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Development and Optimization of Sorghum-Flakes Based Nutribar for Physcio Chemical and Organoleptic Evaluation

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ABSTRACT: Nutribar is a highly nutritious snack food that can be prepared using variety of ingredients as cereals, legumes, oilseed and many more. Flakes based bar now becoming popular due to its nutritional value and ease of availability. The present study was conducted for standardize the procedure for preparation of sorghum flakes based nutribar and its optimization for sensory parameters and proximate composition. Nutribar formulated using sorghum flakes, rice flakes, sesame, peanut, jaggery and liquid glucose. While preparing confectionary product like nutribar the challenges occurs as selection of ingredient that will provide nutrition and results in acceptable taste. The findings revealed that nutribar with 20% sorghum flakes and 10% rice flakes were highly acceptable. Prepared bar was rectangular in shape, weight, length and width of all samples were found to be almost same. Further the proximate composition was assessed and found that protein content ranged from (13.51-14.42%), carbohydrate (62.51-63.59%) and crude fiber ranged from (5.61-6.34%).

Keywords: Nutribar, Sorghum flakes, Rice flakes, Organoleptic evaluation, Proximate composition.

INTRODUCTION

Nutribars are supplemental bars composed of cereals and other high-energy foods designed for people who need quick energy but don't have time to eat a meal. Nutribars provide energy from ingredients used to prepare it (Tiwari *et al.*, 2016). Protein deficiency in Indian diet can be supplemented by introducing some jaggery based cereal or pulse products by taking advantage of nutritional values of both (Gupta *et al.*, 2006).

Nutribar or granola bar is a highly nutritious snack food that can be prepared with a variety of ingredients. Cereal grains, rolled or flaked oat and barley, cereal grain germ part, honey, nuts, raisins, and other ingredients may be included. It is a baked or cooked product, and the mixture is constantly stirred during cooking to maintain its consistency. Prepared mixture is being transformed into a pressed bar shape for easier consumption. Nutritional value of bar can be altered by changing the ingredients. Making granola bars or nutribars from cereal grains is a worldwide practice. This is owed because the increasing popularity of cereals, which has been used in the formulation of various products due to their functional and nutraceutical properties. Combining cereals with other ingredients is nutritionally beneficial because it provides a balanced amount of protein, particularly sulphur-containing amino acids and lysine, which are otherwise deficient in most cereal grains (Ahmad *et al.*, 2017).

Cereal bars have a high fiber content and a low-fat content. It also includes a significant amount of major nutrients such as carbohydrates and proteins. Millets can be used in place of cereals because they contain large amounts of vitamins, phytochemicals, proteins and minerals like iron, magnesium, phosphorus, and potassium (Kavitha, 2018).

Nutritional bars are mostly made by using a base of grains, such as rice or oats proteins such as legumes. The bars can be fortified with a variety of vitamins, minerals, herbs, and other nutrients or energy sources. Nutritional bar gains the customer attention due to their nutritional quality and ease of availability to meet the energy requirements between meals (Gonzalez and Draganchuk 2003).

Cereal based bars are a concentrated carbohydrate source that raises blood sugar levels and aids in glycogen replenishment. So, cereals can be replaced by millets, which are high in carbohydrate, fiber, lipids, and proteins, can be used as a pre- and post-competitive meal to ensure slow digestion and maximize muscle and glycogen stores (Vahini, 2018).

Nutribar can be consumed as a meal part (as part of breakfast, lunch, or dinner or as a snack between meals), as a dessert (after lunch or dinner), or as a meal replacement (breakfast, lunch, or dinner). People involved in sports and dieting have increased their demand for high-protein snack bars in recent years as meal substitutes. Because of their high protein content and other nutritionally beneficial ingredients, these snack bars are a healthier alternative to traditional snacks (Constantin and Istrati 2018).

Sorghum (*Sorghum bicolor* L.) is a major cereal crop grown in Africa and Asia's semi-arid tropics due to its drought tolerance. It is a staple food crop grown on a large scale by farmers in these areas for human nutrition (FAO, 2011).

It is obvious that using sorghum alone or in combination with other cereals, legumes, oilseeds, and so on in the development of value-added foods may result in their widespread use among non-traditional sorghum consumers. This will also improve the status of sorghum among cereals in the economic empowerment of millet growers and contribute to public health (Verma *et al.*, 2018).

Sorghum is usually recommended as a safe food for celiac patients, who cannot tolerate the protein sequences found in wheat gluten's gliadins and glutenins. Flaking, puffing, shredding and granule formation in wheat, corn and rice are the processes used in the preparation of ready-to-eat cereals. Cereal flakes are a popular breakfast item that is currently made primarily of corn. Sorghum flakes could be produced through appropriate processing (Chavan *et al.*, 2015).

Sorghum flakes could be toasted or expanded by hot air or sand to serve as a snack or supplementary food for obese and calorie-conscious individuals. After toasting, they can be easily used as ingredients in muesli and other products (Divya *et al.*, 2017).

Flaked or beaten rice is a traditional rice product popular in India and other rice consuming nations. This is consumed as a snack after roasting, frying, or seasoning, or as a breakfast item. Various rice-based, ready-to-eat food products are available at the market. Rice is a gluten-free diet that can be used as a good substitute for celiac patients (Kumar *et al.*, 2018).

Sesame seeds are source of carbohydrates, proteins, fats, fibers and minerals. It is rich source of oil from its half of the chemical component. It gives same amount of the amino acids, monosaturated fatty acids, polyunsaturated fatty acids. It has antioxidant activity, which has a significant effect on lowering blood pressure, vessel degenerative changes, and preventing chronic diseases (Aglave, 2018).

Sesame is a good source of iron, magnesium, manganese, copper, and calcium, as well as important vitamins B1 and E (Najeeb *et al.*, 2012).

The groundnut or peanut is an important legume crop in tropical and semiarid tropical nations, where it is a key source of edible oil and protein. Groundnut kernels have 47-53% oil and a protein content of 25-36% (Prasad *et al.*, 2011).

Peanuts are regarded as an important source of nutrition. Nutrition is essential to the growth and energy intake of living organisms. Peanuts are high in calories and abundant in nutrients, minerals, antioxidants, and vitamins, all of which are necessary for good health. All of these biomolecules are critical for delivering necessary nutrients to the human body and maintaining normal health (Settaluri *et al.*, 2012).

The objective of this research was to develop and optimize nutribar using sorghum flakes with other easily available ingredients as rice flakes, sesame and peanut that would provide balanced nutrients, required for various body functions.

MATERIAL AND METHOD

Procurement of selected ingredients. Raw material like sorghum flakes, rice flakes, sesame seed, peanut, liquid glucose and butter etc. were purchased from local market of Parbhani.

Pre-processing of ingredients. Sorghum flakes, rice flakes sesame seed were roasted separated in pan on low flame at 120ºC. Peanut splits were prepared according to the procedure given below.

Preparation of peanut splits

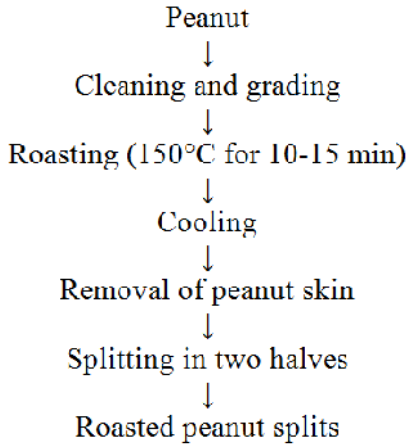

Fig. 1. Preparation of roasted peanut splits.

Preparation of binder syrup. The binder syrup was prepared using jaggery, liquid glucose, butter and water. In sauce pan add butter, after melting of butter crushed jaggery and water added and heated. Simultaneously check and maintained 85°Brix TSS of syrup. Add glucose syrup added in prepared syrup.

Preparation of nutribar. Dry ingredients- roasted sorghum flakes, rice flakes, sesame seed and peanut splits were added in binder syrup and mixed properly, obtained mixture transferred to greased tray, hand pressed and cut in rectangular shape. The tray kept in oven for baking at 110°C for 15 min. After baking tray left for cooling at ambient temperature. The nutribars removed from tray then packed in aluminum foil pouches and kept at ambient temperature.

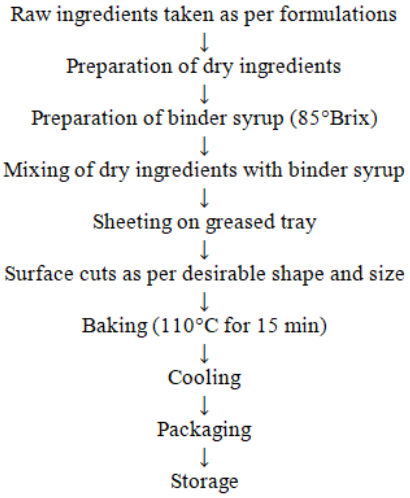

Fig. 2. Preparation of nutribar.

Formulation for preparation of nutribar. Sorghum flakes based nutribar was prepared with varying the composition of ingredients as rice flakes and sorghum flakes. The proportion of sesame seed, peanut, jaggery, liquid glucose, butter and water was kept constant. The formulation for samples is presented in Table 1.

Organoleptic evaluation of prepared nutribar. Organoleptic evaluation of developed sorghum based nutribar carried out by using 9-point hedonic scale with 15 semi-trained panel members with respect to different quality attributes such as colour, taste, flavour, texture and overall acceptability.

Proximate analysis of nutribar. Proximate analysis of selected sample on basis of organoleptic evaluation were carried out for determination of moisture, protein, fat, carbohydrate, crude fiber and ash (AOAC 2005).

Table 1: Formulation for preparation of nutribar.

Ingredient(g)	T_0	T_1	T_2	T_3
Sorghum flakes	0	10	20	30
Rice flakes	30	20	10	0
Sesame	10	10	10	10
Peanut	10	10	10	10
Jaggery	30	30	30	30
Liquid glucose	10	10	10	10
Butter	2	2	2	2
Water	10	10	10	10

T_0 – Without addition of sorghum flakes; T_1 – With addition of 10% sorghum flakes
T_2 – With addition of 20% sorghum flakes; T_3 - With addition of 10% sorghum flakes

RESULT AND DISCUSSION

Physical parameters of nutribar. Physical properties of prepared nutribar were characterized by their shape, length, width and weight. The physical properties of sorghum-jaggery nutribar were studied and results obtained are presented in Table 2.

Table 2: Physical parameters of nutribar.

Formulation	Length	Width	Weight	Shape
T_0	6.1	2.5	28.3	Rectangular
T_1	6.2	2.6	28.6	Rectangular
T_2	6.2	2.6	28.7	Rectangular
T_3	6.0	2.5	29.0	Rectangular

*Each value is average of three determinations

It can be observed from the above table that weights of different formulations of nutribar were slightly varied. The weight of the sample T_0, T_1, T_2 and T_3 were observed in the range 28-29 g. The length of sample T_0, T_1, T_2 and T_3 were found as 6.1, 6.2, 6.2 and 6.0 cm respectively. The width of sample T_0, T_1, T_2 and T_3 were found as 2.5, 2.6, 2.6 and 2.5 cm respectively. The shape of all samples of nutribar were found to be similar i.e., rectangular. A slight difference was observed in weight and length of prepared sorghum based nutribar. The physical parameters analysed for developed nutribar was in line with (Ghatge *et al.*, 2016).

Organoleptic evaluation of nutribar. Organoleptic evaluation of prepared product was carried out and selected highest scored sample on basis of 9-point hedonic scale.

Various parameters as colour, taste, texture, flavour and overall acceptability. The colour serves as a preliminary attribute for food acceptance and signifies the suitability for consumption. T_0 sample scored 7.1 whereas T_2 obtained highest score 8.7 for colour. Different samples obtained various scores for colour due to ingredient variance.

It is revealed from Fig. 3 that the taste of T_2 secured the highest score (8.5) followed by T_1 (7.7) and T_3 (7.5), whereas control (T_0) secured minimum score (7.4) for taste. Sample T_2 obtained highest score for texture followed by T_0 and T_1, whereas T_3 sample scored minimum for textural parameters. Addition of sorghum flakes significantly effects on texture of nutribar. T_2 sample scored highest for flavour and overall acceptability (8.8). On the basis of sensory evaluation sample T_2 was selected and further analysis was carried out. Organoleptic quality evaluation of optimized nutrient bar was carried out by (Srivastava and Mishra 2016) and selected best formulation.

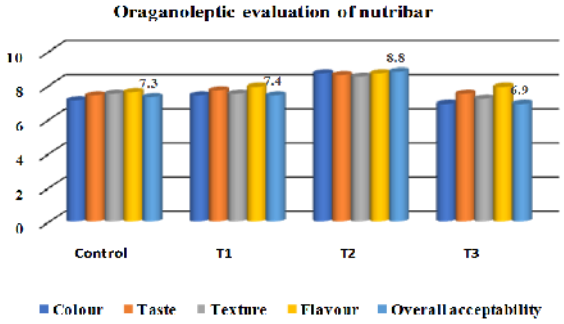

Fig. 3. Oraganoleptic evaluation of nutribar.

Proximate composition of nutribar. The moisture content in prepared nutribar found to be 9.40 % in T_0 sample, it is observed that incorporating sorghum flakes reduces moisture content in final product. Table 3 revealed that highest protein content found in T_3 14.42% followed by T_2 and T_1. Increasing protein content level found in sorghum based cereal bar by Verma *et al.* (2018). Fat content of different formulations found to be almost similar, whereas control sample having highest fat 8.71%. Developed nutribar is good source of carbohydrates, T_3 having highest 63.59% carbohydrates followed by T_2 and T_1.

Crude fiber content increased significantly wit increasing sorghum flakes percentage and found to be highest in T_3 sample 6.34%. The results for crude fiber content are in similar agreement with findings revealed by Verma *et al.* (2018) who prepared iron rich sorghum based cereal bar.

Table 3: Proximate composition of nutribar.

Formulation	Proximate composition (%)					
	Moisture	Protein	Fat	Carbohydrate	Crude fiber	Ash
Control	9.40	13.51	8.71	62.51	5.61	1.81
T_1	9.12	13.64	8.69	62.83	5.66	1.83
T2	8.43	14.33	8.55	63.04	6.23	2.21
T3	8.22	14.42	8.51	63.59	6.34	2.26

*Each value is average of three determinations

CONCLUSION

The study concluded that different formulations of sorghum flakes based nutribar were organoleptically acceptable, in which T_2 sample scored highest for overall acceptability. The developed nutribar was found to be high in carbohydrates, protein and fiber with good amount of fat. Hence, it is recommended that sorghum flakes based nutribars are better in terms of sensory attributes, rich in nutrients and techno-economically feasible which can be explored on commercial level.

FUTURE SCOPE

Development of nutribar using low cost ingredients which will provide better nutrition to people is scope for researchers. Millet based nutribars are not available on large scale on a commercial level that can be done in the coming future.

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Conflict of Interest. None.

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