

Production, Quality Evaluation and Sensory Acceptability of Mixed Fruit Juice from Pawpaw and Lime

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Abstract

Pawpaw and lime juices were blended to produce mixed pawpaw/lime juice samples in the ratios of 90:10, 80:20, 70:30, 60:40 and 50:50) v/v giving samples A, B, C, D and E respectively. The moisture, mineral and vitamin contents, as well as the physical, microbiological and sensory qualities of the individual juices and blended samples were evaluated. While lime juice had higher moisture, calcium and vitamin C with values of 97.90%, 2.21 mg/100 g and 67.47 mg/100 g as compared to pawpaw juice with 92.96%, 1.53 mg/100 g and 35.49 mg/100 g respectively; the pawpaw juice had higher ash, phosphorus and vitamin A contents, with values of 3.12%, 54.97 mg/100 g and 5.90 IU/100 g as against 2.84%, 29.53% and 0.16% for lime juice respectively. While there was a general increase in moisture, calcium and vitamin C contents with blending, ash, phosphorus and vitamin A contents increased with increase in lime. The total solids content and specific gravity of pawpaw juice were remarkably higher at 7.04% and 1.15 g/m³ compared to 2.09% and 1.09 g/m³ respectively for lime juice. However, lime juice had a higher titratable acidity, while recording a lower pH of 2.89 as compared to 5.36 for pawpaw juice. The Total Viable Count (TVC) of lime juice was much lower (2.33×10^5 CFU/ml) than that of pawpaw juice (5.33×10^6 CFU/ml). There was significant difference ($p < 0.05$) in all the sensory parameters evaluated. Generally, there was an increase in the scores of each parameter from sample A to B and then a decline through to sample E. Sample B (80:20) mixed pawpaw/lime juice was most preferred, while sample E (50:50) was least preferred.

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Keywords

Blends, Fruit Juice, Pawpaw, Lime, Acceptability

1. Introduction

Throughout history, fruits have been valued not only for the taste, texture and colour they add to a diet, but for their contribution to health [1]. They are a rich source of vitamins and minerals, and fruit juices are a popular way of consuming them. In the tropics, a great variety of fruits are produced all year round. These are highly perishable and suffer post-harvest losses due to inadequate processing technologies [2]. It has therefore become imperative to explore affordable and easily adoptable food processing and preservation methods to convert the abundant fruits into shelf stable products like juices, jams and jellies which are easy, cheap and economically reliable alternative for reducing post harvest losses.

The food market has stimulated the development of new products that present good sensory acceptance and and of high nutritional value [3]. Development of new products where two or more kinds of fruit juices are blended to obtain a product that combines the nutritional value of both fruits with the benefit of a pleasant taste, has been encouraged by the food industry and has been well accepted by consumers [4].

Pawpaw (*Carica papaya*), a member of small family (*Caricaceae*), having four genera and thirty-one species, is a native of tropical America, now spread all over the tropical region of the world [5]. The fruits are eaten green or ripe, fresh or in salads because of its high sugar content (59%) and thus can be used for juice and wine production [6].

Acid Lime (*Citrus aurantifolia*) is one of the important commercial fruits, which has been cultivated in many part of the world and in addition, comes under third position within the citrus fruit species, after Mandarin and Sweet orange in terms of area and production [7] [8]. It is used for juice, desert, pickle and other medicinal purpose.

Pawpaw and lime, despite their over abundance, are currently being under utilized in Nigeria. In the household, consumers ordinarily sprinkle lime juice on pawpaw before consumption because of the flavour impact it has on the pawpaw. Conversely, lime juice is very sour and it is not usually consumed alone. Mixing pawpaw and lime could result in a juice product with more vitamins and minerals as well as different and more acceptable sensory characteristics when compared to the raw materials. In addition, production of mixed fruit juices from pawpaw and lime will create variety in the fruit juice market and reduce post harvest losses.

The objective of this study was therefore; to assess the quality and organoleptic acceptability of a mixed fruit juice produced using blends of pawpaw and lime juices.

2. Materials and Methods

2.1. Sources of Materials

The pawpaw and lime fruits were purchased at North Bank market in Makurdi, Benue State, Nigeria; while sample preparation and analysis were carried out in the Biochemistry Laboratory of the National Root Crops Research Institute (NRCRI), Umudike.

2.2. Preparation of Juice Samples

Fresh, juicy, good quality Pawpaw and Lime fruits were sorted for processing using physical characteristics such as uniformity of size, colour and firmness, freedom from defects such as sunburn, skin abrasions, pitting, insect injury, and blotchy colouration as well as freedom from decay. Thereafter, the methods of [9] and [10] were followed for the production of pawpaw and lime juices respectively. About 6.50 kg of the pawpaw fruit was weighed, washed, peeled, cut into pieces and blended in a sterile electric blender (Vitamix 1782 Turbo Blend). It was sieved to get the pulp and 2.0 litres of water was added into it. Similarly, about 4.00 kg of lime fruit was also weighed, washed, peeled and cut into halves, and the juice was extracted and filtered through sterilized muslin cloth. The sieved pawpaw and lime juices were filled into five different cans in the ratio of 90:10, 80:20, 70:30, 60:40 and 50:50 respectively and stored in the refrigerator at about 10°C for subsequent analysis that same day.

2.3. Analyses

2.3.1. Nutritional Properties

Moisture content and ash were determined by the method of [11]; while vitamins A and C were determined by the methods described by [12] and [13] respectively, and mineral content was determined by the method described by [14].

2.3.2. Physico-Chemical and Microbiological Properties

Total solids and specific gravity of the samples were determined by the methods of [11] and [14] respectively. While pH was determined by the method of [15], total titratable acidity (TTA as lactic acid) was determined by the method of [16]. The total viable count (TVC) of the sample was determined by the method of [17].

2.3.3. Sensory Evaluation

Sensory evaluation of the five mixed juice samples was carried out using 5-point Hedonic scales as described by [18]. The five samples were coded and presented to 20 trained panelists from the Department of Food Science and Technology, University of Agriculture, Makurdi in one session, in identical containers. They were instructed to express their feelings about the samples by scoring the sensory attributes using the Hedonic scale (5 = like very much, 4 = like moderately, 3 = neither like nor dislike, 2 = dislike moderately and 1 = dislike very much).

2.3.4. Statistical Analysis

The data generated was analyzed using analysis of variance (ANOVA) as described by [19]. Separation of means was done by Tukey's Test [20], to determine whether significant difference existed.

3. Results and Discussion

3.1. Nutritional Composition of Pawpaw and Lime Juice Samples

Table 1 presents the nutritional composition of the individual pawpaw and lime juice samples. The moisture content of lime (97.90%) was higher than that of pawpaw juice (92.96%). These values are however in the same range as consistent with those of 90% - 91% reported by [21] lime fruit juice. The Pawpaw juice had higher ash, phosphorus and vitamin A contents, with values of 3.12%, 54.97 mg/100 g and 5.90 IU/100 g as against 2.84%, 29.53 and 0.16 IU/100 g for lime juice respectively. This is in agreement with the report of [20] that pawpaw fruit is a fair source of minerals. Onimawo and Egbekun [22] also reported high vitamin A content for pawpaw. However, lime juice had higher amounts of calcium and vitamin C with values of 2.21 mg/100 g and 67.47 mg/100 g as compared with 1.53 mg/100 g and 35.49 mg/100 g respectively for pawpaw juice.

The nutritional composition of the mixed pawpaw/ lime juice samples is presented in **Table 2**. There was a general increase in moisture, calcium and vitamin C contents with blending with values ranging from 93.49 to 95.12%, 1.19 to 1.70 mg/100 g and 37.11 to 55.27 mg/100 g respectively. Conversely there was a decrease in ash, phosphorus and vitamin A contents with values ranging from 3.11 to 2.75 mg/100 g, 54.20 to 49.13 mg/100 g and 5.77 to 4.08 IU/100 g respectively. This could be due to substitution effect as shown by the contents of the individual juices before blending. Though there was decrease in vitamin A, the values of 5.77 - 4.08 IU/100 g for all the samples is much higher than recommended daily allowances (RDAs) for adults [23]. The increase in

Table 1. Nutritional composition of individual pawpaw and lime juices.

Parameter	Pawpaw	Lime
Moisture (%)	92.96	97.90
Ash (%)	3.12	2.84
Calcium (mg/100 g)	1.52	2.21
Phosphorus (mg/100 g)	54.97	29.53
Vitamin A (IU)	5.90	0.16
Vitamin C (mg/100 g)	35.49	67.47

Table 2. Nutritional composition of mixed pawpaw and lime juice samples.

Parameter	A	B	C	D	E	LSD
Moisture (%)	93.49 ^c	94.25 ^a	94.54 ^a	94.78 ^a	95.12 ^a	-
Ash (%)	3.11 ^a	2.95 ^b	2.86 ^c	2.77 ^d	2.75 ^e	0.08
Calcium (mg/100 g)	1.19 ^a	1.36 ^a	1.53 ^a	1.60 ^a	1.70 ^a	-
Phosphorus (mg/100 g)	54.20 ^a	54.03 ^a	53.50 ^a	52.73 ^b	50.13 ^c	1.15
Vitamin A (IU)	5.77 ^a	5.61 ^b	5.33 ^b	4.27 ^c	4.08 ^c	0.29
Vitamin C (mg/100 g)	37.11 ^e	44.15 ^d	45.91 ^c	49.13 ^b	55.27 ^a	2.42

Values are means of triplicate determinations. Means within the sample row bearing different superscript are significantly different ($p < 0.05$). Key: A = 90:10 mixed pawpaw/lime juice; B = 80:20 mixed pawpaw/lime juice; C = 70:30 mixed pawpaw/ lime juice; D = 60:40 mixed pawpaw/ lime juice; E = 50:50 mixed pawpaw/lime juice; LSD = Least Significant Difference.

vitamin C could be due to the high citric acid content of lime juice [21], bringing all the samples to higher than adult RDAs [24]. Though there was no significant difference ($p > 0.05$) in moisture and calcium contents of the samples, there were significant differences ($p < 0.05$) in the ash, phosphorus, vitamins A and C of the samples.

3.2. Physico-Chemical and Microbial Composition of Pawpaw and Lime Juice Samples

The physico-chemical and microbiological properties of the individual pawpaw and lime juice samples are shown in **Table 3**. The total solids content and specific gravity of pawpaw juice were remarkably higher at 7.04% and 1.15 g/m³ compared to 2.09% and 1.09 g/m³ respectively for lime juice. This indicates high concentration of solids (mainly sugars, vitamins, minerals etc) dissolved in the juice as stated by [25]. However, lime juice had a higher titratable acidity (1.21%) than pawpaw juice (0.27%). This could be as a result of the much lower pH (higher acidity) of lime juice. Lime juice recorded a pH of 2.89 making it more acidic than pawpaw juice (5.36). This could be due to the high concentration of organic acids (mainly citric acid) in lime than in pawpaw [21]. The value of pH (5.36) obtained for pawpaw juice is slightly higher than that of 4.42 reported by [26]. This could be due to variety, maturity, fruit growth stage, bearing side of the tree and method of extraction used [27]. The Total Viable Count (TVC) of lime juice was much lower (2.33×10^5 CFU/ml) than that of pawpaw juice (5.33×10^6 CFU/ml). This could be due to the high acid content of lime juice, which could have inhibited microbial growth.

Table 4 shows the physico-chemical and microbiological composition of mixed pawpaw/lime juice samples. Total solids, specific gravity, pH and TVC decreased significantly ($p < 0.05$) with blending from 6.51% to 4.85%, 1.11 to 1.09 g/m³, 4.36 to 3.60 and 3.67×10^5 to 2.14×10^5 CFU/ml respectively; while total titratable acidity (TTA) increased significantly ($p < 0.05$) from 0.36 to 1.14%. The decreases could be due to substitution effect, while the increase in TTA could be due to the decrease in pH (increase in acidity) with increase in quantity of lime juice. Robins [21] as well as Ihekoronye and Ngoddy [20] also reported the highly acidic nature of lime juice. The TVC decreased significantly ($p < 0.05$) with addition of lime juice. This is attributed to the preservative effect of lime juice (as a result of the high acidity) [28]. However, the lowest TVC value of 2.14×10^5 CFU/ml is still much higher than the specification of $<10^5$ by the [17] for fruit juices. Bagdeand [29] also reported total viable counts of between 2.0×10^6 and 1.0×10^5 CFU/ml in juice samples in Nagpur, India. This means that the mixed pawpaw/lime juices have to be pasteurized before they can be safe for consumption.

3.3. Sensory Evaluation

The mean sensory scores of the mixed pawpaw/lime juice samples are presented in **Table 5**. There was significant difference ($p < 0.05$) in all the sensory parameters evaluated. Generally there was an increase in the scores of each parameter from sample A to B and then a decline through to sample E. The colour increased from 4.55 (A) to 4.85 (B) and the declined to 4.20 (E). The other attributes followed the same trend from 3.95 to 4.80 to 2.65 (for taste), 4.15 to 4.75 to 3.30 (for aroma), 4.85 to 4.85 to 3.20 (for mouth feel) and 4.35 to 4.45 to 3.00 (for acceptability). Sample E scored least in taste, compared to the other samples. This could be due to the sour and astringent taste peculiar to lime juice [20]. Sample B (80: 20) mixed pawpaw/ lime juice was most preferred, while sample E (50:50) was least preferred.

Table 3. Physico-chemical and microbial composition of individual pawpaw and lime juices.

Parameter	Pawpaw	Lime
Total solids (%)	7.04	2.09
Specific gravity (g/m ³)	1.09	1.15
pH	5.36	2.89
Titratable acidity (%)	0.27	1.21
Microbial count (CFU/ml)	5.33 × 10 ⁶	2.33 × 10 ⁵

Table 4. Physico-chemical and Microbioal composition of mixed pawpaw/lime juice samples.

Parameter	A	B	C	D	E	LSD
Total Solids (%)	6.51 ^a	5.75 ^b	5.45 ^b	5.22 ^c	4.85 ^c	0.48
Specific Gravity (g/m ³)	1.11 ^a	1.10 ^a	1.09 ^a	1.09 ^a	1.09 ^a	-
pH	4.36 ^a	3.97 ^a	3.90 ^b	3.72 ^b	3.60 ^c	0.30
Titratable Acidity (%)	0.36 ^d	0.62 ^c	0.98 ^b	1.12 ^a	1.14 ^a	0.09
TVC (CFU/ml)	3.67 × 10 ^{5a}	3.33 × 10 ^{5b}	2.67 × 10 ^{5c}	2.33 × 10 ^{5d}	2.14 × 10 ^{5e}	12.56

Values are means of triplicate determinations. Means within the sample row bearing different superscript are significantly different ($p < 0.05$). Key: A = 90:10 mixed pawpaw/lime juice; B = 80:20 mixed pawpaw/ lime juice; C = 70:30 mixed pawpaw/ lime juice; D = 60:40 mixed pawpaw/ lime) juice; E = 50:50 mixed pawpaw/lime juice; LSD = Least Significant Difference.

Table 5. Mean sensory scores of mixed pawpaw/ lime juice samples.

Parameter	A	B	C	D	E	LSD
Colour	4.55 ^b	4.95 ^a	4.55 ^b	3.55 ^d	4.20 ^c	0.22
Taste	3.95 ^b	4.80 ^a	3.95 ^b	2.80 ^c	2.65 ^c	0.33
Aroma	4.15 ^b	4.75 ^a	4.15 ^b	3.80 ^c	3.30 ^c	0.20
Mouth Feel	4.85 ^a	4.85 ^a	4.80 ^a	3.40 ^b	3.20 ^b	0.37
Acceptability	4.35 ^b	4.45 ^a	4.35 ^b	3.45 ^c	3.00 ^d	0.08

Means within the sample row bearing different superscript are significantly different ($p < 0.05$). Key: A = 90:10 mixed pawpaw/lime juice; B = 80:20 mixed pawpaw/ lime juice; C = 70:30 mixed pawpaw/lime juice; D = 60:40 mixed pawpaw/ lime) juice; E = 50:50 mixed pawpaw/lime juice; LSD = Least Significant Difference.

4. Conclusion

This work showed that acceptable mixed fruit juice from pawpaw and lime could be produced. Generally, increase in lime concentration decreased the ash, phosphorus and Vitamin A as well as pH, total solids and specific gravity while increasing total titratable acidity, moisture, calcium and vitamin C contents. Microbial analysis showed reduced microbial load in sample blends with high lime concentration, due to high acid content of lime. Sensory evaluation showed that the mixed fruit of the 80:20 blend of pawpaw/lime juice was mostly preferred.

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