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Product Development and Nutritional Assessment of Banana Pseudostem Squash

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ABSTRACT

The study, titled "Product Development and Nutritional Assessment of Banana Pseudostem Squash," aimed to create and assess a squash derived from banana pseudo stem and sugar syrup, enhanced with three distinct essences: vanilla, mint, and ginger. Sensory analysis gauged the acceptability of the banana pseudo stem squash variants, revealing that the vanilla-infused version scored notably higher, averaging 8 out of 9. The investigation involved tracking protein, antioxidant, carbohydrate, total ash, acidity percentages and total soluble solids (°Brix) over three months. Findings indicated a rising trend in total soluble solids and declining trends in titrable acidity, antioxidant, carbohydrate, and protein during storage. The squash, bottled in glass, exhibited a shelf life of three months at ambient conditions without compromising sensory qualities, meeting established quality standards. This product's heightened acceptability in sensory evaluation highlights its potential for the profitable utilization of banana pseudo stem, contributing to the development of various value-added products.

Keywords*:* Banana pseudostem, Squash, Antioxidants, Functional beverage, Utilization of banana waste

INTRODUCTION

The banana plant, known for its rapid growth and abundant biomass, is a significant agricultural product, with India ranking as its second-largest producer after mangoes. Belonging to the Musaceae family, this herbaceous plant's stem, termed the pseudostem, yields a single bunch of bananas. Post-harvesting, substantial residue in the form of the pseudostem and leaves remains. Improper disposal leads to fungal contamination and environmental pollution when incinerated openly. However, repurposing this banana waste, particularly the pseudostems, presents an opportunity to efficiently manage solid waste while leveraging its nutritional and functional qualities. Studies highlight the pseudostem's richness in fiber and medicinal value, urging exploration into its optimal utilization. Despite its potential in food products due to mineral and nutrient richness, knowledge gaps persist regarding its composition, drying properties, impact of drying on its constituents, quality of resulting dried products, and its application in food manufacturing. Emphasizing its potential primarily in the food sector, transforming discarded banana pseudostems into products not only benefits the environment but also enhances its economic value.

The banana stem, rich in fiber, potassium, and vitamin B6, holds potential for treating ulcers and supporting the creation of a sports drink that benefits muscles, hemoglobin, and insulin production. In Ayurveda, it's used for weight loss, acting as a diuretic, preventing kidney stones, and promoting overall health. Pseudostems contain bioactive compounds like polyphenols and flavonoids, offering antioxidant properties beneficial for conditions like obesity, type II diabetes, glucose regulation, and inflammation [1]-[4]. Abundant in cellulose, hemicellulose, protein, fat, and dietary fibers, banana pseudostems also include minerals such as calcium, iron, magnesium, and phosphorous [5]. This material, often discarded, can be repurposed into various profitable products for human consumption, benefitting banana farmers and entrepreneurs. From fibers, fabrics, jellies and bio-ethanol, multiple value-added items have been developed. Additionally, banana flours from fruits and peels have been transformed into diverse baked goods like cookies, bread, snacks, noodles, and cakes with health-enhancing properties [6].

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This study focuses on a novel product derived from the banana pseudostem, squash. Traditionally, squash refers to a concentrated, non-alcoholic syrup made from fruit juices, water, and sweeteners, constituting a significant portion of the fruit juice and soft drinks market. While literature exists on processing banana pseudostem, including juice extraction, pickle, jaggery, and candy production, scant research investigates the

creation of food products from this source. Furthermore, limited studies have explored the evaluation of the newly developed squash product in terms of its physical and chemical properties, antioxidant qualities, and consumer acceptance.

MATERIALS AND METHOD

The product originated from the Agricultural Research Station in Anakkayam, Manjeri, Malappuram, Kerala, India. To create it, tender banana pseudostems were carefully chosen based on their maturity, size, and firmness, ensuring they were undamaged. After a thorough cleaning to remove any dirt or chemical residues, the stems were chopped into small pieces by removing the outer sheaths. These pieces were briefly blanched in hot water for 5 minutes, cooled, and then juiced using a mixer, with the extracted juice filtered through a strainer. A sugar syrup was made separately, then mixed into the juice along with citric acid and essence to enhance the taste and flavour. KMS was included as a preservative before bottling the squash into 750ml glass bottles. The blended squash was observed up to three months while keeping at ambient storage condition. The product can be served by diluting three times with water for obtaining better taste, flavour and overall acceptance of the product.

Biochemical analysis

The banana pseudo stem squash samples measured TSS using an Abbe's refractometer. Total ash was determined through the dry ash technique as outlined [7]. Estimation of protein by Lowry’s method [8] and carbohydrate content were assessed following guidelines [9]. Antioxidant activity was estimated using the DPPH Radical Scavenging Assay.

Sensory evaluation

Squash samples with different flavours were analysed for sensory characteristics. A panel of 10 semi-trained individuals used a 9-point Hedonic scale to evaluate sensory quality characteristics such as appearance, colour, flavour, texture, odour, taste, aftertaste, and overall acceptability. Scores for each parameter were totalled and the overall acceptability score for each squash variant—Banana Pseudo stem Squash with ginger (T1), mint (T2), and vanilla (T3)—was determined by averaging these scores.

RESULTS AND DISCUSSION

Figure 1 Newly developed Banana Pseudostem squash

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The sensory evaluation of banana pseudostem squash of different flavours was done among 10 people and they evaluated the sample for sensory attributes like appearance, colour, flavour, texture, odour, taste, after taste and overall acceptability. According to this evaluation banana pseudostem squash with vanilla essence scores more. Taste, after taste and flavour gained a better acceptance followed by colour, texture and appearance. Developed banana pseudostem squash with vanilla gained a better overeall acceptability with an average grade 8 out of 9. According to this evaluation the standardized banana pseudostem squash have good taste with overall acceptability and choosen for further analysis.

Table I SENSORY AVERAGE SCORES OF BANANA PSEUDOSTEM SQUASH

Sample	Appearance	Flavour	Colour	Texture	Odour	Taste	After taste	Overall acceptability
T1	7.2	7.8	6.8	7.5	8	7.4	7.4	7.15
T2	7.3	7	7.1	7.5	7	7.2	7.1	7.18
T3	7.5	7.9	7.4	7.7	6.6	8.2	8	8

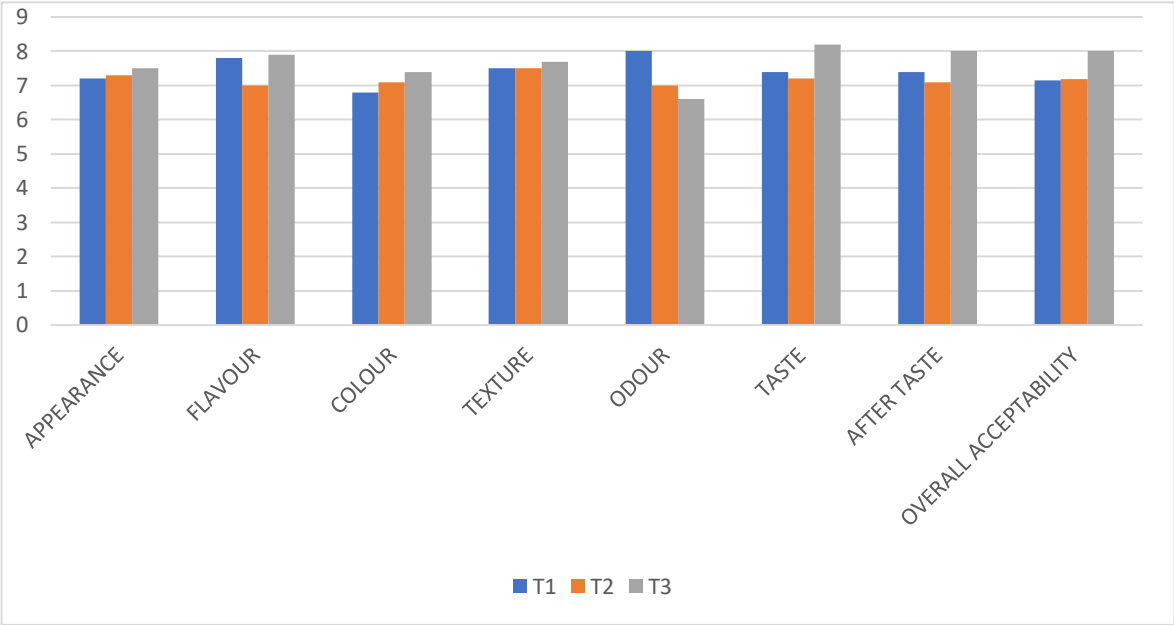

Figure 2 Sensory evaluation chart representation

Total soluble solids (TSS) of pseudostem squash started at 45^0Bx in the initial month P1, experiencing slight rises in P1 and P2 to 45.31 and 45.35, respectively.[10] found a comparable trend in mixed fruit squash, echoed in studies [11] examining blended squash using banana pseudostem sap alongside mango, papaya, and Aloe vera, as well [12], investigation into environmentally friendly mango squash made from natural ingredients. These increases in TSS are likely attributed to the breakdown of polysaccharides into sugars.

The titrable acidity of banana pseudostem squash was measured at 3.31 in the initial month P1, declining slightly to 3.30 in subsequent months. This decline in acidity mirrors findings from studies [12], [13]. The reduction in acidity is attributed to acids being utilized in the breakdown of polysaccharides into simpler sugars.

The DPPH assay findings indicated that initially, the pseudostem squash exhibited 38.28% antioxidant activity, which slightly declined to 38% after being stored for three months at room temperature. A parallel decline in antioxidant activity during storage was observed in a study on pomegranate squash[13], as well as in research conducted[14], where higher storage temperatures led to increased decreases in antioxidant activity. This decline was attributed to a reduction in polyphenols and flavonoids within the squash.

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Over a storage period of three to six months, various studies, including those [11] in Standardization of Blended Squash using Banana Pseudostem Sap with Mango, Papaya and Aloe Vera[15], in banana pseudostem based novel functional blended ready to drink beverages with ginger rhizome and nannari root extracts. Blended nectar using banana pseudostem sap and mango pulp, observed a consistent decrease in carbohydrate content in squash and blended beverages incorporating banana pseudostem sap[16]. This reduction was also noticed in banana pseudostem squash from an initial 21.4% to 20.92% was attributed to the transformation of complex polysaccharides into simpler sugars.

The protein content in squash derived from pseudostems fluctuates between 2.39% and 2.30%. This variance is likely attributed to protein denaturation and oxidation. A comparable study on the standardization of mixed squash employing banana pseudostem sap, mango, papaya, and aloe vera[11]. Similarly, the blending of aonla and aloe vera nectar using stevia as a sugar alternative [17]. Additionally, the creation of blended nectar using banana pseudostem sap and mango pulp[16].

The percentage of ash in the sample provided insights into its inorganic composition, offering a basis for deriving the mineral content [18]. There's negligible change observed in the ash content from the initial month to the three-month mark. Ash, the residue left after eliminating water and organic components from food, signifies a notable presence of minerals. Elevated ash content correlates with increased mineral levels.

TABLE II BIOCHEMICAL ANALYSIS DURING STORAGE PERIOD

Biochemical Analysis		Storage period		mean
	P1	P2	P3	
TSS	45	45.31	45.35	45.22
Titrable acidity	3.31	3.30	3.30	3.30
Antioxidant activity	38.28	38.10	38	38.12
Carbohydrate	21.4	21.16	20.92	21.16
Protein	2.39	2.37	2.30	2.35
Ash	0.3	0.29	0.29	0.29

CONCLUSION

The experimental findings on the development and nutritional assessment of Banana pseudostem squash have been remarkably promising. The product showcases exceptional taste and superior nutritional content, notably rich in antioxidants crucial for promoting good health and preventing chronic diseases. Chemical analysis revealed that the composition aligns impeccably with FPO specifications, with notable attributes such as 45 Brix, 38.12% antioxidants, 21.16% carbohydrates, 3.30% acidity, 2.35% protein, and 0.29% total ash, all meeting the desired standard. Moreover, sensory evaluation involving a panel of 10 individuals indicated high acceptability and excellent taste, particularly for the Banana pseudostem squash flavoured with vanilla. Importantly, the product demonstrates an impressive shelf life of more than three months when appropriately packed in pre-sterilized bottles and stored under ambient conditions. In conclusion, the developed Banana pseudostem squash stands as a testament to both quality and taste. Its ease of preparation from the Banana pseudostem, combined with its extended shelf life and exceptional sensory appeal, positions it as a valuable and enjoyable addition to the market of nutritious and flavourful food products.

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