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Nutritional composition of Grand-9 tender banana pseudo-stem flour

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Abstract
Grand-9 banana pseudo-stem was considered as waste after harvesting and generally used to burn which cause environmental issues. But the nutrients present in the pseudo-stem have a great impact on human health. The present study focused on the nutritional composition of Grand-9 tender banana pseudo-stem flour. The moisture content was 7.46 ± 0.16%, protein 6.72 ± 0.15%, fat 2.86 ± 0.12%, ash 28.91 ± 0.02%, carbohydrate 39.17 ± 0.20%, energy 209.32 ± 0.49 K.cal, crude fibre 14.86 ± 0.23%, dietary fibre 33.04 ± 0.08%, total phenols 172.27 ± 0.10 mg of GAE/100g, total flavonoids 978.62 ± 0.59 mg of RTE/100g, DPPH 36.88 ± 0.21% inhibition, tannins 3.21 ± 0.01 mg of TAE/100g, water holding capacity (WHC) 539.4 ± 0.57%, oil holding capacity (OHC) 225 ± 1.0%. Therefore, it shows that banana pseudo-stem flour can be used to incorporate in various foods to improve the nutritional quality.

Keywords: Environmental issues, banana pseudo-stem flour, human health, nutritional quality

Introduction
In recent years, the production of the banana crop is increasing with a global annual production of 116 million tons (FAOSTAT, 2018) [1]. India is one of the top producers of banana, which produces 30.8 million tonnes with a 26.83% share of the world's bananas production. In India, 16.27% production share is from Andhra Pradesh and Telangana shares 0.29% (NHB, 2017-18) [2]. Telangana state mostly produces Grand-9 variety which belongs to the species *Musa Acuminata* with ploidy AAA (Hasan & Khasim, 2018) [3]. Banana is the largest herbaceous perennial plant which consists of an aerial pseudo-stem, leaves, subterranean stem and inflorescence. The corm is the actual stem to which growing suckers and roots are attached; the corm supports the pseudo-stem, the leaves and the inflorescence that contains the flowers and then the fruit. As the shoots flower only once and die after fruiting this plant is monocarpic (Karamura *et al*., 2011) [4]. The pseudo-stem that rises from the corm consists of concentric layers of leaf sheaths with the centre tender core. After each harvesting, the banana crop produces a vast amount of pseudo-stem residue which was burned and causes air pollution. And this biomass was described to be rich in nutrients such as minerals, sugars, resistant starch, dietary fibres, and antioxidant compounds. Thus, wastage of this residual biomass is a loss of the nutrient value therein (Aziz *et al*., 2011) [5]. In recent years, demand for the utilization of banana pseudo-stems is increasing through different processing methods to enhance its economic and nutritional benefits (Ho *et al*., 2017) [6]. Pseudo-stems are not only nutritious but also used to treat many health ailments (Ahmad *et al*., 2018) [7]. Banana pseudo-stems are rich in dietary fibre which helps to treat constipation and weight loss (Chandrasekaran, 2012) [8]. Due to its low glycemic index and high fibre content, it is good for diabetic patients (Bhaskar *et al*., 2011) [9]. Pseudo-stems are also rich in antioxidants, antimicrobial, antitumour, antiallergic and antiurolithiatic properties which helps to fight against various diseases and keep the human body healthy (Ghany *et al*., 2019) [10], (Mesa *et al*., 2019) [11], Panigrahi *et al*., 2017) [12].

Materials and Methods
In this present study, the pseudo-stems were dried, powdered and evaluated nutritional and phytochemical compounds present in the pseudo-stem flour. Banana pseudo-stems of Grand-9 variety were procured from the banana fields of Athvelly village, Vikarabad Mandal, Telangana state. The banana pseudo-stem was cleaned under tap water. Then the outer sheaths were removed till the inner tender core. The inner tender core was made into slices with slicer. Then the slices were soaked in 0.2% citric acid solution for 10 minutes to control the browning reaction. Then these tender core pieces were blanched at 100 °C for 2minutes and dried using

a laboratory tray dryer at 60 °C. It took 12 hours to dry completely. The dried sample was powdered using a mixer. Then the powder was sieved with a 400-micron sieve and stored in airtight containers.

Nutritional composition of Grand-9 Banana pseudo-stem flour

The nutritional quality parameters of Grand-9 banana pseudo-stem flour include moisture (AOAC, 2005) [13], protein (AOAC, 2005) [14], crude fibre (AOAC, 1995) [15], ash (AOAC 2005) [16], fat (AOAC,1997) [17], carbohydrates & energy (AOAC, 1980) [18], dietary fibre (AOAC, 1995) [19], total phenols (Slinkard and Slingleton 1997) [20], total flavonoids (Zhishen *et al*., 1999) [21], DPPH (Tadhani *et al*., 2007) [22], tannins (Kavitha Chandran and Indira, 2016) [23] and physical parameters like water holding capacity and oil holding capacity (Chau and Huang 2003) [24] were analysed using standard methods.

Results and Discussion

Table 1: Nutritional composition of Grand-9 tender banana psuedo stem flour (100gms)

Nutritional parameters	Values	Units
Moisture	7.46 ± 0.16	%
Protein	6.72 ± 0.15	%
Fat	2.86 ± 0.12	%
Ash	28.91 ± 0.02	%
Crude fibre	14.86 ± 0.23	%
Total dietary fibre	33.04 ± 0.08	%
Carbohydrates	39.17 ± 0.20	%
Energy	209.32 ± 0.49	K. cal
Total phenols	172.27 ± 0.10	mg of GAE/100g
Total flavonoids	978.62 ± 0.59	mg of RTE/100g
DPPH	36.88 ± 0.21	% inhibition
Tannins	3.21 ± 0.01	mg of TAE/100g
Water holding capacity (WHC)	539.4 ± 0.57	%
Oil holding capacity (OHC)	225 ± 1.0	%

*GAE- Gallic Acid Equivalent *RTE- Rutin Equivalent *TAE- Tannic Acid Equivalent

Grand-9 variety of tender core banana pseudo-stem flour consists of various nutrients which help to maintain good health. The nutrient parameters of the pseudo-stem flour were presented in Table-1.

Moisture

The moisture content of Grand-9 variety tender core banana pseudo-stem flour was 7.46%. Sangroula (2018) [25] reported lower moisture content (6.2%) while Aziz *et al*. (2011) [5] reported higher moisture content (8.82%). However there was no significant difference in the moisture content, the variations may be due to differences in the variety of banana, size of the banana pseudo-stem slices and drying conditions (Sangroula, 2018) [25]. It helps to maintain the good keeping quality of the flour, as the moisture content of flour was less than 10%. Though, the keeping quality is affected by other environmental and storage conditions (Wakeel, 1995) [26].

Protein

Tender core banana pseudo-stem flour of Grand-9 variety protein content was 6.72%. It was reported that protein in banana pseudo-stem flour of Bichi variety was 9.130% and Kacha variety was 4.260% which were slightly higher and lower than Grand-9 variety respectively (Farzin *et al*., 2014) [27]. The protein content in the wheat flour was 10.2%, higher than the pseudo-stem flour. It shows that banana pseudo-stem flour has the potential to make low gluten food, such as cake (Sangroula, 2018) [25].

Fat

The fat content of Grand-9 variety pseudo-stem flour was 2.86% which was higher than the study conducted by Sangroula (2018) [25] i.e., 1.8%, which may be due to differences in the varieties of the banana pseudo-stems.

Ash

Ash is the inorganic residue after the removal of water and organic matter from the food which indicates a good amount of minerals. Ash content of Pseudo-stem flour was 28.91g/100g which was similar to the study conducted by Tiroutchelvame *et al*. (2019) [28] i.e., 28g/100g at 60 °C. Higher ash content represents higher mineral contents.

Crude fibre

Crude fibre is the indigestible cellulose, pentoses, lignins and other components present in the food. Grand-9 banana pseudo-stem flour contains 14.86% of crude fibre which was similar to Tiroutchelvame *et al.* (2019) [28] study showing a slightly higher crude fibre content of 15%. Whereas, Sangroula (2018) [25] reported lower crude fibre content of 13.3%.

Total dietary fibre

Grand-9 variety of banana pseudo-stem has 33.04% of total dietary fibre content which was slightly higher than Bhaskar *et al*. (2011) [9] (28.8%). Total dietary fibre is composed of both soluble dietary fibre and insoluble dietary fibre. It is a type of carbohydrate, withstands digestion and absorption and may or may not undergo microbial fermentation in the large intestine. Consumption of dietary fibre has a lot of positive health effects such as it helps to maintain GI tract function, reduces the risk of diabetes, obesity, coronary heart disease and several types of cancer (Lattimer *et al*. 2010) [29].

Carbohydrates

Total carbohydrates had been expressed as residual percentage weight by the formula: [100-(moisture + ash + fat + fibre + protein)]. Carbohydrate percent in the Grand-9 variety of pseudo-stem was 39.17%. The carbohydrate percent in the study conducted by Ramu *et al.* (2017) [30] was 46.58%. The variation may be due to varietal difference and higher ash content in the Grand-9 variety.

Energy

Banana pseudo-stem flour of Grand-9 variety provides 209.32 K.cal per 100g. It was found that the calorific value of Musa species Bichi and Kacha varieties were 363.8 K.cal and 335.944 per 100g (Farzin *et al*., 2014) [27]. The energy was computed by the formula: Energy (Kcal) = (Protein×4) + (Fat×9) + (Carbohydrates×4). Therefore banana pseudo-stem flour can also be used as an energy supplement in low-calorie foods.

Phytochemicals

Total phenols and flavonoids

Total phenols and flavonoids are the natural bioactive compounds act as free radical scavengers, reducing agents which help to control cancer and other diseases. Total phenols

and flavonoids content in Grand-9 banana pseudo-stem was 172.27 mg of GAE/100g and 978.62 mg of RE/100g respectively. Ramu *et al.* (2017) [30] reported total phenols content was 188.64 mg of GAE/100g in Musa species Nanjangud Rasa Bale. Whereas, total flavonoids content in tender banana pseudo-stem flour (*M. acuminata* × *balbisiana Colla cv. Awak*) was 1042 mg CEQ/100 g (Aziz *et al*. 2011) [5].

DPPH

DPPH (α-diphenyl-β-picrylhydrazyl) assay is a free radical scavenging method that evaluates the antioxidant capacity of the sample extract. Grand-9 variety of banana pseudo-stem flour has 36.88 percent inhibition on free radicals. Saravanan *et al*. (2011) [31] reported that DPPH radical scavenging activity in methanol extract of different banana pseudo-stem cultivars was 40.02 to 12.73%. Therefore free radical scavenging activity in the Grand-9 variety was good and helps to inhibit the cellular damage in our body.

Tannins

Tannin is an antinutrient that inhibits the absorption of dietary minerals such as iron, copper and zinc. Tannin content in Grand-9 banana pseudo stem flour was 3.21 mg TAE/100g. Delimont *et al*. (2017) [32] reported that four weeks of supplementation of condensed tannic acid (1.5, 0.35 and 0.03 g 3 times/day) had no effect on iron bioavailability or status in premenopausal women. Therefore, the amount present in the banana pseudo-stem flour had no effect on human health when consumed at the required levels.

Functional parameters

Water holding capacity (WHC)

Water holding capacity is the ability to hold the water. It is an important property for the digestion and satiety of foods rich in fibre. WHC helps to reduce the loss of nutrient values present in the foods. WHC of Grand-9 banana pseudo stem was 539.4%. It was reported that WHC of *Musa cavendish* banana pseudo-stem flour was 433% (Yuliatmoko *et al*., 2019) [33]. The dissimilarity may be due to the varietal difference.

Oil holding capacity (OHC)

Oil holding capacity is the quantity of the oil that a sample can absorb per unit of weight. OHC aids to improve the texture of a product. OHC of Grand-9 banana pseudo stem was 225%. It was reported that the OHC of *Musa cavendish* banana pseudo-stem flour was 300.40% (Yuliatmoko *et al*., 2019) [33]. The variation may be due to the difference in the varieties of banana pseudo-stems.

Conclusion

It was concluded that the Grand-9 tender banana pseudo-stem flour was mostly rich in dietary fibre, antioxidants and minerals due to more ash content that is used to control various health problems like diabetes, kidney stones, hypertension etc. Pseudo-stem flour is also used in the development of various value-added products to improve human health. Hence, it is the best option for the banana cultivated farmers to use the banana pseudostems which is cost-effective.

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