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PREPARATION AND EVALUATION OF THE NUTRITIONAL VALUE AND SENSORY ATTRIBUTES OF BANANA PEEL POWDER BISCUITS

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ABSTRACT

The research was focused on the potential of banana peel powder combined with wheat flour to prepare biscuits with high phytochemical composition (bioactive compounds, antioxidant capacity, and crude fibre) and its effect on the nutritional profile and sensory attributes of the biscuits. Many observational studies from all over the world have shown that phytochemical compounds are the most important qualitative qualities of fruits for lowering progressive chronic disorders. The banana peel powder was prepared by drying the banana peels. All the findings were statistically tested to determine the importance of the fluctuation in the effects involved in the biscuit's recipe. One-way analysis of variance (ANOVA). Of the four different formulations, the aesthetic rank was highest for sample D (10% banana peel) of wheat flour with banana peel powder. Fortified biscuits had lower moisture, protein, fat, fibre, ash, and some bioactive compounds (polyphenol, flavonoids, and anthocyanin) but higher fat, fibre, ash, and some bioactive compounds compared to wheat flour. When 10% banana peel powder was replaced with wheat flour, nutritious and fibre-rich biscuits of good quality, nutritious, and fibre-rich biscuits were obtained (moisture 3.87 %, carbohydrate 64.83%, protein 10.13%, fat 18.18 %, ash 1.65%, and fibre 0.75%). The generated biscuit showed higher amounts of phytochemical compounds (Polyphenol 4.22%, flavonoid 23.87%, anthocyanin 13.41%, and antioxidant capacity 2. 85%) than sample A (reference biscuit). The maximum value for fragrance (8.0), taste (8.10), colour (6.80), texture (5.40), and overall acceptance (7.60) was obtained in 10% banana peel with wheat flour. The substitution of wheat flour with 10% banana peel powder can be a compatible resource for value-added product manufacture and waste utilisation, which may improve the food security of Bangladesh, as there is plenty of banana in Bangladesh. In terms of nutrition and organoleptics, the finished product was found to be somewhat more acceptable.

INTRODUCTION

Banana pseudostem incorporated biscuit is a small baked unleavened cake, usually crisp, flat, and sweet, made using banana pseudostem powder as the major ingredient. The present study was carried out to develop the formulation of a biscuit incorporated with banana pseudostem powder and to study the effect on the biscuit quality. The calcium, potassium, and sodium contents of banana pseudostem-incorporated biscuit and wheat biscuit were evaluated. The calcium, potassium, sodium, ash, fibre, and fat content were found to be higher in the banana pseudostem-incorporated biscuit in comparison to the normal wheat flour biscuit. The samples were subjected to sensory evaluation for consumer acceptability. Banana is one of the most important crops of tropical plants. It is a member of the family Musaceae and the genus Musa sapientum. It is called banana in English and avaba in Hausa. The plant has long overlapping leaf stalks and a stem that is 1.22 to 6.10 m high (Oladen et al., 2010). Its life span is about 15 years (Philips, 1982). The fruits are borne in clusters, with individual bananas of the cluster about 1 inch in diameter. The banana fruit is ready to be harvested approximately two and a half to four months after shooting, or about eight to twelve months after planting. Banana is high in fibre and can help reduce cholesterol levels, relieve constipation, and prevent colon cancer. It is found to be useful in preventing high blood pressure and muscle cramps due to its high potassium content. Different parts of the plant viz., leaves, root, fruit stalk, bract and fruit have been used for medicinal and domestic purposes. The sap is used to cure diarrhoea, dysentery, hysteria and epilepsy. The root is used as a cold infusion in venereal diseases and anaemia. Besides, the fruit is used as an antiscorbutic. aphrodisiac and diuretic. It is known to have originated in tropical Southern Asia. Now it is grown in all the tropical regions. Fruits are one of the most eaten parts of the plants in raw form with fleshy structures. Fruits are the main source of sugars, vitamins, and bioactive compounds like phenolic compounds and fibres. Fruits are useful to decrease the risk of various chronic diseases. WHO recommends daily consumption of about 400 g of fruits. Banana is one of the most widely consumed fruits is a large herbaceous plant belonging to the genus Musa of the family Musaceae. Banana is usually grown in tropical and sub-tropical regions of the world. After coffee, cereals, sugar, and cacao, banana is the fifth agricultural crop in world trade and an important fruit crop after citrus fruits, grapes, and apples. Banana is one of the oldest cultivated crops of the world, and it was cultivated in India about 600 BC. Also reported from different studies that the annual production of bananas is about 145 million tonnes throughout the world. The largest banana-producing countries of the world are China,

Ecuador, the Philippines, and India. Therefore, the USA is the largest banana-importing country, while Ecuador is the largest banana exporter. It is estimated that the demand for banana exports reached about 20.2 million tonnes in 2019. Banana is a nutrient-rich fruit and is the main source of many macronutrients, micronutrients, and phytonutrients. It contains an immense number of vitamins and phenolic compounds. Banana is also a good source of minerals like sodium (Na), potassium (K), iron (Fe), copper (Cu), phosphorus (P), manganese (Mn), and zinc (Zn). Banana pulp contains several ingredients in different concentrations, like 72% moisture, 2.9% total fibre, 1.4% protein, 1.28% ash, and other compounds like 14.4% sucrose, 8.5% vitamin C, and 2.4% glucose.

Banana is very useful for the good health and well-being of people due to its highly nutritive values. In many countries, banana is eaten as a perishable food. It is also present in many food products, which are very effective for human health. Banana has been reported as a major source of different health-promoting phytochemicals by several studies. Both ripe and unripe bananas contain antiulcer, anti-diabetic, and radical scavenging compounds. Banana is used as a vector for several vaccines due to its easy availability and simple administration. Pectin from banana is used as a pharmaceutical excipient in the preparation of capsules. Banana is consumed in raw as well as cooked form. Banana is used by human beings, and green, unpeeled banana is used as feed for animals. It is a very important source of energy, and mostly it is consumed by athletes. It is the best source of energy for many

sports activities, described by food specialists. Therefore, bananas are included in many energising drinks and bars which are beneficial to athletes. The application of drinks and other food products loaded with bananas diminishes the risk of muscular contraction in athletes due to the sufficient concentration of minerals (K and Mg) and vitamins. All the traditional plants are used to treat different illnesses around the world. Banana has many medicinal properties other than nutritional aspects, like wound healing, anticancer, anti-ulcerogenic, hypoglycemic, antioxidant, antidiarrheal, etc. In recent years, food industries are more interested in increasing healthy products, consumers' interest in a healthy diet, as well as food manufacturers developing novel, sustainable food products. And with the fast growth of the world population, it is essential to generate innovative and effective food manufactured through banana by-products like peel through the use of suitable techniques. Thus, the banana pulp and peel can be used in different functional food products such as baked products (bread, cookies and pasta), confectionery and other gluten-free products. This review emphasises the nutritional composition, bioactive profile, possible health benefits and auspicious food application of banana peel and pulp. The main aim of this review is to focus on the important nutritional properties of banana and its prospective applications in food and pharmaceutical industries.

LITERATURE REVIEW

Biscuits are the best form in terms of nutrient availability, palatability, compactness, and convenience. These products are different from other baked products like bread, cake, etc., as they have low moisture content, are comparatively free from microbial spoilage, and have long shelf life. The earliest biscuits were dried-out rusks, handy as long-life food for sea voyages, but earlier cooks making sweetmeats with fat and sugar would have found out that if you baked small pieces of dough in a normal hot oven and pulled them out when they had a good colour and a stable structure, they wouldn't have been dry enough to be truly crispy. Putting them back into a slightly cooler oven to dry them out helped their eating, but originally the word biscuit was used for dried pieces of bread. These too were flavored and sweetened with spices. Other products, such as our modern biscuits, were made but were given more cake-like names, for example, shortcake and shortbread. Biscuits today are made almost exclusively in factories, in large-scale production plants, large and complicated, and calling for a great deal of mechanical sophistication. Forming, baking, and packaging are generally continuous operations, but metering ingredients and dough mixing are usually batch operations.

METHODS

Raw materials sourcing

Ingredients were purchased from a local supermarket: wheat flour, margarine, baking powder/yeast, bicarbonate soda, salt, sugar, eggs, and bananas. Prickly pears were obtained through a community project (Matoks, Limpopo province, South Africa). All chemicals (analytical grade) and reagents were purchased from Merck (Pty, Ltd, South Africa).

Preparing Prickly Pear Flour: Uniform-sized and coloured ripe prickly pear were selected. The prickly pears were washed well and peeled carefully with a knife to separate the peel, pulp, and seeds. The peels were dried at 60 C for 24 h in a hot air oven dryer. Dried peels were ground to flour in a hammer mill.

How to make banana flour

The banana fruits at the stage of ripeness were washed and peeled. The pulps were removed, and the peels were cut into small pieces of about 2 mm thickness. To prevent enzymatic browning, banana peels were dipped in 0.5% (w/v) citric acid solution for 10 min, drained, and dried in an oven dryer (60 C overnight). Banana peel flour was obtained by milling the dried peels in a hammer mill (Retsch ZM 81 200miller, Haan, Germany) at 16,000 rpm for 30 s. All banana peel flours were stored in sealed polyethylene bags at 10 2 C until use

Preparation of cookies

The biscuit formulations consisted of flour (49.50%), margarine (20%), beaten whole egg (10%), sugar (20%) and baking powder (0.50%). The flour, sugar and baking powder were mixed by hand in a 500 cm3 bowl, as the amount of mixture was too small for a laboratory mixer. Margarine and beaten whole egg were creamed well for 60 s, and then the dried ingredients were added all at once and mixed for a further 60 s. The batter was prepared with a round shaper (0.25 35 mm) and baked in an electric oven at 180 C for 8 min. All were left to cool on the table, followed by packing them in a low-density polyethylene bag and storing them in a plastic container for further analysis.

BISCUIT PREPARATION:

PROCESSING OF BANANA PEEL POWDER

Banana Pseudostem
↓
Removal of Outer Sheath
↓
Washing
↓
Slicing
↓
Soaking in 0.2% Citric Acid for 10min
↓
Cabinet Dry 600C for 48 hours
↓
Pulverising [400u]
↓
Banana Central Core
↓
Mixing [Ingredients]
↓
Dough Preparation

↓
Add Peel Powder
↓
Rolling
↓
Cutting [8mm]
↓
Baking [2200C for 20min]
↓
Cooling
↓
Storage { Room Temperature }

Table: Formulation of dough containing banana peel powder and other ingredients for biscuit development.

FORMULATION OF BANANA PEEL POWDER BISCUIT

INGREDIENTS	SAMPLE A (CONTROL)	SAMPLE B (2% PEEL POWDER	SAMPLE C (5% PEEL POWDER)	SAMPLE D(10%NpEEEL POWDER
Wheat flour (g)	300	290	275	250
Peel powder (g)	0	10	25	50
Butter (g)	100	100	100	100
Almond Powder(g)	130	130	130	130
Baking Powder (g)	3	3	3	3
Water (ml)	80	80	80	80
Salt (g)	30	30	30	30
Funnel(gm)	1	1	1	1

EVALUATION PARAMETERS

All nutritional tests of different biscuit samples were determined using different methods.

[1] Moisture content (% by weight)
The crucibles were cleaned, dried for three hours in an oven set at 105 ° C, and then chilled in desiccators. The crucibles were then weighed after that. About 2 g of the substance were placed in the crucible. The sample was put in the crucible and dried for around 48 hours at 105°C in the oven. The crucibles were dried, then put in desiccators to cool. After cooling, the crucibles were weighed and recorded. The formula stated in the equation was then used to obtain the percentage moisture content.

Calculation:
% of Moisture Content = $w1-w2/w2$
Where,
W1= weight of sample (g) before drying and W2 = weight of sample (g) after drying

[2] **Total ash content (% by weight):**
Total ash content was determined by a muffle furnace.
Total ash content (% by weight) = (weight of ash / total weight of sample) 100

[3] Crude fiber content:
For crude fibre determination, one gram of each sample was obtained.
The materials were first digested for 30 minutes in 0.125 M diluted sulfuric acid, followed by three hot water rinses. After another 30 minutes of mild alkali digestion (0.125 M KOH), the residue was rinsed three times in hot water. After being cooked for five hours, the digested remnant was chilled and weighed. After burning for two hours at a temperature of 525°C in a muffle furnace, the residue was cooled and weighed once again. The following calculation was used to calculate the total amount of fibre:

Calculation:

Crude fiber (% by weight) = (W1-W2 / WS) 100 Where, Ws=weight in gram of sample W1=Weight in gram of crucible with fiber
W2 = weight in grams of crucible with ash

[4] Protein content:
Crude protein content of enriched biscuits and peel powder was calculated using the macro Kjeldahl technique number 920.87. On oiled filter paper, a sample piece weighing around 1g was measured. The supplies were put in a 100 cc Kjeldahl digestive tube after being safely wrapped. An empty 100 mL digestive tube was made into a blank by inserting a piece of filter paper into it, and each tube received 5.0 mL of concentrated sulfuric acid and 2 g of Kjeldahl catalyst. The samples were further digested to allow the nitrogen contained in the heterocyclic ring to be liberated after generating a clear blue solution. Before adding 20 cc of distilled water to dissolve the ingredients, the digest was refrigerated. the diluted. 50 cc of sodium hydroxide at a 40% concentration was added to the digest to promote ammonia release. Ammonia was extracted by steam distillation and collected in a 50 mL flask containing 4 percent boric acid. The distillate was titrated with 0.1520 N HCl standard solution while using a bromocresol green/methyl red combination as an indicator. The following formula was used to calculate the nitrogen content.

Calculation:
% of Nitrogen= Titre (blank)in ml×Conc.of acid N/mol / Weight of sample(g)

[5] Carbohydrate determination:

The total carbohydrate determined by 100 – (moisture + protein + fat + ash + fiber)

RESULT

EVALUATION PARAMETER	SAMPLE A	SAMPLE B	SAMPLE C	SAMPLE D
CRUDE FIBRE (%)	**2.5%**	**3.6%**	**6.8%**	**6.2%**
MOISTURE (%)	**6.4%**	**4.9%**	**5.3%**	**5.9%**
CRUDE FAT (%)	**16.23%**	**12.14%**	**20.73%**	**16.3%**
CARBOHYDRATE TEST (%)	**62.54%**	**57.45%**	**64.32%**	**59.0%**
TOTAL ASH	**2.6%**	**2.7%**	**3.1%**	**2.4%**

The outcomes of the study are covered in this section in relation to the study's goals, which were to determine the gross chemical composition by proximate analysis, characterize the bioactive compounds, and evaluate panelist sensory evaluation. Overall acceptability of fortified biscuit measured on a hedonic scale. These elements were mentioned in the previous chapter, which covered the methodology of the study.

Proximate composition

The table shows the chemical make-up of the reinforced biscuits. The moisture, total carbohydrate, crude fibre, ash, fat, and crude protein composition of the samples

Carbohydrate

The carbohydrate content in sample A is 62.54%, while sample B shows 57.45%, sample C shows 64.32%, and sample D is 59.0%

Moisture content

The total Moisture Content in sample A is 6.4%, while sample B shows 4.9%, sample C shows 5.3%, and sample D is 5.9%

Crude fat

The total fat content in sample A is 16.23%, while sample B shows 12.14%, sample C shows 20.73%, and sample D is 16.3%

Ash content

Ash content was shown in sample A as 2.6%, while sample B shows 2.7%, sample C shows 3.1%, and sample D is 2.4%

Crude fibre

The amount of crude fibre in flour biscuits with banana peels exceeds that in sample A, which is 2.5%, and in sample B is 3.6%, and in sample C is 6.8%, and in sample D is 6.2%

SUMMARY

The banana peel wastes were rich in crude fibre, carbohydrates, crude protein and ash and can serve as basal materials or components of animal feed. The wastes were high in calcium, phosphorus, magnesium and iron, and can be a good source of these minerals. Banana peel wastes have the potential to be good sources of nutrients for the production of animal feeds, and their utilization for this purpose should be encouraged, as this will also help in reducing the menace of banana peel waste in the environment. The study underscores the nutritional relevance and mineral potentials of the peels of banana. The banana peel can be a source of nutrients in animal feed preparation, as they are high in protein, fibre, and essential mineral content. This will result in dual benefits of its use as animal feed and a proper banana waste management (waste reduction) strategy, as the wastes would have constituted a nuisance to the environment. Although banana peel may offer a good perspective as a value-added ingredient in food products, detailed research, legislation, and regulations are required to guarantee its quality, suitability, and long-term consumers' safety. The publication on which safety evaluation is focused is also limited; hence, the safety assurance of banana peel application is far from an unavoidable step for most established studies. Straightforward analytical tools have been used to determine the physicochemical properties of material intended for human consumption, such as nutritional content, colour, and moisture content.

CONCLUSION

The results of this study revealed that replacing banana peel powder with wheat flour raised the proportion of crude ash, crude fibre, bioactive components, and antioxidant capacity in biscuits. The protein, fat, carbohydrate, and calorie composition of the made biscuits showed significant differences. The prospective juror found that a 10% swap of banana peel powder biscuits was more satisfactory with all quality parameters in a sensory evaluation test. As a result, substituting wheat flour for banana peel powder will be much more nutritious and cost-effective. The physiological and nutritional specific properties of flour made from banana peel powder were investigated. According to the findings of this investigation, composites made with up to 10% banana peel powder were necessary for the creation of biscuits. Beyond 10% banana peel powder blends, the colour of the biscuits darkens due to the Maillard browning reaction, the inclusion of high fibre content, and baking process conditions. Banana peel powder could potentially be used to make a variety of bakery goods and useful food additives. This upregulation of AOA and bioactive chemicals was indicated as a marker of the existence of health-beneficial substances, which has a positive impact on environmental issues. It can also be turned into critical foods such as nutraceutical and rehabilitative functional food items. It is also a functional food because it contains a satisfactory limit of tannin, even after processing. Most often, these human diseases are linked to free radical formation and metabolism, including cardiovascular disease, cancer, cataracts, age-related muscle degeneration, rheumatoid arthritis, and a variety of neurodegenerative disorders. Tannin can alter this structure and ensure resistance to a variety of diseases. The bioactive components found in banana peels make them a valuable resource that is worth exploring. Banana peels are an appealing material to research and utilize since they are a plentiful supply of bioactive components. The trash produced by banana cultivation areas can be used as supplemental feed for livestock and as a source of high-value raw materials for other industries. Banana peels' use in various food products is justified by their nutritional composition and has been shown to have antioxidant and antimicrobial properties.

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