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Nutritional and Functional Potential of Banana Peel Powder: Proximate and Mineral Analysis for Sustainable Applications

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Abstract

The goal of this study is to assess the nutritional and functional value of banana peel powder through its nutrient composition and mineral analysis in a sustainable manner. The analysis performed indicated that the carbohydrate content was considerably high (78.37%) and that there was a significant amount of dietary fibre (8.5%), moderate quantity of protein (3.84%), and low level of fat (1.59%). It was found to be high in energy and bioactive compounds that support a healthy gastrointestinal system. The results of the mineral analysis showed that banana peel powder contains calcium (5.4 mg/100g), phosphorus (2.19 mg/100g), iron (6 mg/100g), zinc (1 mg/100g), and copper (1 mg/100g) which are vital micronutrients. This finding indicates the potential of the banana peel powder in addressing the global burden of micronutrient deficiencies. Moreover, as the powder contains antioxidant properties, the functional benefits of the powder are further increased thus suitable for food fortification, animal feed and other health products. This research stresses the need to incorporate the banana peel powder as an eco-friendly and cost-effective means to combat food loss and enhance dietary health quality.

Keywords: antioxidant properties, Banana peels, bioactive compounds, fruit wastes, trace elements

1. Introduction

The peels of bananas are a major by pallet waste of the fruit peelings as bananas are one of the staple fruits in most households especially in world (Padam et al., 2014). Due to the immense volume of bioactive compounds they contain, banana peels have been identified as a valuable source of nutrients (Zaini et al., 2022) and sources of nutrition and industrial development applications (Kumar et al., 2016; San-Cristobal et al., 2020). This research aims to study the nutritional components of banana peel powder to explore its potential use in food products and animal feed.

2. Materials and Methods

2.1 Sample Preparation

Fresh yellow banana peels were first cut into little pieces and then dehydrated in a hot air circulating oven at 50 degrees Celsius for 72 hours after being thoroughly cleaned with tap water to get rid of any remaining particles. The grinder is used to create powder once the sample has released free water. After that, fine banana peel powder was created using a 45-mesh filter and put in a glass container for later use (Al-Sahlany et al., 2020).

2.2 Proximate and Mineral Composition Analysis

The sample's proximate content was evaluated in line with the Standard AOAC approaches as stated in (2019) so as to establish its key constituents. The moisture content was assessed using a standard procedure that involved the sample being placed in an oven and dried at a temperature of 105 degrees Celsius until a constant weight was attained. The ash content was assessed by burning the sample in a muffle furnace at 550 degrees Celsius. In order to analyze the total crude protein content, the kjeldahl method was employed, where the nitrogen content present was taken and multiplied by the factor 6.25. The extraction of crude fats was accomplished through the Soxhlet extraction method using hexane as the solvent. Determination of crude fibre was performed by sequential treatment with acid and base digestion. An estimation of the global carbohydrate was carried out using an anthrone method that is a colorimetric method of carbohydrate quantification. These analyses helped in providing a complete picture of the nutritional make-up of the sample under analysis. As for the mineral contents of the analysis, zinc, copper, calcium, iron and phosphorus were calculated using a defined procedure. Calcium and phosphorus were measured with the AOAC Method (2016), involving wet ashing and spectrophotometric analysis. Quantification of zinc, copper and iron was achieved using AAS as described by Skoog et al. (2017) with suitable calibrations to the standards.

3. Results and Discussion

The findings of this study show that banana peel powder is a suitable sustainable ingredient for a range of applications, offering important insights into its nutritional and functional potential. Its potential as an energy source and functional food additive was highlighted by the proximate analysis, which showed a varied macronutrient profile with high quantities of dietary fibre and carbohydrates.

Table: 1 The proximate analysis results of banana peel powder

Parameters	Mean Value
Moisture (%)	6.36 ± 0.04
Total Ash (g/100g)	9.85 ± 1
Protein (g/100g)	3.84 ± 0.05
Fat (g/100g)	1.59 ± 0.62
Dietary Fibre (g/100g)	8.5 ± 0.4
Energy (kcal/100g)	324.67 ± 0.04
Carbohydrate (g/100g)	78.37 ± 2.67

A mixture of nitric acid and perchloric acid in a ratio of 4:1 was used to digest the samples in microwave digestion system in order to ensure complete mineral extraction. The digests were filtered, made up to volume and then analyzed in triplicate for precision and reproducibility. For quality assurance, the analysis included procedures such as use of certified reference materials and analyzing blanks.

The chemical composition analysis by means of a proximate analysis of banana peel powder was done and it was found that there is a wide range of composition and thus it is likely to be a good nutritional supplement. The moisture content was determined to be 6.36%, which is quite low as compared to the other plant-based powders and this indicates that it has stability and the ability of having a long shelf life (Prabha et al., 2015). Such low moisture content would assist greatly in curbing microbial growth and even spoilage, improving the chances of storage and food processing of the powder.

The remarkably high ash content (9.85%) of banana peel powder boosts the interpretation on the adequacy of the respective mineral constituents (Zou et al., 2022). This goes in line with the findings of other researchers who have reported high levels of minerals in banana peels, including potassium, magnesium and calcium (Sahu et al., 2020). The mineral content of banana powder may therefore prove beneficial with regard to the potential uses of the powder as a source of fortification in food products or supplementation in order to meet daily requirements for certain critical minerals. The results also indicated that the protein content of banana peel powder is 3.84 percent which is relatively low but relatively closer to other plant-based powders such as that of potato peels (6.5 %) and sweet potato leaves (5.0%) (Muwonge et al., 2021). Banana peel powder should not be regarded as a major protein source, but as an alternative source of protein together with other products, especially in food products to ameliorate protein deficiency in the affected population.

According to Gupta (2022), it is interesting to find out that the fat content of banana peel powder (1.59%) is lower than that of many other fruit and vegetable powders, which typically range between 3-7%. To put it into better perspective, the low-fat content fits well within the requirements of product formulation for weight management as well as low fat containing dietary items. Additionally, because the banana peel powder is low in fat, it is excellent in creating formulations for healthy foods because it helps to keep the calories in check.

Though the recommended level of dietary fibre is higher than 8.5%, the figures established were approximately comparable to the amount of fibre contained in some other plant-based ingredients like cassava peels (8.6%) and wheat bran (11.7%) (Olaniyan et al., 2020). Additionally, with regards to the high fibre content of banana peel powder, it would be considered as an ideal functional food additive in various formulations which will support the gut health, enhance bowel movement and support weight loss through higher satiety levels.

With a carbohydrate content of 78.37%, Aremu et al., (2020), reported banana peel composition grossly explaining the energy value of 324.67 kcal/100g. It shows a significant amount of potential energy value of banana peel powder particularly when used in the production of energy dense foods, snacks, and beverages emphasizing the energy sourcing requirements in developing countries where food sourcing is a challenge as mentioned by Aremu et al, 2020 which is consistent with Aremu et al, 2020.

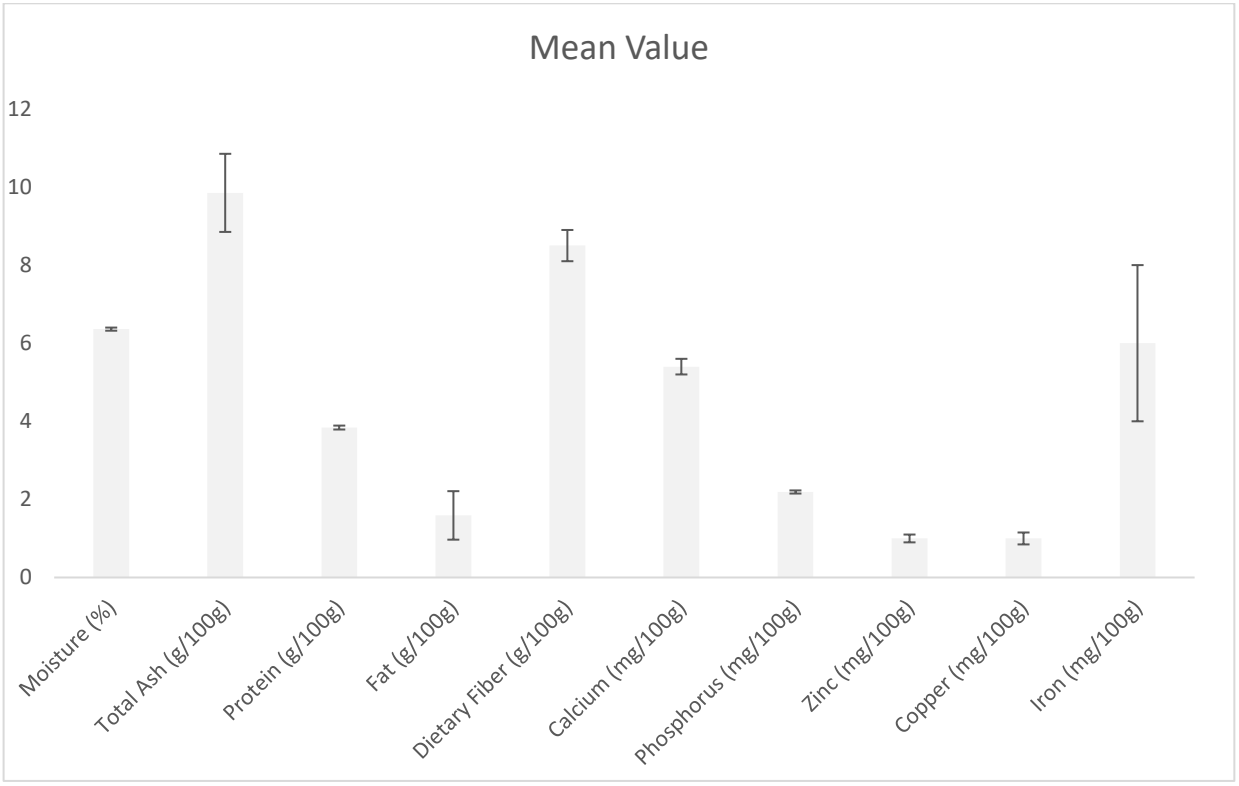

Figure 1 The proximate analysis results of banana peel powder

Table: 2 The minerals content of banana peel powder

Parameters	Mean Value
Calcium (mg/100g)	5.4 ± 0.2
Phosphorus (mg/100g)	2.19 ± 0.04
Zinc (mg/100g)	1 ± 0.1
Copper (mg/100g)	1 ± 0.15
Iron (mg/100g)	6 ± 2

Mineral election of banana peel powders was conducted and core minerals that give nutritional value to the powder were listed. Gaps on the use of banana peel powder especially on supplementation strategies in bone health and muscle function were now targeted; as calcium content of 5.4 mg/100g of the peel was far lower than other sources of calcium such as dairy products or leafy greens but at the same time sufficient in diminishing regions of high calcium demand relative to supply (Aremu et al, 2020). This is somewhere noticeably common with Sahu et al, 2020 in which there were generally low to moderate levels of calcium in the present study.

The amount of phosphorus that was recorded is 2.19 mg/100g phosphorus. Phosphorus is highly necessary for the healthy aspects of bones as well as energy and cell functioning. Even though the amount that was registered in banana peel powder is quite small though due to the diet inclusivity with other food rich in potassium it would be significant over time (Muwonge et al., 2021). The low amount of potassium that is in banana peels could be an indication that the peels may not be sufficient source for the minerals but they could be used as supplementation.

The content of Zinc in banana peel powder was recorded at 1 mg/100g zinc. Zinc is greatly needed for immune functioning, enzymes usage and even in healing of wounds. But, considering their amount of zinc content banana peels may not be enough since the amounts are lower than other food sources namely meats, legumes as well as seeds, despite this they inclusion may help even boost the overall amount of zinc ingested. The amount of zinc content was low in banana peels, which is also the case in other researches on banana peels (Zou et al., 2022) which also found out that that potassium is not sufficiently available in the peels.

Copper, another trace mineral, has been detected in banana peel powder at 1 mg/100g. Several enzymes also require copper for functioning and these enzymes play a crucial role in the body including in red blood cell synthesis, nerve cells

maintenance and collagen formation. The copper content in banana peel powder is about the same level as in many plant foods and can help in the copper requirements of the body when consumed with other enriched food. For copper, as with zinc, only traces are available which explains why Aremu et al. (2020) observed that banana peel powder is not a significant source of copper but rather a minor one for food products.

The iron level was found to be at 6 mg/100 g which is quite moderate and value addition for a common nutritional problem which is low iron status that is soldiered around the globe. Iron has many crucial roles in the body particularly in transport of oxygen and generating energy at cellular level. Certainly, the iron content of banana peel powder is not as rich as that of red meats and legumes but statistically comparable with other sources of iron from plants such as spinach and fortified cereals such as corn cereals (Olaniyan et al., 2020). The iron content in banana peel powder has the potential of helping to resident the iron deficiency in those groups of population who do not have enough animal sources of iron.

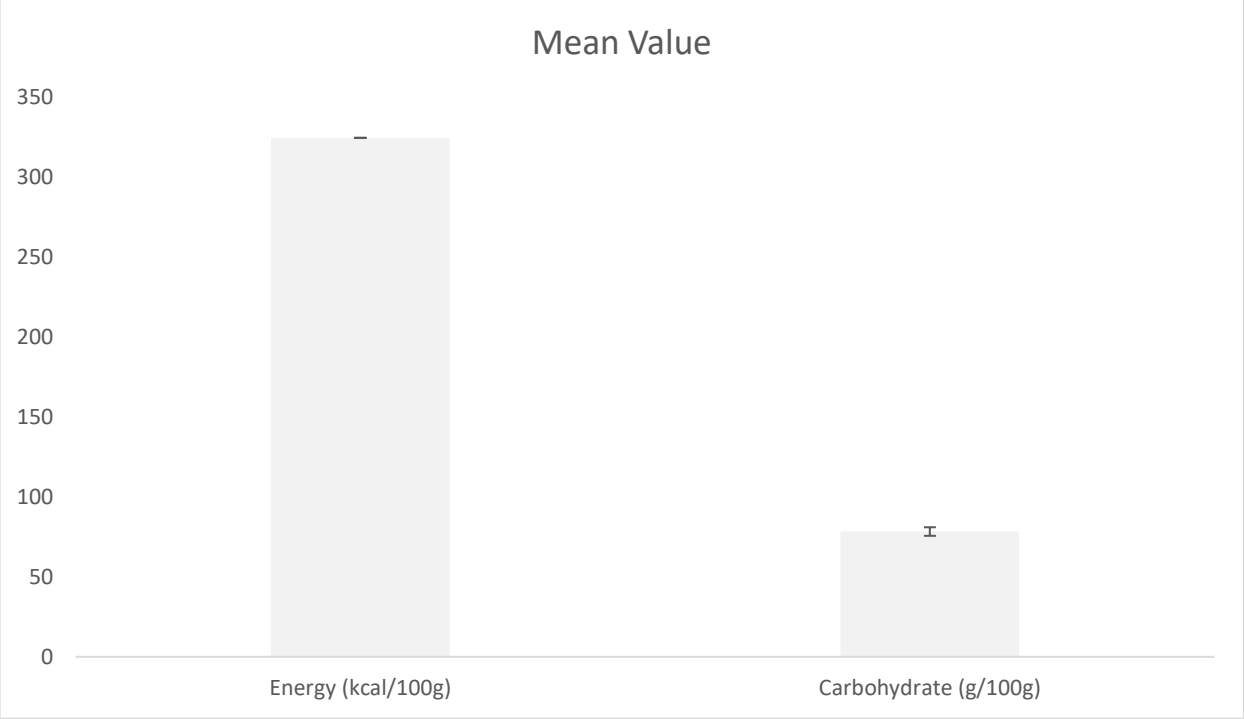

Figure 2 The minerals content of banana peel powder

4. Conclusion

Findings from proximal analysis of banana peel powder indicates that it can provide nutrition and can be of popular application throughout the food industry. Being an excellent source of low-cost material and having wide availability, banana peel powder is quite rich in dietary fibres, carbohydrates, minerals, proteins and fats as well. With all of this, banana peel powder serves well for food industry and more precisely extends opportunities for research on energy-controlled and micronutrient rich food. Its extract has a great potential that can be explored towards anti-oxidants and various aspects of musical nutrition and nutrition science. Throwing light into asset valuation while revealing insights peering into the lens of bioavailability is essential to ensure satisfaction from using these types of food products along with banana peel powder. Although minerals are posed threat in terms of availability, banana peel powder is a good source of numerous biofunctional minerals like calcium, phosphorus, zinc, copper and iron. Considering these micronutrients are prevalent at many places especially in food fortification programs where deficiencies of these minerals are quite commonly, then the banana peel powder can be used. Further exploration in terms of how effectively these minerals are absorbed and if they contribute positively to health once added to food products should be continued.

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