equilibration periods (0, 10, 20 and 30 minutes) were tested for their effect on post thawed motility of striped catfish spermatozoa. Of these, 0 minute was suggested as control.

One ml each of extended milt was dispensed into three sets of cryo-vials. Each set included 12 units of 1.5 ml cryo-vials (Costar, USA). A total of 36 cryo-vials were used. Three different CPAs (Glycerol 10%, DMSO 10% and Propylene Glycol 15%) were added to each set of vials by using micropipette. As soon as after addition of CPAs, three vials each from every treatment group underwent cryostorage by two steps freezing method (without equilibration period or control group). Another three vials each from different treatment groups were equilibrated (for 10, 20 and 30 minutes respectively) at 4°C and then all vials were cryopreserved in liquid nitrogen for 3-5 days by using two steps freezing method.

After keeping in liquid nitrogen for 3-5 days, vials were thawed at 37°C (In DHK tissue bath shaker, Japan) and examined their motility under stereomicroscope at x 400 magnification. Viability of spermatozoa was determined by their post-thawed motility. Spermatozoa showing forward movement in linear motion were counted as motile spermatozoa. Data were further confirmed by using Improved Neubauer Type Haemocytometer (Arthur and Thomas Co., Philadelphia) in accordance with the method used by Parish (2003). Statistical analysis was made by using SPSS version 12.0 (2000). Data were subjected by analysis of variance (ANOVA). The Duncan's Multiple Range Test (DMRT) was used to compare the treatment means.

Result

Percent motilities of spermatozoa of all treatments were tabulated in Table (1). Post thawed motility percent in different treatment groups was not differed greatly. Propylene glycol in 15% concentration could maintain the highest motility percent in 10 minutes equilibration period. However, the difference between treatment groups is not significant.

Discussion

As described by Simione (1998), equilibration allowed time for the cryoprotective agent to penetrate the cells, with larger and less permeable cells require a longer equilibration period. However, fish spermatozoa are usually small, consequently, the penetration of cryoprotectants is rapid (Jamieson 1991), and no equilibration period is required (Toner and Fowler, 2002). Gwo *et al.* (2005) also used the equilibration period of 5-20 minutes for cryopreservation of Pacific bluefin tuna semen. Lahnsteiner *et al.* (2000) reported that the optimal sperm equilibration period in the extender was 5 minutes or less in cyprinid fishes. These statements were in agreement with present findings. The best motility percents were achieved when the extended semen were equilibrated for about ten minutes. However, no significant difference in motility percents was found in the control and all treatment groups.

Dong *et al.* (2005) also pointed out that in case of the cryopreservation of Pacific oysters, temperatures at which sperm samples were equilibrated with cryoprotectant before freezing varied from 0 to 26 °C with time intervals ranging from 0 to 60 min. In general, shorter equilibrations time were considered to be more effective in retaining post-thaw sperm quality, but long equilibration (e.g., 60 min) with the cryoprotectant at low concentrations (< 10%) may not decrease percent fertilization. In case of cryopreservation for mirror carp semen, Akcay *et al.* (2004) used the equilibration period of 45 minutes at 4°C. These reports were in contrast with present finding. In the present study, shorter equilibration period (0-10 min) yielded the best post-thawed motility.

Toner and Fowler (2002) reviewed the reports of various investigators concerning the effect of equilibration time on post thawed motility of fish sperm. Increasing the equilibration period from 5 to 60 minutes and the DMSO concentration from 10 to 30% lowered the post-thaw motility of yellowfin seabream spermatozoa (Gwo, 1994). In seabream, the fertilizing ability of frozen-thawed sperm decreased in DMSO extender when the equilibration period exceeded two minutes (Billard, 1978). A similar effect was observed after one hour in grey mullet (Chao, Chen and Liao, 1975). However, Tabata and Mizuta (1997) found that an equilibration time of 10 to 60 minutes had no effect on the fertility of frozen-thawed spermatozoa of hirame.

In rainbow trout, Ogier de Baulny (1997) observed that DMSO needed 10 minutes to penetrate into spermatozoa although the fertilization capacity of frozen-thawed spermatozoa was the same with or without equilibration period. With glycerol as cryoprotectant, the motility rate of frozen-thawed spermatozoa of bluefin tuna (*Thunnus thynnus* L.) was increased at long equilibration periods (30 minutes) compared to short ones (10 minutes), but the opposite was recorded for DMSO. Since penetration of

glycerol is slow, an equilibration time may be necessary (Suquet *et al.*, 2000). Jackowski *et al.* (1980) also noted that cryoprotective additives have different rates of diffusion into the cell. For example, the rate of diffusion for propylene glycol into oocytes is relatively fast (5-7 min) compared to the rate of diffusion for DMSO (20-30 min) or glycerol (>60 min). This report was in accordance with present finding. Cryoprotective ability of propylene glycol was higher when shorter equilibration period was used. In conclusion, in case of semen cryopreservation in striped catfish, effective equilibration period ranged between 0 minute and 30 minutes. Better post thawed viability of striped catfish spermatozoa could be obtained when the equilibration period of 10 minutes is used.

Table 1. Effect of different equilibration period on post-thawed motility of striped catfish spermatozoa

CPA and %	Percent motility at different equilibration period			
	0 Min	10 Min	20 Min	30 Min
PG 15%	74±1.87[a]	78±1.22[a]	74±1.87[a]	73±1.22[a]
Glycerol 10%	70 ±1.58[a]	73±1.22[a]	73±1.22[a]	72±1.22[a]
DMSO 10%	65±1.58[a]	67±1.22[a]	65±1.58[a]	64±1.87[a]

[abc] Different superscripts in the same row differ significantly ($p<0.01$)

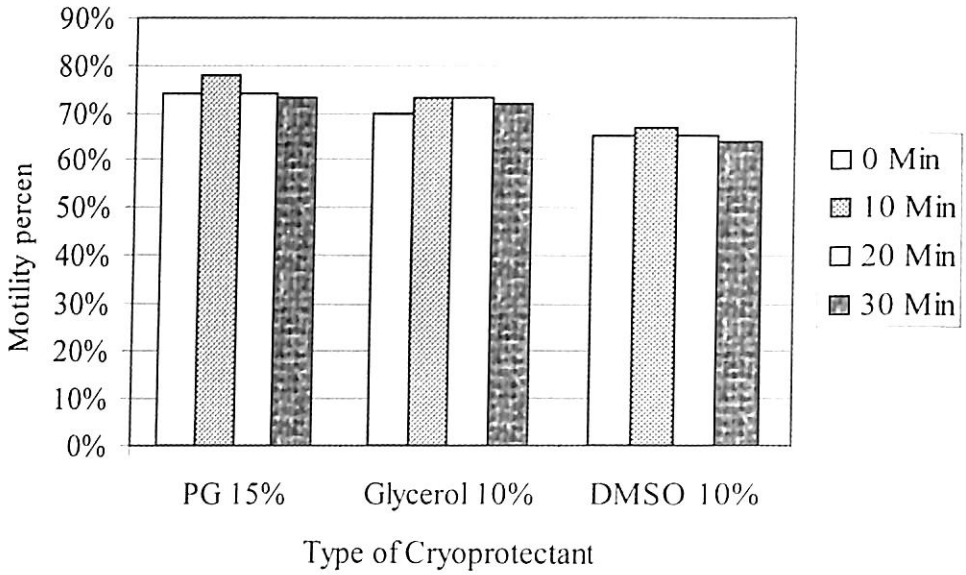

Fig.1. Effect of equilibration time on post thawed motility of striped catfish semen

References

Akcay, E., Bozkurt, Y; Secer, S and, Tikin, N 2004: Cryopreservation of Mirror Carp Semen. Turk. *J. Vet. Anim. Sci.* **28**: 837-843.

Billard, R. 1978: Changes in structure and fertilizing ability of marine and freshwater fish spermatozoa diluted in media of various salinities. *Aquaculture.* **14**: 187-198.

Chao, H. N. 1991. Fish sperm cryopreservation in Taiwan: Technology enhancement and extension efforts. *Monograph* **16**: 263-283. Reprinted from Bulletin of the Institute of Zoology, Academia Sinica.

Chao N.H., Chen, H.P. and Liao, C.I. 1975: Study on cryogenic preservation of grey mullet sperm. *Aquaculture* **5**: 389-406.

Dong, Q., Huang,C; Eudeline, B. and Tiersch, T. R. 2005. Systematic factor optimization for cryopreservation of shipped sperm samples of diploid Pacific Oysters, *Crassostrea gigas*. *Cryobiology*. **51**: (2).

Ferguson, A.B. 1984. The freezing and thawing of bovine embryos. In. Bovine Embryo transfer workshop. Proceeding no. 70. The University of Sidney. Victoria. 107-114.

Gwo, J.C. 1994: Cryopreservation of yellowfin seabream (*Acanthopagrus latus*) spermatozoa (teleost, perciformes, sparidae). *Theriogenology* **41**: 989-1004.

Gwo, H.H., Weng, T.S; Fan, L.Sl and Lee, Y.H. 2005: Development of cryopreservation procedures for semen of Pacific bluefin tuna *Thunnus orientalis*. *Aquaculture* **249**(1-4): 205-221.

Jackowski, S.C., Leibo, S.P and Mazur, P 1980: Glycerol permeabilities of fertilized and unfertilized mouse ova. *J. Exper. Zool.* **212**: 329-341.

Jamieson, G.M. (1991). Fish evolution and systematic: Evidence from spermatozoa. Cambridge University Press, Cambridge.

Lahnsteiner,F., Berger, B; Horvath, A. Urbanyi, B. andWeismann, T. 2000. Cryopreservation of spermatozoa in cyprinid fishes. *Theriogenology* **54**(9): 1477-1498.

Mazur, P. 1984. Freezing of living cells: Mechanisms and implications. *Am. J. Physiol.* **247**: C125-C142.

Ogier de Baulny B. 1997: Cryoconservation du sperme de poissons. Evaluation des dommages cellulaires. Amélioration de la technique de congélation. Perméabilité membranaire aux cryoprotectants. Thesis, Rennes. 129 pp.

Parish, J. 2003. Evaluation and freezing of semens. Reproductive Physiology and Endocrinology Lab. University of Wisconsin. www. wisc.edu/ansci_repro/ (16-5-2003).

Simione, F.P. 1998. Cryopreservation manual Nalge Nunc International. American Type Culture Collection (ATCC). Nalge Nunc International Corp. PDF version. http/ www.nalgenunc.com/cryo (5-4-2005).

Suquet, M., Dreanno, C; Fauvel, C.;Cosson, J. and Billard, R 2000. Cryopreservation of sperm in marine fish. *Aquaculture Research* **31**(3): 231 – 243.

Tabata, K. and Mizuta,A 1997: Cryopreservation of sex reversed gynogenetic females sperm in hirame. *Fisheries Science* **63**: 482-483.

Toner, M and Fowler, A.J 2002: Ultra rapid freezing for cell Cryopreservation. US Patent Issued on June 11, 2002. Patent Storm No. 587778.

ဆွေးနွေးအကြံပြုချက်များ

Dr. မောင်မောင်စံ	-	Conclusion တွင် may ဟု မသုံးသင့်ဟု အကြံပြုပါသည်။
အကြံပြုချက်	-	ငါးသည် သွေးအေး သတ္တဝါဖြစ်သည့်အတွက် Spermatozoa ၏ metabolism က နွားဇ၏ Sperm နှင့် ကွဲခြားနိုင်ပါသည်။ ဤသို့ကွာခြားခြင်းသည် ယခုတွေ့ရှိထားသော တွေ့ရှိချက်များ အပေါ် သက်ရောက်မှု ရှိ/မရှိ ဆက်လက် လေ့လာသင့်ကြောင်း အကြံပြုပါသည်။
Dr. ယဉ်ယဉ်မိုး	-	Cryopreservation သည် အိမ်နီးချင်းနိုင်ငံများ (ဥပမာ-ထိုင်း)တွင် ဖြစ်ထွန်းအောင်မြင်ပြီး ဖြစ်သည့် နည်းလမ်းဖြစ်ပါသည်။
အကြံပြုချက်	-	ယခုစမ်းသပ်ချက်သည့် ကိန်းဂဏန်းအရ Statistically significant difference ထွက်ခဲ့သော်လည်း မွေးမြူရေးနှင့် ရေလုပ်ငန်းဝန်ကြီးဌာနအတွက် အထူးသဖြင့် ငါးကဏ္ဍအတွက် အလွန်အရေးပါသော Research တစ်ခု ဖြစ်သဖြင့် ဆက်လက်ဆောင်ရွက်နိုင်ပါရန် တိုက်တွန်း အကြံပြု ပါသည်။
Dr. နွဲ့နွဲ့ထင်	-	Cryoprotectant သုံးမျိုးသုံးထားပြီး Equilibrium period (4) ဖေါ်ပြထားသည်ကို တွေ့ရပါသည်။ အသုံးပြုခဲ့သော Cryoprotectant ကိုလိုက်ပြီး Mobility of fish sperm (Survival rate) ကွာခြားခြင်း ရှိ/မရှိ ကို Analysis လုပ်ခဲ့ပါသလား၊ Type of cryoprotectant နှင့် Equilibrium period interaction ရှိ/မရှိ သိလိုပါကြောင်း ဆွေးနွေး မေးမြန်းပါသည်။
ဖြေကြားချက်	-	Conclusion အမျိုးအစားကို လိုက်ပြီး Spermatozoa ၏ Survival ကွာခြားမှုရှိနိုင်ပါသည်။ Mobility ကွာခြားခြင်းကို DMRT ဖြင့် ဖေါ်ပြထားပါသည်။ Interaction ရှိ/မရှိ စမ်းသပ်ချက်ပြုလုပ်မထားပါ။

A Comparative Study on the Effects of Different Leaf Protein Supplementation on the Performance of Pyar Zein Growing Calves Fed Rice Straw Based Diet

[1] Yan Naing Soe and [2] Mi Mi Thaw

ABSTRACT

A study was conducted to evaluate the voluntary feed intake, digestibility and performance of local Pyar Zein growing calves fed on rice straw based diet supplemented with *Leucaena leucocephala*, *Gliricidia* and Rumex K- 1 livestock fodder. Four local Pyar Zein growing calves live weight averaging 89.4±16.3 kg were allocated to four dietary treatments in a 4 x 4 Latin square design. The animals were offered rice straw *ad. libitum* and supplemented with a kind of fodder and concentrates at 1% of live weight each at fresh basis. Dietary treatments were Rice straw + *Leucaena* + Concentrate (RSLC), Rice straw + *Gliricidia* + Concentrate (RSGC), Rice straw + Rumex K-1 + Concentrate (RSRC) and Rice straw + Concentrate (RSC). Preference of animals to consume fodder leaf in ranking order of *Leucaena, Gliricidia* and Rumex K-1 were first, second and third respectively. Total dry matter intakes (DMI) of all dietary treatments were not significantly different. There were no differences of nutrient digestibility except for DM and ADF ($p<0.05$). Higher digestibility of DM was observed in RSRC ($p<0.05$) diet compared to the other treatments (52.8, 52.7 and 52.3% for RSLC, RSGC and RSC respectively). Higher digestibility of ADF was also observed in RSRC diet ($p<0.05$) compared to RSLC, RSGC and RSC. Average daily gain (ADG) of growing calves were not found significantly in all dietary treatments ($p<0.05$), however, numerically highest ADG was observed in RSRC diet (479 g/d). Rumex K-1 is one of the promising fodders to supplement rice straw to improve nutrient intake, digestibility and animals' performance. *Leucaena* and *Gliricidia* may also be useful nitrogen supplement in areas where cattle are fed on rice straw or low quality roughages. Fodder supplementation rate in this study (20% of total diet DM) could not improve DMI compared to NRC (1976) recommendation but it could improve digestibility. It is therefore suggested that fodder supplementation rate for rice straw based diet should be higher than 20% as DM basis and consideration must be taken into account for toxicity of secondary compounds that contain in fodder leaves. It is suggested that fodder leaf supplementation is required for optimal efficiency of utilization of rice straw by cattle with deficient in nitrogen or protein. Crude Protein content of total diet should be higher than 8% and roughage to concentrate ratio should be maintained at 50:50 to improve performance of cattle.

Key words: Pyar Zein cattle, *Leucaena, Gliricidia*, Rumex K-1, livestock fodder

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1. Introduction

Productivity and efficiency of livestock production per animal unit in developing countries is considerably less than in the more-developed world. Because forages and grasses for the ruminant livestock in the tropics are generally low in nitrogen and digestible nutrients (Leng, 1990). Grasses in wet season and cereal straws in dry season are the major roughage sources for ruminants. Among the roughages, rice straw is the most abundant crop residue and used as a major source of roughage for cattle in Myanmar (Yan Naing Soe, 2001). Cattle and buffaloes fed rice straw alone cannot maintain even the live weight due to its low nutrient composition. Low nutritive value of rice straw contributed to low palatability, low voluntary intake and low digestibility. To overcome these constraints it could be supplemented with other protein sources to increase intake of digestible nutrients (Doyle, Devendra and Pearce, 1986).

Seasonal availability and high fluctuation price of protein rich livestock feeds such as oil cakes and cereal byproducts also are limitations for smallholder farmers to meet the nutrient requirement of their livestock especially for ruminant animals. The utilization of cereal straws may be improved by supplementation with fodder tree foliages and legumes to improve the supply of fermentation nitrogen, carbohydrates and micronutrients (Devendra, 1990). Dutta et al (1999) also mentioned that foliage from legume trees offer an economic alternative to costly protein supplements.

Department of Forestry has launched Dry Zone Greening Project in central dry zone of Myanmar with the support of JICA. This project aimed to conserve environment by the establishment of agro-forestry tree plantation and it could cover Mandalay, Sagaing and Magwe Divisions. Agro-forestry trees consist of *Leucaena, Gliricidia, Cassia gluaca, Cassia siamea* and Neem. Ni Ni Maw et al (2006) stated that the potential role of tree foliages in ruminant nutrition are high nitrogen sources, as a source of un-degradable protein, provision of vitamins and minerals for rumen microbes and high digestibility.

Forage from legume trees such as *L. leucocephala* and *Gliricidia sepium* can be used as nitrogen sources in supplementary feeds (Mjema-Mweta et al., 1995) and also be used in combination with other locally available feed resources in formulating on farm supplementation (Ondiek et al., 2000). *L. leucocephala* has been shown to be a promising forage for animal production (Wongsrikeao et al., 1985) and Than Kyaw (2005) also stated that *L. leucephala* has already been adopted and very common in Myanmar but farmers do not pay much attention to its use as animal feed. *Gliricidia* has been grown very recently and Rumex K-1 livestock fodder is also newly introduced livestock fodder in Myanmar. The objectives of this study were to:

1. Find out the voluntary intake of rice straw when supplemented with different leaf protein sources.
2. Investigate the dry matter, crude protein and fibre digestibility of different leaf protein.
3. Study the response of leaf protein supplementation on live weight gain in growing calves.

2. Materials and Methods

2.1. Location and experimental period

The study was conducted at Livestock Research and Development farm, Livestock Breeding and Veterinary Department, Mingaladon Township, Yangon from 8 February to 21 May 2006.

2.2. Experimental animals and their management

Four local Pyar Zein growing calves, age between 12 to 18 months old were used to evaluate four dietary treatments during successive period. Their mean initial live weight before entering to the study was (89.4±16.3) kg. Before commencement of the trial, all animals were treated against internal and external parasites by Ivermectin 1% and Clorsulon injection at the rate of 50 kg per 1 ml (Ivocip plus, Cipla Ltd, India) and also were vaccinated against Haemorrhagic Septicaemia, Anthrax and O Type Foot and Mouth Disease (Recommended Vaccination Programme, Biologics Production Section, LBVD). Animals were confined in individual, well ventilated stalls.

One percent of live weight of fresh fodder leaf was offered to the animals in two equal portion before giving the rice straw. Respective amount of concentrates (1% of live weight) were given at two equal parts before rice straw were fed to ensure complete intake of concentrates. Rice straw was offered *ad libitum* by giving a weighed amount twice a day, providing 10% in excess of the previous day intake, at 8: 00 hr and 14:00 hr so that there was always some left-over in the next feeding time. Amounts of all feeds offered and refused were monitored for calculating intake levels. Clean water was provided free of choice to all animals.

Animals were weighed before morning feeding at the end of every trial on three successive days. Digital weighing machine for cattle was used to determine the live weight of animals. The amount of supplementation in each trial was adjusted on the basis of live weight. Each feeding trial consisted of 5 days preliminary, 15 days experimental and last 3 days during experimental period for sample collection.

2.3. Experimental design

The growing calves were randomly allocated to receive four dietary treatments according to 4 x 4 Latin Square design. Table 1 shows the experimental design of dietary treatments.

Table 1. Experimental design

Calf No.	Period 1	Period 2	Period 3	Period 4
1	RSLC	RSRC	RSGC	RSC
2	RSC	RSLC	RSRC	RSGC
3	RSRC	RSGC	RSC	RSLC
4	RSGC	RSC	RSLC	RSRC

RSLC: Rice Straw+Leucaena+Concentrate
RSRC: Rice Straw+RumexK-1 +Concentrate
RSGC: Rice Straw+Gliricidia+Concentrate
RSC: Rice Straw+Concentrate

2.4. Supplements and diet preparation

Calf concentrates consisted of rice bran, pea bran, sesame cake and chick pea husk with the proportion of 30, 20, 30 and 20% respectively as fresh basis. Fodder leaf was harvested every day and directly fed to animals on fresh basis.

2.5. Analytical methods

Dry matter (DM) and Crude Protein (CP) in feed and faeces were determined according to the methods of AOAC (1980). Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) were determined by the method of Goering and Van Soest (1970).

2.6. Statistical analysis

Data were subjected to analyze by the Analysis of Variance and treatment means were compared by using Duncan's new multiple range Test (Steel and Torrie, 1980).

3. RESULTS

3.1. Chemical composition of feedstuff and experimental diets

The chemical composition of rice straw, Leucaena, Gliricidia, Rumex K-1 fodder and concentrates are shown in table 2. The dry matter, organic matter, crude protein, ADF and NDF in rice straw were 97.5, 76.2, 3.56, 66.5 and 49.2% respectively. The CP content in Leucaena, Gliricidia, Rumex K-1 and concentrates were 22.1, 21.32, 29.94 and 16.7% respectively.

Table 2. Chemical composition of rice straw, tree fodders and concentrate on % dry matter basis.

Name of sample	%DM basis				
	DM	OM	CP	NDF	ADF
Rice straw	97.50	76.20	3.56	66.5	49.2
Leucaena leaf	22.36	18.15	22.10	32.1	15.8
Gliricidia leaf	30.05	5.14	21.32	65.6	35.7
Rumex K-1 leaf	6.38	3.25	29.94	69.2	28.5
Concentrate	71.32	67.87	16.70	60.3	25.7

Each of experimental diet contained a kind of fodder as 1% of live weight of animal as fresh basis. Dry Matter content of all experimental diets except no fodder supplemented diet (RSC) were almost similar. Crude Protein contents of RSLC, RSRC, RSGC and RSC were 8.6, 9.6, 7.3 and 7.1% respectively. NDF and ADF contents also were similar in all experimental diets. Chemical composition of experimental diets was shown in table 3.

Table 3. Chemical composition of diets

Name of sample	%DM basis				
	DM	OM	CP	NDF	ADF
RSLC	71.0	69.2	8.6	62.0	40.3
RSGC	69.6	72.5	7.3	65.0	43.0
RSRC	70.6	65.1	9.6	64.6	40.7
RSC	88.7	73.9	7.1	64.8	42.8

3.2. Palatability order of the different type of fodders

According to the selection behaviour of the animals, it was observed that *Leucaena* leaf supplementation was consumed within short period of time (<15 minutes) and followed by Gliricidia and Rumex K-1 (>30 minutes). Table 4 shows the palatability order of different types of fodders.

Table 4. Palatability order of the different type of fodders

Sr	Name of fodder	Palatability Ranking	Time taken to consume
1	Leucaena	1	<15 minutes
2	Gliricidia	2	20-30 minutes
3	Rumex K-1	3	>30 minutes

3.3. Voluntary dry matter intake and crude protein intake

Table 5 shows mean values of daily dry matter intake, crude protein intake and digestibility of different fodder supplemented diets. Dry matter intake of RSLC, RSGC, RSRC and RSC calculated based on 100 kg BW were 2.53, 2.60, 2.87 and 2.64 kg/ day respectively. However daily dry matter intakes of different fodders were numerically differed, there were no significant differences observed. Mean values of daily crude protein intakes of RSLC, RSGC, RSRC and RSC were 226, 246, 213 and 188 g/day respectively.

3.4. Dry matter digestibility and crude protein digestibility

Dry matter digestibility for RSLC, RSGC, RSRC and RSC were 52.8, 52.7, 57.4 and 52.3% respectively. Highest DM digestibility was observed significantly in Rumex K supplemented diet. Crude protein digestibility for RSLC, RSGC, RSRC and RSC were 41.1, 53.1, 44.3 and 49.5% respectively. Highest CP digestibility was observed in RSGC diet but all dietary treatments were not significantly differed. Table 5 also shows the digestibility of experimental diets.

3.5. Neutral Detergent Fibre and Acid Detergent Fibre intake

Intakes of Neutral Detergent Fibre in RSLC, RSGC, RSRC and RSC were 1.69, 1.66, 1.9 and 1.71 kg per 100 kg live weight respectively. Numerically highest NDF intake was observed in Rumex K-1 containing diet (RSRC) but NDF intake in all diets were not differed significantly. Acid Detergent Fibre intakes of RSLC, RSGC, RSRC and RSC diets were 1.09, 1.05, 1.26 and 1.13 kg per 100 kg live weight respectively. ADF intakes were not significantly differed among experimental diets.

3.6. Neutral Detergent Fibre digestibility and Acid Detergent Fibre digestibility

Digestibility of NDF of RSLC, RSGC, RSRC and RSC diet were found to be 40.5, 39.8, 46.3 and 43% respectively but not differed significantly. While in digestibility of Acid Detergent Fibre, significant differences ($P<0.05$) were observed in all experimental diets. RSRC and RSLC diet shows highest (48.4%) and lowest (34.2%) respectively. ADF digestibility of RSLC diet was similar to those of RSGC diet. RSRC and RSC diet also show similar ADF digestibility.

Table 5. Voluntary dry matter, crude protein intake and digestibility (100 kg live weight)

Parameter	Diet				P value
	RSLC	RSGC	RSRC	RSC	(P<0.05)
DM Intake (kg)	2.53	2.60	2.87	2.64	NS
DM Digestibility	52.8^{a}	52.7^{a}	57.4^{b}	52.3^{ac}	P<0.05
Crude Protein Intake (g)	226	246	213	188	NS
CP Digestibility	41.1	53.1	44.3	49.5	NS
NDF intake (kg)	1.69	1.66	1.90	1.71	NS
NDF Digestibility	40.49	39.8	46.26	43.00	NS
ADF intake (kg)	1.09	1.05	1.26	1.13	NS
ADF Digestibility	34.19^{a}	34.51^{a}	48.44^{bc}	43.17^{b}	P<0.05

a,b and c means bearing different superscripts are significantly different ($P<0.05$)

3.7. Roughage to concentrate ratio and inclusion rate of fodder leaf in total diet

Roughage to concentrate ratio of RSLC, RSGC, RSRC and RSC diets were 49:51, 49:51, 45:55 and 37:63 respectively. All diets except RSC diet used in this study were almost similar (approximately 50:50). Fodder leaf proportion to the total diet as DM basis in RSLC and RSGC diet were 21:79 and 27:73 respectively where as in RSRC diet was 9:91 but RSC diet was 0:100 due to absence of fodder supplementation in RSC diet. Table 6 shows Roughages to concentrate ratio and inclusion rate of fodder leaf in the total diet DM of experimental diets.

Table 6. Roughages to concentrate ratio and inclusion rate of fodder leaf in the total diet (DM) of experimental diets

Parameter	Diet			
	RSLC	RSGC	RSRC	RSC
Roughage: Concentrate	49:51	49:51	45:55	37:63
Fodder leaf, % of total diet DM	21:79	27:73	9:91	0:100

3.8. Average Daily Gain (ADG) and Feed Gain Ratio (FGR)

Average Daily Gains on calves receiving different fodder supplemented diets were shown in Table 7. ADG of RSLC, RSGC, RSRC and RSC were 469, 413, 479 and 416 g/day respectively but there was not observed significantly. Percent live weight gains of calves fed on different diets of above order were 0.46, 0.41, 0.50 and 0.41. Feed gain ratio for RSLC, RSGC, RSRC and RSC were 5.33, 6.35, 5.97 and 6.35 respectively.

Table 7. Average Daily Gain and Feed Gain Ratio

Parameter	Diet				P value
(Mean value)	RSLC	RSGC	RSRC	RSC	(P<0.05)
Initial live weight (kg)	99.68	100.80	99.55	99.93	NS
Final live weight (kg)	109.06	109.05	109.13	108.25	NS
Live weight change (kg)	9.38	8.25	9.58	8.33	NS
Days of measurement	20	20	20	20	
ADG (g)	468.75	412.50	478.75	416.25	NS
ADG, % LW	0.46	0.41	0.50	0.41	NS
DMI (kg/day)	2.50	2.62	2.86	2.64	NS
FGR (kg DMI/kg ADG)	5.33	6.35	5.97	6.35	NS

4. DISCUSSION

4.1. Chemical composition of feedstuff and diets

The dry matter content of rice straw used in this experiment was 97.5% and which was relatively higher than those of 91.2% (Yan Naing Soe, 2001), 93.9% (Tin Ngwe, Mar Mar Kyi, Cho Cho Thein and Zaw Win Maung, 1993a) and 95.2% (Wongsrikeao, Wanapat and Taesakul, 1985) but organic matter content (76.2%) was lower than the value (82.0%) reported by Tin Ngwe et al (1993a), (83.5%) reported by Yan Naing Soe (2001) and (83.7%) reported by Wongsrikeao et al (1985). The crude protein content of rice straw used in this study was 3.56% and that was relatively higher than those of 3.27% (Yan Naing Soe, 2001), reported value of 2.5% (Tin Ngwe et al., 1993a) and 2.6% (Wanapat et al., 1985). The different chemical composition of rice

straw indicated the differences among rice varieties, storage method and environmental factors. Rice straw used in this experiment was stacked in open air and fed to animals directly. The experiment was carried out during the hottest months of the year. For those reasons, the DM content of rice straw in this experiment was relatively higher than those of reference values. The straws Neutral Detergent Fibre (NDF) and Acid Detergent Fibre (ADF) contents were comparable to other published values (Wanapat et al, 1985 and Wongsrikeao et al. 1985). Mean Crude protein (CP) content of *Leucaena* leaf in this study was 22.1% and which was similar to values reported by Ni Ni Maw et al (2006) and Devendra (1992) but lower than 29.6% value reported by Dutta et al (1999). Mean value of CP for *Gliricidia* was 21.32% and which was lower than observation of Ni Ni Maw et al., 2006 (18.64%) and 14.7% reported by Devendra (1992). Crude Protein content of Rumex K-1 used in this study (29.94%) was felt within the value of product specifications, 28-34% CP at DM basis (http://www.romax.com.cn).

Higher and lower CP content were found in RSRC and RSC diet which may be due to different CP content of fodder leaves included in the diets.

4.2. Palatability of fodder

Palatability of tree fodder has been attempted to assess through short term intake trials. These trials do not take into consideration the fact that animals can be trained to consume fodder which they do not like the first day they are exposed to it. Palatability of tree fodders in this study was assessed by period of time needed to consume specific type of fodder by animals completely. Of the tree fodders, *Leucaena* had highest palatability but its containing diet showed numerically low DMI. Reluctance to eating *Gliricidia* leaves may be due to its odour (Brewbaker, 1986), astringency and post-negative influences of tannins on the epithelium of oral cavity of the animals (Aganga and Tshwenyane, 2003). Lowry (1990) also mentioned that in some parts of the world the use of *Gliricidia* is limited for ruminants by unpalatability.

However Rumex K does not contain tannin according to product specification (http://www.romax.com.cn) and it was observed that cattle taken some times to complete consumption of Rumex K-1 (<30 minutes) and it may be due to its sour taste.

4.3. Voluntary dry matter and crude protein intake

Total dry matter intake of Rumex K-1 supplemented diet in the present study was higher (2.87 kg/day) than in the other treatments calculated based on 100 kg live weight but not differed significantly. NRC (1976) recommended that thin yearling steers should be provided high quality roughages at the rate of 3% of live weight as dry matter basis. Voluntary dry matter intakes of this study were slightly lower than (<3%) NRC recommendation but it means that animals fed only on high quality roughages. In this study animals were supplemented with green fodders as well as concentrates. It is therefore DMI may be lower than NRC due to substitution of concentrate to roughages. Another reason for lower DMI compared to NRC (1976) was due to animals suffered from heat stress during experimental period which was summer in Myanmar. Leng at al (1991) also found that in tropical countries, often low intakes of poor quality forage by ruminant may be imposed by a combination of metabolic heat stress, high environmental temperature and humidity.

Preston and Leng (1987) stated that 20% of the dry matter of a diet in the form of green forage is enough to meet the requirement for microbial nutrients. Green fodder supplementation rate for RSLC and RSGC diets in this study were agreed with them while in RSRC diet, it was very much lower than their recommendation. On the other hand fodder supplementation rate in this study was contrary to Devendra (1988) and who suggested that optimum dietary level on DM basis of leguminous fodder should be 30-50% for practical application.

To just maintain the live weight of cattle, high level of forage tree supplementation at 1.1% of live weight or 33% of total diet DM of either *Leucaena* (Moran et al., 1983) or *Gliricidia* (Doyle et al., 1986) on rice straw based diets are required. Palatability can be an important factor for the voluntary intake of fodder (Ralph, 1999) however, in this study, palatability could not determine the voluntary intake or DMI of all experimental diets may be due to lower supplementation rate of tree fodder (>0.3% Live weight) than recommendations made by other workers.

Due to very low dry matter content (6.38%) of Rumex K-1 and based on the feeding level (1% of live weight of fresh basis), its dry matter intake was very much substituted with rice straw (9:91) to maintain required DMI for animals themselves. Devendra (1992) stated that voluntary feed intake is influenced a very large extent by the dietary crude protein content. A low protein and high fibre content are major limitation for the utilization of rice straws. Crude protein content of different fodders used in this study were higher than 20% and could be used as protein supplement to improve rice straw utilization. Numerically highest DMI was observed in RSRC diet may be due to its highest CP content.

Numerically highest CPI was observed in RSGC diet but treatment means were not significant. Although, Rumex K-1 provided highest CP (29.94%) to the diet, CPI for it containing diet showed lower than RSLC and RSGC due to its lower supplementation rate at DM basis. Figure 1 shows the mean intakes of DM, CP, NDF and ADF.

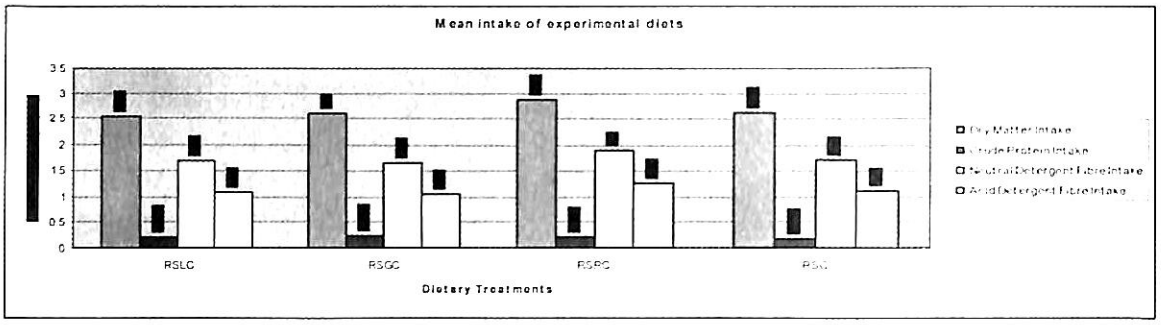

Figure 1. Mean Intakes of DM, CP, NDF and ADF of four dietary treatments

4.4. Dry matter digestibility and crude protein digestibility

Apparent digestibility (%) of DM and ADF exhibited a higher trend ($p<0.05$) in Rumex K-1 supplemented diet resulting in higher dry matter intake than in other treatments. Preston and Leng (1987) mentioned that diet less than 8% CP are considered deficient as they cannot provide the minimum ammonia levels required for microbial activities in the rumen. Rumex K-1 does not contain tannins, highest CP content of its containing diet (9.6%) compared to other diets and it will be rapidly degraded in the rumen, providing high level of NH3-N which favoured to increase microbial activities and promote digestibility of its supplemented diet. In the RSLC and RSGC diets, *Leucaena* and *Gliricidia* respectively contained tannin and which bound to plant protein. Tannin determines leaf protein to be digested slowly and provide lower ammonia nitrogen into the rumen insufficiently for optimum microbial activities which could lower digestibility. However, *Leucena* and *Gliricidia* may contain different levels of tannin, crude protein digestibility of all experimental diets were not differed significantly due to there was no significant differences in DMI, CPI and CP content of the diets. Figure 2 shows the apparent digestibility of four dietary treatments.

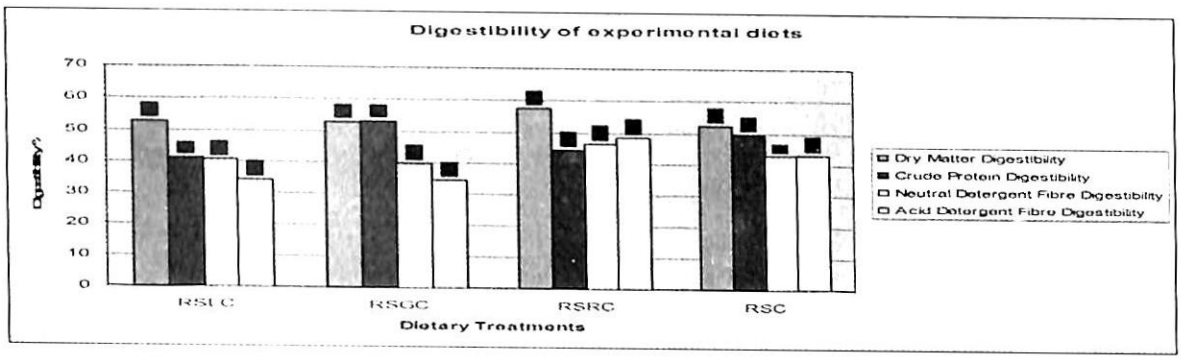

Figure 2. Apparent digestibility of DM, CP, NDF and ADF of four dietary treatments

4.5. Neutral Detergent Fibre and Acid Detergent Fibre intake

NDF intakes of all experimental diets in this study were not observed significantly. It may be due to NDF contents of different leaf protein sources except *Leucaena* were similar and amount fed to animals were also the same (calculated on the 1% of live weight) because live weight of experimental animals were almost the same. Even though highest and lowest ADF content were observed in Rice straw and *Leucaena* leaf respectively, Acid Detergent Fibre intakes of all experimental diets were not differed significantly. Possible reason for similar intakes of NDF and ADF on experimental diets was lower supplementation rate (>0.3% of live weight at DM basis) of green fodder which contributed to lower intakes.

4.6. Neutral Detergent Fibre and Acid Detergent Fibre digestibility

Digestibility of Neutral Detergent Fiber of RSLC, RSGC, RSRC and RSC diet were not differed significantly. It may be due to NDF contents and intakes of different diets were similar in this experiment. RSRC diet showed numerically highest in Digestibility of NDF.

The ADF digestibility of RSLC, RSGC, RSRC and RSC diets showed significantly different (P>0.05). RSRC diet was found in highest ADF digestibility and lowest in RSLC diet. RSRC diet provided highest CP (9.6%) and highest intake of DM and ADF among all experimental diets. RSRC diet contained more soluble and fermentable protein in the rumen that contributed to highest ammonia concentration in the rumen for efficient microbial activity and it creates efficient ADF digestibility.

4.7. Roughages and concentrate ratio and inclusion rate of fodder leaf in total diet

Roughage to concentrate ratio of RSLC, RSGC, RSRC and RSC diets were 49:51, 49:51, 45:55 and 37:63 respectively. All diets except RSC diet used in this study were almost similar (approximately 50:50) in roughage to concentrate ratio. Those diets provided ADG of 412 to 480 g/d and FGR at 5.3-6.4 were higher than observation of Wanapat and Wachrapakorn (1990) who found that rice straw was used as a sole source of roughage with concentrate at 50:50 could achieve on Average Daily Gain of 526.9 g/d and FCR at 12 for fattening beef buffaloes. NRC (1976) stated that average daily gain is related to the amount and nature of the various metabolites that are absorbed from the digestive tract and these metabolites are determined by the microbial fermentation in the rumen, which in turn is influenced by the proportion of roughage and concentrate in the diet.

Fodder leaf proportion to the total diet as DM basis in RSLC and RSGC diet were 21:79 and 27:73 respectively. RSRC diet was 9:91 but RSC diet was 0:100 due to low DM content of Rumex K-1 and absence of fodder supplementation in RSC diet. Preston and Leng (1987) stated that 20% of DM of total diet in the form of green forage is enough to meet the requirement for the microbial nutrients. Recommendation made by Devendra (1988) on the optimum dietary level of fodder tree was 30-50%of the total ration on DM basis and that was higher than Preston and Leng (1987). Fodder leaf supplementation rate of RSLC and RSGC diet in this study were felt within their recommendations but RSRC diet was found contrary. It has two reasons, first is fodder supplementation rate in this experiment was based on the 1% of live weight as fresh basis and secondly, DM content of Rumex K-1 fodder was very low (6.38%).

4.8. Average Daily Gain (ADG) and Feed Gain Ratio (FGR)

Average Daily Gain (ADG) of growing calves fed on all experimental diets were not significantly different. Numerically highest ADG was observed in calves receiving Rumex K-1 supplemented rice straw based diet however, numerically highest Feed Gain Ratio (FGR) was found in *Leucaena* supplemented diet due to its low dry matter intake and moderately high ADG compared to other treatments. This indicated that Rumex K-1 is one of the most suitable protein rich forage to supplement rice straw. The reason may be due to its higher protein content, no tannin content, higher degradability in the rumen compared with either *Leucaena* or *Gliricidia* forage, which results in high fermentable nitrogen available in the rumen and it stimulates rumen function. Numerically higher dry matter intake and higher digestibility ($P<0.05$) of RSRC diet tended to increase overall nutrient intakes of animals which may provide higher average daily gain of animals. Figure 3 and 4 shows the average daily gain (ADG) and feed gain ratio (FGR) respectively.

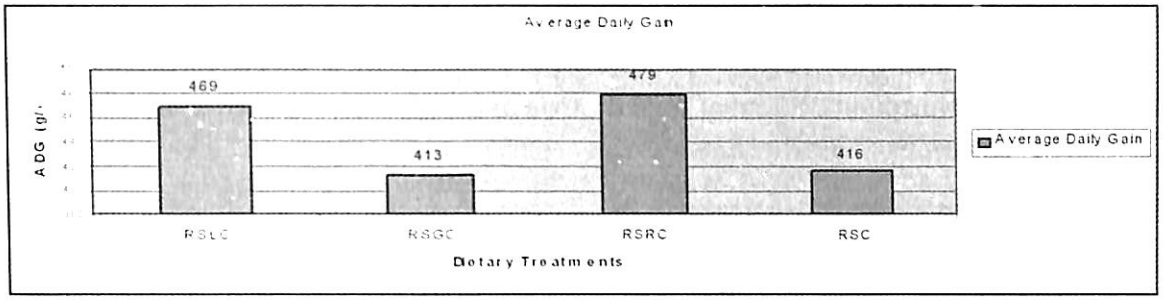

Figure 3. Average daily gain of four dietary treatments

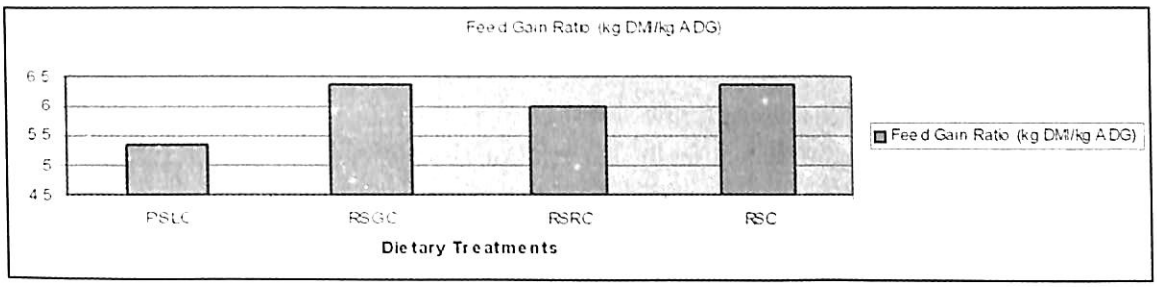

Figure 4. Feed gain ratio of four dietary treatments

5. CONCLUSION

The discussion in this experiment defines and highlights the potential use of three types of leaf supplements required for optimal efficiency of utilization of rice straw by cattle with deficient in nitrogen or protein. Rumex K-1 is one of the most suitable protein rich forages to supplement rice straw. The China ministry of Agriculture, mentioned that Rumex K-1 is the development of efficient high quality livestock forage and it's varieties stand as perennial herbaceous plant of long life, fast growing, high yield and high yielding period of 10-15 years (http://www.romax.com.cn). *Leucaena* and *Gliricidia* leaves can also be used as supplement to rice straw based diet to improve palatability and nutrient digestibility of rice straw but attention is also needed to focus on secondary compound, which limiting the nutritional values of tree fodders. Diet containing *Leucaena* less than 30% of total diet is generally safe for ruminants to avoid mimosine toxicity (Hiremath, 1981). In this study, fodder supplementation rate was only focused on the 1% of live weight of animals as fresh basis and observations were not differed significantly. Animal performances in all treatments were not significantly different in this experiment may be due to experimental periods for each treatment were short (3 weeks) Effects of long term feeding and high supplementation rate of leguminous fodders should be explored to achieve concrete information on animal performance that could be promising for low cost ruminant production. It is therefore furthur investigation on higher supplementation rates and long term feeding of tree fodders on animal performance will be needed.

Tannin bio-assays were not conducted in this study and observations were not focused on the effects of tannins. Although fodder supplementations may increase rice straw to improve nitrogen content of total diet, on average, it could provide only 8% of CP which could just maintain the minimum level of rumen microbes.

Roughage to concentrate ratio in this study was acceptable for beef fattening to achieve good performance. According to the observations from this study, 20% inclusion rate of green fodder to total diet could not improve ADG significantly. Moran et al (1983) also mentioned that an ideal forage supplementation should maintain or increase intake of basal diet rather than substitute for it.

Following recommendations were made to improve performance of local cattle:

1. Fodder supplementation rate should be increased to 30% as total diet DM to improve nitrogen utilization by animals and it could reduce the risk of mimosine toxicity when *Leucaena* is supplemented
2. Total diet CP must be maintained at 10-12% to improve DMI, digestibility and ADG
3. Roughage to concentrate ratio should be maintain at 50:50

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REFERENCE

Aganga, A. A. and S. O. Tshwenyane. 2003. Feeding values and anti-nutritive factors of forage tree legumes, Pakistan Journal of Nutrition 2 (3): 170-177, 2003.

AOAC 1980. Official methods of Analysis. 13th edition, Association of Official Analytical Chemists, Washington, DC.

Brewbaker, J. L. 1986. Leguminous trees and shrubs for Southeast Asia and South Pacific. In: Bliar, G. J., Ivory, D. A. and Evans, T. R. (eds), on Proceedings of a workshop held at Cisarua, Indonesia. ACIAR Proceedings No. 12. ACIAR, Canberra, pp. 43-50.

Devendra, C. 1990. Shrubs and Tree Fodders for Farm Animals. Proceedings of a workshop in Denpasar, Indonesia, 24-29 July 1989. Ottawa, Canada, International Development Research Centre, Pp 42-60.

Devendra, C. 1992. Nutritional potential of fodder trees and shrubs as protein sources in ruminant nutrition. In: Legume trees and other fodder trees as protein sources for livestock. FAO Animal Production and Health Paper 102, pp. 95-113.

Devendra, C. 1988. Forage supplements, Nutritional significance and utilization for draught, meat and milk production in Buffaloes. Proceedings II World Buffalo Congress, Indian Council of Agricultural Research, 2: 409-423.

Doyle, P. T., Devendra, C. and Pearce, G. R. 1986. Rice straw as a feed for ruminants. International Development Programme, Canberra, pp. 101-102.

Dutta. N, K. Sharma and G. Z. Hasan 1999. Effect of supplementation of rice straw with Leucaena leucocephala and Prosopis Cineraria leaves on nutrient utilization by goats. Asian-Aus. J. Anim. Sci. 1999. Vol. 12, No. 5:742-746.

Goering, H. K. and P. J. Van Soest. 1970. Forage Fibre Analysis. U.S. Dept. Agric. Handbook No.379.

Hiremath. N. B. 1981. Leucaena leucocephala, A wonderful plant. Indian Dairyman 33:351-356.

http:///www.romax.com.cn. Rumex K-1, Lu Mei Ke of high protein plant.

Leng, R. A. 1990. Factors affecting the utilization of poor quality forages by ruminants particularly under tropical conditions, Nutr. Res. Rev. 3:277-303.

Leng, R.A., Choo B. S. and Arreaza C. 1991. Practical technologies to optimize feed utilization by ruminants. In: Legume trees and other fodder trees as protein sources for livestock. Proceedings of the FAO expert consultations held at the Malaysian Agricultural Research and Development Institute (MARDI) in Kuala Lumpur, Malaysia, 14-18 October, 1991.

Lowry, J. B. 1990. Toxic factors and problems: Methods of alleviating them in animals. ed. In: Devendra, C., ed. Shrubs and Tree Fodders for Farm Animals. Proceedings of a workshop in Denpasar, Indonesia, 24-29 July 1989. Ottawa, Canada, International Development Research Centre, Pp 76-88.

Mjema-Mweta, W. J., Mtimuni J. P. and Kamwanja L. A. 1995. The effect of leucaena and or maize bran supplementation of goats grazing star grass on birth weight of kids. Int. J. Anim. Sci. 10: 35-40.

Moran, J. B., Satoto, K. B. and Dawson, J. E. 1983. The utilization of rice straw fed to Zebu cattle and buffalo as influenced by alkali treatment and Leucaena supplementation, Australian Journal of Agricultural Research, 34: 73-84.

Ni Ni Maw, Khin San Mu, Aung Aung, Moe Thida Tun and Lwin Naing Oo, 2006. Preliminary report on nutritive value of tree foliages locally available in Yezin area, Department of Physiology and Biochemistry, University of Veterinary Science.

NRC, 1976. Nutrient requirements of Beef Cattle, 5th revised edn:, 1976. National Academy of Science, Washington D.C. pp 2.

Ondiek, J. O., Tuitoek, J. K. Abdulrazak, S. A. Bareeba F. B. and Fujihara, T. 2000. Use of Leucaena leucocephala and Gliricidia sepium as nitrogen sources in supplementary concentrates for dairy goats offered Rhodes grass hay. Asian-Aus. J. Anim. Sci. 2000. Vol.13, No.9: 1249-1254.

Preston and Leng. 1987. Matching Ruminant Production Systems with Available Resources In the Tropics and Sub-tropics, Technical Centre for Agricultural and Rural Cooperation, ACP-EEC Lome Convention, Postbus 380-6700 AJ Wageningen, Netherlands.

Ralph L. Roothaert 1999. Feed intake and selection of tree fodder by dairy heifers, Animal Feed Science and Technology 79 (1999) 1-13.

Steel, R. G D. and Torrie J. H. 1980. Principles and Procedures of Statistics, A Biometrical Approach. 2nd edn. McGraw-Hill Book Company, New York.

Than Kyaw 2005. Constraints to pasture development and some possible solution to the ruminant feed scarcity in Myanmar.

Tin Ngwe, Mar Mar Kyi, Cho Cho Thein and Zaw Win Maung, 1993. Effect of level of rice bran on voluntary intake of rice straw and digestibility of rice straw diet in growing bulls. Myanmar J.Agri.Sci 5(1) 1993: 65-75.

Wanapat, M. and C. Wachirapakorn 1990. Utilization of roughage and concentrates by feedlot swamp buffaloes. AJAS. 3:195-204.

Wanapat, M., Wachirapakorn C. and Kongpiroon N. 1985. Comparative dry matter and nitrogen degradation of intact leaf protein sources in fistulated rumen of cattle and buffalo fed untreated or urea treated rice straw. In: The utilization of fibrous agricultural residues as ruminant feeds project, Department of Animal Science, Faculty of Agriculture, Khon Kaen University, Thailand in collaboration with the University of Melbourne, Parkville, Victoria, Australia.

Wongsrikeao, W., Wanapat M. and Taesakul S. 1985. A comparison of untreated or urea treated rice straw when supplemented with fresh *Leucaena* for swamp buffaloes. In: The utilization of fibrous agricultural residues as ruminant feeds project, Department of Animal Science, Faculty of Agriculture, Khon Kaen University, Thailand in collaboration with the University of Melbourne, Parkville, Victoria, Australia

Yan Naing Soe 2001. Effects of cotton seed cake and sunflower cake supplemented with untreated or urea treated rice straw on growing bulls. M.V.Sc Thesis, University of Veterinary Science, Yezin, Pyinmana, Myanmar.

ဆွေးနွေးချက်

Dr. မောင်မောင်စံ အကြံပြုချက် - The difference, statistically not significant ဟု ပြောထား ပြီးလျှင် But numerically highest ဆိုတာ ပြောရန် မသင့်ကြောင်း အကြံပြု ဆွေးနွေးပါသည်။

Dr. နှင်းသီတာမြင့် အကြံပြုချက် - နွားများသည် အစာရွေးစားတတ်၍ Palatability ကွာသော အစားကို ကြိုက် မကြိုက် တစ်ကောင်နှင့် တစ်ကောင် ကွာခြားနိုင်သဖြင့် Head number ကို (၄)ထက်ပို၍ ဆောင်ရွက်သင့်ပါကြောင်း အကြံပြုပါသည်။

Selective Breeding and Proper Management of Village Chicken

Saw Plei Saw[1]

ABSTRACT

Nucleus stocks of indigenous chicken were selected from Sittagaung (Chittagong) breeds and naked neck chicken. Chicken hatched from the nucleus stock are rigidly selected on the basis of health and fast growing characters. The standard criteria for selection of good breeders have been followed. A housing system and feeding method which may be practicable for the farmers has been described. Vaccination programme is also recommended. A proper management system is necessary for the increase of production by the indigenous chicken. It is anticipated that a further improvement and establishment of an indigenous breed is feasible in the near future.

Introduction

The farmers of Myanmar depend mainly on the crop production for their livelihood and give very little attention to the livestock production as one of the means for their income. Most of them keep a few livestock in their backyards, but they do not consider the livestock production as an important source of income for their households. They mainly keep their livestock according to tradition and do not care much about the productivity of these stocks. One survey record taken in Thanlyin and Taikkyi Township, Yangon Division showed that 50% of the village chickens reared in backyards are lost through diseases and predators. One of the reasons that the farmers do not invest into the livestock production is because of the poor performance of the indigenous breeds and the unstable price of the livestock products. In Myanmar more than 80% of the poultry population are of indigenous breeds and therefore it is important that the performance of these poultry are improved to make it much practicable for the farmers to invest into livestock production for an additional household income. The livestock marketing system should also be improved so that there will be mutual benefit for both the farmers and the traders.

The Myanmar indigenous chickens are well known for their hardiness and resistance to various diseases. They thrive well on limited nutrition. All the modern breeds of poultry are the descendents of the jungle fowls which are also the ancestors of Myanmar indigenous chickens. In this experiment a simple and effective selective breeding method is used for the improvement of village chicken. A good management and

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nutritional improvement is introduced to boost up the performance of the selected chicken. The experimental results showed a tremendous increase of production in laying capacity and weight gain. It is anticipated that a further improvement and establishment of an indigenous breed is feasible in the near future.

The objectives of this experiment are:

1. To improve the existing potential of indigenous chicken through selective breeding.
2. To establish a standard poultry breed which is of a true indigenous characters.
3. To contribute towards the conservation of genetic resources in Myanmar through preservation of Myanmar's indigenous chicken.
4. To introduce a proper management system for better performance and control of diseases.
5. To extend the poultry farming knowledge to the farmers and convince them that the indigenous poultry farming is practicable and profitable.

Materials and Methods

Nucleus stock: The poultry selected for the experiments are obtained from Henzada township, Thanlyin Township and Taikkyi township. The breed selected is locally known as Sittagaung breed, but the phenotype of the chicken from each township showed variable colour and body conformation. They are obtained from the farmers who are interested in rearing chicken and maintain a good stock chicken of large size and having growth potential are chosen for the experiment. One cockerel and eight pullets are initially selected as the nucleus stock.

Selective breeding: Chicken hatched from the nucleus stock is selected very rigidly. Only the healthy and fast growing chickens are chosen for future breeding. The cock selected out of the brood have the following characters. They are fast grower, carry themselves erect, deep-chested with broad back and possess strong bone. The hens selected are of good size and weight, deep chested broad back with wide pelvic girdle.

Housing: In back yard farming system the farmers do not provide a separate poultry house for their stock. The poultry sleep on trees or in the cow shed or under the eves of houses. They are let to roam freely during the day. This type of free range system favours the spread of diseases and prone to loss through predators. A simple and cheap poultry shed enclosed within a fence is quite feasible for rearing indigenous chicken. The shed is constructed with thatched roof with sleep perch erected at three to four feet above the ground. A fence enclosing an area of 15' x 12' and 6ft high is enough for 12 adult

chickens. During the phase of a disease outbreak village Chicken are blamed for the spread of disease. If they are reared within enclosure the cause for spreading of diseases by the village chicken will be checked.

Feeding: If the poultry are reared within an enclosure, it is important that they are properly fed. A good nutrition cannot be ignored if the poultry is expected to be productive. Under the free range system the poultry can roam about and scavenge for their nutritional requirements. If they are reared under an intensive system the farmers must provide for their nutrition. An economical and practicable poultry feed can be formulated for rearing indigenous chicken at the village level. Table 1.

Management of indigenous chicken: A proper management system is also necessary for the increase of production of indigenous chicken. The reason for low productivity of indigenous chicken is their poor growth rate, low egg laying capacity and loss due to diseases. These problems can be reduced through proper management system. The duration of broodiness of a hen can be shortened through proper management and hence improve production. The physical stimulants of broodiness can be easily managed through the removal of the cause. Fig. 1.

Vaccination programme: The chicken are regularly vaccinated against the common poultry diseases using the locally produced vaccines which are easily available for the farmers. The vaccination programme is shown in Table. 2.

Results and Findings

The standard body weight of indigenous chicken at the age of maturity (24-26 Wks) is approximately 80 tickles for hens and 120 tickles for cocks. In this continuing experiment the specially selected hens for nucleus stock have an average weight of 95 tickles and the cock weighs at 135 tickles. The cock from the nucleus stock has two tone colour of feathers with silver back and wings and black colour on its breast. The hens are of various colour including barred, grey, black and red feather. Plate. 1.

After continuous selection the chicken having the required traits reveal the phenotypic characters of black grey and red plate. 2.

The increase of body weight obtained after the first and second selection is presented in Table. 3.

The maximum growth rate is recorded between the ages of 14-22 Wks. Fig.

In the earlier experiment the average egg laying capacity of indigenous chicken is recorded as 197 eggs per year and the hatching interval has improved to an average range of 70 days - 84 days.

Discussion

In livestock production the productivity is governed by their breed, the nutrition provided for them and a proper management system. All these factors have been considered when this experiment is designed in order to develop the performance of Myanmar indigenous chicken. There are precedents that a high performing poultry breeds are obtained through vigorous selection without any crossing between breeds. During the decades within the sixties and seventies of the twentieth century, Rhode Island Red breed has been very popular in Myanmar. They are known for their good performance and easy to manage characters. They are obtained by selective breeding. Another breed called New Hempshire is also obtained through selective breeding of RIR. Therefore it is much logical to develop a high performing breed out of the indigenous chicken. There is a potential in these indigenous chicken to be developed in to a commercial stock suitable for the farmers in Myanmar. These chickens may not be as productive as the modern commercial breeds but they have the advantage of consumers' high preference for their meat and eggs and they fetch much better price than the exotic breeds. A standard procedure for measurement of productivity in poultry is to calculate the feed conversion ratio or to measure the amount of feed which is converted into the egg mass. Such measurement may be justified interms of productivity but it may not always imply to the economic benefit. Another way of measuring the productivity of chicken is to calculate the cost of feed consumed by a chicken to attain the weight of 1kg and compare the price of chicken meat to the feed cost. This latter method of calculation is much practicable to apply in the production of indigenous chicken. The productivity of livestock is also by the utilization of less input including feed, Land use and Labour. These factors have been considered and the experiment leading to the development of Myanmar's indigenous chicken is carried out.

In this continuing research work, the first part of experiment covers the performance of indigenous chicken interns of egg laying capacity and hatching intervals. In this former experiment the annual egg production was recorded as 197 eggs per hen per year and the brooding cycles has improved from 3 cycles to 5 cycles per year.

In this experiment priority is given to growth rate of indigenous chicken and therefore rigid selection has been made on chicken having fast growing characters. When the first nucleus stock was selected the hens have an average weight of 95 tickles and the cock weights 135 tickles. After the second batch of rigid selection the hens have an

average weight of 1 viss and 5 tickles while the cock weights 1 viss and 50 tickles at 24 weeks of age. The hens started laying at 22 weeks old and reach 50% lay at the age of 25 weeks. An increase rate in weight gain was observed between the ages of 14 to 22 weeks. There is a potential for the growth curve to shift to the left resulting in a better growth if further selection is carried out from the existing stock. Although the indigenous chicken cannot match the modern broilers chicken in terms of growth rate but they are very much competitive with the meat production of cockerels from laying breeds or dual purpose breeds. In this present study the indigenous chicken attain the weight of 1 viss at the age of 22 weeks and there is still a potential for improvement for selecting the fast growers out of the breeding stock.

Back yards farming at the village level are practiced under the free range system with very limited feeding of easily available feed stuff. This feeding system does not meet the nutritional requirement of back yard chicken. Moreover this free range system becomes the problem for village chicken to be an agent of disease carriers. During the outbreak of Avian Influenza in Asia and South East Asia countries, the village chicken has been blamed as the major agent for spreading the disease. In fact main problem is not the village chicken but the management system. There has been no evidence that the indigenous breeds of chicken are more susceptible to avian influenza virus. The village chickens are not the reservoirs for avian influenza virus like the wild birds or domestic ducks. Therefore they do not pose to be of any threat more than any other breeds of poultry if they are reared under confinement. In Myanmar indigenous chicken constitute more than 80% of the total poultry populations and they are one of the assets of the farmers. By improving the management system at village level the poultry production can be protected during the crisis of avian influenza disease outbreak. The farmers have enough land space and agricultural by products which can be used for livestock production. It is important to provide the farmers with the knowledge that if the indigenous chickens are properly managed, they can provide a much lucrative return and help increase the total income for their households.

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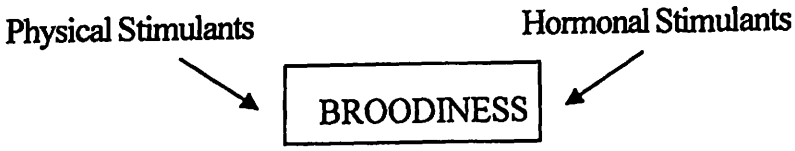
Table 1. Feed formulation guide to feeding indigenous chicken

Ingredients	Chick feed 0-8 week	Adult chicken 8 weeks above
Broken rice	30%	25%
Maize	25%	30%
Groundnut cake	10%	10%
Sesame cake	5%	5%
Rick bran	5%	10%
Wheat bran	5%	5%
Sunflower seed cake	0/5%	5/0%
Cotton seed cake	5/0%	0/5%
Dried fish meal	8%	5%
Green feed	7%	5%
CP	18%	16.98%
ME	2278 kcal/kg	2366 kcal/kg

Source: Veterinary Assay Laboratory,



1. Tactile Stimulation
2. Dimly lit area
3. Warmth

1. Oestrogen
2. Progesterone
3. Prolactin

Fig. 1. Factor influencing the broodiness of a hen.

Table 2. Recommended Vaccination Programme.

Vaccine	Route	Age at Vaccination
Newcastle I_2	Eye drop	7 day
Fowl pox mild	Wing web	14 day
New castle I_2	Eye drop	21 day
Fowl pox standard	Wing web	14 week
Newcastle I_2	Orally	Every 2 month
Fowl cholera	s/c injection	3 M.O repeat every 6 M

Table 3. Weekly growth rate of indigenous chicken through selection

Age in weeks i	First selection Av weight (tickles) n = 13	Second selection Av. Weight (tickles) n = 10
Egg weight	2.5 t	3.0 t
Doc	2.0 t	2.5 t
2 WO	-	3.6 t
4 WO	8.5 t	8.8 t
6 WO	-	16.2 t
8 WO	16.5 t	22.2 t
10 WO	-	23.7 t
12 WO	28.5 t	31.6 t
14 WO	-	43.3 t
16 WO	49.0 t	53.3 t
18 WO	-	72.2 t
20 WO	70.0 t	82.14 t
22 WO	-	99.20 t
24 WO	1 v . 5 t	1 v . 5 t
26 WO	-	1 v . 16 t
28 WO	1 v . 20 t	1 v . 24 t

References

Anonymous: World Poultry 9, Vol. 15, 1999. Cluttow, B.J. 1981. Domesticated animals from early times. British Museum Press, London, UK.

Fawkee A.K. 1945. Poultry Farming in the East. Lucknow Publishing House, India.

Henning. J., R. Pym, T.Hla, N.Kyaw, J.Meers 2007. Village chicken production in Myanmar, purpose, Magnitude and Major Constraints. World Poultry Science Journal Vol. 63, No. 1, March 2007.

Jall, Morley A. and T.G Byerly 1945. Poultry Farming U.S. Armed Forces Washington.

MacMilaw, CTA, the Tropical Agriculture, Poultry, 1990.

Slater, A-E. 1948 Tweed's Poultry Keeping in India. Thacker Spink and Co., Ltd, Calculta.

Warren Don C. 1953. Practical Poultry Breeding. The Macmillan Co., New York.

ဆွေးနွေးချက်

Dr. မင်းစိုး - What are the criteria for selection carry them erect in selective breeding?

ဖြေကြားချက် - That means their body position.

Dr. ရဲထွဋ်အောင် - စစ်တကောင်းနှင့် လည်ပြောင် Slide ပြပေး နိုင်ပါသလား၊

- Selective breeding ရဲ့အဓိက Objective က Fast growing indigenous breed ရဖို့လား၊
- Chicken ကို စပြီး Domesticate လုပ်ခဲ့တာလား။

ဖြေကြားချက် - လည်ပြောင်ပုံစံ မရှိပါ။

- Selective breeding ရဲ့ အဓိကရည်ရွယ်ချက်က Fast growing indigenous breed ရဖို့ဖြစ်ပါတယ်။ Breeding နှင့် Management တွဲဖက်လုပ်ဆောင်ခဲ့ခြင်းဖြစ်ပါသည်။ Day Old Chick မှ စပြီး ရွေးခဲ့ပါတယ်။
- Chick မှ စပြီး Domesticate လုပ်ပါတယ်။

Dr. သန်းကျော် - Selection criteria က ဘာကို ဦးတည်သလဲ။

- Selection လုပ်ရာမှာ အနည်းဆုံး (၃)နှစ်လောက် တစ်ပြိုင်တည်း သွားသင့်တယ်။ Genetic programme ဆို ပိုထိရောက်မယ် ထင်ပါတယ်။

ဖြေကြားချက် - Dual purpose အတွက်ပါ၊ Meat နှင့် Egg အတွက် ဖြစ်ပါတယ်။

- Yes, လက်ခံပါတယ်။

Dr. တင်ငွေ - Hormonal control မှာ Prolectin ကို တွေ့ရပါတယ်။ Gn RH ဟုတ် မဟုတ် သိလိုပါတယ်၊ ယခုအခါတွင် LH နှင့် FSH ပါပါသည်။

- Prolectin မှာ Broodiness ကို ဖြစ်စေပါသည်။ Oestrogen က ဘာကြောင့် Broodness ကို ဖြစ်စေသလဲဆိုတာ သိလိုပါ သည်။
- Broodiness-laying hen တွေမှာ Progesterone သုံးရင် ပျောက်သွားတယ်လို့ ကြားဖူးပါသည်။
  ထိုကြောင့် Progesterone က Broodiness ကို control လုပ်တယ် ဆိုတာ ဖြစ်စေတာလား။ မဖြစ်စေတာလား မသိပါ။

ဖြေကြားချက် - Oestrogen က Broodiness ကို Effect ဖြစ်စေတာ သေချာတယ်။

Dr. မင်းစိုး - Broodiness မှာ Graffian follicle မှ Oestrogen ထွက်လာ သောကြောင့် Oestrogen level မြင့်ပြီး Sexual activities ဖြစ်လာနိုင်ပါတယ်။

နိဂုံးချုပ်အမှာစကား

ဒေါက်တာမင်းစိုး၊ ဒုဥက္ကဋ္ဌ မြန်မာနိုင်ငံစိုက်ပျိုးရေး၊ သစ်တောနှင့်မွေးမြူရေးနှင့် ရေလုပ်ငန်းပညာရှင်အဖွဲ့မှ အခမ်းအနားကို အောင်မြင်စွာပြီးမြောက်စေရန် လမ်းညွှန်မှုပေးသော မွေးမြူရေးနှင့်ရေလုပ်ငန်းဝန်ကြီးဌာနဝန်ကြီးနှင့်တကွ ဌာနဆိုင်ရာအကြီးအကဲများနှင့် တာဝန်ရှိပုဂ္ဂိုလ်များအားလည်းကောင်း၊ သုတေသနနှီးနှောဖလှယ်ပွဲကို အောင်မြင်စွာ ကျင်းပနိုင်ရေး အတွက် လုပ်ငန်းများကို စနစ်တကျ စီမံဆောင်ရွက်ပေးခဲ့သော ကျင်းပရေး ဆိုင်ရာကော်မတီ အသီးသီးမှ ကော်မတီဝင်များ၊ ကျင်းပရန် နေရာထိုင်ခင်းနှင့်စနစ်တကျ ညှိနှိုင်းမွေးရေးကို ကူညီဆောင်ရွက်ပေးသော မွေးမြူရေးဆိုင်ရာ ဆေးတက္ကသိုလ်ပါမောက္ခချုပ်နှင့် ဒုတိယပါမောက္ခချုပ်များ သုတေသနစာတမ်းဖတ်ပွဲတွင် သဘာပတိအဖြစ် ဆောင်ရွက်ပေးကြသော ပါမောက္ခချုပ်(ငြိမ်း)၊ ပါမောက္ခချုပ်နှင့် ဒုပါမောက္ခချုပ်များ၊ သုတေသနစာတမ်းရှင်များနှင့် တက်ရောက်အားပေးပါဝင်ဆွေးနွေးကြသော သုတေသီများနှင့်ပါဝင်ကူညီဆောင်ရွက်ပေးကြသော တာဝန်ရှိပုဂ္ဂိုလ်များနှင့်ဝန်ထမ်းများအားလုံးတို့ကို ကျေးဇူးတင်ရှိပါကြောင်း နိဂုံးချုပ်ပြောကြားပြီး သတ္တမအကြိမ် သုတေသနညီလာခံကို အောင်မြင်စွာပြီးမြောက်စေခဲ့ပါသည်။