Nutritional potential of developed ready-to-use multi-nutrient malt mix

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The present works aims to develop ready-to-use malted cereal pulse mix which could be utilised as base flour for instant convenient or weaning food. Wheat and green gram was malted, sesame seeds were roasted and whey protein added to increase nutritional profile. The malt mix was developed by mixing all the ingredients in such a combination to extract maximum nutrient in desirable way. Bio-chemical analysis, physical and functional properties were determined and data was analysed in SPSS software for ANOVA at 0.5% level of significance. It was found that there was significant rise in protein, fiber, carbohydrate and mineral except non-significant decrease in fat content. The developed malt mix contains 23.5 g protein, 18 g fat, 458kcal calorific value and 3 g fiber per 100 gram. Calcium (641 mg) and iron (6.3 mg) was also increased but were non-significant. Bulk density of malted mix flour was significantly less (0.75 ± 0.1 g/ml) than unprocessed cereal pulse mix (0.82 ± 0.2 g/ml) which would be beneficial for growing children and diseased persons where low bulk density is desirable with more capacity to absorb water. Titratable acidity and pH were 0.6 ± 0.1 and 4.7 ± 0.2 respectively. Free radical scavenging activity (79%) was increased upon malting however; total polyphenolic content was decreased by 7.3%. It can be concluded that malting and roasting enhances nutritional components and functional properties of the ready-to-use multi-nutrient malt mix developed for low economical section to meet their nutritional demands.

Key Words: Multi-nutrient mix; Malting; Functional property; Whey protein

INTRODUCTION

Nutritional deficiency is widespread problem among Indian population affecting more children, expecting women and elderly people from weaker section of the society. Interest to eat right and food with functional property has increased among consumers. Development of cost-effective nutrient dense ready-to-use value added product has long been advocated. Cereal and pulses are staple food as most important energy and protein source constituting 60-70% of the total food intake [1]. To improve nutritional potential of cereal and pulses, household techniques such as roasting, germination, fermentation and malting are excellent alternative. Malting induces beneficial bio-chemical modification in plant seeds thereby enhancing bioavailability of the nutrients. Malting increases protein content dietary fiber and reduces of bulk density and palatability of food, making it suitable for the children and patients of various diseases. Wheat represents most important cereals in human nutrition with largest consumption. It contributes good proportion of nutrients in our daily diet, whereas pulses like green gram contains 25% protein, high dietary fiber and micronutrients. Pulses compliment cereals for limiting amino acid (lysine). Sesame has superior quality of fat, high tocopherol and lignin contributing anti-oxidant and cholesterol lowering effect [2,3]. Whey protein concentrate possess high amount of amino acids and biologically active component which supplements the diet in beneficial way. The present works aims to develop ready-to-use malted cereal pulse mix which could be utilized as base flour for instant convenient or weaning food.

MATERIALS AND METHODS

Collection of raw ingredient

Wheat (variety MP-3336) was collected from Jawaharlal Nehru Krishi Vishwa Vidyalaya, research farm, Jabalpur. Green gram was made available from National Research for Weed Science, ICAR, Jabalpur. Whey protein concentrate (WPC 70%) was obtained from Mahaan Protein Limited, Delhi. Sesame seeds were purchased from the local market of Jabalpur.

Preparation of malt-mix ingredient

The whole wheat was soaked in clean water for 12 hour, kept for germination for 36 hour, followed by oven-dried, de-vegetated and roasted for 15 minutes then powdered to obtain malted flour and sieved. The green gram was soaked for 12 hour in clean water and germinated for 24 hour. Sprouted dried green gram was de-vegetated and de-husked to obtain malted dhal. Then it was roasted for 15 min followed by grinding to get fine powder and sieved while sesame seed was roasted at 180°C to increase taste and functional value. Whey protein Concentrate (WPC) was not processed and mixed as such.

Formulation of malt mix base

Malt mix flour was developed by blending both the malted flour of wheat and green gram in such combination that possesses maximum desirable nutritional quality making it suitable for all age group based on the guidelines given by the Food Standards Program Codex Alimentarious Commission on the nutritional and technical aspects of the production of formulated convenient foods [4]. The formulated ready-to-use (RTU) malt mix composition is presented in Table 1.

TABLE 1) Composition of RTU malt mix.

S. No	Raw Food	Amount (g)
1	Wheat Malt Flour	30
2	Green Gram Flour	30
3	Sesame Roasted	20
4	Whey protein Concentrate (WPC)	20
	Total	100

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Nutritional properties of malt mix

Proximate composition of wheat and green gram and sesame viz. as moisture, fat, fiber, energy estimated by AOCA (2004) methods while energy and protein content determined by Lowry's method and carbohydrate by Sadasivum. Calcium and iron was calculated spectrophotometrically. All chemicals used were of analytical grade.

Physical properties

Physical properties of developed malted mix such as bulk density was estimated by taking known volume of weighted flour into graduated cylinder filled to 10ml by gently tapping. The procedure was repeated three times; average was calculated and expressed in g/ml. Water absorption capacity (WAC) was assessed by the method of Anderson [5]. Distilled water of 30 ml at 30°C for suspending 2.5 gram of flour in a centrifuge tube, constant stirring for 10 minutes at 3000 rpm was applied. Supernatant fluid was discarded, remaining gel was measured and expressed as gel obtained (g) by per unit gram of sample. The pH of the unprocessed and malt mix flour was assessed by the method of AOAC. Titrable acidity was determined by titrating against 0.1 N NaOH to phenolphthalein up to end-point and expressed as lactic acid/100 g. All analysis was carried out in triplicate and the average of the three readings was calculated.

Functional properties

The total polyphenolic content estimated by Folic-ciocalteau method of Singleton and Rossi and anti-radical scavenging activity was quantified by DPPH (2,2-diphenyl-1-picrylhdrazyl) methods given by Lee gallic acid was used as a standard [6].

Statistical analysis

The Statistical Package for Social Sciences (SPSS Version 16.0) was used for statistical analysis. Three replicates were obtained for each parameters of developed ready-to-use malt mix flour. Analysis of Variance (ANOVA) was applied to determine difference between unprocessed wheat- green gram mix and malt flour mixes with significant level of 0.05%.

RESULTS AND DISCUSSION

Developed malt mix was analysed for the quality in terms of nutritional, functional and physical characteristics of different combination of malt mix flour and discussed below.

Nutritional property of developed malt mix

Nutritional composition of both type of mixes i.e. from unprocessed raw food ingredient and malted raw ingredients depicted in Table 2 so that effect of malting or processing could be studied. It was found that many nutrients have significantly increased due to bio-chemical changes during malting germination in plant seeds. The moisture content of malted mix flour was significantly higher (9.3%) than that unprocessed raw flour (7.2%) which is an indication of rapid water uptake by a viable grain expected during steeping. Dry legumes absorb water rapidly, influenced by the structure of the legume. Increase in moisture content has been associated with increase in fiber content [7].

The protein content of malted mix flour was significantly ($p \leq 0.05$) higher when compared with the untreated raw flour, this finding could be attributed to the fact that during germination step the micro-organisms in food utilized the carbohydrate content in the food sample to synthesis amino acid needed for their growth and development and due to breakdown of protein compounds into peptides and amino [8]. There is slight decrease in fat content during the germination or malting period. Similar results occurred in study by El-Adawy and Hahm where the fat content decrease with increase in the time of germination [9,10].

The carbohydrate content of germinated or malted mix flour was lower (144 ± 3.7 g) than flour of raw samples (152 ± 3.0 g). The carbohydrates may have been digested into simple sugars by amylolytic enzymes which are rapidly taken up by the growing embryo to serve as its energy source during germination [7]. The decrease in carbohydrate level is beneficial to diabetes mellitus patients. The increase in fiber (10%) attributed to increased bran matter and the building of dry matter during the growth and development (germination) of the plant. The calorific value of the malted flour is higher (458 ± 5.1 Kcal) than raw flour (387 ± 5.7 Kcal) due to increase in the protein content.

TABLE 2) Nutritional composition of RTU malt mix and unprocessed mix (100 g).

Nutrient	Unprocessed Mix	Malt Mix	Difference
Moisture (g)	7.2 ± 1.0	9.3 ± 1.1	Sig.
Protein (g)	22.6 ± 2.3	23.5 ± 2.1	Sig.
Fat (g)	19.8 ± 1.3	18.1 ± 1.5	Non-sig
Fiber (g)	2.7 ± 0.2	3.0 ± 0.3	Sig.
CHO (g)	152 ± 3.0	144 ± 3.7	Sig.
Energy (Kcal)	387 ± 5.7	458 ± 5.1	Sig.
Calcium (mg)	636.1 ± 12.8	641.8 ± 15.2	Non-sig
Iron (mg)	6.1 ± 0.1	6.3 ± 0.3	Non-sig

Calcium and iron value of malted mix was high as calcium and iron were highest in sesame seeds (1359 mg/100 g). The mineral composition of the malted mix increased as compared to unprocessed raw sample mix. Thus, malting improved the content of both the major and trace mineral ions. This observation may be possibly as a result of enzyme solubilisation and leaching of the anti-nutritional factors binding them through leaching found that germination improves calcium, copper, manganese and zinc in legumes and cereal seeds [11-13].

Physical properties of developed malt mix

Bulk density in all the blends depicted in Table 2. It was noted that malted mix flour has less density (0.75 ± 0.1 g/ml) than unprocessed cereal pulse mix (0.82 ± 0.2 g/ml) which would be beneficial for growing children and diseased persons as well with improved digestibility after malting. Bulk density represents heaviness of flour and generally affected by particle size and flour density [14]. The low bulk density may be due to smaller particle size and is an advantage in the formulation where low bulk is desired. Water absorption capacity was noted in unprocessed sample flour was 2.39 ± 0.1which increases on malting to 2.50 ± 0.1 g/unit g sample significantly ($p \leq 0.05$) indicating more ability of the flour to absorb water. Green gram contributes more in increasing water absorption capacity than other samples due to increased protein content on malting. Sub-units of proteins have more water binding sites than before [15] thereby escalating the ability of flour to form gel of the developed malt mix.

Titratable acidity in raw and malted flour mix was found to be 0.5 ± 0.1 and 0.6 ± 0.1 respectively. Increase in titratable acidity was noted while pH was slightly declined on malting (Table 3).

Cereal and legumes are major source of antioxidants and having hundreds of chemicals with antioxidant activity and potentially beneficial effects on human health. Phenolic compounds have significant antioxidant potential and are abundant in pulses. Phenolic content (mg/100 g equivalent of Gallic acid) in malted mix flour was found to be decreased during malting by 7.3% compared to raw cereal pulse flour. The decrease in polyphenols during germination may be attributed to the polyphenol oxidase based enzymatic hydrolysis by [16].

TABLE 3) Physical and functional properties of RTU malt mix (Mean ± SD).

Parameter	Unprocessed Mix	Malt Mix	Remark
Bulk Density (g/ml)	0.82 ± 0.2	0.75 ± 0.1	Sig.
Water Absorption Capacity (g/ unit g sample)	2.39 ± 0.1	2.51 ± 0.1	Sig.
pH	5.1 ± 0.3	4.7 ± 0.2	Sig.
Titrable Acidity	0.5 ± 0.1	0.6 ± 0.1	Sig.
Total Polyphenolic Content (mg/100 g)	6.8 ± 1.3	6.3 ± 1.2	Sig.
Anti-radical Activity (%)	72.4 ± 3.1	79.1 ± 3.5	Sig.

#Values are mean ± SD, Sig. (significant difference at 0.5% level).

Antioxidant activity in raw food samples ranged from 21.3-36.84% with the highest activity exhibited by roasted sesame (95%). The antioxidant activity in raw green gram was (36%). The anti-oxidant activity was found to be increased the malted in wheat by 20% and 32% in mung dhal. The increase in antioxidants activity after germination seems that additional antioxidants other than polyphenols might be present cereals and legumes such as vitamins and arytenoids at different concentrations that might also behave as antioxidant [17-25].

CONCLUSION

The present work was conducted to develop a base product for low economical section to meet their nutritional demands and hidden deficiency at low cost than commercially fortified protein rich supplements which are not in the reach of poor people. From the results it can be concluded that malting and roasting enhances nutritional components and functional properties of the multi-nutrient malt mix. The developed blended product containing malted cereal pulses with nutrient dense sesame and dairy product (whey protein) in the ratio of 30:30:20:20 was suitable as base material flour for supplementary food or nutrient rich snacks as convenient food for all age group.

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