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Organoleptic and Nutritional Attributes of Chia and Soybean Based Instant Multigrain Sweet Mix Breakfast Cereal

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ABSTRACT
Background: Breakfast is the most crucial meal after overnight fasting but the morning has the most rushed hours for working people. Ready to eat and ready to cook breakfast cereals are very popular these days that provide maximum nutrition with less effort than cooking breakfast cereals.
Methods: Instant Multigrain sweet Mix breakfast cereals by using Chia in different proportion with cereals which varies accordingly, and Soybean with constant amount along with skimmed milk powder, sugar, brown sugar and golden syrup. Breakfast mixes were made with whole Chia seeds and secondary processed i.e. popped maize, puffed rice paddy and flaked wheat.
Results: After organoleptic evaluation by panel list by using 9 hedonic scales, 10% Chia seeds with other cereals and soybean combination could be used best quality instant multigrain sweet mix breakfast cereals with nutritionally adequate compared with other market brand product along with 6-month shelf life.
Conclusion: Instant multigrain sweet mix breakfast cereals by using Chiahave essential nutrients that require in commercial breakfast cereals brands.

Key-words: Breakfast Cereals, Chia, Multigrains, Millets, Ready-to-Eat

INTRODUCTION

Breakfast is the most important meal that has a maximum nutritional contribution to dietary meals and sound health [1]. Rice (*Oryza sativa* L.) is an in-demand cereal that gives 700 kilo calories/ person/ day to the large community of Asia and Africa. Rice is a considerable carbohydrate, and also a source of vitamin-B complex but it contains a modest amount of protein and fat [2].

Maize kernel is an edible and nutritionally dense part of the plant that contains vitamins like vitamin C, vitamin E, vitamin K, vitamin B complex, folic acid, selenium and significant amount of potassium [3]. Popcorn is the prominent snack of maize that supplies protein (10.36-12.78%), fat (3.55-4.86%) and starch (70.57-75.37%) and well-provided fibres in the human diet, which will upgrade the digestion process [4].

Soybeans are a well-provided source of protein that contains the essential number of amino acids and oil content, which scores 60% of dry soybeans by weight and the remaining, consists of 35% carbohydrates and 5% ash. Many relevant vitamins, flavonoids, and polysaccharides also exist within soybeans [5].

Chia seeds are used in many forms like whole seeds, mucilage, flour, and oilseed. Chia seed is just about 15.24% protein, 26.41% carbohydrates, and 25.40% fat and its oil quality content, acquires almost 55.60% linolenic acid (ω-3), 18.20% linoleic acid (ω-6), 6% monounsaturated ω-9, and 10% saturated fat.

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On the other hand, the seed has extraordinarily soluble and insoluble dietary fibre, over 35% of the total weight, and it is a rich source of B vitamins and minerals. It also occupies 6 times more calcium, 11 times more phosphorus, and 4 times more potassium than 100 g of milk, besides getting holds magnesium, iron, zinc, and copper [6].

Sugar is extensively consumed and liked food products in the forms of sweeteners, blenders and colouring agents, which provide a favourable amount of energy [7].

Milk is a broadly consumed product worldwide and that can be preserved by removing water using spray drying and roller drying methods to forbid microbial growth and hinder enzymatic spoilage. Milk powders are frequently used for convenience in transportation and product [8].

Hence, the main objectives of this study were to prepare an instant multigrain sweet mix for breakfast cereals with different combinations of wheat, rice or maize, soybean and Chia seeds along with skim milk powder and variable products of sugarcane (brown sugar, golden sugar syrup). Then evaluate the suitability of the mix and prepare breakfast cereal of multiple choices and also determine the physicochemical, sensory and shelf-life characteristics of the product.

MATERIALS AND METHODS

Source of Raw material- Chia seeds, skim milk powder and other ingredients from the commercial slot of supermarkets whereas rice paddy, wheat grains and pre-gelatinized maize were purchased from the local market of the chin, Lucknow, India.

Primary processing of Cereals and soybean- Processing of grains is broadly classified into two parts before mixing in key products firstly; primary processing includes cleaning of grains from dust and other foreign matters like straw and weeds.

Secondly, secondary processing was done with slight modifications to obtain desired texture i.e. puffing of rice paddy by sand roasting [9] temperature of sand is about 250°C cleaning of rice paddy followed by sieving separate husk and rice puffs then rolled for desirable texture. The popping of maize by the traditional sand roasting method that followed by heating of the sand at which popping occurs at about 177°C then sieving and rolling [10]. Soybean processing has been done through the soaking in water for 12 hrs, steamed in a pressure cooker for 15 min at 80°C, dried in a cabinet dryer at 35°C for 2 days, roasting the seeds for 20 min, grounded in an electric grinder and then roasting of soy flour to remove antinutrients and to achieve flavour [11].

Preparation of instant multigrain sweet mix breakfast cereal- The instant multigrain sweet mix was composed of using different cereals i.e. wheat flakes, puffed rice paddy and popped maize dry ingredients with Chia seeds, soybean powder, and ingredients like skim milk powder and sugar. All ingredients were poured into the bowl and the mass was kept under constant stirring until completely mixed. Stainless steel spoon was used for stirring. The three formulations of each cereal (Table 1) are tried for the preparation of instant multigrain sweet mix breakfast cereal. Based on sensory scores, a final product was selected.

Table 1: Formulation of instant multigrain sweet mix breakfast cereal in different combinations with constant ingredients with variation in an amount in percentage

Cereals (%)	Chia (%)		Soybean (%)	Sugars (%)	Skim milk powder (%)	Code
Wheat (%)	40	10	10	30	10	W2C1
	30	20	10	30	10	W2C2
	20	30	10	30	10	W2C3
Rice (%)	40	10	10	30	10	R2C1
	30	20	10	30	10	R2C2
	20	30	10	30	10	R2C3
Maize (%)	40	10	10	30	10	M2C1
	30	20	10	30	10	M2C2
	20	30	10	30	10	M2C3

Sensory evaluation- The formulated breakfast cereals were organoleptically evaluated on the 9-point hedonic scale [12], the evaluation of products was done by 10 semis trained panels drawn from Babu Banarasi Das University, Lucknow and CFTRI Resource Centre, Dewa road Lucknow were asked to score the food products for their colour, flavour, texture, taste, appearance and overall acceptability then the data were analysed statistically by the independent Kruskal-Wallis test.

Proximate composition- The proximate nutritive analysis of the sensorial best accepted instant multigrain sweet mix formulations was estimated [13]. The moisture content was calculated based on the weight loss of the sample while heating in a hot air oven at 105°C. Ash content was analysed by incineration in a muffle furnace at 550°C. Fat was estimated by the Soxhlet method.

RESULTS

Organoleptically 10% incorporation of chia with 40% bowls of cereal along with other constant ingredient scores maximum in independent -samples Kruskal-Wallis tests as shown in Fig. 1 that further shows nutritional composition analyses on parameters of ash, moisture, fat fibre, protein, carbohydrate, energy, calcium, iron and phosphorous values shows in Table 2. The formulated instant multigrain sweet mix breakfast cereal was then compared with market popular brand Quaker

Carbohydrates were mathematically calculated difference [100- (moisture + ash + protein + fat + dietary fibre)] [13].

Each value was the average of three determinations. Total dietary fibre was determined by boiling alternatively in acid and alkali and ash in muffle furnace. Protein content was determined by the conventional method of "micro-Kjeldahl" [14] total nitrogen, obtained considering a conversion factor of N (%)×6.25. The mineral analysis i.e. calcium, iron and phosphorous was done by AAAS.

Statistical Analysis- All the experiments were carried out in triplicates and the standard deviation of the results was calculated using Excel -2010. The best product was statistically analysed by Independent samples Kruskal-Wallis Test ($p < 0.05$).

instant oats maple and brown sugar and Kellogg's oats organoleptically as well as nutritionally. The nutritional values of the brand product were taken from nutritional information on the pack and then compared with analyses of the nutritional value of the developed product (Table 3), which concludes that the developed product has parallel nutrition adequacy as brand products hold.
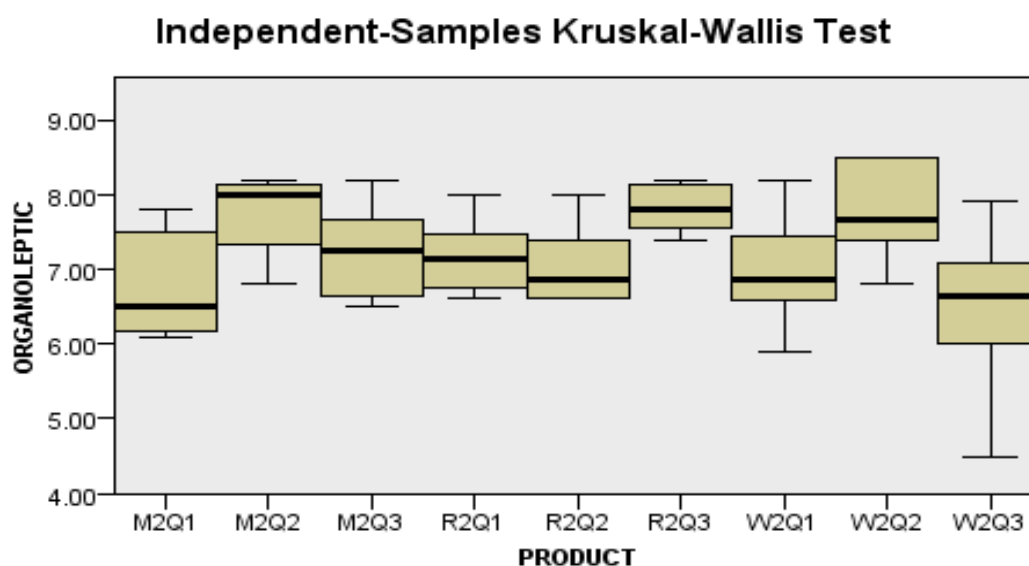

Fig. 1: Analysis of selecting the best ready-to-cook instant multigrain sweet mixes using Chia incorporated with different variations of wheat, rice and maize based on organoleptic evaluation (Color, Appearance, Aroma Texture, Taste and OAA) comparison

Table 2: Nutritional composition of best instant multigrain sweet mixes of Chia seeds incorporating wheat (W2C1), rice (R2C1) and maize (M2C1)

Nutritional and Mineral components	W2C1	R2C1	M2C1
Ash (g/100g)	4.42±0.12	3.11±0.04	3.05±0.08
Moisture (g/100 g)	10.36±0.01	9.19±0.03	5.68±0.32
Fat (g/100 g)	10.37±0.06	9.40±0.11	9.51±0.16
Fibre (g/100 g)	5.19±0.32	4.37±0.05	3.74±0.04
Protein (g/100 g)	16.81±0.08	15.84±0.03	14.47±0.05
Carbohydrate (g/100 g)	63.20±0.47	67.29±0.12	69.23±0.23
Energy (g/100 g)	413.41±1.34	417.10±0.67	420.38±0.60
Calcium (mg/100 g)	75.31±0.97	74.51±0.62	62.76±0.34
Iron (mg/100 g)	8.82±1.26	7.94±0.52	3.75±0.51
Phosphorous (mg/100 g)	89.45±6.15	141.69±5.08	101.84±6.52

Data were represented as mean±SD

Table 3: Nutritional adequacies of developed best instant multigrain sweet mix with popular breakfast cereal brands i.e. Quaker instant oats maple and brown sugar and Kellogg's oats

Nutritional components	W2C1	R2C1	M2C1	Quaker instant oats maple and brown sugar	Kellogg's oats
Ash	4.42±0.12	3.11±0.04	3.05±0.08	NA	NA
Moisture	10.36±0.01	9.19±0.03	5.68±0.32	NA	NA
Fat	10.37±0.06	9.40±0.11	9.51±0.16	4.6	9
Fibre	5.19±0.32	4.37±0.05	3.74±0.04	2.3	10
Protein	16.81±0.08	15.84±0.03	14.47±0.05	9.3	11.6
Carbohydrate	63.20±0.47	67.29±0.12	69.23±0.23	76.7	67.8
Energy	413.41±1.34	417.10±0.67	420.38±0.60	372.1	379
Calcium	75.31±0.97	74.51±0.62	62.76±0.34	NA	NA
Iron	8.82±1.26	7.94±0.52	3.75±0.51	2.3	2.4
Phosphorous	89.45±6.15	141.69±5.08	101.84±6.52	NA	NA

Data were represented as mean±SD

DISCUSSION

Sensory analysis is a key parameter for acceptance of a new product in terms of modification, improvement, and development (Kumar *et al.* [12]). Effect of incorporation of Chia to different cereals on sensory characteristics of instant multigrain sweet mix breakfast cereal. With the increase in the level of Chia seeds, the sensory scores for colour, aroma, texture, taste and overall acceptability of products decreased. 10% incorporation of Chia seed has maximum scores. But a further increase in the addition of Chia seeds and decrease in cereal amount significantly decreased scores in all parameters of sensory evaluation. In wheat products W2C1 10% incorporation of Chia seed

had scored highest in colour, appearance, aroma, texture, taste and overall acceptability on a 9-point hedonic scale and it decreased in W2C2 and W2C3, respectively. Similarly, the incorporation of Chia seed in cereal rice R2C1 the score highest in colour, appearance, aroma, texture, taste and overall acceptability respectively. It is also showing a decrease in scores in R2C2 and R2C3. The same result was also shown with the incorporation of Chia with cereal maize M2C1 scores highest among M2C2(20%) and M2C3(30%) then decreases respectively addition by 30%. The Chia seeds are black, which affect the colour of the product and slightly become bitter. The analysis of macronutrient and mineral composition of three selected breakfast cereals W2C1, M2C1 and R2C1. The result showed that high moisture (10.36±0.01 g/100 g), fat (10.37±0.06 g/100 g), fibre (5.19±0.32 g/100 g), protein content (16.81±0.08 g/100 g) and ash (4.42±0.12 g/100 g) were presented in W2C1 product. High carbohydrate (69.23±0.23 g/100 g) and energy (420.38±0.60 kcal) were recorded in the M2C1 variation. The least ash (3.05±0.08), moisture (5.68±0.32), fibre (3.74±0.04) and protein content (14.47±0.05) was found in M2C1 variation. In W2C1, the carbohydrate (63.20±0.47) and energy content (413.41±1.34) was very less as compared to other products.

The study of the mineral content of these three products viz. W2C1, M2C1 and R2C1 depicted that W2C1 contained high calcium (75.31±0.97 mg/100 g) and iron content (8.82±1.26 mg/100 g) as well as least phosphorous content (89.45±6.15 mg/100 g). While M2C1 contained the least calcium (62.76±0.34 mg/100 g) and iron content (3.75±0.51 mg/100 g) as compared to other variations. High, phosphorous was recorded in R2C1 i.e. 141.69±5.08 mg/100 g.

The best-accepted product compared with a commercial brand available on the local supermarket shelf shows nutritional adequacy that provides well-balanced nutrition. Instant multigrain sweet mix macronutrient compared to popular brand quaker instant oats maple and brown sugar and Kellogg's oats. The protein content range between 12.84 to 16.81 g/100 g as compared with 9.3 and 11.6 g/100 g, respectively. In commercial product micronutrient information was higher than brand calcium, iron and phosphorous range between 61.66 to 75.31 mg/100 g, 3.75 to 9.87 mg/100 g, and 73.6 to 141.69 mg /100, respectively.

CONCLUSIONS

Based on the results obtained, it was concluded that good quality instant multigrain sweet mix breakfast cereals with high acceptability can be made from a combination of chia, soybean and different combination of cereals (wheat, rice, and maize) along with skim milk powder and sugar. The finding of the study showed products with 10% chia incorporation were best in sensory evaluation. The nutritional analysis reveals that a product that has been accepted organoleptically is nutritionally well-balanced compared to other commercially available brands in the market. These kinds of ready to eat mixes are nutritious as well as a healthy option to satisfy taste buds in breakfast.

The present study is confined to product development and nutritional adequacy or analysis but it can be extended to study the consumer acceptability of developed products. In addition, the bioavailability of nutrients will also be analyzed and the processing of products with new advanced technology will improve texture and acceptability.

CONTRIBUTION OF AUTHORS

Research concept- Dr. Varuna Singh
Research design- Dr. Varuna Singh
Supervision- Dr. Lashmi Bala
Materials- Dr. Varuna Singh
Data collection- Dr. Varuna Singh
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