

DEVELOPMENT AND EVALUATION OF VALUE ADDED MILLET BASED NUTRI-BAR

¹K.LAKSHMI and ²N.ANUSHA

¹Assistant Professor and ²Research Assistant

¹Department of Food Science and Nutrition,

¹College of Community Science, Acharya N. G. Ranga Agricultural University, Lam, Guntur

ABSTRACT - The study was carried out to develop value added millet based nutri-bars and to evaluate the organoleptic attributes such as colour, appearance, flavour, taste, texture and overall acceptability. In this study seven varieties of millet based value added nutri-bars were developed, which were Millet – Germinated wheat Nutri-bar, Millet- Chocolate Nutri-bar, Millet-Dates Nutri-bar, Millet- Nuts Nutri-bar, Millet-Seeds Nutri-bar, Millet-Oats Nutri-bar, Millet- Barley Nutri-bar. The bars were evaluated for obtaining sensory scores using 9 points hedonic rating scale by a panel of semi-trained judges. All the seven types of nutri-bars were highly acceptable in terms of sensory properties. The storage conditions of the bars were well maintained for one month at room temperature when packed in polypropylene pouches. The developed value added millet nutri-bars were found to be highly nutritious and cost effective without containing any preservatives and met one-third of RDA. The nutri-bars serve as ideal snacks for different age groups and help to overcome nutritional deficiencies.

INDEX TERMS: Nutri-bar, Millet, Value addition, Organoleptic

I. INTRODUCTION

Millets are a group of highly variable small-seeded grasses, widely grown around the world as cereal crops or grains for fodder and human food. Millets are important crops in the semi-arid tropics of Asia and Africa with 97 percent of millet production in developing countries. Millets are the cereal crops which are available in different sizes and color which vary with the variety of crop. The millets are divided into two main categories as major and minor millets. Major millets are pearl millet (*Pennisetum glaucum*), foxtail millet (*Setaria italica*), proso millet (*Panicum miliaceum*) and finger millet (*Eleusine coracana*). Minor millets are kodo millet (*Paspalum scrobiculatum*), Barnyard millet (*Echinochloa esculenta*) and little millet (*Panicum miliare*). Millets are recommended for well-being of infants, lactating mothers, elderly and convalescents owing to their high fiber and protein contents. The millets are preferred as dietary foods for people with diabetes and cardiovascular diseases[2]. Millets are also rich in phytochemicals including phytic acid which is believed to lower cholesterol and phytate which is associated with reduced cancer risk[6].

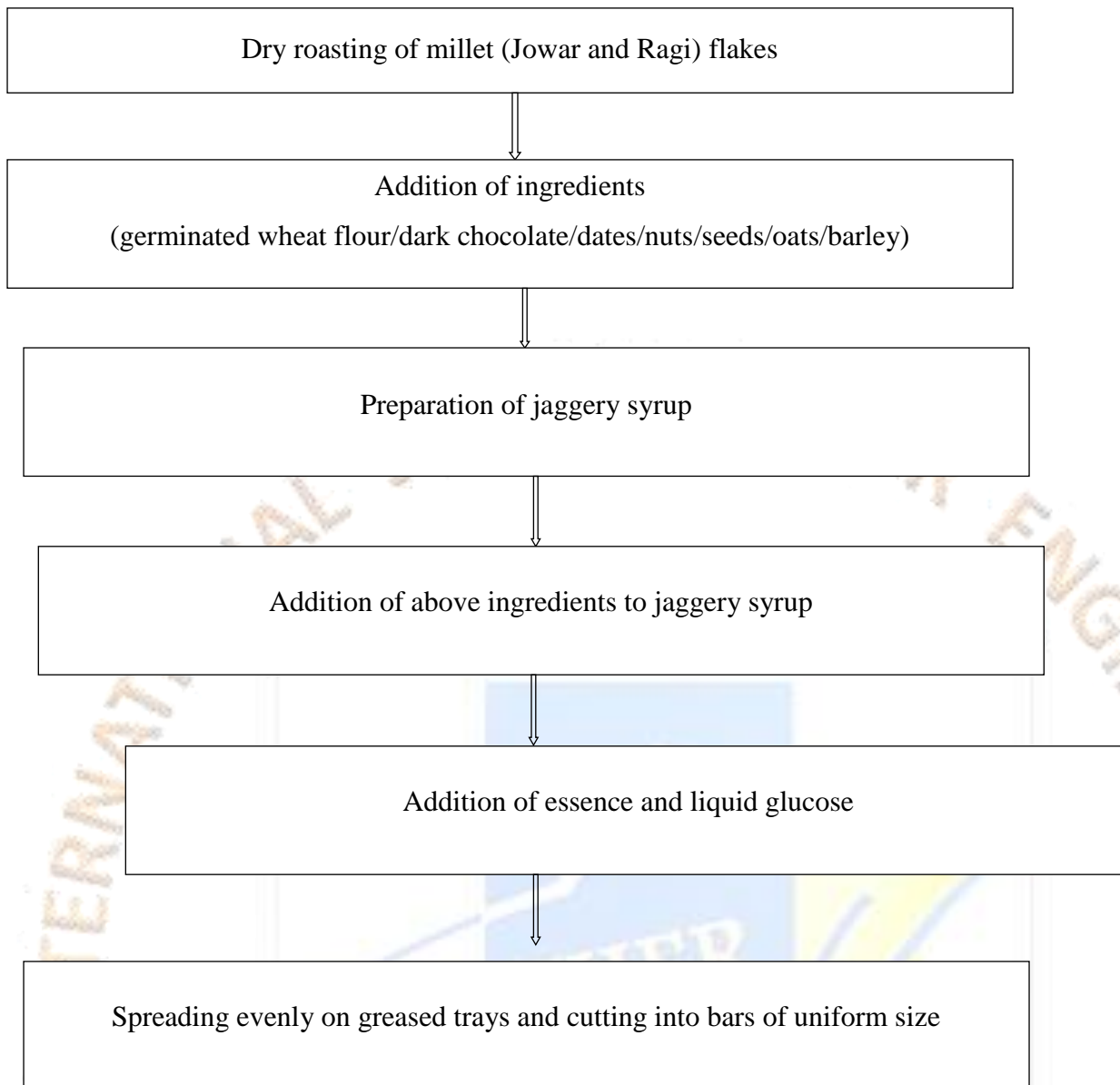
Millet consumption has been shown to improve insulin sensitivity because of the high fiber content, which lowers the glycemic index of the diet. The magnesium and vitamin E contents of millets are also beneficial in maintaining the blood glucose at normal levels. Another advantage of millets is that they do not contain any allergens such as gluten, which is found in wheat. Thus, millets can be recommended for people with gluten allergy. These days, the nutritional advantages of millets are being highly recognized and the demand for millets is increasing. The consumers are looking forward for value added products from millets. Some of the value added products that can be produced from primary processing of millets include dehulled grain, flour, semolina and flakes. These value added products can be incorporated as the major ingredient in several secondary processed products which include breakfast recipes such as *idli*, *dosa*, *upma*, *vada*, noodles; bakery items such as, biscuits, bread, buns and cakes; and ready-to-eat snacks such as *muruku*, *chegodi*, *namakpara*, *chekkalu*, pops, *chudwa*, nutri-bars, etc. Nutri bars are supplementary bars containing cereals and other high energy foods targeted at people who require quick energy. Nutri-Bar is a convenient and healthy ready-to-eat food which supplies balanced nutrients (carbohydrate protein, fat, mineral, vitamins and calories) and abates hunger[5]. A Nutri-bar is a product containing one or more vitamins recommended for consumption by pregnant, lactating women or women of child bearing potential, in an amount that is effective for enhancing the nutrition[4]. Owing to its nutritional composition, nutri-bar is a wholesome snack for children and for all other age groups meets the 1/3rd of days nutrient requirement. The present study was carried out to standardize a multi millet based nutri-bar that can be recommended as a snack containing protein, fiber and micronutrients for all age groups.

II. MATERIALS AND METHODS

Preparation of Nutribars

Seven varieties of millet based value added nutribars in combination with other ingredients having nutritional significance were standardized in the present study. Jowar and Ragi are the two main millets which were used in the form of flakes to add crunchiness to the bars along with ingredients like nuts, seeds, dates and germinated wheat in the preparation of millet based nutribars. The materials were procured from local organic stores.

Jowar and ragi flakes were dry roasted to which ingredients like germinated wheat flour, dark chocolate, dates, nuts, seeds, oats or barley were added. Jaggery syrup of soft ball consistency at 112 °C – 116°C temperature was prepared. To the jaggery syrup, all the ingredients were added along with essence and liquid glucose and mixed well. The mix was then spread evenly on greased tray and cut into equal sized bars of 30 g each. The same procedure was followed for preparation of all the bars with varying proportions and combinations of ingredients. The method of preparation of the bars and the proportion of ingredients used in each type of bar are given in Figure 1 and Table 1.



Sensory evaluation

The nutri-bars were subjected to sensory evaluation initially and after a period of one month. The bars were packed in polypropylene pouches during the storage period and were stored at room temperature. The sensory evaluation was done by a semi-trained panel of 25 judges, both initially and after one month of storage. A nine-point hedonic scale for used for obtaining the sensory scores, with a score of 9 for “Like extremely” to a score of 1 for “Dislike extremely”. The bars were evaluated for appearance, colour, texture, flavour, taste and overall acceptability and the scores were obtained.

Nutrient Composition

The nutrient composition of all the seven nutri-bars was computed from the Indian Food Composition Tables[1].

Statistical analysis

The scores obtained from sensory evaluation studies were subjected to Analysis of Variance to test for statistical significance in difference in scores by considering significance at $p < 0.05$ for the scores that were obtained initially and after a period of one month of storage.

III. RESULTS AND DISCUSSION

The method of preparation of seven different types of nutribars was standardized at laboratory level after many trials with combinations of the ingredients and their quantities in each type of bar. The standardized quantity of ingredients required for preparation of nutribars is presented in Table 1.





Table 1: Quantity of ingredients required for preparation of millet nutribars (per 500 g)

S. No	Ingredients	Quantity ingredients for preparation of millet nutribars (in grams)						
		Millet-Dates Nutribar	Millet-Nuts Nutribar	Millet-Seeds Nutribar	Millet-Oats Nutribar	Millet-Barley Nutribar	Millet-Chocolate Nutribar	Millet-Germinated Wheat Nutribar
1.	Ragi flakes	100	138	94	68	50	125	75
2.	Jowar flakes	200	138	94	45	50	50	75
3.	Corn flakes	-	15	48	18	20	20	-
4.	Jaggery	-	139	180	160	150	-	250
5.	Dates	150	-	-	-	-	125	-
6.	Oats	-	-	-	132	50	-	-
7.	Barley	-	-	-	-	150	-	-
8.	Chocolate	-	-	-	-	-	150	-
9.	Germinated	-	-	-	-	-	-	50

	Wheat Flour							
10.	Almonds	20	35	-	17	10	10	15
11.	Pumpkin seeds	20	-	28	17	-	10	10
12.	Flax seeds	10	-	28	17	-	10	15
13.	Groundnuts	-	35	-	26	20	-	-
14.	Sesame seeds	-	-	28	-	-	-	10
15.	Liquid glucose	As required	As required	As required	As required	As required	As required	As required
16.	Vanilla essence	As required	As required	As required	As required	As required	As required	As required

The mean sensory evaluation scores that were obtained for the seven types of bars initially are presented in Table 2.

Table 2: Mean scores of sensory evaluation of the Nutribars

S.No	Name of the product	Mean scores					
		Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
1	Millets-Germinated wheat nutribar	7.7±1.05	7.9±0.6	7.2±1.1	7.3±1.0	7.4±0.9	7.4±0.9
2	Millets-Chocolate nutribar	7.7±1.1	7.6±1.03	7.3±1.0	7.5±1.04	7.3±0.74	7.5±1.08
3	Millets-Dates nutribar	7.7±1.06	7.8±0.9	7.7±1.0	8.0±0.4	7.7±1.02	7.9±1.05
4	Millets-Nuts nutribar	8.4±0.8	8.0±0.4	7.8±0.9	8.0±0.5	8.2±0.7	8.2±0.7
5	Millets-Seeds nutribar	8.0±0.4	8.2±0.7	7.7±1.1	7.7±0.92	8.1±0.62	8.1±0.6
6	Millets-Oats nutribar	7.9±0.9	8.4±0.8	8.2±0.7	8.1±0.6	8.2±0.7	8.4±0.4
7	Millets-Barley nutribar	8.3±0.4	8.3±0.5	7.9±1.05	8.0±0.4	8.0±0.3	8.3±0.5

The scores presented in Table 2 represent the values obtained on a 9 point scale. The mean scores of sensory evaluation obtained initially for the bars were 7.7 to 8.4 for appearance, 7.6 to 8.4 for colour, 7.2 to 8.2 for texture, 7.3 to 8.1 for flavour, 7.3 to 8.2 for taste and 7.4 to 8.4 for overall acceptability. These scores indicate that the products are liked moderately to very much by the panel members. Though the overall acceptability of nutribars prepared in combination with germinated wheat flour, chocolate and dates were scored a little lower when compared to other bars, the difference was not significant ($P < 0.05$). Padmashree *et al* (2018) observed significant changes in textural properties after 3 months of storage. The

bars became hard after 3 months and affected the sensory properties. Thus it can be said that all the seven types of Nutribars that were developed through the present study were equally and highly acceptable for all their sensory properties.

The mean scores of sensory evaluation of the nutribars that were stored for a period of one month in polypropylene pouches at room temperature are presented in Table 3.

Table 3. Mean scores of sensory evaluation of stored nutribars

S.No	Name of the product	Mean scores					Overall acceptability
		Appearance	Colour	Texture	Flavour	Taste	
1	Millets-Germinated wheat nutri bar	7.5±1.04	7.5±1.0	7.0±0.8	7.0±0.8	7.2±0.5	7.6±0.9
2	Millets-Chocolate nutri bar	7.3±0.7	7.0±0.8	7.2±0.5	6.9±1.05	7.0±0.8	7.1±0.9
3	Millets-Dates nutri bar	7.3±0.6	7.5±1.0	7.1±0.2	7.0±0.1	6.8±1.0	7.0±0.8
4	Millets-Nuts nutri bar	8.0±0.8	7.8±0.6	7.8±0.9	7.5±0.3	7.4±0.4	8.0±0.7
5	Millets-Seeds nutri bar	8.1±1.0	7.9±0.5	7.7±0.5	7.3±0.9	7.1±0.8	7.8±0.6
6	Millets-Oats nutri bar	7.9±1.0	8.0±0.9	8.2±0.5	7.6±1.0	7.8±0.9	8.0±0.7
7	Millets-Barley nutri bar	8.3±0.6	7.9±1.0	7.9±1.05	7.7±1.02	7.6±1.0	7.9±1.0

The scores presented in Table 3 represent the values obtained on a 9 point scale. The mean scores of sensory evaluation obtained for the bars packed in polypropylene pouches and stored at room temperature were 7.3 to 8.3 for appearance, 7.0 to 8.0 for colour, 7.0 to 8.2 for texture, 6.9 to 7.7 for flavour, 6.8 to 7.8 for taste and 7.0 to 8.0 for overall acceptability. These scores indicate that there is a decrease in the mean sensory scores of stored nutribars for all the characteristics. The bars which had chocolate and dates seemed to have lost their freshness for flavour and taste during storage. However, the decrease in scores was non-significant ($p < 0.05$) indicating that the nutribars were equally acceptable for their sensory properties even after one month of storage. Thus, the Nutribars that were prepared by incorporating germinated wheat, chocolate, dates, nuts, seeds, oats and barley could be stored well for one month without any significant change in sensory attributes after storage.

Padmashree *et al* (2018) have observed significant differences ($p < 0.05$) in the sensory properties during storage of choco quinoa nutribars. Highest values for colour, aroma and taste were found to be 8.07, 8.10 and 8.20 respectively at zero day of storage and least value was observed in samples stored in Polypropylene films during 9 months of storage at 37°C on a 9 point Hedonic scale. However, between the packaging material and temperature of storage, colour, aroma and taste parameters in bar did not vary significantly ($p > 0.05$) at each interval of time.

The nutritive values of all the seven types of millet nutribars that were standardized in the present study are presented for 100g of the bars in Table 4.

Table 4. Nutritive value of Millet Nutribars per 100 g

S.No	Name of the product	Energy (Kcal)	Protein (g)	Fat (g)	Carbohydrates (g)	Fibre (g)	Iron (mg)	Calcium (mg)
1	Millets-Germinated wheat nutri bar	358	8	6	66	8	5	226
2	Millets-Chocolate nutri bar	376	7	10	63	8	4	165
3	Millets-Dates nutri bar	344	8	6	62	9	3	105
4	Millets-Nuts nutri bar	373	9	9	62	8	5	162
5	Millets-Seeds nutri bar	375	8	8	66	7	8	205
6	Millets-Oats nutri bar	390	11	11	61	7	2	122
7	Millets-Barley nutri bar	351	10	5	66	10	4	81.5

The data presented in Table 4 shows that the energy value of the bars per 100 g ranges from 344 to 390 kcals. The bars provide 8 to 11 g of protein per 100 g. The bars also provide significant quantity of fiber ranging from 7 to 10 g per 100 g. The iron and calcium contents of the bars ranged from 2 to 8 mg and 81 to 226 mg respectively for 100 g of the bars.

The functions ingredients that were added to the bars along with jowar and ragi contributed to enhanced nutritive value of the bars.

While the market samples of nutribars come in serving sizes of 25 g to 120 g, the serving size of the nutribar developed in the present study is fixed at 30 g per bar so that one serving of the bar is an ideal snack for children and two servings, making 60 g, will be suitable for pregnant and lactating women to meet the nutritional needs in terms of protein and fiber.

IV. CONCLUSION

The present study concludes that all the seven types of nutribars that were prepared using millets in combination with other ingredients of nutritional significance were highly acceptable in terms of sensory properties. The bars could be stored well for one month without change in sensory properties when packed in polypropylene pouches and held at room temperature. The bars are rich sources of energy, protein and fiber. These Millet nutribars are ideal for use as snacks for pregnant women, lactating mothers and children of different age groups to overcome their nutritional deficiencies

V. REFERENCES

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