

Development and Quality Evaluation of Ready to Serve (RTS) Beverage from Banana Pseudo Stem

ABSTRACT

Vegetable beverage was part of a balanced diet that make sure the vigor and healthy body. Vegetable juices were rich in fiber content which was quickly inducing the feeling of satiety and also improve digestion. The objective of this study was to formulate and prepare ready to serve (RTS) banana pseudo stem beverage. Two banana varieties were selected viz., ottu vazhai (syn Mupaddai) (V_1), vayal vazhai (V_2). Banana pseudo stem beverage was developed from banana tender core, natural flavorings (lemon, mint)extracts, 2% citric acid as a anti-browning agent, KMS (70ppm) as preservative and CMC (0.1%) as a stabilizer. The proximate composition, physico- chemical analysis, sensory evaluation and microbial study of the pseudo stem beverage was evaluated using standard procedures. The beverages were evaluated at 15 days interval period. During storage conditions the quality of juice with minimum significant changes in chemical properties was observed with the addition of KMS. Based on the sensory evaluation, lemon juice flavored pseudo stem beverage was highly accepted by consumer than mint flavored beverage. Storage study for the pseudo stem beverage was also carried out and significant difference was noticed in beverage. Compare to vayal vazhai (V_2), the yield of juice (87.0%) content was higher in ottu vazhai (syn Mupaddai) (V_1).The maximum desirable results were obtained from (V_1) lemon flavored beverage stored at refrigeration condition. The results were showed that pH (3.28 to 4.75), TSS (12 to 14.0°brix), Acidity (0.35 to 0.26) and vitamin C (0.77 to 0.59). From the storage studies, the lemon flavored pseudo stem beverage (Mupaddai variety V_1) was found to be the best in nutrient retention and sensory evaluation than mint flavour beverage and it was accepted up to 45 days.

key words: Banana pseudo stem, browning reaction, pasteurization, blanching, antioxidant

1.0 INTRODUCTION

Banana was one of the major fruit crop grown in India and area and production wise it stands second position. The banana stem otherwise known as pseudo stem. The pseudo stem juice contains rich fiber. Pseudo stem (vegetable) used as common foods in some regions of India (CFTRI,Mysore). Banana pseudostem which one considered as waste material and create environmental problem, now it greatly used for nutritious food [1].

After harvesting of the banana, disposing of the pseudo stem in the field was one of the problem. An average, 60 to 80 tones/hecter of the pseudo stem wasted alone. The banana tender core mainly contains 90 % moisture content and it cannot be maintain long period of time [2]. The banana pseudo stem is highly perishable, because it comprises more moisture content and had a short shelf life [3]. The banana tender core rich in fiber content and it helps in weight control. The high fiber content relieves the constipation. It also rich in potassium and vitamin B6, it helps to detoxify the body being a diuretic. So, the tender core juice best remedy for kidney stones [4].

Fruit extracts that was rich in antioxidants such as lemon juice were used as an effective agent in decreasing intracellular ROS concentration and protecting lipid, DNA and mitochondrial functionality from the damage induced by free radicals. Lemons are an excellent source of vitamin C and flavonoids, which are antioxidants. Lemon juice has several important chemical components with therapeutic features such as citric acid (Vitamin C, 2-hydroxy-1,2,3-propanetricarboxylic acid) [5]. Citrus fruits are also known to contain bioactive compounds such as phenolics, flavonoids, vitamins, and essential oils which are believed to be responsible for a range of protective health benefits including anti-oxidative, anti-inflammatory, antitumor, and antimicrobial activities. Citrus juices are consumed majorly because of their nutritional value and special flavor [6].

Mint leaves were well known herb and considered stimulant, carminative and antispasmodic. It leaves was good source of β -carotene, calcium, Iron, and vitamin C. It had antibacterial effect [7]. Mint was also a rich source of polyphenolic compounds and hence it had strong anti-oxidant properties [8]. It was used in the food industry as an additive in beverages or food products. Intensely fragrant mint essential oil contained primarily in the leaves of this plant [9].

2.0 MATERIALS AND METHODS:

The variety of banana pseudo stem such as Ottu vazhai (syn Muppada), vayal vazhai was procured from Kovilpappakudi & Thathakkoundampatti, Madurai district, Tamil Nadu, India. Natural flavorants such as lemon, mint was purchased from local market, Madurai, India.

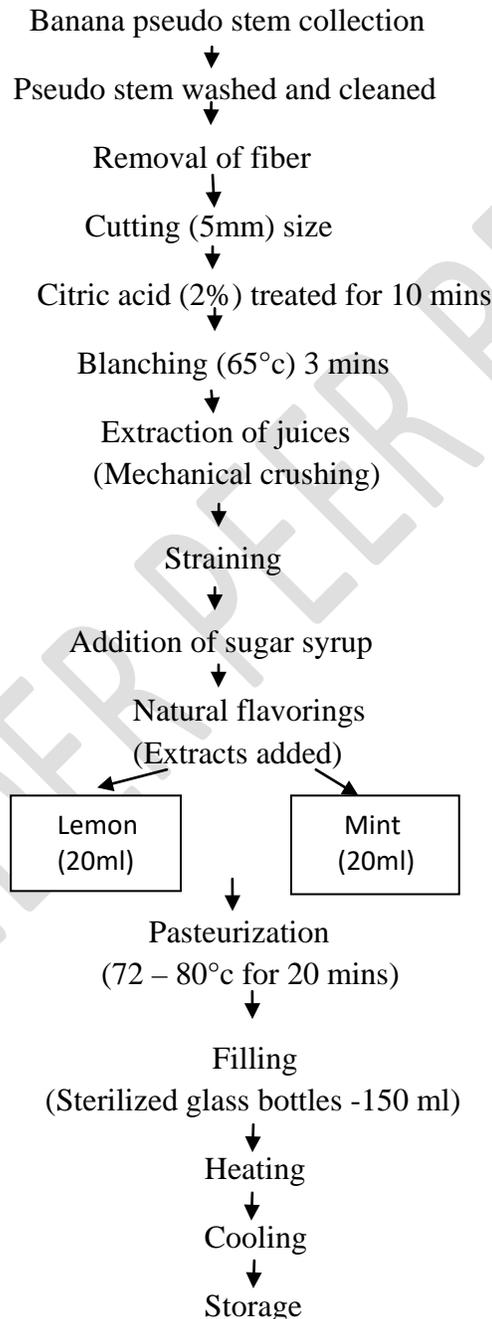
2.1 PREPARATION OF BANANA PSEUDO STEM JUICE:

Banana pseudo stem (1 kg) was weighed and washed thoroughly. Pseudo stem center core was cut into slices and fiber was removed. The pseudo stem were chopped into cube shape and it was soaked in citric acid (2%) solution for 10 mins, to prevent the browning reaction. The banana pseudo stem were steam blanched at 65°C for 3 mins, the pseudo stem was crushed using the mechanical crusher. The juice extracted was filtered through muslin cloth, juice and water was mixed in the ratio of 3:1. The beverage was prepared using sugar solution (sugar: water ratio 2:1). The natural flavours of lemon juice and mint (20 ml extract /lit) was added separately. The

prepared banana pseudo stem juice was pasteurized at 80 - 85°C temperature. It was cooled and then preservative (70ppm KMS), stabilizer (0.1%CMC) were added. Beverage was filled in sterilized glass bottle (150ml), leaving the head space of 1 cm. The bottles were crown corked air tightly. The crown corked bottles were heated up to 72 – 80 °c for 30 mins and then stored at ambient and refrigerated condition.

2.1.1 Flowchart:

Fig. 1. Flow chart showing preparation of banana pseudo stem juice



(Refrigerated and room temperature)

2.1 Chemical Analysis:

The control and flavored banana pseudo stem beverage physico-chemical properties were analysed such as total soluble solids, pH, titrable acidity and vitamin C. The stored samples were analysed at 15 days interval periods during storage condition. The total soluble solids content was recorded by using the hand refractometer. Then, the digital pH meter was used to recorded pH of the pseudo stem beverage. Titrable acidity, total sugar, reducing sugar, starch, phenols was determined as given by Sadasivam and Manickam (2008) [10]. Total acidity (% citric acid), vitamin C, and microbial study were estimated as given by Ranganna (2000) [11].

2.3 Statistical Analysis:

The results of the chemical analysis was analysed statistically by ANOVA using computer aided AGRES statistical analysis package to evaluate the significance at $P < 0.05$. All the obtained data from test was triplicate and it was subjected to the single factorial completely randomized design AGRES software.

3.0 RESULTS AND DISCUSSION:

The prepared banana pseudo stem beverage was organoleptically evaluated by using 9 point hedonic scale. It was observed that the highest sensory score was obtained for lemon flavored pseudo stem beverage. Based on nutritional and sensory score, lemon flavored pseudo stem beverage was highly accepted than mint flavored one.

Table 1 showed that proximate composition of the developed pseudo stem beverage. Pseudo stem Juice yield (%) from the two varieties also differs. Comparing the two varieties of banana pseudo stem, variety1 provides high yield (87%) of juice content. Dawn et al., (2016) reported that the banana tender core mainly contains 90 % moisture content [2]. The control sample V_0 had TSS 12°brix, pH 5.7, acidity 0.17%, vitamin C 0.61 mg and protein content 3g, total sugar, reducing sugar and starch was nearly 8.61g, 6.34g and 20.78g respectively. The V_0 sample had 51.92 mg phenols and 11.03 mg flavonoids.

The lemon flavored pseudo stem RTS beverage from V_1 & V_2 had TSS content (12° brix), pH (3.28, 3.23), acidity (0.35%, 0.38%), vitamin C (0.77 mg, 0.73 mg) and protein content (3.20g, 3.11g). Total sugar, reducing sugar and starch content of lemon flavored beverage from V_1 & V_2 was (16.2g, 15.40g), (9.01g, 8.57g) and (22.73g, 21.34g) respectively. The lemon flavored RTS had nearly V_1 (53.11mg), V_2 (52.42mg) of phenol content and V_1 (14.02 mg), V_2 (13.38 mg) of flavonoids.

Bhaskar *et al.* (2011) researched that proximate composition of banana pseudo stem, had 2.5% protein, 1.7% fat, 27.3% starch, 3.4% free sugar, 1.4 % soluble dietary fiber, 27.4 % insoluble dietary fiber, 0.3% ash, 15.1% moisture respectively [12]. Aziz *et al.* (2011) researched the proximate composition of banana pseudostem. The banana pseudo stem had the 8.8% moisture, 3.5% protein, 1.2% fat, 10.1% ash, 19.5% crude fiber, 56.9% total carbohydrate respectively [13].

Table 1: Proximate composition of ready to serve (RTS) non-flavored and lemon flavored banana pseudo stem beverage

S.No	Parameters	Non –flavored V ₀	Lemon flavored	
			V ₁	V ₂
1.	pH	5.7±0.011	3.28±0.075	3.23±0.068
2.	TSS °brix	12.0±0.081	12.0±0.084	12.0±0.028
3.	Acidity %	0.17±0.001	0.35±0.009	0.38±0.010
4.	Protein g	3.00±0.014	3.20±0.009	3.11±0.018
5.	Total Sugar g	8.61±0.210	16.2±0.286	15.40±0.353
6.	Reducing Sugar g	6.34±0.138	9.01±0.084	8.57±0.217
7.	Starch g	20.78±0.636	22.73±0.107	21.34±0.427
8.	Phenols mg	51.92±1.554	53.11±1.502	52.42±0.957
9.	Flavonoids mg	11.03±0.142	14.02±0.074	13.38±0.078
10.	Vitamin C mg	0.61±0.007	0.77±0.001	0.73±0.018

V₀–control, V₁- ottu vazhai (syn Muppadaai), V₂- vayal vazhai. Values are Mean ± S.E from 3 determinations

3.1 CHANGES IN CHEMICAL CONSTITUENT OF PSEUDO STEM (RTS) BEVERAGE:

The storage studies for prepared pseudo stem RTS beverage were conducted. Table 2 showed that the results for pH, TSS, acidity, vitamin C of control as well as lemon juice flavored pseudo stem beverage. In refrigerated storage condition, significantly slight variation only occurs in pH, TSS acidity and vitamin C of the naturally flavored banana pseudo stem beverages.

3.1.1 Changes in pH

The results showed that no significance ($P < 0.05$) difference was noticed in pH values during storage condition. The pH was slightly increased after 15th day of storage period and rapid increase in pH was observed on the 45th day of the ambient storage condition. The control (V₀) pH value was 5.7 which increased to 6.4 and 6.5 at end of condition R₁ and R₂ condition. The lemon juice flavored pseudo stem beverage from V₁ and V₂, initially had 3.28 and 3.23 pH value. So, pH was significantly ($P < 0.05$) increased with gradual storage conditions. When compare to mint

flavour, lemon flavored pseudo stem beverage from V_1 had minimum changes in pH content (4.75) at R_2 condition.

Islam, M. A., et al., (2014) in his study revealed that there was a significant increase in pH (5.6) during storage period. This might be due to decrease in titrable acidity, as acidity and pH are inversely proportional to each other [14]. Hiridyani, H. (2015) reported that there was a significant decrease in pH during storage. This might be due to increase in titrable acidity [15].

3.1.2 Changes in TSS

At initial storage condition, there was no significant ($P < 0.05$) difference noticed in TSS. Initially the TSS content of the control (V_0) was recorded as 12.0°brix. It was increased to (14.5°brix & 14.3°brix) at the final R_1 and R_2 condition. The lemon juice flavored pseudo stem beverage from V_1 and V_2 , initially had 12°brix TSS. So, the TSS was significantly ($P < 0.05$) increased with gradual storage conditions. So, lemon flavored pseudo stem beverage from V_1 had minimum changes in TSS content (14.0°brix) at R_2 condition than mint flavored pseudo stem beverage.

Hiridyani, H. (2015) reported that the TSS increased with gradual passage of storage time, which might be due to hydrolysis of polysaccharides into monosaccharide and oligosaccharides [15]. Jan and Masih (2012), Deka and Sethi (2001) in their studies revealed that in juice blends found an increasing trend in total soluble solids during storage at ambient and low temperature in lime - aonla and mango pineapple spiced RTS beverages [16][17].

3.1.3 Changes in Acidity

The significant difference ($P < 0.05$) was present in the acidity of the sample during R_1 and R_2 storage condition. Initially the control samples had 0.17% acidity. Finally it was decreased to (0.12% & 0.13%) acidity during R_1 and R_2 storage condition. The lemon flavored pseudo stem beverage from V_1 & V_2 , initially had (0.35% & 0.38%) acidity. So, the acidity level of beverage was significantly ($P < 0.05$) decreased. So, lemon flavored pseudo stem beverage from V_1 had minimum changes in acidity level (0.23%) at R_2 condition. Comparing these two natural flavors, Lemon flavored pseudo stem beverage from V_1 had the desirable acidity content during R_2 storage condition.

Del Caro *et al.* (2004) reported that titrable acidity was decreased during storage. This might be due to conversion of acids into salts and sugars by enzymes particularly invertase [18]. Hiridyani, H. (2015) reported that there was a significant decrease in titratable acidity content during storage condition; this was due to the decreasing amount of Kinnow juice in the respective blends [15].

3.1.4 Changes in Vitamin C

Significant difference ($P>0.05$) was observed in the vitamin C content of the ambient (R_1) and refrigerated (R_2) stored sample. The vitamin C content of the sample was decreased from initial day to 45th day. Initially control sample had (0.61mg) of vitamin C content. It was decreased to (0.31mg & 0.41mg) of vitamin C content during R_1 and R_2 storage condition. The lemon flavored pseudo stem beverage from V_1 & V_2 , initially had (0.77mg & 0.73mg) of vitamin C content. So, the vitamin C level of beverage was significantly decreased. So, lemon flavored pseudo stem beverage from V_1 had minimum changes in vitamin C content (0.50mg) at R_2 condition. Comparing these two natural flavors, Lemon flavored pseudo stem beverage from V_1 had the desirable vitamin C content during R_2 storage condition.

Singh et al (2018) reported that Vitamin C content decreased significantly during storage under 25°C as compared to 10°C. The reduction in Vitamin C during storage could be due to its oxidation to dehydro-ascorbic acid [19]. Similar results were shown by Majumdar *et al.* (2009) reported 74% loss of vitamin C in cucumber-litchi-lemon juice after six months of storage [20].

Table2: Changes in control and lemon flavored banana pseudostem beverage during storage period

Parameters	Storage temperature	Non- flavored		Lemon flavored			
		V_0		V_1		V_2	
		Initial	Final	Initial	Final	Initial	Final
pH	R1	5.7±0.043 ^d	6.4± 0.165 ^a	3.28±0.075 ^d	5.08±0.152 ^a	3.23±0.068 ^d	5.14±0.076 ^a
	R2	5.7±0.020 ^d	6.5±0.048 ^a	3.28±0.063 ^d	4.75±0.158 ^a	3.23±0.081 ^d	4.86±0.069 ^a
TSS	R1	3.0± 0.003 ^d	4.5±0.146 ^a	12.0±0.084 ^c	14.8±0.352 ^a	12.0±0.028 ^d	15.0±0.367 ^a
	R2	3.0±0.019 ^d	4.3±0.114 ^a	12.0±0.169 ^c	14.0±0.381 ^a	12.0±0.120 ^d	14.4±0.225 ^a
Acidity	R1	0.17±0.001 ^a	0.12±0.003 ^d	0.35±0.009 ^a	0.23±0.005 ^d	0.38±0.010 ^a	0.24±0.008 ^d
	R2	0.17±0.003 ^a	0.13±0.002 ^d	0.35±0.007 ^a	0.26±0.005 ^d	0.38±0.004 ^a	0.25±0.003 ^d
Vitamin C	R1	0.61±0.011 ^a	0.31±0.004 ^d	0.77±0.001 ^a	0.50±0.007 ^d	0.73±0.018 ^a	0.49±0.015 ^d
	R2	0.61±0.013 ^a	0.41±0.005 ^d	0.77±0.021 ^a	0.59±0.005 ^d	0.73±0.015 ^a	0.56±0.003 ^d

ambient temperature (R_1), refrigerated temperature (R_2), V_0 - control V_1 - ottu vazhai (syn Muppattai), V_2 - vayal vazhai,

^{a-d}Values are means of 4 replicates. Means in the same column followed by different superscripts are significantly different at $P<0.05$

3.2 MICROBIAL CHANGES OF BANANA PSEUDOSTEM BEVERAGE

At storage conditions, the bacteria and fungi count was below detectable level. The study results indicated that microbial quality of pseudo stem beverage was satisfactory. It was still remain fresh for up to 45 days at refrigerated condition. It was safe for consumption. The

quality of banana pseudo stem beverage was safely maintained by pasteurization process and could be preserved by the addition of potassium metabisulphite.

Afreen et al (2018) in his study reveals that no bacterial growth was observed in the freshly made RTS beverage samples. Therefore, there was no total plate count in these samples [21]. Swarnalakshmi et al (2019) reported that total plate count was found to be <10 which showed that the product would still remain fresh for 30-45 days when refrigerated [22].

4.0 CONCLUSION

Nowadays, the people's food habits were changing towards the natural drinks in compare with artificial drinks. The acceptability of vegetable beverages may be improved by using natural flavors which enhancing the flavour, taste of beverage. From the storage studies, the lemon flavored pseudo stem beverage (Mupaddai variety V₁) was found to be the best in nutrient retention, juice yield and sensory evaluation. The storage studies reported that the pseudo stem beverage flavored with lemon juice could be successfully stored for period of 45 days with significant changes in physico- chemical parameters and sensory qualities. The pseudo stem beverage could be preserved at refrigerated temperature with desirable quality. The present study reported that this pseudo stem beverage possible to satisfy the consumer taste and preferences. It was found nutritionally as well as organoleptically desirable. From this study, utilization of banana biomass such as pseudo stem to solve the waste disposal problem.

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