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**Keywords:** Millets; Popping; Nutribars; Nutrients; Sensory; Quality parameters

## Introduction

Indian population is 1,410,881,069 according to the world meter out of which 25% are below the poverty line and 75% are above the poverty line (Niti Aayog data), and the rural population constitutes 64% (India-Rural population-2022 data forecast) wherein the consumption of millets is more apart from the consumption of paddy and wheat among the population.

Millets are small-seeded cereal grains that have been grown for ages in infertile, drought conditions. The major cultivators of millets like jowar, bajra, and ragi are seen to be predominantly harvested in geographical areas like Maharashtra, Rajasthan, and Karnataka and a portion of minor millets are cultivated in Madhya Pradesh and Uttarakhand state [1]. Millets have also been recognized as a crucial substitute for cereal crops like paddy and wheat which are predominantly consumed by the population to overcome the worldwide food shortage and increasing demands of the population in both developing and developed countries [2]. Nutritionally, millets are favorable in terms of proteins, fat, and mineral content, when compared with other cereal grains [3] and due to nutraceutical properties like management of weight, controlling blood sugar levels among the population [4], have gained a lot of attention in urban areas in recent times. The coarse texture, high fiber content, and typical flavor which can be unacceptable to the population, ready-to-eat products from millets have gained momentum. Fermented foods like dosa and idli,

## Materials and Method

### Sample procurement

Little millet intact with husk was procured from a local farmer Chitradurga district, Karnataka, India. Pearl millet, nger millet, honey, palm jaggery, brown sugar, and dates were procured from the local market of Mysore, Karnataka, India. Popping was carried out by the sand roasting method in a traditional setup.

### Preparation of nutribars

In a pan, the popped millets were roasted for two minutes. The mixture of honey and dates were added to bind ingredients in the case of the standard nutribars while in the experimental nutribars the different sweeteners were made to a syrup consistency and added in the place of honey. Then the mixture was transferred to a mold pressed and kept in the freezer to set for thirty minutes. The mass was cut into bars and baked in a preheated at 150°C for thirty minutes and cooled at room temperature.

### Nutrient analysis

#### Principle nutrients

The sample was homogenized into a fine powder using a mixer grinder and were used for the analysis of nutrient and antinutrient parameters. Nutrient analysis was carried out using AOAC method [5]. Moisture content was determined gravimetrically after uniformly drying the test portion in a preheated oven (AOAC 934.01.). Ash content was determined after reducing the test portion into the inorganic matter in muffle furnace (AOAC 942.05). Total fat content

was determined in the petroleum ether extract of the raw and popped millet our samples using the classic SoxPlus apparatus (AOAC 963.15) after moisture removal. Total nitrogen content was determined by titrimetry method using Kjeldahl instrument and multiplied with a conversion factor of 6.25 to obtain the protein content (Jones,2018). Insoluble dietary fiber (IDF) and soluble dietary fiber (SDF) were quantified after enzymatic digestion of test the portion by Hellendoorns method [6]. The carbohydrate content was calculated by the difference method.

#### Minerals

Raw and popped millet our was weighed 1g in duplicate in silica crucibles for ashing. The ash of the samples were digested by adding 5ml of Hcl and 1 ml of distilled water were added and the sample is digested in a hot plate at 200°C for 10 minutes. The clear residue thus obtained was diluted with double distilled water and minerals were

Sample	Sample stored at room temperature (27°C)			Sample stored in refrigeration (5°C)		
	Free fatty acids (%)					
	0th day	15th day	30th day	0th day	15th day	30th day
Honey nutribars	Nil	0.32	0.74	Nil	Nil	Nil
Brown sugar nutribars	Nil	0.56	1	Nil	Nil	Nil
Jaggrey nutribars	Nil	0.48	0.96	Nil	Nil	Nil
Palm jaggrey nutribars	Nil	0.24	0.8	Nil	Nil	Nil
	Preoxide Value					
	0th day	15th day	30th day	0th day	15th day	30th day

### Free fatty acids estimation

Free fatty acids of stored products on 0,15, and 30th day was determined by the standard method of [8]

### Peroxide value

Peroxide value of stored products on 0, 15 and 30th day was determined by the method of [8]

### Microbial analysis

The microbial load of the developed products was enumerated in terms of total viable count on 15th and 30th day of storage as per the method described by American Public Health Association (APHA,1984).

### Statistical analysis

The results were subjected to two-way variance (ANOVA) using the Statistical Package for Social Science (SPSS) version 20

## Results and Discussion

### Nutrient analysis

A significant variation in moisture, fat, protein, carbohydrate, dietary fiber, calcium, and iron were observed among the different varieties of nutribars (p < 0.05) (Table-1). The moisture content in the case of jaggery nutribars was highest (9.87%) and lowest in brown sugar nutribars (5.6%). The fat was highest in the case of nutribars prepared out of honey with 2.43g/100g as the quantity of dates used was more when compared with other nutribars. Protein content was found to be

highest in case of jaggery with 1.97g/100g. The carbohydrates content was highest in case of palm jaggery nutribars with 2.37g/100g. The ash content was highest in the case of palm jaggery nutribars with 2.01g/100g. This significant difference in the nutrients might be due to the difference in the nutrient composition of the different sweeteners. Such a variation in the nutritional status in accordance with nutrient were observed by [9] wherein they reported an increase in nutrient content when the sugar was replaced with jaggery in the preparation of muns. Calcium content was highest in case of palm jaggery nutribars with 114.00 mg/100g as the palm jaggery is rich in calcium content.

The iron content was highest in case of brown sugar nutribar with 7.07 mg/100g. Similar results were reported by [10] where there was significant difference between the two types of ladoos prepared using popped millet. The calcium, phosphorous, and iron content was higher in type-1 ladoos i.e., 65.51,168.26, 4.89 and 0.49 mg/100g, respectively when compared with type-2 ladoos. [11] reported similar nutrient content in the crunchy bars developed using popped pearl millet wherein it consisted of 82.3g/100g carbohydrate,10.8g/100g protein and 4.3g/100g fat content. The total ash content of the nutri bar was 1.39g/100g. The calcium, phosphorus, iron and zinc content were found to be 58.7,215.6, 5.13 and 3.17 mg/100g, respectively.

### Sensory evaluation

The sensory attributes of the nutribars were tested in terms of preferences of the panelists (Graph-1). The quality standards were tested against the properties like appearance, sweetness, flavor, mouth-feel, and overall acceptability in nutribars developed using various sweeteners, the maximum panelist found jaggery (74%) and palm jaggery (61%) nutribars appealing due to bright glossy colour. The

brown sugar and palm jaggery nutribars were ranked high (100%) for the pleasant sweetness while nutribars developed using honey and jaggery were unpleasant to (6%) of the panelist. The mouthfeel of jaggery nutribars was found to be chewy (74%) due to the incomplete crystallization of the sugars present while palm jaggery, brown sugar and honey nutribars had gritty desirable texture (58%, 48%, and 52% respectively). The overall acceptability was rated delicious for both brown sugar and palm jaggery nutribars (55% and 45% respectively) due to their pleasant sweetness, flavour and gritty texture which are the characteristic features, in spite of having appealing appearance, pleasant sweetness, and flavour jaggery nutribars were only palatable (61%) to the panelist due to the soggy texture of the nutribars. On conducting the sensory evaluation, the brown sugar nutribars were rated the highest followed by palm jaggery nutribars which can be selected as the best and can be further popularized amongst the population. There was no significant change in the sensory attributes when evaluated from 0th to 30 days storage conditions. Similar studies were conducted by [12] on the sensory evaluation of chapati, biscuit, sattu and noodles prepared by using mixed flours in different proportions, and the best was selected on the basis of the sensory scores of products prepared and findings used for further study.

#### **Storage stability**

The free fatty acid content increased gradually from 0th day to