

# Formulation, Standardization and Quality - An Analysis of Fibre Bites

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## Abstract

Rice bran is one of the important by-products of the rice milling process that contains various bioactive compounds<sup>1</sup>. Rice bran ingredients have been widely used to increase the functionality of some foods and as a functional component to enhance the properties of foods against chronic disease<sup>2</sup>. Rice bran has the highest amount of  $\gamma$ -oryzanol than other parts of the rice kernel and is mostly used for oil extraction or animal feed. So, these compounds can be extracted and utilized in many products with value addition<sup>3</sup>. Cereal bars have gained acceptance among consumers as they are good in terms of nutritional composition, and contribute an appreciable amount of dietary fiber<sup>4</sup>. Hence in the present study, fibre bites were formulated with rice bran in different proportions and the physico-chemical properties, nutrients, antioxidant activity and shelf life were determined. Results showed that fibre bites with 10% rice bran were highly acceptable. The dietary fibre content of fibre bites was higher. The fibre bites could be stored for a period of seven days.

**Keywords:** Cereal Bars, Dietary Fiber, Physicochemical Properties of Rice Bran, Sensory Evaluation

## 1. Introduction

Rice (*Oryza sativa* L.) supports a large number of populations over millennia compared to other crops as it was domesticated from 8,000 to 10,000 years ago<sup>5</sup>. Currently, rice is one of the important cereal crops in Asia consumed by nearly half of the world's population as their daily staple food<sup>6</sup>. Rice as harvested from the field is called paddy. In the rice milling process, the outermost layer, the hull, is removed first to produce brown rice<sup>7</sup>.

Nowadays, by-products from the rice milling process have started to gain more attention as a functional food because of their high amount of fibre, minerals and vitamins, which might be able to reduce cholesterol levels and have other functional activities<sup>8</sup>.

The total dietary fibre content of rice bran ranges from 20 to 27%, with less than 2% as soluble dietary fiber<sup>9</sup>. Consumption of these rice bran-containing foods could

slow down glucose uptake and display significant health benefits<sup>10</sup>.

The request for a healthier life associated with rapid and practical ways of eating has led to a continuous search for alternative products that can offer both convenience and nutritional balance. Amongst these foods, it is included cereal bars with their different types, flavours and nutritional compositions, are among the products which had higher growth in the food sector in recent years<sup>11</sup>. The cereal bars can offer high concentrations of fibres, vitamins and minerals that are considered essential for good organic functioning and thus preventing and controlling certain pathologies such as obesity, cancer, and diabetes, among others<sup>12</sup>.

Hence the present study was undertaken to formulate and standardize fibre bites, test the sensory attributes and analyze their physico-chemical properties, nutrient composition, antioxidant activity and shelf life.

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## 2. Materials and Methods

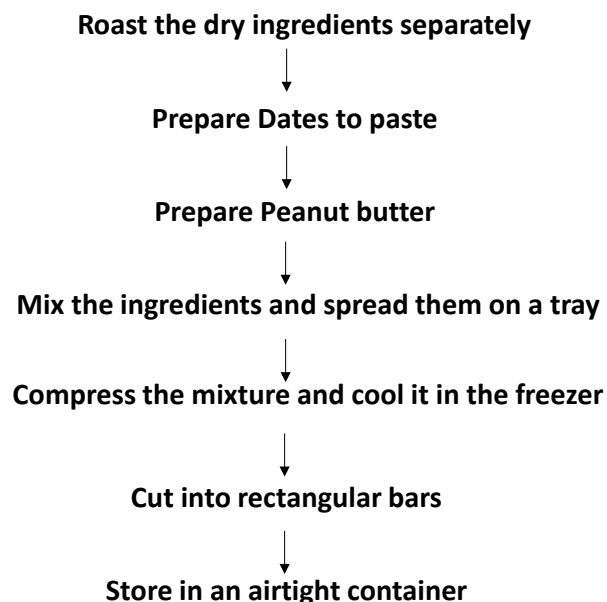
### 2.1 Selection and Procurement of Materials

The raw materials such as oats, dates, honey, peanuts, almonds and sesame seeds were purchased from the local supermarket. Stabilized rice bran was procured from NPPV Organics in Amazon (An online shopping app, in India).

### 2.2 Formulation and Preparation of Fibre Bites

The fibre bites were formulated in four different variations with 5%(A), 10%(B), 15%(C) and 20%(D) rice bran. The proportion of rice bran in the mixture was selected on a trial basis. The taste of the bar was found to be unacceptable when the proportion of rice bran in the mixture exceeds 20%. Table 1 presents the formulations of fibre bites.

All the dry ingredients were weighed and roasted separately under medium flame. Dates were pitted and soaked and ground to a fine paste. Peanuts were roasted and the skin is removed and ground in a mixer to smooth peanut butter. All the ingredients were mixed in different variations with a spatula and spread in a flat tray, compressed manually and cooled in the freezer for one hour, to ensure proper binding. The mixture was brought to room temperature and then cut manually with a knife to obtain rectangular-shaped fibre bites. Then it was stored in an air-tight pouch or container (i.e. stainless



**Figure 1.** Preparation of fibre bites.

steel/plastic). The flow chart for the preparation of fibre bites is given in Figure 1.

### 2.3 Sensory Evaluation

The developed fibre bites were subjected to sensory evaluation concerning the appearance, colour, flavour, taste and texture using a nine-point Hedonic Rating Scale. The evaluation is carried out with the help of 25 semi-trained panel members. Based on the mean scores

**Table 1.** Fibre bites formulations

| Ingredients   | Amount (g) |    |    |    |
|---------------|------------|----|----|----|
|               | A          | B  | C  | D  |
| Rice bran     | 5          | 10 | 15 | 20 |
| Honey         | 15         | 15 | 15 | 15 |
| Dates         | 15         | 15 | 15 | 15 |
| Peanut butter | 15         | 15 | 15 | 15 |
| Almonds       | 10         | 10 | 10 | 10 |
| Sesame seeds  | 5          | 5  | 5  | 5  |
| Oats          | 35         | 30 | 25 | 20 |

of sensory characteristics obtained, the most acceptable fibre bites were selected for further nutrient analysis.

## 2.4 Physicochemical Properties of Fiber Bites

The moisture content, ash content and pH of the most acceptable fibre bites were analyzed. The texture and colour analysis was done for all the fibre bites formulations.

## 2.5 Nutrient Evaluation

The macronutrients analyzed were energy, protein, fat, carbohydrates and fibre. Minerals such as iron, calcium, and phosphorus were also analyzed. The antioxidant activity of the fibre bites was also evaluated using a DPPH assay.

## 2.6 Shelf Life of Fibre Bites

The shelf life of the most acceptable fibre bites sample stored at room temperature in an airtight container was determined by analyzing the microbial count and peroxide value on the 7<sup>th</sup> and 14<sup>th</sup> day of storage.

# 3. Results and Discussion

## 3.1 Yield of Fiber Bites

From 100 g of the fibre bites formulation, four bars were obtained each of them weighing 25 g.

## 3.2 Sensory Evaluation of Fiber Bites Formulations

The mean overall acceptability scores obtained through the sensory evaluation of free bites formulations were consolidated, tabulated, and statistically analyzed using mean, standard deviation and F-test and the results are presented in Table 2.

It is observed that the fibre bites with 10% rice bran received the highest scores for all the quality parameters when compared with other formulations. Hence the fibre bites with 10% rice bran were found to be highly acceptable. Statistical analysis of the 'F' ratio value among the overall acceptability of fibre bites with 5%, 10%, 15% and 20% rice bran showed significant differences at the 5% level.

## 3.3 Physicochemical Properties of Fibre Bites

The physicochemical properties of food constituents are very important for developing new products. The physicochemical properties such as moisture content, ash content, pH, texture and colour of fibre bites were determined and the values are presented in Tables 3 and 4.

The moisture content of the fibre bite with 10% rice bran was found to be 16 g per 100 g. The moisture content of the fibre bite is found to be high which might be due to the addition of wet ingredients like honey, dates paste and

**Table 2.** Mean acceptability scores of fibre bites formulations

| Criteria              | Mean±StandardDeviation |           |           |           |
|-----------------------|------------------------|-----------|-----------|-----------|
|                       | A                      | B         | C         | D         |
| Appearance            | 8.52±0.77              | 8.76±0.52 | 8.56±0.65 | 8.44±0.65 |
| Colour                | 8.64±0.57              | 8.88±0.32 | 8.6±0.58  | 8.56±0.58 |
| Flavour               | 8.4±0.70               | 8.76±0.53 | 8.48±0.59 | 8.36±0.64 |
| Taste                 | 8.44±0.77              | 8.76±0.52 | 8.36±0.76 | 7.92±0.96 |
| Texture               | 8.68±0.69              | 8.84±0.38 | 8.76±0.44 | 8.56±0.50 |
| Overall acceptability | 8.54±0.12              | 8.8±0.06  | 8.55±0.15 | 8.40±0.26 |
| Groups compared       | A,B,C,D                |           |           |           |
| F-ratio value         | 8.4818*                |           |           |           |

Fibre bite with 5% rice bran, B- Fibre bite with 10% rice bran, C- Fibre bite with 15% rice bran, D- Fibre bite with 20% rice bran; \* -Significant at 5% level

**Table 3.** Physicochemical properties of fibre bites

| Physicochemical properties | Mean |
|----------------------------|------|
| Ash (%)                    | 2.33 |
| Moisture (%)               | 16   |
| pH                         | 5.8  |

**Table 4.** Texture and colour analysis

| Fibre bites Formulations | Hardness (N) | * L    | * a   | * b    | C      | H      |
|--------------------------|--------------|--------|-------|--------|--------|--------|
| A-5% Rice bran           | 1.06446      | 32.297 | 5.576 | 10.062 | 11.504 | 60.982 |
| B-10% Rice bran          | 1.02719      | 30.781 | 5.369 | 11.615 | 12.796 | 65.165 |
| C-15% Rice bran          | 1.17978      | 31.151 | 5.075 | 9.217  | 10.522 | 61.138 |
| D-20% Rice bran          | 1.03124      | 31.393 | 5.026 | 9.701  | 10.926 | 62.587 |

peanut butter as they constitute about 45% of the total fibre bites formulation. The ash content of the fibre bites was 2.33%. The pH of the fibre bite with 10% rice bran was found to be 5.8.

Table 4 shows that the hardness of the fibre bite with 15% rice bran (formulation C) was found to be the highest (1.17978 N), while formulation B had the lowest value (1.02719 N). In general, low hardness was observed when a low amount of rice bran was incorporated into the formulation. Thus the hardness is increased in proportion to the rice bran content. However, minor differences were observed between formulations which might be due to the non-homogenization of the fibre bites content.

The L\* value (lightness) of the formulations was increased with the increasing amount of rice bran, suggesting the influence of rice bran on the lightness of the fibre bites of colour. The findings also showed that formulation A had the highest a\* rating, which shows the fibre bite's redness. The fibre bite's red colour may be attributed to the amounts of almond, dates paste, peanut butter, and rice bran in the formulation as well as the presence of other ingredients. The Formulation B's b\* value (yellowness) was found to be the highest (11.615), while Formulaion C was found to be the lowest (9.217). The colour of fibre bites formulations is quite similar to each other due to the colour of their ingredients, as the

amount of wet ingredients like honey, peanut butter and date paste gives some colour to the fibre bites.

### 3.4 Nutrient Content of Fibre Bites

The nutrient content of 100 g of the most acceptable fibre bites (with 10% rice bran) is presented in Table 5.

**Table 5.** Nutrient content of fibre bites (per 100 g)

| Nutrients           | Amount |
|---------------------|--------|
| Energy (Kcal)       | 380.78 |
| Carbohydrate (g)    | 55.07  |
| Protein (g)         | 12     |
| Fat (g)             | 12.5   |
| Crude Fibre (g)     | 2.1    |
| Dietary Fibre (g)   | 24.5   |
| Soluble Fibre (g)   | 7.7    |
| Insoluble Fibre (g) | 16.8   |
| Iron (mg)           | 1.05   |
| Phosphorus (mg)     | 66     |
| Calcium (mg)        | 68     |

The energy value of fibre bites was found to be 380.78 kcal. The energy content of fibre bites was considerably higher. This might be due to the addition of ingredients like rice bran, oats, honey, dates, peanut butter, almonds and sesame. The carbohydrate content of fibre bites was 55.07g. The protein content of the fibre bits was 12 g.

The fat content of the fibre bite was 12.5 g. The fatty acid composition of peanuts, rice bran and sesame is found to be high in Mono Unsaturated Fatty Acids (MUFA and moderate LA. MUFA are less susceptible to oxidation. MUFA is resistant to peroxidation and helps to lower oxidized Low-Density Lipoprotein (LDL) by preserving High-Density Lipoprotein (HDL) level<sup>13</sup>.

The crude fibre and dietary fibre content of the fibre bites were found to be 2.1 g and 24.5 g respectively. The amount of insoluble fibre is about 16.8 g and that of the soluble fibre is 7.7 g. The high fibre content of the fibre bites was contributed by the presence of rice bran, oats, nuts and seeds. Fibre has an excellent role in the prevention of diseases.

The iron content of the fibre bites was found to be 1.05 mg. The amount of calcium present in 100g of fibre bites

was about 68 mg. The amount of phosphorus present in 100 g of the fibre bites was about 66 mg.

### 3.5 Antioxidant Activity of Fibre Bites

The antioxidant activity of the most acceptable fibre bite was evaluated using a DPPH assay. The various concentrations of fibre bites ranging from 10 to 200 mg had about 4.2 to 107 inhibition %. The calculated Inhibition Concentration (IC<sub>50</sub>) for the DPPH scavenging activity of fibre bites was 96 mg.

### 3.6 Storage Stability of Fibre Bites

Microbial analysis was carried out on the 7<sup>th</sup> day and 14<sup>th</sup> day for the most acceptable fibre bite. The results of the microbial analysis of fibre bites are presented in Tables 6, 7 and 8.

On the 7<sup>th</sup> day, the bacteria present in 10<sup>-6</sup> dilution were 06×10<sup>-6</sup> CFU/ml the and bacteria present in 10<sup>-7</sup> dilution were 04×10<sup>-7</sup> CFU/ml. On the 14<sup>th</sup> day, the bacterial count in both dilutions was too numerous to count. Thus, as the length of the storage time increases, the microbial load is also increased.

**Table 6.** Bacterial load of fibre bites

| Type of food | Time                          | Dilution         | Number of Colonies | Total Plate Count (TPC) |
|--------------|-------------------------------|------------------|--------------------|-------------------------|
| Fiberbite    | Initial (7 <sup>th</sup> day) | 10 <sup>-6</sup> | 06                 | 06×10 <sup>-6</sup>     |
|              |                               | 10 <sup>-7</sup> | 04                 | 04×10 <sup>-7</sup>     |
|              | Final (14 <sup>th</sup> day)  | 10 <sup>-6</sup> | TNTC               | TNTC                    |
|              |                               | 10 <sup>-7</sup> | TNTC               | TNTC                    |

TNTC-Too numerous to count

**Table 7.** Fungal load of fibre bites

| Type of food | Time                          | Dilution         | Number of Colonies | Total Plate Count (TPC) |
|--------------|-------------------------------|------------------|--------------------|-------------------------|
| Fibre bite   | Initial (7 <sup>th</sup> day) | 10 <sup>-3</sup> | Nil                | Nil                     |
|              |                               | 10 <sup>-4</sup> | Nil                | Nil                     |
|              | Final (14 <sup>th</sup> day)  | 10 <sup>-3</sup> | Nil                | Nil                     |
|              |                               | 10 <sup>-4</sup> | Nil                | Nil                     |

**Table 8.** Peroxide value of fibre bites

| Days                 | Peroxide Value (meq/kg) |
|----------------------|-------------------------|
| 7 <sup>th</sup> day  | 2.52                    |
| 14 <sup>th</sup> day | 2.84                    |

On the 7<sup>th</sup> day, the fungus present in 10<sup>-3</sup> dilution was found to be nil and the same was observed in 10<sup>-4</sup> dilution. The same was observed on the 14<sup>th</sup> day. Thus the length of the storage time of the fibre bites does not influence the fungal load. Hence only the bacterial load seems to be increased on storage and there is no fungal load observed.

The peroxide value of fibre bites determined on the 7<sup>th</sup> and 14<sup>th</sup> day was 2.52 meq/kg and 2.84 meq /kg respectively and are well within the limits of the Bureau of Indian Standards (BIS).

### 3.7 Cost Calculation

The cost for the production of fibre bites formulations weighing 400 g containing 16 fibre bites was Rs. 264/- and the cost per fibre bite was Rs. 17/-. Thus it is evident that the cost of the fibre bites was considerably lower when compared to that of the Nutri bars available in the market.

## 4. Conclusion

It is concluded from the above finding that among the four different fibre bites formulations, fibre bites with 10% rice bran are highly acceptable. The dietary fibre content of the fibre bites was considerably higher. The antioxidant activity of the fibre bites was also found to be higher. The fibre bites could be stored at room temperature for a period of 7 days. Thus the rice bran which is obtained as a byproduct of rice milling can be effectively utilized for value addition of snack foods and it was also economical.

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