

Quality Evaluation of Jam Formulated from Baobab and Pawpaw Fruits

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ABSTRACT

In this work, possibility of making jam from two underutilized fruits (baobab and pawpaw fruits) known to have high pectin content was investigated. Formulation was made in different proportions (100:0, 0:100, 70:30, 30:70, and 50:50) using both fruits. Granulated sugar solution and acidifying agent (lime) were added to the mixture and heated at 80°C until it set. The samples were stored under refrigeration till analysis. The jam samples were analyzed for pH, total soluble solids (^oBrix), titratable acidity (TTA), ascorbic acid, β -carotene and moisture content (M.C). Sensory attributes of the samples were compared with a commercial jam (apricot jam, APJ). Results from this study showed that TTA ranged between 3.27% for 100% baobab jam (BBJ) and 5.37% for APJ. The pH of the samples was highest in 100% BBJ and lowest in Apricot jam. The moisture content (29.03-30.13) and soluble solids (60.33-65.67) of the samples were within the recommended range for commercial jam. Vitamin C ranged between 24.27 to 51.57 mg/100g for APJ and BBJ, while β -carotene for the samples was between the ranges of 30.00 to 105.00 μ g/100g for APJ and BBJ. Jam sample formulated from 70:30 of baobab and pawpaw fruit respectively had better ratings in terms of flavor, taste, texture and spreadability. Similarly, the sample had better retention of vitamin C. Two bacterial species were isolated from the formulated products which were identified to belong to the genera *Pseudomonas* spp, and *Proteus* spp.

Keywords: Baobab, Pawpaw, Ascorbic acid, Jam, Beta carotene

INTRODUCTION

Baobab or *Adansonia digitata* L. belongs to the Malvaceae family (Bremer et al., 2003) and is a deciduous tree native to arid Central Africa (Yazzie et al., 1994). The different plant parts are widely used as foods, medicines and the bark fibres are also used (Sidibe & Williams, 2002). The pulp is acidic due to the presence of the organic acids citric, tartaric, malic, succinic and ascorbic, with pH 3.3 (Nour et al., 1980). The fruit pulp also contains a high amount of carbohydrate, low protein, and extremely low fat (Osman, 2004). According to Murray et al. (2001)

simple sugars in baobab pulp account for about 35.6% of the total carbohydrate content. This explains the noticeable sweet taste of the pulp. However, the sweetness may vary for different types of pulp (Chadare *et al.*, 2009). The low water content, strong acidity and high sugar content was confirmed by Cisse *et al.*, (2009). Vitamin C content of baobab fruit pulp has been compared with oranges by Manfredini *et al.*, (2002) and has been shown to be at least three times higher (150-499mg/100g as against 46mg/100g). The pulp of baobab fruit contains high level of pectin ranging between 23.4 and 33.g/100g (Wilkinson and Hall, 2007).

Papaya (*Carica papaya*) is a highly perishable tropical fruit rich in minerals, vitamins A, C and riboflavin (Muthukrishnan and Irrulapan, 1990). The fruit is also a good source of carotenoids and has an unusually high pH of 5.5–6.0 when ripe (Dzogbefia and Djokoto, 2006).

Jams are products formulated from a minimum fruit content of 40% and a final soluble solid content of 45o Brix. Some additives such as citric acid, gelling agents and pectin can be added (García-Martínez *et al.*, 2002). In conventional jam manufacture, all the ingredients are mixed in predetermined proportions and the mix is concentrated by applying thermal treatments at normal or reduced pressure to reach the final soluble solid content. This process leads to thick consistency, destroys fruit enzymes, extracts some of the pectin from the fruit and concentrates the product to a point and reduced water activity becomes self- preserving (García-Martínez *et al.*, 2002). The objective of this work is to produce and evaluate the quality of jam prepared from baobab and hog plum fruit.

Materials and Methods

Fresh pawpaw, baobab fruits and acidity agent (lime) were obtained from a farm in Ogbomoso, while food grade commercial sucrose was also purchased from a laboratory chemical store in Ogbomoso, Nigeria.

Jam preparation

Cleaned baobab and pawpaw fruits were crushed separately in a Warring commercial blender (Model number: 35BL64, Serial number: 001843A, USA). A weight of 200g was used to formulate the sample composition in ratios of 100:0, 0:100, 70:30, 30:70, and 50:50 for baobab and pawpaw respectively. Pulp from the two fruits were processed into fruit jams according to the FAO guideline (FAO, 1997). Total soluble solids (TSS), total titratable acidity (TTA) and pH of the pulp were determined before jam preparation in order to establish

any additional requirement to meet the recommended acid to sugar ratio. The amount of sugar required (as total soluble solids) to meet the requirements of jam was calculated using the following formula:

$$\text{Sugar to be added} = \frac{\text{TSS Final} - \text{TSS Pulp} \times W}{100}$$

Where: TSS (final) = required sugar level of the jam (69%); TSS (pulp) = sugar level of the pulp as total dissolved solids; and W = Weight in gram of the pulp to be used.

The mixture was cooked to the desired TSS and checked by using a hand refractometer (Atago hand refractometer 0 to 100% Brix). Thereafter, the hot jam was stored in sterilized glass bottles which were air tight closed and kept under refrigeration until analysis.

Quality Evaluations

Titrateable acidity (TTA), pH, moisture content, total soluble solids (Brix), gel strength, ascorbic acid and β -carotene were determined using methods described by AOAC (1990).

Sensory Evaluation

The jam samples with bread serving as a carrier were presented to 10 semi-trained panelists using the method described by Taiwo *et al.*, (1997). The panelists were asked to indicate their observations using a 9-point hedonic scale for aroma, colour, taste, spreadability and overall acceptability. Like extremely and dislike extremely were ranked 9 and 1 respectively.

Microbiological Analysis

1ml of each sample from 10⁻⁴ dilution was taken and pipetted into a sterile petridish. The nutrient agar to be used was sterilized, allowed to cool and poured aseptically into the sample using pour plate method. The mixture was allowed to solidify; the plate was inverted and incubated at 37°C for 48 hours. Colonies were counted and recorded as colony forming unit per gram (cfu/g) (Gilliland, 1999).

Statistical analysis

All analyses were carried out in triplicates. Data were subjected to analysis of variance (ANOVA) and means were separated using Duncan's Multiple Range Test at $p \leq 0.05$ (Steel and Torrie, 1980; Gomez and Gomez, 1985).

RESULTS AND DISCUSSION

The results in Table 1 showed the chemical composition of baobab and pawpaw fruit pulps.

Table1: Selected Chemical Composition of raw Baobab and pawpaw fruits

Parameters	Baobab	Pawpaw
Pectin (%)	2.43±0.12b	22.80±0.301a
pH	4.52±0.03b	5.93±0.015a
TTA (%)	9.77±0.15b	2.93±0.12a
Vitamin C (mg/100g)	88.33±2.89a	16.63±0.15b
β-carotene (μg/100g)	30.00±0.00b	88.33±2.89a

means are triplicate determinations and values with different alphabets indicates significant difference (p≤0.05).

The pectin content of pawpaw was significantly higher than that of baobab fruit. However, both fruits had higher pectin contents than those used in conventional jam manufacture as reported by Belitz and Grosh (1999) and Singh (1986). These results indicated that baobab and pawpaw are good sources of pectin in jam and jelly processing.

Pawpaw fruit had higher pH value of 5.93 with a corresponding low TTA of 2.93, while baobab fruit pulp had a low pH value of 4.52 with a corresponding high TTA of 9.77. High acidity in fruit pulp has been reported to influence gel formation in jam processing (Ndabikunze *et al.*, 2011), indicating that both fruits are good ingredients for jam production.

The chemical compositions of jam samples formulated from baobab and pawpaw fruits are shown in Table 2.

Table2: Selected Chemical Composition of Jam prepared from Baobab-hog plum fruit pulp

Parameters	APJ	BBJ	BPJ	PPJ	PBJ	JBP
MC (%)	29.50±0.100a	29.47±0.058a	29.20±0.100a	30.13±0.115a	29.03±0.100a	29.50±0.100a
Brix (°)	65.00±1.00a	65.33±0.577a	62.33±0.577b	60.33±0.577c	65.67±0.577a	64.33±0.577b
pH	3.27±0.058d	4.47±0.001a	3.63±0.058c	4.23±0.578b	4.27±0.153b	3.67±0.115c
TTA (%)	5.37±0.058a	3.27±0.100d	4.93±0.058b	4.67±0.058c	4.53±0.058c	5.03±0.153b
Vitamin C (mg/100g)	24.27±0.252b	51.57±0.060a	21.23±0.252c	15.13±0.115f	17.50±0.100e	19.80±0.346d
β-Carotene (μg/100g)	105.00±0.000a	30.00±5.774f	56.67±2.887d	80.00±0.000b	66.67±2.887c	60.00±0.000e

The values with the same alphabets are not significantly different from each other (P < 0.05).

APJ – Apricot Jam

BPJ – 70% Baobab and 30% Pawpaw Jam

BBJ – 100% Baobab Jam

PBJ – 70% Pawpaw and 30% Baobab Jam

PPJ – 100% Pawpaw Jam

JBP – 50% Baobab and 50% Pawpaw Jam

The observed M.C. ranged between 29.03 and 30.13 for sample PBJ (70% pawpaw and 30% baobab) and PPJ (100% pawpaw) respectively. All the samples did not differ significantly from the commercial apricot jam (APJ). The observed M.C. of the samples compares well with values (30.96 to 34.06) reported by Ndabikunze *et al.* (2011) for jam produced from fruits using baobab fruit powder as fruit substitute for commercial pectin and also agreed with M.C. recommended for stable jam formulation by Kirk and Sawyer (1991) and FAO (1997).

The total soluble solids (TSS) of the samples are presented in Table 2 below. There was a significant difference in the TSS of the samples. However, sample BBJ (100% baobab), PBJ (70% pawpaw and 30% baobab) and APJ (Apricot jam) were not different from one another. Samples PBJ and PPJ (100% pawpaw) had the highest (65.67° brix) and lowest (60.33° brix) TSS respectively. The formulated samples and the control maintained the recommended level (65%) of TSS except sample PPJ. Kirk and Sawyer, (1991) reported that the shelf life of jam is dependent on a minimum TSS of 65%, pH (3.0-3.5) and pectin of about 0.5%.

The observed pH of the samples showed that sample APJ (Apricot Jam) had the lowest pH with a corresponding high acidity of 5.37, while sample BBJ (100% baobab jam) had the highest pH of 4.47 with a corresponding low acidity of 3.27. All the samples were shown to differ significantly in their pH values. However, sample APJ had a value (3.27) within the recommended pH range (3.3-3.5). The high values recorded may be attributed to the stage of maturity (ripeness) of the fruits. Partially ripened fruits with low sugar and high pectin content are good starting materials in jam formulations. Similarly, the TTA of all the samples are observed to be significantly different.

The vitamin C content of the various jam samples ranged from 15.13 to 51.57mg/100g with 100% baobab jam (BBJ) having the highest value and 100% pawpaw jam (PPJ) with the least value. The control sample had a vitamin C content of 24.27mg/100g (Table 2). The high values recorded for baobab jam is not unexpected as the fruit is highly rich in vitamin C (88.33mg/100g), while pawpaw is low in vitamin C (16.63mg/100g) (Table 1). Although there was a reduction in the vitamin C content of the jam samples, 100% baobab jam retained an appreciable amount of the vitamin and compares favourably with the control (Apricot jam). This result confirms previous claims that baobab is a good source of vitamin C, indicating its significance in the treatment of scurvy especially in the developing nations of the world.

The β -carotene of the jam samples ranged from 30 to 105 μ g/100g with 100% baobab jam having the least value and Apricot jam having the highest. All the samples differ significantly with respect to their β -carotene content. Sample PPJ (100% pawpaw jam) had a considerable amount of β -carotene content and therefore could be a good source of vitamin A when consumed. β -carotene is a precursor of vitamin A which is important in preventing night blindness, xerophthalmia and general good health.

Data on sensory evaluation is presented in Table 3.

Table 3: Sensory properties of jams made from Baobab-pawpaw fruit pulp

Sample	Colour	Flavour	Taste	Texture	Spreadability	Overall acceptability
APJ	8.66a	7.12c	8.34b	6.44d	8.66a	8.66a
BBJ	5.34d	6.22c	5.78d	7.34a	7.34a	6.88b
PPJ	8.88a	7.34c	7.34c	8.22b	9.56a	5.56d
BPJ	6.00c	6.44b	6.44b	6.22c	6.00c	8.88a
PBJ	7.78c	7.12d	7.56c	8.00b	8.66a	6.88e
JBP	6.44b	5.78c	6.00c	6.66a	5.56d	5.78c

Means followed by the same letters along the same column are not significantly different ($p \leq 0.05$).

APJ – Apricot Jam

BPJ – 70% Baobab and 30% Pawpaw Jam

BBJ – 100% Baobab Jam

PBJ – 70% Pawpaw and 30% Baobab Jam

PPJ – 100% Pawpaw Jam

JBP – 50% Baobab and 50% Pawpaw Jam

Sample BPJ (70% baobab and 30% pawpaw) had the best rating for overall acceptability. Sample PPJ had the highest rating for colour and sample BBJ had the lowest. The colour ratings differ significantly amongst the samples except for sample APJ and PPJ. The poor rating for baobab was probably due to the stage of maturity of the fruit used as this affected the colour of the pulp. Pawpaw jam (100%) with the highest rating was influenced by its natural yellowish colour due to the rich presence of β -carotene.

Table 4: Microbial load of jam formulated from baobab and pawpaw fruit

Samples	Total viable count (cfu/g)
APJ	4.0x10 ⁻¹
HPJ	4.0x10 ⁻³
BBJ	4.0x10 ⁻³
JHB	4.0x10 ⁻³
BHJ	4.0x10 ⁻³
HBJ	4.0x10 ⁻³

Values reported are the means of triplicate determinations

APJ – Apricot Jam

BPJ – 70% Baobab and 30% Pawpaw Jam

BBJ – 100% Baobab Jam

PBJ – 70% Pawpaw and 30% Baobab Jam

PPJ – 100% Pawpaw Jam

JBP – 50% Baobab and 50% Pawpaw Jam

The flavour ratings showed that the control sample (APJ) was best rated while sample JBP had the lowest rating. The flavours of the samples are not significantly different except sample BPJ and PBJ. Sample APJ had the best rating for taste while BBJ had the least. Jam formulated from 50% baobab and 50% pawpaw fruit had the least rating for spreadability while sample PPJ had the highest. Sample APJ, PPJ and PBJ are not significantly different from one another. This observation may be due to the amount of pectin present in the samples Tiisekwa *et al.*, 2002; Saka *et al.*, 2007).

CONCLUSION

This study has proved the potentials of baobab and pawpaw fruits in jam formulations and has provided a simple low-cost method of preparing jam particularly in the rural areas where these fruits are in abundant. The study has also revealed that jam can be formulated without reliance on commercial pectin since pawpaw is rich in pectin and baobab has a high acidity, both properties being important in the production of jam. Therefore, if farmers particularly women are trained to have requisite skills in jam preparation, they can easily utilize the fruits to make jam and earn more income. In this way, indigenous fruits can assist in achieving food and nutrition security. It is recommended from this study that sample BPJ (70% baobab and 30% pawpaw jam) with the best rating for sensory evaluation and considerably good chemical composition with vitamin C and β -carotene content of 21.23mg/100g and 56.67 μ g/100g respectively should be considered. However, the effect of storage on the quality attributes of the local jam may require further studies.

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