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Effects of Addition of Whey on Phytic Acid Degradation of Bread

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Abstract- ***The investigation was carried out to study the effect of addition of whey on phytic acid degradation and to improve nutritional quality of bread. Bread was prepared from wheat variety Trimbak (NIAW 301) maida with addition of different levels of whey viz., 20% (T_1), 40% (T_2), 60% (T_3), 80% (T_4), 100% (T_5) by replacing requisite amount of waterand control (T_0)without addition of whey using straight dough method. Maida was analyzed and it contained 14% moisture, 2.9% fat, 12.98% protein, 66.3% carbohydrate, 4.2% ash, 0.7% fiber and micronutrients like calcium 34 mg/100g, phosphorous 508mg/100g and iron 3.52 mg/100g. Sedimentation value of maida was 37.8ml. Dry and wet gluten were 9.92% and 29.80% respectively. Phytic acid of maida was 9.8 mg/g on dry weight basis.Whey contained 1% protein, 5.50% carbohydrate, 45mg/100g calcium and 41 mg/100g phosphorous.As concentration of whey increased, phytic acid in bread was decreased from 3.20mg/g up to 1.58mg/g. Positive correlation was obtained with respect to reduction of 50% of phytic acid with increasing level of whey. Addition of whey helped to improve micronutrientof bread with respect to calcium and iron content.***

Index Terms**-bread; whey; phytic acid.**

I. INTRODUCTION

The *bread* is leavened product prepared using cereals most commonly wheat. Bread is usually made from a wheat flour dough that is cultured with yeast, allowed to rise, and finally baked in an oven. The salt, fat and leavening agents such as yeast are common ingredients of leavened bread. The wheat flour (*maida*) containing high levels of gluten (which give the dough sponginess and elasticity), common wheat (also known as bread wheat) is the most common grain used for the preparation of bread [1]. Whey proteins are widely used as food ingredient and have several functional properties [2]. Whey proteins enhances browning when protein combines with lactose and heat as a result of maillard reaction and increased nutritional value [3]. Whey proteins are considered as natural functional additives having the ability to interact with the starch and gluten network in a dough system and act as dough improvers [4]. Earlier scientist analyzed whey and found that acid casein whey contained 93.1% water, 0.25% fat and 1% protein [5]. The proximate composition of whey varies accordingly from the source its obtained and the method employed for its preparation [6]. Calcium and phosphorous content of whey was 38.5 mg/100g and 43 mg/100g respectively [7]. Phytic acid is present in many plant systems, constituting about 1 to 5% by weight of many cereals and legumes. Phytic acid, which is myoinositol 1,2,3,4,5,6-hexakis (dihydrogen phosphate) as it interferes with the intestinal absorption of certain minerals like zinc and iron which causes nutritional deficiencies[8]. Phytic acid has a strong ability to chelate multivalent metal ions, specially zinc, calcium, and iron. The binding can result in poor bioavailability of minerals.Phytic acid has a high potential for chelating the mineral which may decrease the bioavailability of minerals [9]. Phytate in the form of phosphorous was determined to evaluate the effect of whey addition on phytic acid. Phytic acid (myoinositolhexa-phosphoric acid) is the major phosphorous storage compound of most cereal grains, it may accounts for 70% of the total phosphorous. The binding with minerals can result in poor bioavailability of minerals. It reduces the nutritional value. During bread making the content of phytic acid decreases due to the action of phytases in the dough. Phytate degrading enzymes exist in cereals and yeast [10][11][12].

II. MATERIAL AND METHODS

Raw material:-The wheat (*Trimbak NIAW 301*) was procured from AICRP on wheat, Niphad under MPKV, Rahuri. Dist- Ahmednagar, Maharashtra (India). Wheat was cleaned and conditioned with 2% water (v/w) for 24 h at ambient temperature to equilibriate moisture content. *Trimbak* wheat was fed to brabender quadramat flour mill to obtain *maida*. *Maida* was again sieved by using 70 mesh screen. Ingredients for bread like vanaspati ghee, sugar and other required ingredients were procured from local market. Chemicals used in this investigation were procured from M/s Fine chemicals, Mumbai and M/s Loba Chemicals, Mumbai. Whey was prepared freshly by adding 0.2% citric acid solution added to fresh milk heated near boiling pointto coagulate all casein in milk. The whey was separated from casein coagulated with muslin cloth and was used in further experiments. Proximate composition Proximate composition of maida (*Trimbak*) like moisture, fat, protein, carbohydrates, ash.sedimentation value and gluten percentage was determined by standard methods [13]. The crude fat was determined by Soxhlet method using hexane (60-80 ºC) as solvent in SOCS plus SCS 4 system (Pelican equipments, Chennai, India). For protein analysis, Micro kjeldahl method [13] was used. The crude protein was then calculated by multiplying nitrogen content with factor 5.7. Carbohydrates was calculated by difference method, subtracting total value of other nutrients. The ash content was determined by muffle furnace (Servo, Salem, India) set at 500-550 ºC for 15 h. Crude fibre was determined by

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digesting fat free sample [17]. In order to determine the gluten content in *maida*, the dough was prepared by addition a sodium chloride solution and wet gluten was isolated by dough washing under running water and weighed. Dry gluten was determined by using *maida* at optimized conditions of hot air oven method. The determination of calcium and phosphorous was carried out by using method described by Chapman and Pratt [14][15]. Phytic acid was determined by standard procedure [16]. Iron, total solids and protein of whey were determined by method described by Ranganna [17]. pH of whey was determined by digital pH meter. Statistical analysis Statistical analysis was carried out by completely randomized design [18].

III. RESULTS AND DISCUSSION

Chemical composition of maida

The proximate composition of *maida* plays an important role for deciding its nutritional and functional qualities. It was observed (Table 1) that, moisture content of *maida* was 14%, fat 2.9%, protein 12.98%, carbohydrates 66.3 g/100g, ash 4.2%, fiber 0.7%, calcium 34 mg/100g, phosphorous 508 mg/100g, iron 3.52 mg/100g, sedimentation value 37.8 ml, dry gluten 9.92%, wet gluten 29.80% and phytic acid 9.8 mg/g. Similar results were reported for proximate composition (moisture 9.69 to 10.35%, crude protein 9.57 to 14.3%, crude fat 1.47 to 2.93%, ash 1.48 to 2.03% and crude fibre 0.98 to 1.43%) [19][20]. In our investigation, it was recorded that sedimentation value, dry gluten, wet gluten and phytic acid were 27.8ml, 9.92%, 29.80% and 9.8 mg/g respectively. Similar results of phytic acid content of flour in bread making was ranged from 5.4 to 11.3 mg/g [21]. The overall results with respect to chemical constituents in wheat *maida* of variety *Trimbak* were more or less similar to earlier reports. The sedimentation value which depends on the protein quality significantly correlates with bread baking, mixing characteristics and strength of the hard wheat [22]. The values for dry gluten (9.92%) and sedimentation (37.8 ml) in this investigation were slightly higher than the values 9.7% dry gluten and 34 ml sedimentation value of maida [23]. The results (Table 2) indicates that the whey contained 93% moisture, total solids 6%, fat 0.32%, protein 1%, carbohydrates 5.50%, calcium 45 mg/100g, phosphorous 41mg/100g and pH 4.5% [24]. These results are in close agreement with those reported by the earlier researchers.The proximate composition of whey varies accordingly from the source it is obtained and the method employed for its preparation [6]. Calcium and phosphorous content of whey was 38.5 mg/100g and 43 mg/100g respectively [7]. The results obtained (Table 3) indicated decrease in phytate content with the increased addition of whey during preparation of bread. The highest phytic acid content was observed in treatment T_0 (3.20 mg/g) and lowest in treatment T_5 (1.58 mg/g). Considerable reduction in phytic acid was observed in bread samples added with 100% whey. The degradation of phytic acid with addition of whey might be due to the acidic nature of whey [9]. The degradation of phytic acid is necessary as it binds with minerals and reduces its bioavailability. The sensory evaluation indicated that the bread prepared with 60 % whey was superior with respect to crust colour (8.4), crumb colour (8.5), texture (8.6), flavour (8.5), taste (8.7) and overall acceptability (8.6) over all other treatments as shown in Table 4 It was clear from the results (Table 5) that nutritional value of bread with addition of whey was improved with respect to mineral content. Lowest calcium content was observed in treatment T_0 (72.33 mg/100g) and highest calcium content in treatment T_5 (75.17 mg/100g). The calcium and iron content of bread was ranged from 72.33 to 75.17 mg/100 and 2.51 to 2.89 mg/100g respectively. There was increase in calcium and iron content of bread with increased level of whey in bread [8]. Calcium and iron deficiency disease could be overcome by addition of whey in bread. It was observed that content of phytic acid was decreased due to the high temperature during baking and degradation of phytic acid into lower inositol phosphates during a long fermentation time [25].

IV. CONCLUSION

The whey can be added up to 60% to bread during preparation as it has highest overall acceptability. In addition the whey helped to improve final quality of bread with respect to calcium and iron content.

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APPENDIX

Table 1 Proximate composition of maida from wheat variety (Trimbak) NIAW 301

Parameters	Values
Moisture (%)	14
Fat (%)	2.9
Protein (%)	12.98
Carbohydrate (%)	66.3
Ash (%)	4.2
Fiber (%)	0.7
Calcium (mg/100 g)	34
Phosphorous (mg/100 g)	508
Iron (mg/100 g)	3.52
Sedimentation value (ml)	37.8
Gluten (%)	
a) Dry gluten	9.92
b) Wet gluten	29.80
Phytic acid (mg/g) dry weight basis	9.8

The each value is average of three determinations

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Table 2 Proximate composition of whey

Parameters	Values
Moisture (%)	93
Total solids(%)	6
Fat (%)	0.32
Protein (%)	1.00
Carbohydrate (%)	5.50
Calcium (mg/100 g)	45
Phosphorous (mg/100 g)	41
pH	4.5

The each value is average of three determinations

Table 3 Effects of different level of whey on phytic acid in bread

Parameter/ Treatments	Phytic acid (mg/g)
T_0	3.20
T_1	2.59
T_2	2.19
T_3	1.93
T_4	1.72
T_5	1.58
SE ±	0.03
CD at 5%	0.10
CV (%)	2.43

The each value is average of three determinations

Table 4 Sensory evaluation of bread prepared with addition of different levels of whey

Attributes	Appearance	Crust colour	Crumb colour	Texture	Flavour	Taste	Overall accepatbility
Treatments							
T_0	8.3	8.4	8.4	8.6	8.3	8.4	8.4
T_1	8.1	8.1	8.3	8.4	8.4	8.5	8.5
T_2	8.2	8.2	8.1	8.2	8	8.4	8.5
T_3	8.4	8.4	8.3	8.4	8.5	8.7	8.6
T_4	7.8	6.7	6.8	6.8	7.2	7.7	7.8
T_5	6.9	5.7	6.6	6.6	6.6	6.2	6.8
SE	0.45	0.43	0.34	0.42	0.43	0.37	0.41
CD at 5%	1.31	1.26	1	1.24	1.26	1.08	1.19
CV (%)	9.78	9.89	7.68	9.36	9.57	8	8.73

The each value is average of ten scores

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Table 5 Effects of different level of whey on micro-nutrients of bread

Parameters/ Treatments	Calcium (mg/100g)	Iron (mg/100g)
T_0	72.33	2.51
T_1	72.50	2.55
T_2	73.67	2.60
T_3	74.53	2.69
T_4	74.97	2.78
T_5	75.17	2.89
SE ±	0.45	0.01
CD at 5%	1.39	0.03
CV (%)	1.05	1.28

The each value is average of three determination