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Research Article

Banana Peel Bar: An Effective Nutritional Supplement

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Abstract

Every year a lot of kitchen waste is generated, mainly fruit and vegetable peels. The increasing population increases the demand for raw materials and thus impact the generation of this waste. The large amount of waste gets dumped into dumping grounds, causing various airborne and waterborne diseases. The peels of vegetables and fruits can result as nutritional components of food or medicinal components of pharmaceutical products, as they contain various phytochemicals and nutrients. This research looks upon such a beneficial and cost-effective element that is Banana peels. Banana peels have been used since ancient times due to their soothing, anti-inflammatory, and fibre-rich properties. Banana peel is the core component of our nutritive bar along with various beneficial components like dates, rice flakes, germinated wheat, magaj (Watermelon seeds), and charoli seeds (Cuddapah almond) which provide an additional and balanced nutrient value to our nutritive bar. Why a nutritive bar? Nutritive bars are a balanced source of nutrients that fills the satiety and are also cost-effective so that the common man can affordably purchase them.

Keywords: Banana peel, Nutritive bar, Nutrition supplement, Fruit waste, Peel bar.

1. INTRODUCTION

Globally 1.3 billion tons of food is wasted according to the United Nations Food and Agriculture Organization. From which 15-60% of global waste is of fruit and vegetable peels¹. Peels can be overlooked as a promising nutritional source; it is also considered to show better biological and pharmacological activities than other parts of fruits and vegetables². Fruit peels are a rich source of different essential components like carotenoids, xanthophylls, anthocyanins, vitamins, minerals, amino acids and other phenolic substances. Fruit peels can be used to extract bioactive compounds that can be used in the cosmetics, textiles, food, and pharmaceutical industries³⁻⁴. Nutrition bars provide a balanced source of essential nutrients that fills the satiety of one's and are also cost-effective for the affordability of the common man. In the nutritive bar, banana peel powder is the main component along with various ingredients incorporated within it for the increment of nutritional value of the bar.

Banana is a fruit crop that is widely cultivated and consumed fruit in tropical and sub-tropical region. In which India is the largest producer of banana

contributing around 27% worlds-total production. Due to the high production of bananas, approximately 36 million tons of banana peel waste is generated each year⁵⁻⁶. Banana peels are composed of enzymes like polyphenoloxidase and pectin which is used as a gelating agent. It also contains phytoconstituents like flavonoids, tannins, phlobatannins, alkaloids, glycosides, and terpenoids. It is a rich source of Vitamin A, Vitamin C, Vitamin E, Vitamin B6, Gallic acid, dopamine, asitosterol, malic acid, palmitic acid, succinic acid, magnesium, phosphorous, potassium, fibre, iron, etc. Extract of banana peel exhibit various pharmacological activities like antibacterial, antihypertensive, antidiabetic, antioxidant, and anti-inflammatory^{3,7}.

Wheat has many beneficial activities than any other grain, sprouting enhances the nutritional components by increasing the bioavailability of minerals like zinc, magnesium, calcium, manganese, and copper compared to unsprouted wheat. It also increases antioxidant levels significantly. Sprouting makes the protein and carbohydrates more bioavailable. Sprouting also increases the digestibility of starch by depolymerization through a hydrolytic enzymatic reaction. Germinated wheat comprises of Vitamin B complex, Vitamin K,

Vitamin E, Vitamin A, amino acids, mucopolysaccharides, and bioflavonoids like luteolin, apigenin, quercetin, and choline⁸⁻¹⁰.

Fard Dates are a variety of dates known for their rich dark colour, high fibre content, carbohydrates, vitamins, minerals, and significant antioxidant properties. They contain phytochemicals like carotenoids, phenolic acid, flavonoids, tocopherol, phytosterols, etc. They have shown various pharmacological activities such as anti-mutagenic, anti-inflammatory, antihyperlipidemic, anticancer, nephroprotective, neuroprotective, and hepatoprotective¹¹⁻¹³.

Magaj Seeds (Watermelon seeds) are a rich source of nutrients. It is used to provide nutrition to infants. They can be roasted as it enhances its flavor and sweetness. Flour of watermelon seeds is used as an alternative to gluten-free flours as it is used in weight reduction. It contains many bioactive compounds, and it is a potential source of minerals, proteins, and fat. It is also used in cosmeceuticals and nutraceuticals, for its economic value. It has anti-microbial and anti-inflammatory properties¹⁴⁻¹⁶.

Charoli Seeds (Cuddapah seeds) are one of India's most famous dry fruits. They are high in calories and have a sweet flavor. Seeds contain various phytochemicals, such as protein, starch, phosphorus, riboflavin, niacin, Vitamin C, calcium, fats and thiamin. They also have pharmacological activities like anti-inflammatory, antioxidant, laxative, and memory-boosting properties¹⁷⁻¹⁹.

Rice flakes are a common breakfast item in the Indian subcontinent. It is a rich in high dietary fibre, minerals, and oryzanol content, which helps in the reduction of blood cholesterol levels and prevents coronary heart diseases, and celiac diseases. Rice flakes are also a great source of Iron²⁰⁻²¹.

Cinnamon is a spice grown in India and Sri Lanka, well known for its medicinal and flavouring properties. Cinnamon is composed of bioactive compounds like cinnamaldehyde, cinnamyl acetate, eugenol, caryophyllene, linalool, and 1.8-cineole. It has exhibited

pharmacological activities like anti-microbial, anti-inflammatory, antidiabetic, cardiovascular, cognitive function, antioxidant, and anti-carcinogenic²²⁻²⁴.

Guar gum is obtained from the endosperm of cluster beans. Because of its ability to form hydrogen bonds with water molecule, it is used as a thickener, emulsifier, and stabilizer. It consists of high molecular weight polysaccharides of galactomannan²⁵⁻²⁷.

2. MATERIALS AND METHODS

2.1. PROCUREMENT OF RAW MATERIALS

Raw materials including Banana, Wheat, Fard dates, Magaj seeds, Charoli seeds, Rice flakes, Cinnamon powder were purchased from the local market of Pune, Maharashtra, India. Guar gum procured as gift sample from Raj Gums, Rajasthan. Analytical grade chemicals were purchased from Pallav Chemicals, Andheri, Mumbai.

2.2. PREPARATION OF BANANA PEEL POWDER

Bananas were purchased from the local market in Pune, India. Peels were collected and rinsed with filter water to remove dirt and grit. Peels were then sundried for 7 days under optimized conditions. Banana peels were covered with muslin cloth, to prevent it from dirt. Dried peels were ground and packed in an airtight container for further use²⁸.

2.3. PREPARATION OF NUTRITIVE BAR

The nutritive bar was prepared by accurately weighing the required amount of all dry ingredients like Banana peel powder, rice flakes, magaj seeds, charoli seeds, cinnamon powder and guar gum in one container and mix, evenly. Dates were ground to paste. Wheat was soaked overnight and kept for germination for 2 days by tightly wrapping it in muslin cloth. Germinated wheat was also ground to fine paste. The wet ingredients were weighed accurately and added to the dry ingredient mixture. The mixture was then roughly ground and was added into suitable greased molds. Fig. 1 illustrates the preparation of the nutritive bar²⁹.



Figure 1: Preparation chart of Nutritive Bar (Banana Peel Bar)

Table 1: Formulation table

Ingredients	Quantity(gms)
Banana Peel Powder	10
Germinated Wheat	10
Fard Dates	15
Rice Flakes	2.5
Magaj Seeds	2.5
Charoli Seeds	2.5
Cinnamon Powder	02
Guar Gum	0.5

2.4. FORMULATION STUDY

Formulation of the nutritive bar was done on the basis of amount of Germinated wheat and dates used. Germinated wheat was marked as Factor 1 and Dates was marked as Factor 2. These factors were responsible for the stability of the bar and sweetness of bar required. More the moisture content less stable will be the bar. On the basis of formulation, amount of ingredients of bar were selected. Table.2. describes the formulation study of the bar.

Table 2: Formulation Study

Sr. no.	Factor 1 (g)	Factor 2 (g)
1	0	25
2	5	20
3	10	15
4	15	10
5	20	5
6	25	0

2.5. SENSORY ANALYSIS

Prepared bars were given to 10 members for evaluating the sensory attributes of bar such as colour, flavour, appearance, and texture of the bar. It also gave an overall acceptability study of the bar. It was evaluated on the basis of the Hedonic scale method in which 9 points represents, like extremely and 1 point represent dislike extremely. Members were suggested to rinse their palate using filtered water before tasting the bar²⁹⁻³⁰.



Figure 2: Nutritive bar preparation as per Formulation Study

2.6. EVALUATIVE STUDIES OF BAR

Various factors like ash value, moisture content, fibre content, and fat content were evaluated on the bar. These factors were undertaken to find out its nutritional value. Values were determined by using methods described by AOAC (2012).

2.6.1. Estimation of Ash value³¹

Ash value was determined by placing a known amount of sample of the bar in Muffles furnace for 1 hour at 500-800°C.

2.6.2. Estimation of moisture content³²

Moisture content was determined by placing a known amount of sample in a Hot Air Oven for 1 hour at 120°C.

2.6.3. Estimation of Fibre content³³

Fibre content was determined by adding a known concentration of acid or base into the sample and then filtering it. The residue was placed into the Muffles furnace for 1 hour at 500-800°C.

2.6.4. Estimation of Fat content³⁴

Fat content was determined by dissolving a known amount of sample into n-hexane or petroleum ether. The mixture was then placed in Soxhlet's apparatus. After that, the mixture was evaporated and the content remaining was measured and fat content was determined.

2.7. STABILITY STUDY OF BAR

Bars prepared as per factorial design were kept for 7 days at room temperature and evaluated for stability. Other bars prepared after selective formulation, were kept at two different conditions i.e. at room temperature and at 0-4°C in a refrigerator²⁹.

3. RESULT AND DISCUSSION

According to the formulation study, bars of various proportions were prepared. It showed that less amount of dates decreased the overall acceptability as it impacted the sweetness of the bar. Whereas more amount of dates showed high sweetness and resulted in chewy bar. The optimum formulation of the bar was then selected which had 10 g of Germinated wheat and 15 g of Dates.

The bar prepared as per the formulation study, showed different stability and taste at different proportions, from which 3rd number bar formulation was selected as

it had overall acceptability. Fig.3. shows the stability of the bar after a week at room temperature.



Figure 3: Stability study of different formulations of the bar

The organoleptic study of the bar evaluated by members showed an average overall acceptability score of 7.4. Texture, colour, appearance and taste were evaluated and resulted in acceptance of the bar by 9 members out of 10 members.

An evaluative study of the bar was found by various methods as per AOAC in which moisture content, ash value, fibre content, and fat content of the bar were evaluated. This study was done to find the nutritive value of the bar. Table 3. contains chemical properties of the bar.

Table 3: Chemical Properties of bar

Chemical properties	Observations
Ash value	63%
Fibre	35%
Moisture	11%
Fat	11%

Stability study of various bars showed that the bar prepared having less concentration of germinated wheat and a high concentration of dates had high stability for 7 days at room temperature. This formulation was then selected and bars were prepared, and kept at room temperature showed less stability than the bar stored in the refrigerator. The one kept at room temperature, showed a very small amount of microbial growth with adverse changes in taste and appearance but the bar stored at 0-4°C showed no microbial growth and there was a slight change in taste, but palatable.

CONCLUSION

The nutritive bar was formulated by optimizing two factors Germinated wheat and Dates. Out of 6 bars, one

bar was optimized with a combination of Germinated wheat- 10g, and Dates- 15g for the formulation of a Nutritive bar along with other ingredients with maximum acceptability. The optimized bar has a balanced nutritional composition along with a soft and chewy texture. Such nutritional fruit peel bars will encourage more utilization of fruit peels in industries that are major waste products worldwide. It is a sustainable and alternative way to feed the global hunger. Fruit peel bars can be enjoyed as a snack with additional nutritional benefits in the future.

Declaration of Competing Interest: The authors declare that they have no known competing financial or personal relationships that could have appeared to influence the work reported in this paper.

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