TECHNOSCIENCE ARTICLE

Nutritional Potentiality of Developed Ready-to-use Multi-Nutrient Malt Mix

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Abstract

The present work aims to develop ready-to-use malted cereal pulse mix which could be utilized 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 components. The malt mix was developed by mixing all the ingredients in a combination to extract maximum nutrients in a desirable way. Biochemical analysis, physical and functional properties were determined. We found no significant rise in protein, fibre, carbohydrate and mineral except a non-significant decrease in fat content. Bulk density of malted mix flour was significantly less ($0.75 \pm 0.1 \text{g/ml}$) than unprocessed cereal pulse mix ($0.82 \pm 0.2 \text{g/ml}$) which would be beneficial for growing children and diseased persons where low bulk density is desirable with more capacity to absorb water. Free radical scavenging activity (79%) was increased upon malting however; total polyphenolic content was decreased by 7.3%. It could be concluded that malting and roasting enhances nutritional components and functional properties of the ready-to-use multivitamin malt mix developed for a low economical section to meet their nutritional demands.

Introduction:

Nutritional deficiency is a widespread problem among the Indian population affecting mostly the children, expecting women and elderly people from the weaker sections of the society. Interest to eat right and food with functional property has increased among consumers. The development of cost-effective nutrient-dense ready-to-use value-added products has long been advocated. Cereal and pulses are staple food as the most important energy and protein source constituting 60-70% of the total food intake (Baranwal, 2017). To improve the nutritional potential of cereal and pulses, household techniques such as roasting, germination, fermentation, and malting are some of the excellent alternatives. Malting induces beneficial biochemical modification in plant seeds thereby enhancing the bioavailability of the nutrients and antioxidative capacity of the food. Malting increases protein content dietary fibre and reduces bulk density and palatability of food, making it suitable for the children and heavy workers of various occupations. Wheat represents the most important cereals in human nutrition with the largest consumption. It contributes a good

proportion of nutrients in our daily diet (Hidalgo *et al.*, 2016), whereas pulses like green gram contain 25% protein, high dietary fiber, and micronutrients. Pulses complement cereals for limiting amino acid (lysine). Whey protein concentrate possesses a high amount of amino acids and biologically active component which supplements the diet in a beneficial way. Sesame has a superior quality of fat, high tocopherol, and lignin contributing anti-oxidant and cholesterol-lowering effects (Luo & Xie, 2017). The food or diet with substantial anti-oxidative capacity is much required for workers engaged in mining and other occupations with the risk of high oxidative stress. By keeping the same in mind, the present work aims to develop ready-to-use malted cereal pulse mix which could be utilized as base flour for weaning food or instant convenient food for all age groups especially belonging to the weaker section of our society.

Methodology:

Collection of Raw Ingredient: wheat (variety MP-3336) was collected from our institutional research farm, Jabalpur, M.P., India. Green gram was made available from National Research for Weed Science, ICAR, Jabalpur, M.P.,

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India. Whey protein concentrate (WPC 70%) was obtained from Mahaan Protein Limited, Delhi, India. Sesame seeds were purchased from the local market of Jabalpur, M.P., India.

Preparation of malt-mix ingredient: the whole wheat was soaked in clean water for 12 hr, kept for germination for 36 hr, followed by oven-dried, devegetated, and roasted for 15 min and then powdered to obtain malted flour (sieved). The green gram was soaked for 12 hr in clean water and germinated for 24 hr. Sprouted dried green gram was devegetated and dehusked to obtain malted dhal. The dhal 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 Alimentarius Commission (FAO/WHO, 1994) on the nutritional and technical aspects of the production of formulated convenient foods (Fig.-1; Composition of RTU Malt mix).

Figure-1: Composition of RTU Malt Mix

Nutritional properties of malt mix: proximate composition of wheat and green gram and sesame viz. as moisture, fat, fiber, energy estimated by AOAC (2004) methods while energy and protein content determined by Lowry's method (Lowry *et al.*, 1951) and carbohydrate by Sadasivum & Manickam (1992). Calcium and iron were calculated spectrophotometrically. All chemicals used were of analytical grade.

Physical properties: Physical properties of the developed malted mix such as bulk density was estimated by taking a known volume of weighted flour into a graduated cylinder filled to 10 ml by gently tapping. The procedure was repeated three times; the average was calculated and expressed in g/ml (Pelembé *et al.*, 2011). Water absorption capacity (WAC) was assessed by the method of Anderson *et al.* (1969). Distilled water of 30 ml at 30°C for suspending 2.5 gm of flour in a centrifuge tube, constant stirring for 10 min at 3000 rpm was applied. The supernatant fluid was discarded, the 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 (2019). Titrable acidity was determined by titrating against 0.1N 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 & Rossi (1965) and antiradical scavenging activity was quantified by DPPH (2, 2-diphenyl-1-picrylhydrazyl) methods given by Lee *et al.* (2003). Gallic acid was used as a standard.

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

Results and Discussion:

Developed malt mix was analyzed for the quality in terms of nutritional, functional, and physical characteristics with different combinations of malt mix flour is discussed below.

Nutritional property of developed malt mix: nutritional composition of both types of mixes i.e., from unprocessed raw food ingredient and malted raw ingredients depicted in Fig.-1 so that the effect of malting or processing could be studied. It was found that many nutrients have significantly increased due to biochemical 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. An increase in moisture content has been associated with an increase in fiber content (Akhtar *et al.*, 2008; Elleuch *et al.*, 2011; Maneju *et al.*, 2011).

Table-1: Nutritional composition of RTU Malt Mix & Unprocessed Mix (100g)

Nutrient	Unprocessed Mix	Malt Mix	p value
Moisture(g)	7.2±1.0	9.3±1.1	<0.05
Protein(g)	22.6±2.3	23.5±2.1	<0.05
Fat(g)	19.8±1.3	18.1±1.5	>0.05
Fibre(g)	2.7±0.2	3.0±0.3	<0.05
CHO(g)	152±3.0	144±3.7	<0.05
Energy(Kcal)	387±5.7	458±5.1	<0.05
Calcium(mg)	636.1±12.8	641.8±15.2	>0.05
Iron(mg)	6.1±0.1	6.3±0.3	>0.05

The protein content of malted mix flour was significantly higher when compared with the untreated raw flour ($p < 0.05$), this 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 (Ade-Omowaye *et al.*, 2006). There is a slight decrease in fat content during the germination or malting period. Similar results occurred in the study by El-Adawy *et al.* (2004) and Hahm *et al.* (2008) where the fat content decrease with an increase in the time of germination.

The carbohydrate content of germinated or malted mix flour was lower (144 ± 3.7 g) than the 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 (Elkhier & Hamid, 2008). 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 an increase in the protein content.

Calcium and iron value of the malted mix were high as calcium and iron were highest in sesame seeds (1359 mg/100gm). The mineral composition of the malted mix increased as compared to the unprocessed raw sample mix. Thus, malting improved the content of both the major and trace mineral ions. This observation possibly a result of enzyme solubilization and leaching of the anti-nutritional factors binding them through leaching (Idris *et al.*, 2005; Alemu, 2009). Kaushik *et al.* (2010) found that germination improves calcium, copper, manganese, and zinc in legumes and cereal seeds.

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 the heaviness of flour and generally affected by particle size and flour density (Nicole *et al.*, 2010). 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 ± 0.1 which increases on malting to 2.50 ± 0.1 g/unit g sample significantly ($p < 0.05$) indicating more ability of the flour to absorb water. Green gram contributes more to 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 (Dev & Quensil, 1988) thereby escalating the ability of flour to form a 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. An increase in titratable acidity was noted while pH was slightly declined on malting.

Cereal and legumes are major sources of antioxidants and having hundred 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/ 100g 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 (Megat *et al.*, 2012).

Table-2: Physical & Functional Properties of RTU Malt Mix (Mean $\pm$ SD)

Nutrient	Unproc. Mix	Malt Mix	P value
Bulk Density(g/ml)	0.82 ± 0.2	0.75 ± 0.1	< 0.05
Water Absorption	2.39 ± 0.1	2.51 ± 0.1	< 0.05
Capacity (g/unit g sample)			
pH	5.1 ± 0.3	4.7 ± 0.2	< 0.05
Titrate Acidity	0.5 ± 0.1	0.6 ± 0.1	< 0.05
Total Polyphenolic	6.8 ± 1.3	6.3 ± 1.2	< 0.05
Content (mg/100g)			
Anti-radical Activity (%)	72.4 ± 3.1	79.1 ± 3.5	< 0.05

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 antioxidant 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 arytensoids at different concentrations that might also behave as an antioxidant (Yang *et al.*, 2001).

Conclusively, the present work was conducted to develop a base product for the low economical section to meet their nutritional demands and hidden deficiency at low cost than commercially fortified protein-rich supplements which should be readily available to the poor people. From the results, it can be concluded that malting and roasting enhance the 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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