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Functional Food Mix and its Quality Assessment

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ABSTRACT

Functional food ingredients are the substances that are believed to possess health advantages in addition to basic nourishment. Chia, grain amaranth and quinoa because of their excellent and well-balanced nutritional qualities, have been employed extensively in food formulations. Nutrition can help to enhance athletic performance. It can be achieved by providing food with the right amount of nutrients *viz.,* protein, carbohydrates, fats, fibre, fluids and other nutrients to maximise energy additionally, aid in sports recovery. The objective of the study was to design functional food mix and quality assessment. Quinoa and grain amaranth were employed in varied quantities of 22, 25, 28 and 03, 06, 09 per cent in the current study to prepare a functional food mix. The results of sensory evaluation revealed that 25 per cent quinoa flour and 06 per cent grain amaranth flour incorporated functional product was accepted with overall acceptability score of 8.90. The accepted product was analysed for functional properties, proximate and mineral composition. Functional food mix was found to have moisture (4.19%), fat (6.36g), protein (21.50g), crude fibre (5.01g), total ash (2.59g), carbohydrate (63.76g) and energy (739 kcal) per 100g. The product was also a store house of minerals such as calcium (208.60mg), sodium (16.37mg), potassium (123.70mg) and iron (9.01mg) per 100g. The designed functional food mix can be stored at room temperature in aluminium packaging for 90 days without disagreeable changes in sensory, chemical or microbiological quality. The consumer preference revealed that developed functional food mix was found to be acceptable. Current findings concluded that functional ingredients such as quinoa and grain amaranth are an excellent dietary beverage substitute to suit the nutritional needs of athletes which is need of hour by the sports persons.

Keywords : Functional ingredients, Quinoa, Grain amaranth, Athletes, Sports nutrition

ATHLETES have different nutritional needs than non-athletes. To meet energy demands and restore glycogen stores, athletes should consume 4 - 6 meals and snacks containing 6 - 10 g of carbs per kilogramme of bodyweight. Due to lack of time and poor availability of nutritious foods during competition, athletes seek foods which are easy to consume and at the same time it should provide all the nutrients (Arazi and Hosseini, 2012 and Barzegari, *et al*., 2011). Sportsmen and women are increasingly interested in nutritionally balanced snacks and drinks that are appealing, portable, convenient and free of additives (Banu *et al*., 2020).

For the sports person, nutrition is an essential component for their exercise and performance. Macronutrients and micronutrients are very essential to make the body to work. In training, recovery and performance, the right balance among energy intake and energy demands is crucial. Therefore, nutrition plays a vital role. Sports drink prepared from composite mixture of various ingredients assure a mutual complementation of nutrients. This will supply adequate energy and increase muscular endurance of sportspersons. After heavy exercises or performances an athlete loose electrolytes level and water by sweating. This loss of electrolytes and liquid content from the body causes dehydration (Sobana, 2017). Sports drink itself being an electrolyte enriched beverage, prolongs the cause of thirst in sportspersons.

Pseudocereals are high in starch, fibre, protein, minerals, vitamins and phytochemicals, all of which have potential health advantages (Villaluenga *et al*., 2020). Furthermore, underutilised crops are closely linked to cultural practices and are expected to have a role in promoting social variety (Pirzadah and Malik, 2020). Sports people are frequently perplexed when it comes to selecting the proper complement. The higher expense of commercial snacks puts them out of reach for many athletes, particularly those from marginalised socioeconomic backgrounds. Hence, pseudocereals being low in cost, nutritious and locally available indigenous food, the present study attempted to develop a functional food mix and evaluate its sensory and nutritional qualities. To explore these neglected crops, there is an increasing interest in research and development that needs heightened direction and focus. With this background, convenient, low bulk, portable and easy to consume functional food mix with compact source of energy as well as nutrients is developed in the present study. The current research aimed to design functional food mix and its quality assessment.

Material and Methods

Selection of Ingredients

The ingredients chosen for the preparation of functional food mix were Quinoa (*Chenopodium quinoa* Willd.), Grain amaranth (*Amaranthus hypochondriacus*), White Chia (*Salvia hispanica* L.), Finger millet (*Eleusine coracana*), salt, cumin and milk solids.

Procurement and Processing of Raw Ingredients

Quinoa and chia were procured from Kilaru Naturals Pvt. Ltd., Hyderabad. The other required ingredients were purchased from local markets of Bengaluru. Quinoa and amaranth grains were soaked in saline water (2% NaCl) for 12 hrs, drained and shade dried for 2 - 3 hrs. The dried grains were then popped at 140^{0}C for 6 min. Finger millet was soaked separately in water for 8 hrs. After soaking, the water was drained and allowed to germinate by tying in a clean muslin cloth for 12 - 18 hours. The germinated finger millet was shade dried to remove the excess moisture content and popped at 140^{0}C for 6 min until pleasant aroma was developed. The popped quinoa, grain amaranth and finger millet (germinated-roasted) were pulverized into fine flour in an electric blender and sifted in 75 µ mesh sized sieve. Chia and cumin seeds were roasted at 55^{0}C. Roasted cumin seeds was ground into fine powder. The other ingredients were checked for the presence of foreign materials and cleaned separately.

Preparation of Functional Food Mix

The processed quinoa (22,25,28g), grain amaranth (3,6,9g), finger millet (5,10,15g) flour and other ingredients were combined and homogenized in an electric blender. The prepared mix was then passed in a sieve of mesh size 75 µm to which roasted chia seeds were added. An attempt to develop the functional food mix with different combinations of pseudocereals, millet, oilseed and milk solids was carried out by keeping other ingredients constant. Totally three functional food mix trials were formulated and subjected to sensory evaluation.

Preparation of Sports Drink from Functional Food Mix

The serving size of about 50g developed functional food mix (Fig.1) was reconstituted with 150ml of different fluids like milk, buttermilk, water and subjected for sensory evaluation.

Sensory Evaluation of the Functional Food Mix

Sensory quality evaluation is important for acceptability and marketing products. The results of sensory evaluation give in-depth insight on the preference and overall acceptance towards product (Kemp *et al*., 2011 and Parn *et al*., 2015). The

Procurement of ingredients
(Quinoa, Grain amaranth, Finger millet)
↓
Cleaning to remove dirt, dust, foreign material
↓
Soaking at 2% NaCl solution/ 8-12 hrs
↓
Shade drying for 2-3 hrs
↓
Popping (140^0 C/ 6 min)
↓
Milling
↓
Sieving (75µ)
↓
Homogenization
↓
Addition of other ingredients
(milk solids, roasted white chia seeds,
cumin and salt)
↓
Packaging – Aluminum foil
↓
Storage

Fig. 1. Preparation of functional food mix

functional food mix developed in three trials was evaluated for appearance, colour, flavour, taste, texture and overall acceptability using nine-point hedonic scale (Kaur *et al.,* 2014) by a group of 25 semi trained panel members comprising staff and students from Department of Food Science and Nutrition, University of Agricultural Sciences, GKVK, Bengaluru.

Functional Properties of Accepted Functional Food Mix

Functional properties are the physical and chemical changes that occur during food preparation, presentation and storage. The developed functional food mix was evaluated for functional properties such as water absorption capacity, oil absorption capacity and bulk density. These properties are among the major quality attributes of foods and flours for infant formulations and sports foods. It also explains the behaviour of ingredients during preparation and cooking.

Nutrient Analysis of Accepted Functional Food Mix

The proximate composition such as moisture, fat, total ash, protein, crude fibre and micronutrients were analyzed using standard procedure by AOAC (2005). The moisture content of the sample was estimated using hot air oven, fat by Soxhlet method, protein by Kjeldahl method and ash using muffle furnace. The total mineral content was determined using the ashing method, whereas the calcium content was assessed using the titrimetric method and the iron content was determined calorimetrically. Total carbohydrate content and energy were calculated using formula.

RESULTS AND DISCUSSION

Sensory Evaluation of Functional Food Mix of Different Variations

The functional food mix developed under three different trials were evaluated for acceptability through sensory analysis (Plate 1). The data was analyzed statistically using one-way ANOVA (Table 1). Appearance is the very first visual quality that attracts product acceptability. The highest appearance mean score of 8.70 was obtained by the functional food mix prepared from trial II, followed by trial I and III. The colour value ranged from 8.30 to 8.80 and was found to be statistically significant ($p \leq 0.01$). Trial II scored significantly ($p<0.01$) high (7.90) flavour scores. Trial III had significantly ($p<0.01$) lowest taste (7.00) and textural (8.40) score. However, trial II with 25 per cent incorporation of quinoa flour (Patiballa and Ravindra, 2022) and 06 per cent grain amaranth flour ranked no. 1 with overall acceptability score of 8.90 followed by trial I and III. Based on the highest acceptability,

Plate 1 : Sensory evaluation of developed functional food mix and drink

the functional food mix developed from trial II was subjected for quality evaluation.

The average score obtained for overall acceptance of optimized raw quinoa beverage (Kaur and Tanwar, 2016) was 4.8, which is lesser than the score compared to beverage from functional food mix. Bamgboye *et al*. (2019) revealed that, the highest overall acceptability score (4.10) for grain amaranth beverage known as *kunu*. Sports drink developed by Bharadwaj and Saraswat (2019) with the incorporation of 4 grams of chia seeds named sample B was most acceptable (7.2) as compared to sample A and sample C with 2 grams & 6 grams of chia seeds. Better acceptability score (8.90) obtained for functional food mix is due to the processing treatments used such as soaking, drying and popping. This might have enhanced the flavour, reduced bitterness, eliminated earthy taste and increased acceptability of product. It has also reduced the saponin and other anti-nutritional factors which impacts adversely on sensory parameters.

Sensory Evaluation of the Accepted Functional Food Mix Reconstituted with different Fluids

The developed functional food mix was reconstituted (Plate 2) with different fluids like water (T1), milk

TABLE 1

Sensory evaluation of functional food mix of different variations

N=25

Functional food mix	Sensory attributes						
	Appearance	Colour	Flavour	Taste	Texture	OA	Rank
Trial I (Quinoa:Amaranth22:09)	8.50 ± 0.48 ^{b}	8.50 ± 0.42 ^{a}	7.40 ± 0.33 ^{b}	7.50 ± 0.66 ^{b}	8.50 ± 0.31 ^{a}	8.50 ± 0.48 ^{b}	II
Trial II (Quinoa:Amaranth25:06)	8.70 ± 0.56 ^{a}	8.30 ± 0.42 ^{a}	7.90 ± 0.69 ^{a}	7.80 ± 0.31 ^{a}	8.70 ± 0.31 ^{a}	8.90 ± 0.42 ^{c}	I
Trial III (Quinoa:Amaranth28:03)	8.40 ± 0.48 ^{b}	8.80 ± 0.66 ^{b}	7.00 ± 0.33 ^{b}	7.00 ± 0.66 ^{c}	8.40 ± 0.31 ^{b}	8.00 ± 0.56 ^{a}	III
S.Em. ±	0.49	0.53	0.49	0.46	0.51	0.48	
CD (5 %)	1.24	0.89	0.97	1.01	0.82	0.91	
F value	4.55 *	5.42 **	9.24 **	15.37 **	11.04 **	8.12 **	

OA – Overall acceptability ; Values are expressed as Mean ± S.D., SEm. ± Standard error of Mean

Significant at *p d 0.05, ** p d 0.01; Different alphabets superscript within a column indicate significant difference at 0.05 level by DMRT

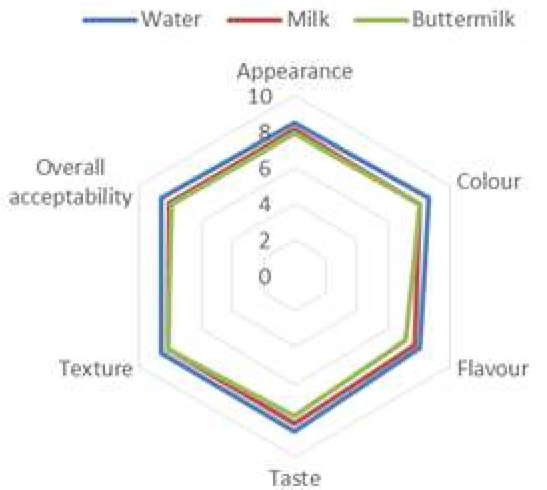

Fig.2. Sensory evaluation of the accepted functional food mix reconstituted with different fluids

(T2), buttermilk (T3) and subjected for sensory evaluation. Sensory attributes of sports drink prepared from functional food mix are presented in Fig. 2. The sensory scores for appearance, colour, flavour, taste, texture and overall acceptability ranged from 7.90 to 8.50, 8.00 to 8.60, 7.10 to 8.00, 7.80 to 8.60, 8.20 to 8.60 and 7.90 to 8.60, respectively. The appearance score was found to be significantly ($p<0.05$) high (8.50) for T1. Colour score of functional food mix reconstituted with water was highest (8.60). T3 scored significantly ($p<0.01$) low (7.10) flavour scores. T1 had significantly ($p<0.01$) highest taste (8.60) and textural (8.60) score. Functional food mix reconstituted with water (T1) ranked no. 1 with overall acceptability score of 8.60 and was also acceptable in terms of viscosity, consistency and less sedimentation. Hence, water was finalized for reconstitution of functional food mix compared to other two fluids such as milk and buttermilk.

Water **Milk** **Buttermilk**

Plate 2 : Functional food mix reconstituted with different fluids

Functional Properties of Accepted Functional Food Mix

Functional properties of developed functional food mix as envisaged by water absorption capacity, oil absorption capacity and bulk density are given in Table 2. Water absorption capacity (WAC) is a product's ability to associate with water in situations where water is scarce. Oil absorption capacity (OAC) related to rancidity that naturally occurs in flours, which is a major predictor of shelf-life. It measures the protein capability to physically bind fat by capillary gravitation (Muttagi *et al.,* 2017). The WAC and OAC of functional food mix were found to be 3.50 and 2.01 per cent, respectively. Bulk density of flour is used to determine the expansion and to know the porosity of flour. It depends on particle size and initial moisture content of the flour. The bulk density of developed functional food mix was 0.67 g/cm^3 and the value was less compared to the foxtail millet composite mix (1.66 g/ cm^3) developed by Yadagouda and Ravindra (2022). The water absorption capacity (1.19 ml/g) and oil absorption capacity (1.26 ml/g) of buckwheat flour reported by Sindhu and Khatkar (2016) are lower compared to the values reported in the present study (Table 2). This high value may be due to small particle size which in turn provides greater surface area.

TABLE 2

Functional properties of accepted functional food mix

Functional properties	Values
Water absorption capacity (g/ml)	3.50 ± 0.09
Oil absorption capacity (g/ml)	2.01 ± 0.31
Bulk density (g/cm^3)	0.67 ± 0.06

Values are presented as mean ± standard deviation

Nutritional Composition of Accepted Functional Food Mix

The moisture content of the prepared functional food mix was found to be 4.19 per cent, indicating low moisture content which is one of the desirable parameters. It provides 63.76g carbohydrate, 21.50g protein, 6.36g fat, 5.01g crude fibre and total ash content of 2.59g per 100g. The developed functional food mix provides 739 kcal of energy per 100g which emphasises the product as an energy dense supplement for the sports persons (Table 3).

TABLE 3

Proximate composition of the accepted functional food mix

Nutrients (g)	Per 100g
Moisture (%)	4.19 ± 0.02
Fat (g/100g)	6.36 ± 0.21
Protein (g/100g)	21.50 ± 0.64
Crude fibre (g/100g)	5.01 ± 0.14
Total ash (g/100g)	2.59 ± 0.25
Carbohydrate (g/100g)	63.76 ± 0.37
Energy (kcal)	739 ± 2.00
Calcium (mg/100g)	208.60 ± 0.51
Sodium (mg/100g)	16.37 ± 0.48
Potassium (mg/100g)	123.70 ± 0.42
Iron (mg/100g)	9.01 ± 0.24

Values are presented as mean ± standard deviation

The findings are similar to the results of Sobana (2017) which showed millet bar prepared from premix had 6.33 per cent moisture, 72.5g carbohydrate, 6.1g fat and 2.29g total ash. But the protein (13.7g) and energy (400 kcal) values were low compared to the values of present study. Chia based sports drink developed by Bharadwaj and Saraswat (2019) contained 0.86g protein and provided 27.24 kcal of energy per 200ml. The results disclosed that these values are lower than that of the current study. Sports drink from fermented whey (Abella *et al*., 2016) had lower protein (0.60%) than the developed functional food mix. Pandey and Singh (2019) revealed the mean score of overall acceptability obtained by organoleptic evaluation of two weaning formulations *viz.*, multigrain and nut mix; banana, apple and rice kheer was 8.22 and 8.36, respectively. Among different treatments of weaning mixes prepared by supplementing wheat flour with pumpkin seed kernel powder, treatment T3 (80:20) was awarded with the highest overall acceptability score of 7.88 followed by T2 (90:10) and T1 (100%) of 7.85 and 7.78 respectively on the basis of sensory evaluation (Dhiman *et al.,* 2018). The overall acceptability of the black gram based healthy mix scored lesser sensory value (3.63) than the other green gram (3.75) and puffed bengal gram (3.75) based mixes (Divya *et al.,* 2017). Coconut water vinegar sports drink (Aziz *et al*., 2016) had less carbohydrate content (8.6%) compared to developed functional food mix.

The product's high protein level is due to grain amaranth and quinoa, which are gluten-free, high in protein and one of the few plant foods that contain enough amounts of all nine essential amino acids. Despite their small size, chia seeds are packed with essential nutrients. They are a good source of omega-3 fatty acids, high in antioxidants and include fibre, iron and calcium. Omega-3 fatty acids help to raise HDL cholesterol, the good cholesterol that protects against heart attack and stroke (Grancieri *et al*., 2019).

When coupled with heavy resistance exercise training, high protein diets can improve muscle mass and strength development. Novice strength athletes may have greater nutritional needs than experienced strength athletes and there is significant inter-individual variability. The right amount of calorie intake is perhaps the most important single determinant affecting absolute protein demand. Athletes should ingest 12 - 15 per cent of daily calorie requirement as protein or 1.5 - 2.0 g protein/kg body weight. Higher protein intakes, despite being frequently ingested by many strong athletes, have not been proved to be consistently helpful and may even be related with some health hazards (Lemon, 1991).

The developed functional food mix is a good source of minerals such as calcium (208.60mg), potassium (123.70mg), sodium (16.37mg) and iron (9.01mg) per 100g (Table 4).

TABLE 4

Correlation between moisture and free fatty acid of functional food mix during storage#

Parameters	Days	Moisture	Free Fatty Acid
Days	1		
Moisture	0.889 **	1	
Free Fatty Acid	0.576 **	0.409	1

**Significant at $p \leq 0.01$

aluminium packaging at ambient temperature

Chia based sports drink developed by Bharadwaj and Saraswat (2019) had lower content of potassium (44.58mg) and higher sodium (101.75mg) per 200ml than the values obtained for functional food mix. The sodium (0.65%) and potassium (1.65%) content of sports drink from fermented whey (Abella *et al*., 2016) was lower compared to the results of present study. The developed functional food mix had higher sodium and potassium content than obtained in coconut water vinegar sports drink (Aziz *et al*., 2016) which had low sodium (0.07%) and potassium (0.02%).

Fluids and electrolytes are consumed or recommended to athletes, before, during and after exercise for a number of reasons. These reasons are generally to sustain total body water, as deficits (hypohydration) will increase cardiovascular, thermal strain and degrade aerobic performance. Sweat is produced as a result of vigorous activity and hot temperatures and it contains both water and electrolytes. Everyday water loss experienced by active athletes (4-10L) and sodium (3500-7000mg) during hot weather exposure might result in dehydration and electrolyte deficiencies. To re-establish normal total body water, both water and sodium must be replenished. If there is no need for recuperation, this can be accomplished through typical eating and drinking habits. However, if rapid recovery (24 hours) is sought or severe hypohydration (>5% body mass) is found, active fluid and electrolyte consumption should be encouraged to assist recovery for subsequent competition.

Quinoa, chia and grain amaranth are good source of antioxidants and minerals (Morales *et al*., 2021). Incorporation of milk solids improves the mineral value of calcium, sodium and potassium. Electrolytes plays an important role in regulating blood pressure, whereas calcium affects by relaxing arterial muscles within the vessel walls and thus helps in Vasodilation (Kostov and Halacheva, 2018).

Table 4 shows the correlation between moisture and free fatty acid of functional food mix during storage. Quality parameters like moisture and free fatty acid content of functional food mix stored at ambient condition in aluminium packaging material was analysed throughout the storage period (3 months). Increasing trend in moisture content of stored sample was observed (4.19 to 5.03%). This rise in moisture could be attributed to the hygroscopic nature of the packed food products. Moisture uptake is influenced by the nature of the packaging material and its porosity. The free fatty acid content in terms of per cent oleic acid increased from 0.09-0.13 per cent from zero day to 90 days. Simultaneously, FFA content was found to increase within the range, which is also attributed to increased moisture content. Moisture promotes hydrolytic rancidity development. A strong positive correlation was observed between moisture, free fatty acid and duration of storage (Table 4).

Amaranth and quinoa blend flour without preservatives could be stored well for 15 days (Shikha *et al.,* 2023) under freezer temperature of -18°C with lower scores for colour, taste, texture, aroma and overall acceptability but still had acceptance in the liked range. Sports energy gel from Chia seeds formulated by Lestari *et al.* (2020) showed that there was a significant difference in the pH and the total soluble solids. During storage, the color was getting darker, cloudy, froth and its acids as well as alcohol odor increased when stored at room temperature. This deleterious effect was not observed in drink prepared from functional food mix.

Correlation between sensory parameters and chemical constituents of functional food mix during storage is displayed in Table 5. Negative correlation was found between duration of storage and sensory parameters

TABLE 5

Correlation between sensory parameters, moisture and free fatty acid of functional food mix during storage#

Parameters	Appearance	Colour	Flavour	Taste	Texture	Overall Acceptability
Days	-0.598 **	-0.723 **	-0.766 **	-0.740 **	-0.649 **	-0.736 **
Moisture	-0.084	0.032	0.266	-0.201	0.000	-0.051
Free Fatty Acid	0.063	0.109	-0.411	-0.020	0.069	0.080

**Significant at $p \leq 0.01$

aluminium packaging at ambient temperature

viz., appearance, colour, flavor, taste, texture and overall acceptability. As the moisture content increased in functional food mix, the appearance, taste and overall acceptability scores reduced showing negative correlation. Similar trend was observed between free fatty acid, flavor and taste scores.

Two blends of weaning mix, A and B, were formulated with and without fishmeal respectively. The moisture in formulation A fluctuated from 6.85 per cent after 10 days, through 6.48 - 6.67 per cent after 30 days whilst formulation B exhibited an increase in moisture content after 10 days from 6.25-7.89 per cent. Both formulations were stable for 30 days (Amankwah *et al.,* 2009). The results were similar to the developed functional food mix stored in aluminum packaging material for 90 days in current study.

The microbial load of stored functional food mix is revealed in Table 6. The functional food mix was enumerated for the Total Bacterial Count (TBC) and *E.coli* monthly during the storage period of 3 months. The TBC increased significantly ($p<0.01$) (2.0 to 12.0 x 10^3 CFU/ g) whereas *E. coli* was not detected in the mix throughout the storage period. Dutta *et al.* (2018) revealed that microbial count for TPC, yeast and mold, *E. coli*, *S. aureus*, *B. cereus* and *Salmonella* was not detected in stored chia and quinoa flour substituted cookies. This indicates that microbial quality of cookies during storage of 60 days remained good and result was similar to the current study.

Highly accepted functional food mix was subjected to consumer acceptance among respondents (n=50). Table 7 represents the consumer's acceptability of highly accepted functional food mix using FACT (Food Action Rating Scale) scale to know the extent of likes and dislikes.

TABLE 6

Effect of storage# on microbial load of functional food mix

Days	TBC (x10^3 CFU/ g)	*E. coli*
0	2.0 ± 1.5	ND
30	7.0 ± 3.5	ND
60	9.0 ± 4.5	ND
90	12.0 ± 6.5	ND
S.Em. ±	3.90	-
CD (5 %)	8.71	-
F value	140.04 **	-

Values are expressed as Mean ± S.D., S.Em. ± Standard error of Mean : ** Significant at $p \leq 0.01$; # aluminium packaging at ambient temperature; ND - Not detected; TBC– Total Bacterial Count, CFU - Colony Forming Unit, x10^3– dilution, *E.coli - Escherichia coli*

The developed mix was reconstituted with water and served for 50 consumers to know their acceptability. Nine statements were provided to test the acceptability of the mix by the consumers. Among the different statements it was noticed that 32 per cent of the consumers opted 'would eat every opportunity they had'. Twenty six per cent of the consumers reported that they 'would eat this very often' and then 14 per cent respondents chosen 'would frequently eat this.'

Ten per cent respondents opted the statement *i.e.*, 'I like this and would eat it now and then' and 8 per cent respondents quoted that 'would eat if available

TABLE 7

Consumer acceptability of functional food mix using FACT scale

Opinion	Number of respondents	Percentage of total
I would eat every opportunity that I had	16	32
I would eat this very often	13	26
I would frequently eat this	7	14
I like this and would eat it now and then	5	10
I would eat if available but would not go out of my way	5	10
I don't like this but would eat this on an occasion	2	4
I would hardly ever eat this	2	4
I would eat this if there were no other food choices	0	0
I would eat this only if forced	0	0
Total	50	100

but would not go out of my way'. Four per cent preferred the statements 'I don't like this but would eat this on an occasion' and 'I would hardly ever eat this'. Only 2 per cent respondents have chosen 'I would eat this if there were no other food choices' This shows that the developed functional food mix was more satisfactory and acceptable among most of the respondents.

Consumer evaluation of millet flaked snack bar was measured based on acceptance with 60 respondents. This survey shows that 50 per cent of the consumers had excellent satisfaction levels, 46.7 per cent had rated very good on satisfaction levels, 1.7 per cent rated good and fair (Sohan *et al*., 2021).

The development of functional fod mix with quinoa, grain amaranth, finger millet, chia seeds and other ingredients garned high acceptability scores. The developed product can be incorporated in hostels/ mid-day meal progranne and food served for athlete persons as one of the complementary foods at low price. The functional food mix will improve athletic performance with holistic development. Hence, the developed functional food mix is one of the best alternatives to be chosen by the athletes.

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