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Development of value added Ready-to-Cook (RTC) convenient mix by using barley, oat and flaxseeds

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Abstract

The present study was carried out with the objective to process barley, oat and flaxseeds and to utilize them to develop value added Ready-to-Cook (RTC) convenient mix. The process for preparation of RTC convenient mix was standardized and prepared product was assessed for various sensory attributes. It was observed that 20% barley flour and 50% oat flour can be incorporated in wheat flour for the preparation of acceptable RTC convenient mix. Various levels of roasted flaxseed powder (5, 10, 15, 20 and 25%) were incorporated in acceptable mixed cereal formulation. The value added barley and oat based convenient mixes containing 5-25% flaxseeds were adjudged 'liked moderately' to 'liked very much' by the judges. Barley and oat-based value added RTC convenient mix containing flaxseed (Type I and II) contained significantly higher protein, fat, fibre and TDF content. Hence, 25% flaxseed can be incorporated in barley and oat based convenient mixes for the preparation of value added Ready-to-Cook (RTC) convenient mix.

Keywords: Convenient mix, sensory attributes, value added, RTC, flaxseeds, oat and barley

Introduction

In this era of industrialization and technological development, life style of the people has changed a lot. As life continues to get busier in the contemporary "cash-rich, time-poor" society, the demand for different types of convenience food increased considerably (Moraru & Kokini, 2003) [12]. Convenience foods have played a vital role in life of human being since antiquity as they reduce varying steps involved in preparation to cooking (Midha & Mogra, 2007) [11]. Low cost and nutritious ready-to-cook food product may be developed using underutilized crops which may be blended or supplemented with each other to provide complete nutrition.

Barley, oat and flaxseed gained a lot of attention worldwide due to their high levels of quality protein, fiber and functional properties.

Barley (*Hordeum vulgare*) is the fourth most important cereal in terms of world production after wheat, rice and corn. It is an important coarse cereal in India. Barley contains 60-64% starch, 8-15% proteins, 2-3% lipids, 3% minerals and 3.6-6.1% β -glucan (Mac Gregor, 1993). In addition, barley is an exceptional source of other bioactive constituents, including vitamin E, B-complex vitamins, enzymes, minerals and phenolic compounds. Moreover, it does not contain any known anti-nutritional factors. In spite of these interesting characteristics barley remain underutilized crop in human foods, except for the malting, brewing and distilling industries (Jadhav *et al.*, 1998) [9].

Oats (*Avena sativa* L.) is a typical northern cereal. For approximately 2,000 years, oat and barley were staples of the diet in Nordic countries. Only at the beginning of the 19th century were oats partially replaced by other cereals. Today, interest in oats is increasing, and it retains a strong image as a nutritious, health-promoting ingredient in food applications due to its high bioactive and functional components (Duss & Nyberg, 2004) [5]. It is a good source of carbohydrates, protein (11-15%) with good amino acid balance, lipids (5-9%) especially essential unsaturated fatty acid, minerals, vitamins and phytochemicals (Head *et al.*, 2010) [7]. In addition it also contains functional ingredient β -glucan (2.3-8.5%), large amount of antioxidants and various phenolic compounds (Peterson *et al.*, 2002) [14].

The public health recommendations in United Kingdom suggest including oats as a part of healthy diet. This has increased the demand of commercially available oat products (Ryan *et al.*, 2011) [15].

The flaxseed (*Linum usitatissimum* L.) is a Rabi crop and is a member of Linaceae family, commonly known as "Alsi" (Gujrati, Hindi and Punjabi). Flaxseed is gaining popularity in the food sector for its functional properties, since it is a rich source of essential fatty acids, protein, lignans, vitamins and minerals (Muir & Westcott, 2003) [13]. It contains approximately 40% lipid of which 47–57% is ALA (Daun & Przybylski, 2000) [4] and other healthful components such as dietary fiber (28%) and secoisolariciresinol diglucoside (SDG), a lignan (Carter, 1993) [3]. The whole and milled flax were given GRAS (generally regarded as safe) status by FDA in January of 2009 (Flax Council of Canada).

Efforts are being made worldwide to utilize these grains and flaxseed in food such as ready-to-eat (RTE) breakfast cereals, through extrusion, flaking, popping and blending with other grains. Considering the nutritional value and health benefits of barley, oat and flaxseeds the present investigation was carried with the objective to process with the objective to process barley, oat and flaxseeds and to utilize them to develop value added convenient mix.

Material and Methods

Procurement of materials

Wheat (WH-1105), barley and oat (OS-6 variety) were procured from the Department of Genetics and Plant Breeding, CCSHAU, Hisar. Flaxseed and other ingredients were procured from local market.

Preparation of convenient mix

The process for preparation of control as well as value added convenient mix was standardized.

Germination and roasting

Wheat, oat and barley grains were cleaned and free from broken seeds, dust and other foreign materials, and soaked in water for 7±1 h at 37 °C. A seed to water ratio of 1:4 (W/V) was used. The soaked wheat and barley grains were germinated for 36 h and 24 h at 37 °C, respectively while oat grains were germinated for 72 h at 18 °C with frequent watering. The sprouts were rinsed in distilled water and dried at 57±3 °C for 9±1 h. The rootlets of were removed by hand scrubbing. The dried germinated seeds were milled to fine flour in milling machine. Flour was sieved to remove husk and bran portion. Malted wheat and barley flour were roasted in iron vessel for 6±1 min while malted oat flour was roasted for 4 min. The sample was stored in plastic containers for future use at refrigerated temperature.

Processing of flaxseed

The seeds were cleaned, free from broken seeds, dust and other foreign materials manually. Microwave roasting was performed. Time of roasting for flaxseeds in a household microwave oven was standardized with 900 W output, under the operating frequency of 2450 MHz for 3 min with shuffling of seeds after 1.5 min. Roasted seeds were ground to coarse powder in an electric grinder and stored in plastic containers for future use.

Preparation of convenient mix

Processed barley/oat flour was blended with 10, 20, 30, 40

and 50% of processed wheat flour. The resultant cereal mix flour was passed through 60 mesh size sieves 2-3 times for uniform mixing. For the preparation of healthy convenient mix roasted flaxseed powder (5, 10, 15, 20 and 25%) was incorporated in acceptable formulation of cereal mix flours and it was again passed through 60 mesh size sieves 2-3 times for uniform mixing.

The formulation of convenient mix was standardized using cereal mix flour, skim milk powder and powdered sugar. These ingredients were mixed properly for uniform mixing. The mixture was packed in laminated pouches for further use. Ratio of convenient mix to water was standardized. Convenient mix was added to boiling water, stirred to mix properly and cooked for 1 min to gain smooth and homogenous consistency. The prepared convenient mix was served at ambient temperature for organoleptic evaluation.

Sensory evaluation

Convenient mix was evaluated for sensory attributes (color and appearance, taste, aroma, texture), using 9-point Hedonic scale by a panel of eight semi-trained judges. Average of the scores for all the sensory characteristics was expressed as overall acceptability score.

Nutritional value

Acceptable products were evaluated for crude protein, crude fat, ash, crude fiber, carbohydrate and dietary fibre (AOAC, 2000) [2].

Results and Discussion

Sensory characteristics of mixed cereal Ready-to-Cook (RTC) convenient mix

Mean score for color & appearance, taste, aroma, mouthfeel and overall acceptability of convenient mix prepared by wheat flour (control) were 7.20, 7.00, 6.80, 6.80 and 6.95, respectively (Table 1).

Except for taste, no significant change in mean scores for all other sensory characteristics of convenient mixes prepared by incorporating barley flour (10-50%) in wheat flour was noticed. Mean score for various sensory characteristics of wheat-barley based convenient mix containing 20% barley were maximum. However, wheat-barley based convenient mixes were adjudged 'liked moderately' to 'liked very much' by the judges.

On the other hand significant improvement in mean score for overall acceptability and no significant change in mean score for all other sensory characteristics were noticed with increase in level of oat flour of (10-50%) in wheat flour.

Perusal of data showed that there was gradual increase in mean score for overall acceptability score with increase in level of oat flour in wheat flour; higher the level of oat flour higher was mean score for overall acceptability.

In terms of overall acceptability the convenient mix prepared by incorporating 50% oat flour of OS-6 variety were adjudged 'liked very much'.

On the basis of overall acceptability score wheat: barely, 80:20 and wheat: oat flour, 50:50 cereal mix formulation was selected for further value addition. Addis *et al.* (2013) [1] formulated complementary food from processed sorghum, pigeon pea, soybean along with skimmed milk and sucrose in the proportion of 65:15:10:5:5.

Tiwari & Awasthi (2014) [16] developed weaning mix, using oat flour, wheat flour, green gram and skim milk powder and found acceptable by panel member.

Table 1: Mean score for sensory characteristics of barley/oat based Ready-to-Cook (RTC) convenient mix

Convenient mix	Color & appearance	Taste	Aroma	Texture	Overall acceptability
Wheat: Barley					
100:00	7.20±0.84	7.00±0.00	6.80±0.45	6.80±0.45	6.95±0.21
90:10	7.20±0.84	7.20±0.45	7.20±0.45	7.20±0.45	7.20±0.48
80:20	7.60±0.55	7.60±0.55	7.40±0.55	7.40±0.55	7.50±0.38
70:30	6.80±1.10	7.00±0.71	7.00±0.71	6.80±0.84	6.90±0.80
60:40	6.80±0.45	7.00±0.00	7.00±0.00	6.80±0.84	6.90±0.38
50:50	6.60±0.55	6.60±0.55	6.80±0.45	6.80±0.84	6.70±0.48
CD at 5%	NS	0.66	NS	NS	NS
Wheat: Oat					
100:00	7.20±0.84	7.00±0.00	6.80±0.45	6.80±0.45	6.95±0.21
90:10	7.60±0.55	7.60±0.55	7.60±0.55	7.60±0.55	7.60±0.45
80:20	7.60±0.55	8.00±0.00	7.60±0.55	7.60±0.55	7.70±0.33
70:30	7.80±0.45	8.00±0.00	7.60±0.55	7.60±0.55	7.75±0.25
60:40	7.80±0.45	8.00±0.00	7.80±0.84	7.60±0.55	7.80±0.33
50:50	7.80±0.45	8.00±0.71	7.80±0.71	7.80±0.45	7.80±0.11
CD at 5%	NS	0.29	NS	NS	0.40

Values are mean± S.D of eight replicates

Sensory characteristics of value added Ready-to-Cook (RTC) convenient mix

Value added convenient mixes were prepared by incorporating 5-25% of flaxseed powder in acceptable formulation of barley and oat based convenient mixes. Mean score for color & appearance, taste, aroma, texture and overall acceptability of barley based convenient mix (prepared from wheat and barley, 80:20) was 7.60, 7.60, 7.40, 7.40 and 7.50, respectively (Table 2). No significant difference in mean scores for color & appearance, taste, aroma and texture was noticed with incorporation of flaxseed powder in the formulation. However, significant increase in mean score for overall acceptability of value added barley based convenient mix was observed with incorporation of 15-25% flaxseed powder in the formulation. Incorporation of flaxseed powder (5-25%) in barley based convenient mix either improved or did not change the sensory characteristics of convenient mix.

Similar trend was obtained for value added convenient mixes prepared by incorporating flaxseed powder in oat based convenient mix (prepared from wheat and OS-6 variety of oat, 50:50). No significant change in mean scores for all the sensory characteristics viz. color & appearance, taste, aroma, texture and overall acceptability was noticed for convenient mixes prepared by incorporating flaxseed powder in the formulation. Mean scores for overall acceptability of value added oat based convenient mixes varied from 7.80 to 8.15 (Table 2). The value added oat based convenient mixes containing flaxseeds were adjudged 'liked moderately' to 'liked very much' by the judges.

Results indicated that 25% flaxseed can be incorporated in barley and oat based convenient mixes for the preparation of value added convenient mix.

Table 2: Mean score for sensory characteristics of value added barley/oat based Ready-to-Cook (RTC) convenient mix prepared by various levels of flaxseed powder

Level of flaxseed (%)	Color & appearance	Taste	Aroma	Texture	Overall acceptability
Barley based convenient mix					
Control I	7.60±0.55	7.60±0.55	7.40±0.55	7.40±0.55	7.50±0.38
5	7.80±0.45	7.80±0.45	7.60±0.55	7.60±0.45	7.70±0.29
10	8.20±0.71	8.00±0.45	7.80±0.89	7.80±0.45	7.95±0.45
15	8.20±0.84	8.20±0.45	8.00±0.71	7.80±0.45	8.05±0.21
20	8.40±0.84	8.40±0.55	8.20±0.45	8.00±0.71	8.25±0.40
25	8.40±0.89	8.40±0.55	8.40±0.84	8.20±0.84	8.35±0.29
CD at 5%	NS	NS	NS	NS	0.49
Oat based convenient mix					
Control II	7.80±0.45	8.00±0.71	7.80±0.71	7.80±0.45	7.80±0.11
5	7.80±0.55	8.00±0.55	7.60±0.55	7.80±0.45	7.80±0.27
10	8.00±0.71	8.00±0.45	7.70±0.55	7.80±0.55	7.88±0.42
15	8.00±0.71	8.10±0.45	7.80±0.55	7.90±0.89	7.95±0.46
20	8.20±0.84	8.20±0.45	8.00±0.89	8.00±1.10	8.10±0.63
25	8.20±0.84	8.40±0.55	8.00±1.00	8.00±1.22	8.15±0.80
CD at 5%	NS	NS	NS	NS	NS

Values are mean± S.D of eight replicates

Control I: Standardized convenient mix prepared from blends of corn: barley (80: 20)

Control II: Standardized convenient mix prepared from blends of corn: OS-6 variety of oat (50: 50)

Nutritional value of value added Ready-to-Cook (RTC) convenient mix: Convenient mix prepared from processed wheat flour (control) contained 11.27 g protein, 9.35 g fat, 3.00 g ash, 0.66 g crude fibre, 75.77 g carbohydrates, 432.11 kcal energy and 1.71 g total dietary fiber (TDF) per 100g, respectively (Table 3). Barley and oat based value added

convenient mix containing flaxseed (Type I and II) contained significantly higher protein, fat, fibre and TDF content. Imtiaz *et al.* (2011) [8] prepared a weaning food from germinated wheat, mungbean, sugar and skim milk powder and observed crude protein, fat and fiber content of formulation increased with increasing levels of mungbean flour in wheat flour.

Flaxseed is good source of protein, fat, and TDF. Hence, flaxseed supplementation in formulation increase these nutrients in the product developed.

Table 3: Nutritional value of barley/oat based value added Ready-to-Cook (RTC) convenient mix (per 100 g on DM basis)

Parameters	Control	Type I	Type II	CD at 5%
Crude protein (g)	11.27±0.24	12.35±0.16	12.12±0.36	0.54
Crude fat (g)	09.35±0.20	11.58±0.20	11.87±0.41	0.58
Ash (g)	03.00±0.22	03.27±0.07	03.19±0.17	NS
Crude fiber (g)	0.66±0.07	01.22±0.10	0.89±0.08	0.17
Carbohydrates (g)	75.77±0.15	71.58±0.28	71.92±0.21	0.44
Energy (kcal)	432.1±1.28	439.9±1.37	442.9±2.23	3.43
TDF (g)	01.71±0.10	02.40±0.10	02.73±0.06	0.18

Values are mean± S.D of three replicates

Control: Convenient mix containing wheat only

Type I: Convenient mix prepared by processed wheat: barley (80:20) cereal mix flour supplemented with 25% flaxseeds.

Type II: Convenient mix prepared by processed wheat: oat (50:50) cereal mix flour supplemented with 25% flaxseeds.

Conclusion

It has been concluded from present study that barley, oat and flaxseed can be processed to prepare flour and utilized for preparation of value added RTC convenient mix. Results indicated that barley (20%) and oat (50%) flour can be utilized for preparation of acceptable convenient mix. The mixed cereal formulation (wheat: barely, 80:20 and wheat: oat flour, 50:50) can be replaced with 25% flaxseed for preparation of value-added convenient mix. Value added products were nutritionally superior as compared to control in terms of protein, fat and total dietary fibre. Thus, the utilization of flaxseed with cereals for product development will help in diversifying its use for achieving food and nutritional security.

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