Biological Forum – An International Journal **14(3): 331-334(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Proximate Composition of different Varieties of Banana Pseudostem Powder for Nutritional and Biochemical properties

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(Received 13 May 2022, Accepted 04 July, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Banana (*Musa* sp.) belongs to the family Musaceae. Banana pseudostem is a by-product of banana cultivation. It has many potential for incorporating as a source of nutrients in the food products. For the effective utilization of banana pseudostem and to reduce the disposal problem, it can be used in food products for improving the nutritional value. The aim of the study is to analyze the nutritional and biochemical properties of pseudostem powder of seven different varieties namely Poovan, Nendran, Monthan, Karpooravalli, Ney Poovan, Grand Naine and Red Banana. The banana pseudostem powder recorded moisture content (7.2%), pH (7.1), total soluble solids (1.5 ˚Brix), ash (4.1%), titratable acidity (0.05%), protein (3.3%), total carbohydrates (29.3 %) and vitamin C content (6.6 mg/ 100g). The biochemical analysis showed that the proximate contents *i.e.,* total soluble solids, titratable acidity, total carbohydrates and vitamin C content were highest in the variety Karpooravalli whereas ash content and protein were highest in the variety Ney Poovan and Monthan respectively. These findings will be useful in the further studies in utilization of banana pseudostem in food industries for making products from banana.

Keywords: Banana pseudostem, cabinet drying, pseudostem powder, biochemical composition.

INTRODUCTION

Banana (*Musa* sp.) is a widely cultivated fruit crop in India. It belongs to the family Musaceae. Banana is commonly called as "Apple of the Paradise." It was originated from South East Asia. There are two species *viz., Musa acuminata* and *Musa balbisiana* from which edible bananas were originated. Banana crop performs well in both tropical and subtropical regions of the world. It is a perennial herb up to a height of 12 to15 feet.

India is the largest banana producing country in the world. According to FAO (Food and Agricultural Organization), approximately 119.83 million tonnes of banana and plantains were produced worldwide (FAO, 2020). In India, Banana is grown in an area of 8.8 lakh hectares with a production of 32.45 million tonnes (Department of Agriculture and Farmers Welfare, 2019). In Tamil Nadu, Banana occupies an area of 97,644 hectares with a production of 3.89 million tonnes (Department of Horticulture and Plantation crops, Government of Tamil Nadu, 2020-21).

Apart from its fruits, there are different parts of banana plant such as flowers and pseudostem which is also consumed in various regions. The stem of banana, usually referred to as pseudostem is an aggregation of leaf stalk bases in cylindrical form. The pseudostem includes a central core and numerous outer sheaths. Elanthikkal *et al.* (2010) reported that fruit of the banana crop contributes about 12% of the total plant weight whereas the remaining 88% of the banana plant (*i.e.,* pseudostem and leaf) is of no economic use. Approximately 220 tonnes per hectare of crop residues were produced in the banana cultivation annually (Shah *et al.,* 2005). Hence after harvest, banana crop produces large amounts of crop residues, which are usually thrown out and cause disposal problems (Li *et al.,* 2010).

Banana pseudostem is also used in the preparation of handicrafts, ropes, fabrics, papers *etc.* Pseudostem has many medicinal properties and contains many nutrients like protein, carbohydrates and dietary fibre. In recent years, the demand for the utilization of banana pseudostem has been increasing in order to enhance the nutritional benefits (Ho *et al.,* 2017). The pseudostem is also used in the treatment of various diseases namely high blood pressure, diabetes and obesity. It also helps in detoxification of the body tissues (Ambrose *et al.,* 2016). Hence, it can be potentially used as an alternative food resource.

There is a lot of potential for using banana pseudostem in food products for human consumption. It can be utilized in food products because of its potential nutritional benefit (Desai *et al.,* 2016). Hence, this

study was undertaken to analyze the nutritional and biochemical properties of banana pseudostem and to utilize in various food supplements.

MATERIALS AND METHODS

Banana pseudostems were collected from the University orchard of Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. Seven varieties were taken for the analysis namely Poovan, Nendran, Monthan, Karpooravalli, Ney Poovan, Grand Naine and Red Banana.

The pseudostem was collected from the University orchard after the harvest of the fruit bunches. It was cleaned to remove any impurities, weighed and cut into pieces using a clean knife. The cut pieces were spread uniformly in cabinet dryer and dried at a temperature of 70˚C till reaching a constant weight. The dried pseudostem was grounded into powder using pulverizer and stored at ambient temperature.

Proximate analysis

Moisture content

The moisture content of the dried pseudostem was determined by using hot air oven method (Ranganna, 1986). The weight of the empty crucible was taken. The dried pseudostem powder of known weight is taken in the crucible and kept at 105˚C for three hours. After drying, the weight of the powder and crucible was taken and moisture content was calculated.

$$\text{Moisture content (\%)} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Final weight}} \times 100$$

pH. The pH value of the powder was estimated by using pH meter. The pH meter was standardized with buffer solution of pH 7.0 and check against buffer of pH 9.2. Once it is calibrated, the sample was dissolved in distilled water and pH was determined.

Total Soluble Solids (TSS). The total soluble solid (TSS) of the pseudostem powder was estimated by using a hand refractometer and values were expressed as ˚Brix.

Ash content. The ash content was calculated by using AOAC 923.03 method. The pseudostem powder (0.5 g) was taken in a crucible and dried in the muffle furnace at 550˚C until white ash was formed. After cooling, the weight was measured and ash content was calculated.

$$\text{Ash content on dry basis(\% by weight)} = \frac{W2 - W}{W1 - W} \times 100$$

Where, W = Weight in gram of empty dish

W1 = Weight in gram of the dish with the dried material taken

W2 = Weight in gram of the dish with the ash

Titratable acidity (TA). Two gram of sample was mixed with 30 ml distilled water and 20 ml methanol. It was kept in water bath for 15 minutes and filtered through cotton. Four ml of the filtrate and five ml distilled water was taken into a conical flask and two drops of phenolphthalein indicator was added. It was titrated against 0.1N NaOH until the end point (appearance of pink colour). Titratable acidity was expressed as percentage lactic acid (Adelekan and Oyewole 2010).

Protein. The protein content of the sample was estimated by using Lowry's method. The sample (0.5 g) was mixed with a solvent and centrifuged. The supernatant part (0.2 ml) was taken in test tubes and 5ml of Lowry's reagent was added. After 10 minutes, 0.5 ml Folin-ciocalteu reagent was added and incubated for 30 minutes. The blue colour developed was read in 660 nm and the amount of protein in the sample was calculated.

Total carbohydrates. The sample (0.1 g) was mixed with 5 ml of 2.5 N HCl and kept at boiling water bath for three hours. Then it was neutralized with sodium carbonate and made up to 100 ml. The sample was centrifuged at 10,000 rpm for 20 minutes. From this 0.5 ml of the supernatant was taken and mixed with 0.5 ml distilled water. The anthrone reagent (4 ml) was added and kept for 8 minutes in boiling water bath. The absorbance was measured at 630 nm (Hedge and Hofreiter, 1962).

Vitamin C content

Vitamin C (Ascorbic acid) content was estimated using the method suggested by Ruck (1963). The banana pseudostem powder (0.5 g) was mixed with 4% oxalic acid and made upto up to a volume of 100ml and centrifuged. The supernatant part (5 ml) was added with 10ml of 4% oxalic acid and titrated against the dye until a pale pink color appeared.

RESULTS AND DISCUSSION

Moisture content. The moisture content of the dehydrated produces determines the keeping quality and longevity of the finished goods. The low moisture content products can be stored for a long period of time without any quality deterioration. The moisture level of food products also has a significant impact on textural quality, chemical and biological reactions as well as microbial growth rates. The moisture content (%) of Poovan, Nendran, Monthan, Karpooravalli, Ney Poovan, Grand Naine and Red banana varieties are 5.0, 7.5, 6.2, 8.9, 8.3, 7.9 and 6.5 respectively at 70˚C drying temperature. The highest moisture content was observed in the variety Karpooravalli (8.9%) and the lowest was recorded in the variety Poovan (5.0%). Aziz *et al.* (2011) reported that moisture content in dried pseudostem powder of *Musa acuminata* × *Musa balbisiana* Colla cv.Awak as 8.82%.

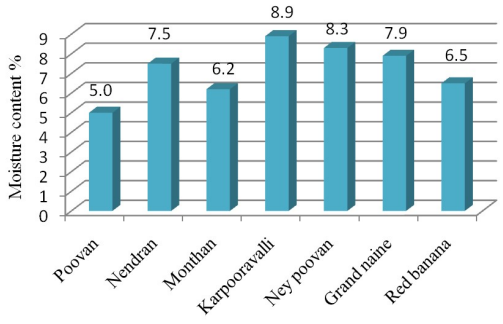

Fig. 1. Moisture content of pseudostem powder.

The differences in the moisture content may be due to the binding capacity of the finished produces due to the presence of high molecular weight components like lignin, cellulose, hemicelluloses in the different varieties of banana under study.

pH. pH of Poovan, Nendran, Monthan, Karpooravalli, Ney Poovan, Grand Naine and red banana varieties were 7.8, 7.2, 7.6, 6.1, 7.4, 7.1 and 6.5 respectively. It shows that Poovan (7.8) variety recorded the highest pH value and Karpooravalli (6.1) has the lowest value. Tiroutchelvame *et al.* (2019) also reported a pH value was 6.02 at 70°C drying temperature of banana pseudostem in the variety Poovan. Though the reports are in accordance with the earlier findings, the reason for the difference in pH value might be due to genetic and genomic constitution of the varieties and growing conditions.

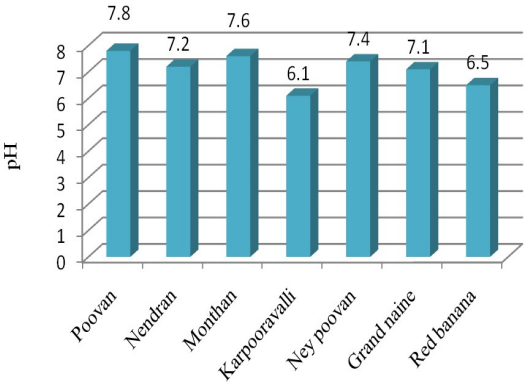

Fig. 2. pH of pseudostem powder.

Table 1: Proximate composition of banana pseudostem powder.

Variety	TSS (˚Brix)	Ash Content (%)	Titratable acidity (%)	Protein (%)	Total carbohydrates (%)	Vitamin C content (mg/100g)
Poovan	2.0	1.8	0.018	2.2	26.0	6.5
Nendran	1.0	3.5	0.036	2.8	22.4	5.2
Monthan	0.8	2.9	0.054	5.0	32.4	8.0
Karpooravalli	3.0	5.2	0.072	2.4	38.8	9.5
Ney Poovan	0.6	7.8	0.060	4.0	29.2	3.4
Grand Naine	1.2	3.0	0.063	3.4	35.6	8.6
Red banana	2.2	4.5	0.025	3.6	20.5	4.7
Mean	1.5	4.1	0.05	3.3	29.3	6.6
SE	0.31	0.69	0.01	0.34	2.37	0.78

Total soluble solids (TSS). Total soluble solids are solid substances which are dissolved in a substance or product. Brix values are important parameters because it is related to flavor and sweetness of the product. Table 1 shows the total soluble solids (˚Brix) of the seven varieties of banana pseudostem ranged from 0.6 to 3.0˚Brix. The highest TSS observed in the variety Karpooravalli (3.0˚Brix) and lowest value in the variety Ney Poovan (0.6˚Brix). Similar studies conducted by Tiroutchelvame *et al.* (2019) shows the total soluble solids of 1.2 ˚Brix in the banana pseudostem flour in the variety Poovan.

Ash content. The ash content of the sample represents the amount of organic matter present in it. If the ash content is high, it indicates the higher amount of minerals present in the sample. It is a part of proximate analysis for nutritional evaluation. Table 1 shows the ash content of the seven varieties of banana pseudostem ranged from varieties 1.8 to 7.8%. The highest ash content was observed in the variety Ney Poovan (7.8%) and lowest value was observed in the variety Poovan (1.8%). Aziz *et al.*(2011) reported the ash content of native banana pseudostem flour as 3.03% and banana (*Musa acuminata* × *Musa balbisiana* Colla cv.Awak) pseudostem flour as 10.08%.Similarly, ash content of 0.8 – 8.47 percent was reported by Lebesi and Tzia (2011) in wheat fibre and rice bran fibre.

Titratable acidity (TA). Titratable acidity of the pseudostem of different banana cultivars is also represented in the Table 1. The result shows that titratable acidity (%) of the seven varieties of banana pseudostem ranged from 0.018 to 0.072%. The highest titratable acidity was observed in the variety Karpooravalli (0.072%) and the lowest acidity was observed in the variety Poovan (0.018%). Ho *et al.* (2012) reported that BPF (Banana Pseudostem Flour) had a 0.04% Titratable Acidity (TA) in *Musa acuminata X balbisiana* cv. Awak.

Protein. Proteins are essential for tissue repair and body building processes. It also helps in maintaining body fluids. The protein content (%) of the seven varieties of banana pseudostem ranged from 2.2 to 5.0%. The highest protein content was observed in the variety Monthan (5.0%) whereas lowest was observed in the variety Poovan (2.2%). It was reported that protein content of the banana pseudostem flour of *Musa acuminata* X *balbisiana* cv. Awak as 2.7% (Ho *et al.*, 2017). Hence protein in the pseudostem can be used for making low gluten foods like cakes (Sangroula, 2018). As reported by Lebesi and Tzia (2011), the protein content was also in normal range in different commercially available fibre of wheat or oat bran.

Total carbohydrates. Carbohydrates in banana crop have low glycemic index or low digestibility hence it can be used in functional food as substitution of flour in cookies (Saguilan *et al.*, 2007). Total carbohydrates (%) of the seven varieties of banana pseudostem ranged from 20.5 to 38.8 %. The total carbohydrate was high in the variety Karpooravalli with 38.8 percent. The lowest carbohydrates content was observed in the variety Red Banana with 20.5 percent. Ramu *et al.* (2017) reported that the total carbohydrate in the banana pseudostem of *Musa* sp. cv. Nanjangud rasa bale was 46.58 %. The difference may be due to different drying condition or part of pseudostem used.

Vitamin C content. Vitamin C (Ascorbic acid) is an essential vitamin for the growth, maintenance and repair of body tissue. Vitamin C content (mg/100g) of the seven varieties of banana pseudostem ranged from 3.4 to 9.5 mg/100g. The Table1 shows that highest vitamin C content was recorded in the variety Karpooravalli (9.5 mg/100 g) and lowest seen in the variety Ney Poovan (3.4 mg/100 g). The observed values were lower than the vitamin C content of banana powder in the variety Poovan (10.5mg/100 g) reported by Harish *et al.,* (2017).

CONCLUSION

The results of this study showed that the banana pseudostem is rich in proximate composition such as total soluble solids, ash content, titratable acidity, protein, total carbohydrates and vitamin C content. Pseudostem powder can be utilized in various value-added products as a source of dietary fibre to improve the nutritional quality. In addition, the low moisture content of the pseudostem powder increases the shelf life and makes it a useful ingredient to incorporate in the food industry. It is an efficient way for using the by-product of banana crop which significantly reduces the waste disposal problem.

FUTURE SCOPE

According to the findings of this study, the banana pseudostem is rich in nutritional value and has a lot of potential for the utilization in food products. Future research should be conducted based on the development of technologies to effectively use the benefits of banana pseudostem.

Acknowledgement. I wish to thank the Department of Fruit science, Horticultural College and Research Institute and Department of Biochemistry, Tamil Nadu Agricultural University, Coimbatore for providing amenities to conduct the research work.
Conflict of Interest. None.

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How to cite this article: Mydhili M., Pugalendhi L., Indu Rani C., Auxcilia J. and Uma D. (2022). Proximate Composition of Different Varieties of Banana Pseudostem Powder for Nutritional and Biochemical properties. *Biological Forum – An International Journal*, *14*(3): 331-334.