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COMPARATIVE NUTRITIONAL QUALITY AND SENSORY PROPERTIES OF PURE SOURSOP JUICE AND ITS BLEND WITH ORANGE AND/OR PINEAPPLE

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Abstract

Consumption of local fruits in most countries is poor, especially seasonal fruits. There is a need for more processing of natural fruits blends to improve our fruit intake and enhance health.The study evaluated the nutritional and sensory properties of pure and mixed fruit juices from Soursop, orange and pineapple. Mature Soursop was washed and the shell removed, then the pulp blended and sieved. Pineapple was washed**,** peeled, blended and sieved. Oranges were washed, the juices squeezed out and sieved. Samples were produced using the following combinations, Samples D (40 % Soursop, 30 % Orange and 30 % Pineapple), C (50 % Soursop and 50 %Orange), B (50 % Soursop and 50 % Pineapple) and A (100 % Soursop). Nutritional properties and sensory evaluation were analysed using standard methods. Data was analysed using Duncan multiple range test. Sample B (79.7%) had the highest moisture content, while sample A (75.0%) had the lowest, the difference was significant ($p \leq 0.05$). Sample D had the highest levels of crude protein 1.1%, fat 0.5%, dietary fibre 0.46% and calorie 0.9%, although carbohydrate (18.68%) was higher in Sample C. It also had the highest PH 4.1 and TTA 2.8g as well as antioxidant (DPPH, Total phenolic compounds and reducing power) while sample A had the highest brix value (8.0), Sample B had the highest content of Vitamin C (38.92%). Sample D was the most preferred in the flavour, sweetness, aroma taste and overall acceptability. Overall data from the study showed that the fruit juice with three fruits (Sample D) contained the highest levels of nutrients, hence the most nutritionally beneficial. It was also the most preferred juice compared with the pure soursop juices and that from two fruits.

Key word: Soursop, Orange, Pineaple, proximate composition, antioxidant, fruit juices

Introduction

Annona muricata fruit, commonly called soursop is a slightly sweet, but sour large fruit that grows mainly in the tropics and frost-free subtropics of the world [1]. It is a lowland tropical fruit-bearing tree in the Annonaceae family whose fruits are known to contain various types of nutrients beneficial to human health such as vitamins C, B_1, and B_{12} and carbohydrates, particularly fructose.

Soursop is reported to have many therapeutic properties; the juice and/or extract is known to possess diuretic property while the other parts have antibacterial, anti-cancerous, astringent, sedative, and other properties [2]. In traditional medicine, the fruit is used for arthritic pain, neuralgia, arthritis, diarrhea, dysentery, fever, malaria, parasites, rheumatism, skin rushes and worms, and it is also eaten to enhance a mother's milk after childbirth [2]. Soursop, like other tropical fruits, serves as a potential source of raw materials for fruit products such as juice, beverages, wine, jellies, jam puree, power fruit bars.

However, it is a seasonal fruit which floods the Nigerian markets in its season, constituting seasonal and post-harvest wastes, and becomes scarce at other seasons. It is therefore the opinion of many that the fruit's nutritional and health benefits be maximized and preserved all-year round via processing into a beverage form with a good-keeping shelve life. In the light of this, several research attempts have been made at transforming soursop fruit into a fruit drink [3].

Soursop fruit is not very sweet to the taste, it's rather sour, the taste from where it derives its common name – *soursop*. Accordingly, the other challenge with juice produced from the fruits is its sensory acceptability. Hence the previous researchers had to enhance acceptability via fortification with milk, or sweetening with honey or simple sugars [3]. But again, there is the health alerts/cautions about sweetened beverages because of their negative cardiovascular effects. Moreover, in chronic health conditions such as diabetes, obesity, cardiovascular disease, etc, there is the concern of aggravation of an already fragile situation.

Therefore, to maximize the potential health impact of soursop in the face of seasonal and post-harvest wastages, yet enhance its acceptability via improved sensory properties, the current study, undertook to produce fruit juice from soursop in combination with other fruits rather than artificial fortification.

The orange (*Citrus cinensis*) and pineapple (*Ananas comosus*) were considered in this combination, given their peculiarities. Whereas pineapple served as the main source of fluid for the juice, the oranges were used for its fluid and to its level of acidity that would enhance stability and a longer shelve life.

Materials and Methods

Sources of Materials

Ripened Soursop fruits were purchased from Oje market in Ibadan, Oyo state, Nigeria, and the oranges and pineapples were purchased from a supermarket in Babcock University. These were conveyed to the food laboratory for fruit juice production.

Production of fruit juices

The fruits were sorted, washed and peeled to access the edible portion (mesocarp), used for fruit juice production. These mesocarps, from the three fruits were used to produce four types of juices, labelled A, B, C and D, by varying the potion size/composition by weight, of each of the fruits (Table 1). Soursop, being of particular interest in this study was used as the base for the four juice types, but in varied proportions.

Table 1: Percent composition of fruits in the juices

Sample	Soursop	Orange	Pineapple
Sample A	100%	0	0
Sample B	50%	0	50%
Sample C	50%	50%	0
Sample D	40%	30%	30%

The weighed mesocarp mix for each type of juice was chopped, blended and the blend sieved and stored cooled until used for evaluation.

Proximate composition analysis

The standard methods of the Association of Official Analytical Chemists [4] were used to determine the proximate composition parameters: moisture, ash, crude protein, crude fat, carbohydrate, and crude fibre. The evaluations were carried out in triplicates.

Determination of total phenolic compounds in the juice

The Folin-Ciocalteu method used earlier by [5] was employed in this assay. The method is based on the action of phenolic compounds on a phosphomolybdate complex to form a blue colour, which intensity is in proportion to the concentration of phenolics in the sample. In brief, 8 g equivalent of the juice samples were treated with 30 ml of 80 % acetone in a 250 ml beaker at 25 °C in the dark to extract the phenolic compounds. The extract was then filtered and treated Folin-Ciocalteu phenol reagent and absorbance measured in triplicate against sample blank (water) at 735 nm using a Spectronic 21D spectrophotometer. Graded solutions from 100ppm of gallic acid were similarly treated and used for production of standard curve from where the concentrations of phinolic compounds in the samples was interpolated.

Total phenolic compound (%): As x gf x df × w x 10,000

Where: As = absorbance of sample, gf = gradient factor, df = dilution factor, w =

Total phenolics in mg/ gallic acid eq/g sample = Absorbance of sample x gradient factor x dilution factor

Determination of free radical scavenging ability

Fifty (50 ul) each of the juice samples was incubated at room temperature with and 250 ul of 0.5 mM DPPH for 20 minutes. Trolox (6-hydroxy-2, 5, 7, 8 - tetramethyl chroman – 2- carboxylic acid), used as standard was prepared in graded concentrations and similarly incubated with DPPH. Thereafter, the absorbance of both the samples and standards were measured at 517 nm with a cecil 2453 UV spectrophotometer, against methanol (50 ul) blank). The DPPH scavenging capacity was measured by interpolation on the standard Trolox graph and expressed as umole Trolox equivalent per 1g sample in fresh weight (FW).

Determination of the reducing power

The reducing power of extract was determined according to the Method described by [6]. In the method, ethanol extract of the juice were treated with 2.5 ml each of phosphate buffer (0.2 M, pH 6.6) and potassium ferricyanide (10 g/l) and incubated at 50 °C for 20 min. Then, 2.5 ml of 10% TCA was added to each mixture and centrifuged at 5000 x g for 20 min. The supernatants (2.5 ml) were mixed with distilled water (2.5 ml) and $FeCl_3$ (0.5 ml; 0.1 %) and absorbance measured at 700 nm with a Spectronic 21D digital spectrophotometer. A high absorbance of the reaction mixture indicated a high reducing power.

Determination of ascorbic acid content

Ten (10) g equivalent of the sample into a 100 ml volumetric flask was diluted to 100 ml with 3% meta phosphoric acid solution (0.0033M EDTA.) The diluted samples were filtered using a Whatman Filter Paper No. 3. From these filtrates, 10 ml each was titrated immediately against a standard solution of 2 - 6 dichlorophenol-in-dephenol to a faint pink end point. The ascorbic acid content of the fruit juice was calculated from the relationship:

$$\frac{V \times T}{W} \times 100 = \text{Ascorbic acid (mg/100 g)}$$

Where V = Volume of dye used in titration (ml).

T = Ascorbic acid equivalent of dye solution (mg/ml)

W = Gram equivalent of test sample.

Determination of Brix value

Hand held sugar refractometer was used to determine the brix value. The prism of the refractometer was cleaned and a drop of each juice sample was placed on the prism and closed. The total sugar content (oBrix) was read off the scale of the refractometer when held close to the eye according to AOAC [7].

Determination of PH Value

The pH of the juice samples was measured with a pH Meter after calibration and adjustments with standard buffers.

Determination of titrable acidity

Ten (10) ml of dilute juice sample was treated with 1 drop of 1 % phenolphthalein and shaken properly to give a pink colour. Thereafter, this mixture was titrated against 0.1 N NaOH until the pink colour was clear at the equivalent point. The % TTA was calculated using the formula:

$$\text{TTA (\%)} = \frac{\text{Titre value} \times M_{NAOH} \times \text{Acid equivalent} \times \text{Df}}{\text{Volume of aliquot taken}} \times \frac{10}{1}$$

Where Df = Dilution factor

Acid equivalent = Respective acid to which the % TTA is expressed

Sensory evaluation

The juice samples were examined by a 10-man panel comprised of male and female staff and students of Babcock University for appearance, texture, taste, and flavour and acceptability.

Statistical analysis

Data were analysed using a one-way analyses of variance (ANOVA) an SPSS (Statistical Package for Social Science) software version 20. Duncan Multiple Range Test was used to compare means and differences were considered significant at $p < 0.05$.

RESULTS

Proximate composition

The proximate/chemical composition of the juice samples studied is shown on Table 2. From the results, it is evident that juices from Soursop when combined with orange and pineapple was the most endowed in nutrients than the pure Soursop juice: Values for crude protein (0.41 – 1.10), fat (0.10 – 0.50), fibre (0.30 – 0.46) and gross energy (0.42 – 0.90) were highest in juice sample D formed from Soursop, orange and pineaple ($p < 0.05$). Notice that in the braces the highest values were obtained with maximum fruit combination and the least obtained from pure Soursop juice (Table 2). Moisture, carbohydrates and vitamin C were also higher with a combination of two fruits than Soursop alone. Hence, based on proximate composition the nutritional endowment of the juice was found to increase in this order: A > B > C > D.

Table 2: Proximate composition of the fruit juice mixtures

Samples/Variables	A	B	C	D
MOISTURE (%)	75.00 ± 0.02^{a}	79.70 ± 0.02^{b}	79.10 ± 0.02^{b}	78.90 ± 0.02^{c}
CRUDE PROTEIN (%)	0.41 ± 0.02^{a}	0.73 ± 0.003^{b}	0.90 ± 0.05^{c}	1.10 ± 0.04^{c}
CRUDE FAT (%)	0.10 ± 0.00^{b}	0.32 ± 0.01^{a}	0.40 ± 0.001^{c}	0.50 ± 0.02^{d}
DIETARY FIBRE (%)	0.30 ± 0.00^{a}	0.32 ± 0.02^{a}	0.40 ± 0.01^{d}	0.46 ± 0.02^{d}
ASH (%)	1.00 ± 0.00^{a}	0.15 ± 0.02^{a}	0.64 ± 0.01^{a}	0.70 ± 0.02^{b}
G.E. (kcal/g)	0.42 ± 0.04^{a}	0.74 ± 0.02^{b}	0.84 ± 0.01^{c}	0.90 ± 0.01^{d}
CARBOHYDRATE	12.52 ± 0.03^{b}	18.64 ± 0.04^{a}	18.68 ± 0.03^{a}	16.49 ± 0.07^{c}
VITAMIN C (mg/100g)	20.90 ± 1.84^{a}	38.92±0.02	37.81 ± 0.02^{ac}	37.95 ± 0.01^{c}

Means with the same superscript along a row are not significantly different ($p < 0.05$)
n = 3 determinations, A = Soursop, B = Soursop/pineaple, C = Soursop/orange and D = Soursop/orange/pineapple, G. E. = Gross energy.

Table 3 shows results of the physiochemical characteristics of the fruit juice samples. Although the measured values for pH, brix and TTA were not found to vary significantly from the others, the juices from three fruits combined noticeably contained the highest amount of titrable acidity, suggesting a longer shelve life.

Table 3: Physiochemical characteristics of the fruit juice samples

Samples/Variables	A	B	C	D
pH	3.70 ± 0.06^{a}	3.33 ± 0.09	3.68 ± 0.05^{b}	4.1 ± 0.14^{c}
Total sugar (^{0}brix)	8.00 ± 0.40^{a}	6.50 ± 0.05^{b}	6.00 ± 0.03^{c}	6.5 ± 0.01^{c}
TTA (g/100g)	1.02 ± 0.43^{a}	1.01 ± 0.02^{b}	2.60 ± 0.03^{b}	2.8 ± 0.03^{d}

Means with the same superscript in a row are not significantly different ($p < 0.05$). n = 3 determinations, A = Soursop, B = Soursop/pineaple, C = Soursop/orange and D = Soursop/orange/pineapple.

Antioxidant activity

Figure 1 shows the antioxidant activities of the sample juices. From the result, the total phenolic compounds were higher in sample D (the three fruit blend) and lowest in sample A (pure Soursop juice) and the difference significant ($p < 0.05$). The DPPH and reducing power were also found to be highest in the three-fruit juice implying improved nutritional and functional properties when compared to pure soursop juice.

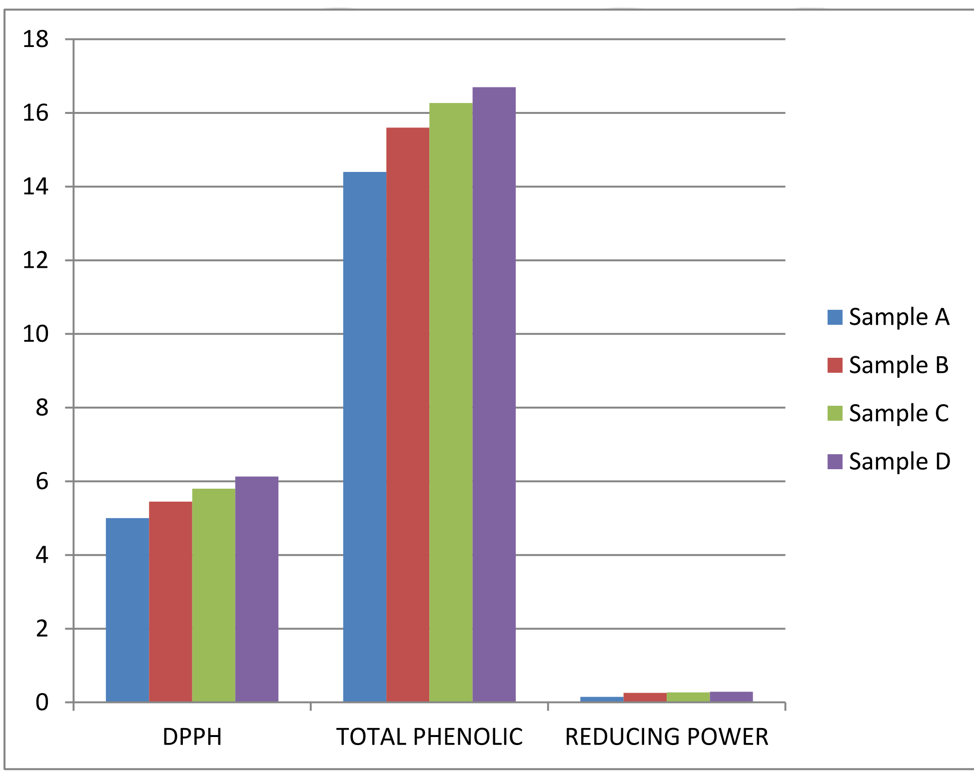

Figure 1: Antioxidant activities in the fruit juice samples

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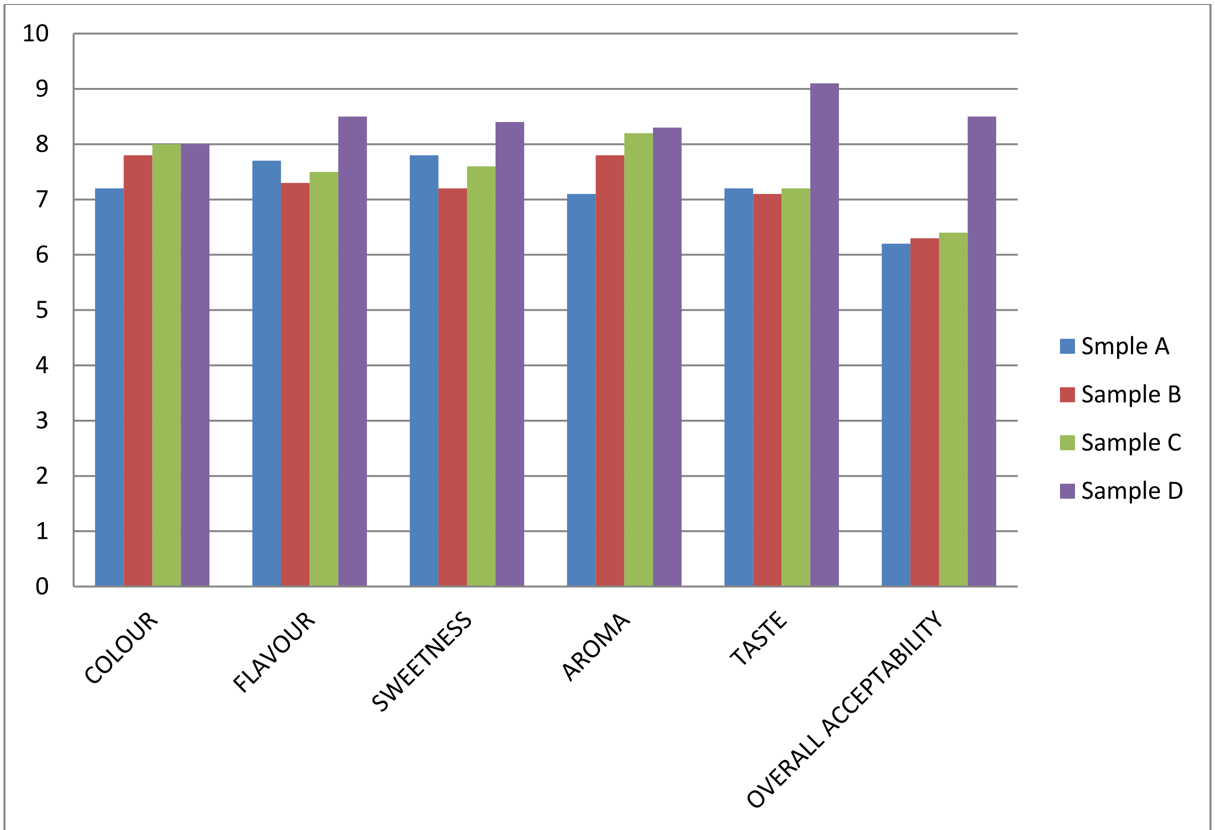

Figure 2: Sensory Characteristics

Means with the same superscript in a row are not significantly different ($p < 0.05$). n = 3 determinations, A = Soursop, B = Soursop/pineaple, C = Soursop/orange and D = Soursop/orange/pineapple.

Sensory characteristics of the fruit juice mixture

Figure 2 shows the result of the sensory characteristics. Sample D (three-fruit juice) had the most preferred flavour and the highest level of sweetness. It also had the most preferred aroma taste and overall acceptability. In generally, sample D which comprises of soursop, orange, and pineapple is most preferred followed by sample C which comprises of soursop and orange, then sample B which comprises of soursop and pineapple and sample A which is soursop alone was the least preferred.

DISCUSSION

The moisture content of the samples were between the ranges of 75.0% -79.7% and sample B had the highest level while sample A had the lowest level, the difference between each samples were significant ($p \leq 0.05$). There was a significant difference ($p \leq 0.05$) in the Crude protein between the samples. The crude fibre ranged between 0.1%-0.5 and there was no significant difference. The ash content ranged between 1.0%- 0.71% and there was no significant difference. There was no significant difference in the gross energy of the samples. These results are comparable to the results of [8]. There was significant difference in the vitamin C content which ranged from 20.9-38.92mg, the high value of vitamin C reported in this study agreed with the literature which stated that fruits have been shown to be a good source of vitamin C [4] which is usually in fruit juices, and it is necessary for the body to form collagen, cartilage, muscle, and blood vessels, and aids in the absorption of iron [9].

In the physiochemical characteristics of the samples, there was no significant difference ($P \leq 0.05$) in the Ph values of the samples which were within the ranges of 3.33- 4.1 this falls within the range of 3-5 for fruits and vegetables juices [10] and the brix value of the samples ranged between 6.0- 8.0, where sample A had the highest value of 8.0 which does not agree with the Ghana standard Board which specifies that non-alcoholic beverage shall have a refractive value of not less than 8°Brix. This may be due to the fact that no sugar was added to the samples.

For the antioxidant activities in the samples, the highest phenolic content was noticed in sample D, this suggests that the consumption of this fruit blend could provide more health benefits, Phenolic substances are pharmacologically active components of fruits which are capable of neutralizing free radicals, chelating metal catalysts and inhibiting the activity of oxidizing enzymes in biological systems [6],[11]. The lowest reducing power was observed in sample A, and the highest in sample D but with no significant difference ($p<0.05$) between each samples, which could be attributed to their high total flavonoids and phenol contents [12]. There was no significant difference ($p \leq 0.05$) in DPPH between the samples.

The Sensory evaluation, showed no significant difference ($p<0.05$) in the attributes of colour, flavour, taste and overall acceptability of the fruit juice samples except with sample A but sample D which comprises of soursop, orange, and pineapple is most preferred. This indicates that mixed fruit juices were more acceptable than the single fruit juice [13] also suggested that homemade fruit juices are more acceptable than the packaged mixed fruit juices already in existence in the market.

Conclusions

This study showed that the fruit juice with three fruits (Sample D) contained the highest levels of most nutrients that are of health benefits. It was also the most preferred juice compared with the juices from two and single fruit, hence highest potential health benefits. Multiple phytochemicals may be present in fruit juices than present results seen. In Nigeria where availability of fruits is usually for a short period due to the highly perishable and seasonal nature, fruit juice production and most importantly mixed fruit juices will be beneficial.

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