

Quality Characteristics of Orange/Pineapple Fruit Juice Blends

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Abstract Mixed fruit juices were produced from the blends of orange (*Citrus cinensis*) and pineapple (*Ananas comosus*) fruit and pasteurized at 80°C for 10 min. Packaged mixed fruit juice was purchased from the open market and used as a reference sample to study the physical, chemical and sensory properties of the juices. The physical properties studied included pH, titratable acidity, total sugar and total solid with value ranges of 3.50 – 3.97, 0.47 – 1.27%, 10.20 – 14.88% and 11.75 – 17.53%, respectively. Chemical composition of the juice blends and the reference sample showed moisture content with a range of 82.48 – 88.35% (E and F samples), crude protein 0.81 – 1.17% (samples B and A), ash 0.42 – 2.68% for samples F and A, carbohydrate 8.16 – 16.19% (A and E samples) and vitamin C with a range of 33.45 – 66.55mg/100g for samples E and A, respectively. Sensory evaluation result showed a significant difference ($p < 0.05$) in the attributes of colour, flavour, taste and overall acceptability of the orange/pineapple juice blends compared to the reference sample. This indicates that homemade fruit juices were more acceptable than the packaged mixed fruit juices already in existence in the market. Though the values for pH and titratable acidity occurred in a reversed case which showed that these juices have the advantage of being stored for a long time, there is need to carry out further investigation to determine its shelf-life stability.

Keywords: orange, pineapple, fruit, juice blends, quality characteristics

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1. Introduction

Fruits are parts of flowering plant derived from the fertilization of specific tissues such as one or more ovaries [1]. Fruits are highly perishable, non-staple foods which make-up about 39% of the food intake (fresh state or processed form) of people living in developing countries of Africa [2]. Based on fruits antioxidant capacities, they are used as indicators for healthy nourishment as well as protection factors of the human body against oxidative destruction [3]. Fruits have been shown to contain high amount of minerals, moisture, low ash and crude fibre [4] and are sources of sugar, vitamin A, C and B groups, low protein and lipid [5]. Fruit juices are liquid, non-alcoholic products with certain degree of clarity and viscosity obtained through pressing or breaking up of fruits with or without sugar or carbon dioxide addition [3]. Fruits and its juices constitute one of the most important foods for man. Their regular consumption maintains health and makes up for the losses in the human diet. Costescu *et al.*, [3] recommended the consumption of juices with pulp from foods and medicinal points of view. Fruits being a seasonal crop by nature have prompted many scientists to embark on researches on how to process fruit juices and preserve them for usage during off-season. Nutritional, chemical composition and the effect of storage on various fruits (orange, pineapple and cashew apples) and their

juices have been reported by Oguntona and Akinyele [6]; Nararudeen [7]; Auta *et al.*, [8]. Muhammad *et al.*, [9] reported on the shelf life of orange juice. Storage conditions on vitamin C and pH value of cashew apple juice was studied by Emelike and Ebere [10].

Orange (*Citrus cinensis*) belongs to the genus citrus of the family *Rutaceae*. It is a distinguished, widely consumed fresh fruits and particularly appreciated for its tangy taste. Its pulp is an excellent source of vitamin C providing 64% of the daily requirement of an individual [11]. Apart from vitamin C content of orange juice, it's also rich in folic acid, potassium and excellent source of bioactive antioxidant phytochemical and they are important trade commodities in most countries [12]. Pineapple (*Ananas comosus*) is an economically important plant in the *Bromelanceae* family which encompasses about 50 genera and 2000 species mostly epiphytic [13]. The worldwide total pineapple production is between 16 – 19 million tons [14,15,16]. Pineapple and its juice is non-alcoholic drink and the demand continues to rise mainly due to increasing awareness of its health benefits [17]. Its juice have an proximate composition of 81.2 – 86.2% moisture, 13 – 19% total solid of which sucrose, glucose and fructose are the main compositions, 0.4% fibre and a rich source of vitamin C [18]. Pineapple also contains polyphenolic compounds and possesses antioxidant activity [19]. Its pulp is juicy and fleshy with the stem serving as a supporting fibrous core. It is an excellent source of antioxidant, vitamin C which is required for the

collagen synthesis in the body. Pineapple juice is largely consumed around the world, mostly as canning industry by-products and in the blend composition to obtain new flavours in beverage and other products [20].

Mixed fruit juice blends together can be produced from various fruits such as orange, pineapple and among others in order to combine all the basic nutrients present in these different fruits. This usually gives a better quality juice nutritionally and organoleptically. Studies showed that the practice of mixing different exotic fruits positively impact on the flavour and taste of the fruit and fruit products [21,22]. Moreover, one could think of a new product development through the blends of different fruits in the form of a natural health drinks which may also serve as an appetizer. Evaluation of soy/carrot drinks flavoured with beetroot was studied by Banigo *et al.*, [23] with the aim of developing new product or improving the existing one in the market. Therefore, to produce mixed fruit juice from the blends of orange/pineapple fruits is the objective of this research and to compare the physical, chemical and sensory properties of the resultant product with already existing industrially packaged mixed fruit juice that are being sold in the market as a reference sample (RS).

2. Materials and Methods

2.1. Materials

Fully matured, ripe and fresh orange and pineapple fruits were procured from Mile 1 market, Diobu, Port Harcourt, Nigeria. They were transported to Food Science and Technology laboratory, Rivers State University of Science and Technology for subsequent study. Chemicals and reagents used in this study were of analytical grades.

2.2. Methods

2.2.1. Preparation of Orange Fruit Juice

Quality traits like uniformity in size, colour, shape and abrasion-free were considered in choosing the orange fruits. The selected ones were sorted and washed thoroughly under running water after which they were washed with 5% hypochlorite solution to get rid of the surface microbes and contaminations. The fruits were immediately rinsed severally with distilled water. The pericarp was removed with the aid of stainless knife and the flesh was separated from the rind (the thick tough outer layer) and the seeds were removed manually. The fruit pulps were blended with the aid of Sumeet Food Processor (Model A), then homogenized in a blender and filtered with the use of readymade double muslin cloth. They were packaged immediately and stored in airtight screw cap sterilized glass bottles then refrigerated at 5°C prior to analysis.

2.2.2. Preparation of Pineapple Fruit Juice

The fruits were selected and were washed with 5% hypochlorite solution and rinsed thoroughly with distilled water. They were peeled with sterile stainless knife, cut into small pieces of about 3 – 4mm thick and the juice extraction using a juice extractor (Iloytron, 23438, UK). The extracted pineapple juice was filtered by passing through a sterile muslin cloth folded into 2, 4 and 8 layers,

respectively into a clean transparent bowl in accordance to the method reported by Emelike and Eberé [24] for cashew apple juice. The juice was bottled in an airtight screw cap sterilized glass bottles and refrigerated at 5°C prior to analysis.

2.2.3. Preparation of Orange/Pineapple Juice Blends

The orange juice was blended with pineapple juice in varying proportions such as 100:0, 70:30, 50:50, 30:70 and 0:100. The blends were homogenised, bottled and pasteurised at 80°C for 10 min in a thermostatically controlled water bath with agitator, cooled to room temperature (27°C) and finally stored in a refrigerator at 5°C until analysed.

Table 1. Formulation of orange/pineapple juice blends

SAMPLE	ORANGE JUICE (%)	PINEAPPLE JUICE (%)
A	100	0
B	70	30
C	50	50
D	30	70
E	0	100
F	---	---

2.3. Physical Properties

2.3.1. pH

The pH of the juice was determined using a digital pH meter (pHs-2F, Harris, England) according to AOAC [25] method. Fifty (50ml) of the juice was transferred into a beaker and the pH was determined after the meter was calibrated using standard buffer solutions of pH 4.0 and 7.0. Sufficient time was allowed for equilibration before readings were taken.

2.3.2. Total Sugar Content (°Brix)

The hand held sugar refractometer was used. The prism of the refractometer was cleaned and a drop of the juice was placed on the prism and closed. The total sugar content (°Brix) was read off the scale of the refractometer when held close to the eye according to the method of AOAC [25].

2.3.3. Titratable Acidity (TTA)

Ten (10ml) of the juice was pipetted into a conical flask and 25ml of distilled water added as described by AOAC [25]. Two hundred metres (200ml) of 0.1M NaOH was powered into a burette and was titrated against the sample in the flask using three drops of phenolphthalein as indicator. It was titrated until a pink colouration was observed and the corresponding burette reading taken using the following formula.

$$\text{Titrateable acidity (\%)} = \frac{\left(\text{Titre} \times \text{blank} \times \text{normality of base} \right)}{\left(\times \text{ml equivalent of citric acid} \right)} \times \text{Weight of sample}$$

$$\text{ML equivalent of citric acid (meq)} = 0.06404$$

2.3.4. Total Solid

The total solid content of the treated juice samples was determined using the air oven method. Aluminium dishes were washed; dried in the oven for 10min and kept in the desiccator to cool, after which their weights were taken. Three grams (3g) of the treated juice samples were weighed into the dishes and weight of the dish plus samples were taken. The dishes were placed in the oven for 1h at 105°C. The dishes were removed after cooling. The total of solid content was calculated.

2.4. Chemical Composition

Moisture content, crude protein and ash content of the juice was determined according to the AOAC [25] method. Total available carbohydrate was determined using the Clegg Anthrone method as described by Osborne & Voogt [26]. Vitamin C was determined by a dye solution of 2, 6 – dichloroindophenol (DCIP) titration method described by Mazumdar and Majumder [27].

2.5. Sensory Evaluation

The sensory analysis was carried out using twenty member panelist consisting of staff and students of Food Science and Technology Department, Rivers State University of Science and Technology, Port Harcourt,

Nigeria. The sensory qualities evaluated were: Colour, Flavour, Taste and Overall acceptability. The orange/pineapple juice blends together with a reference sample (packaged mixed fruit juice already existing in the market) were served with clean glasses to individual panelist. The order of presentation of samples to the panel was randomized, portable water was provided to rinse the mouth between evaluations. Each sensory attribute was on a 9 – point Hedonic Scale with 1 = disliked extremely while 9 = liked extremely as reported by Iwe [28].

2.6. Statistical Analysis

Results were expressed as mean values and standard deviation of three (3) determinations. Data were analysed using a one-way analyses of variance (ANOVA) using Statistical Package for Social Science (SPSS) version 20.0 software 2011 to test the level of significance at 5% probability ($p < 0.05$). Duncan New Multiple Range Test was used to separate the means where significant differences existed according to the method of Wahua [29].

3. Results and Discussion

3.1. Physical Properties

Table 2. Physical properties of orange/pineapple juice blends compared with the reference sample

Samples	pH	Titrateable acidity (%)	Total Sugar (%)	Total solid (%)
A	3.50±0.01 ^c	1.27±0.04 ^a	10.30±0.14 ^e	11.95±0.07 ^e
B	3.62±0.03 ^b	1.00±0.01 ^b	11.70±0.14 ^d	13.43±0.04 ^c
C	3.64±0.04 ^b	0.89±0.01 ^b	12.15±0.21 ^c	13.87±0.04 ^c
D	3.68±0.04 ^b	0.70±0.01 ^c	13.04±0.06 ^b	15.68±0.04 ^b
E	3.97±0.05 ^a	0.47±0.02 ^e	14.88±0.11 ^a	17.53±0.03 ^a
F	3.67±0.01 ^b	0.56±0.01 ^d	10.20±0.07 ^e	11.75±0.07 ^e

^{a,b,c,d,e} Means bearing the same superscript within the column do not differ significantly ($p > 0.05$). ± = means ± standard deviation of triplicate determination.

Key: A = 100:0, B = 70:30, C = 50:50, D = 30:70, E = 0:100 (orange/pineapple juice blends), F = Reference sample.

The physical properties' result showed that the pH of the juices ranged between 3.50 – 3.97 for samples A and E, respectively as presented in Table 2. This falls within the range of 3 – 5 for fruit and vegetable juices as reported by Harris *et al.*, [30]. There were no significant difference ($p < 0.05$) in the pH values for samples B, C, D and F the reference sample (3.62, 3.64, 3.68 and 3.67), respectively. The pH value for sample E (3.97) was significantly higher while sample A (3.50) was significantly low compared to other samples. Several researchers have reported fruit juices with different pH values. Pineapple has been reported to contain a pH range of 3.7 – 4.5 by Frazier and Westhoff [31]. Adubofuor *et al.*, [32] reported a range of 4.82 – 4.99 for cocktail juices, Ndife *et al.*, [33] observed a range of 3.23 – 4.08 for different brands of orange juices, as well as 4.1 reported by Emelike and Ebere [10] for fresh cashew apple juice. A reverse in values was observed for titrateable acidity values with sample A (100% orange juice) having the highest value of 1.27% and E (100% pineapple juice) with the lowest value of 0.47%. Kareem and Adebawale [34] reported that the dominant acid in orange juice is citric acid. Ndife *et al.*, [33] also observed the same reversed case between pH and acidity values. This indicates that juices get more acidic at a decreased pH value. Meanwhile, a significant difference ($p > 0.05$) was observed in the values for titrateable acidity of all the juice samples. The values for total sugar ranged

between 10.20 – 14.88% (samples F and E), respectively and showed significant difference in all the samples except A and F (reference sample). This is in close relationship with the range of 9.15 – 14.25% reported by Ndife *et al.*, [33] for different brands of orange juice. El-Sheikha *et al.*, [35] reported a Recommended Dietary Allowances (RDA) of 130g/day for total sugars, consumption of pineapple fruit juice will contribute about 14.88% while equal quantity of orange/pineapple juice blends will contribute about 12.15%. The values for total solid range from 11.75% for sample F (reference sample) to 17.53% for sample E (100% pineapple juice) and showed significant difference in all the samples except A and F samples. This is higher compared to the range of 7.22 – 9.28% for cocktail juices [32], 8.17 – 9.91% for soy-carrot flavoured with beetroot [23] and 9% for fresh beetroot juice reported by Emelike *et al.*, [36]. This could be attributed to the blends of different fruit types. It is in close relationship with the range of 5.50 – 11.80% for different brands of orange juice samples [33].

3.2. Chemical Properties

The value for moisture content ranged between 82.48 – 88.35% for E and F samples, respectively and there was significant difference ($p < 0.05$) between samples D and E while other samples were significantly higher as shown in

chemical composition of orange/pineapple juice blends shown in Table 3. This is within the acceptable range of 80 – 95% for fruit and vegetable juices [37]. Other fruit juices that fall within this range are cocktail juices (90.72 – 92.78%), fresh beetroot juice (91%) and 89.31 – 92.10% for soy-carrot-beetroot drinks [23,32,36]. Hundred percent (100%) pineapple juice with moisture content of 82.48% agreed with the range of 81.2 – 86.2% moisture value of pineapple juice reported by Dull [18]. Crude protein content of the orange/pineapple juice blends was low, ranging from 1.17 – 0.81% for samples A and B, respectively. Sample A (100% orange juice) was observed to have significantly higher value compared to other samples while sample C (50:50 orange/pineapple juice blends) had no significant difference as compared to sample F (reference sample). Emelike *et al.*, [36] equally observed a low value for protein content of fresh beetroot juice and reported that fruit juices are not good sources of protein. The highest ash content was observed in sample A (2.68%) and lowest in sample F (reference sample) with the value of 0.42%. There was no significant difference between samples B and C (1.86% and 1.64%) as well as samples D, E and F with the values of 0.56, 0.50 and 0.42%, respectively. This is similar to the range of 0.64 – 1.32% as reported by Ndife *et al.*, [33] for different brands

of orange juices. The values for carbohydrate of orange/pineapple juice blends ranged from 8.16 – 16.19% for samples A and E (100% orange and 100% pineapple juice), respectively. This is an indication that pineapple fruit contains higher percentage of carbohydrate compared to orange fruit. The values for carbohydrate in this study are high compared to the carbohydrate value for fresh beetroot juice of 7.3% reported by Emelike *et al.*, [36] and a range of 2.48 – 4.91% for soy/carrot/beetroot drinks [23]. The variations in these values could be associated with different fruits being analysed. Apart from samples B and F, significant difference was recorded in all other juice samples for vitamin C. Samples A, B and C (66.55, 56.63 and 50.01mg/100g, respectively) had significantly higher ($p < 0.05$) vitamin C compared to sample F (42.98mg/100g) while a significant difference was not observed between sample D (43.39mg/100g) and sample F. vitamin C content of 100% pineapple juice and 100% orange juice are in close relationship with vitamin C values of pineapple juice (32.50mg) and orange juice (67.758mg) reported by Awsi and Er-Dorcus [38]; Muhammad *et al.*, [9]. The high value for vitamin C reported in this study agreed with literature which stated that fruits have been shown to a good source of vitamin C [39].

Table 3. Chemical composition of orange/pineapple juice blends compared with the reference sample

Samples	Moisture (%)	Crude protein (%)	Ash (%)	Carbohydrate (%)	Vitamin C (mg)
A	88.10±0.01 ^a	1.17±0.05 ^a	2.68±0.04 ^a	8.16±0.05 ^e	66.55±0.01 ^a
B	86.58±0.04 ^a	0.81±0.01 ^c	1.86±0.04 ^b	10.81±0.01 ^d	56.63±0.03 ^b
C	86.18±0.04 ^a	0.95±0.01 ^b	1.64±0.01 ^b	11.29±0.01 ^c	50.01±0.02 ^c
D	84.38±0.03 ^b	0.82±0.01 ^c	0.56±0.01 ^c	14.30±0.01 ^b	43.39±0.02 ^d
E	82.48±0.35 ^c	0.89±0.01 ^c	0.50±0.01 ^c	16.19±0.01 ^a	33.45±0.01 ^e
F	88.35±0.07 ^a	0.96±0.02 ^b	0.42±0.03 ^c	10.38±0.03 ^d	42.98±0.01 ^d

^{a,b,c,d,e} Means bearing the same superscript within the same column do not differ significantly ($p > 0.05$). ± = means ± standard deviation of triplicate determination.

Key: A = 100:0, B = 70:30, C = 50:50, D = 30:70, E = 0:100 (orange/pineapple juice blends), F = Reference sample.

3.3. Sensory Properties of Orange/Pineapple Juice Blends

The statistical analysis revealed that there were no significant difference ($p > 0.05$) in the colour of all the orange/pineapple juice samples except samples E and F as shown in Figure 1. Sample A scored 6.15, B 6.50, C 6.85, D 6.50, E 5.85 and F 4.40 (reference) in terms of colour of the orange/pineapple juices. Samples F with the score of 4.40 is an indication that panelist prefer the colour of homemade fruit juice compared to the package fruit juice. Apart from sample F, other sensory scores for colour is in close agreement with the report of Ndife *et al.*, [33], who

reported a range of 5.14 – 8.35 for different brands of orange juice samples. The reference juice sample (sample F) showed the least acceptability in all the sensory attributes such as colour, flavour, taste and overall acceptability. This may be related to the freshness of the juice blends. Some fruit juices that have been produced locally and reported by researchers to obtain high sensory value are cashew apple juice with sensory score range of 3.50 – 4.56 on a 5 – point hedonic scale as reported by Emelike and Ebere [24] and soy/carrot/beetroot with the acceptable range of 6.05 – 7.80 on a 9 – point hedonic scale reported by Banigo *et al.*, [23].

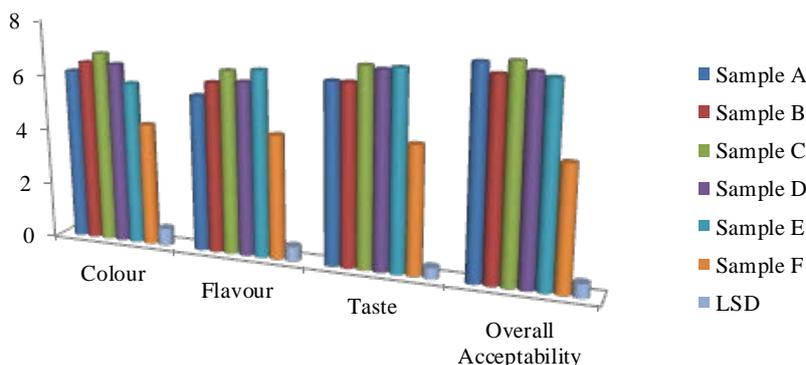


Figure 1. Sensory properties of orange/pineapple juice blends compared with the reference sample

Key: A = 100:0, B = 70:30, C = 50:50, D = 30:70, E = 0:100 (orange/pineapple juice blends), F = Reference sample, LSD = Less Significant Difference

4. Conclusion

Orange/pineapple juice blends were successfully produced and analysed for physical, chemical and sensory properties. It was observed that the resultant juice samples had a pH range of 3.50 – 3.97 for samples A and E, respectively. A reversed case occurred on these samples for titratable acidity with a range of 0.47 – 1.27%. Oranges reduced the sugar content and increases the vitamin C content of the juice blends. Its moisture value falls within the acceptable range and presented no significant difference compared to the reference sample. All the sensory attributes of the orange/pineapple juice blends were preferred more than the reference sample. This is to say that homemade fruit juices are better in terms of sensory parameters to the industrially packaged mixed fruit juices in the market.

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