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ASSESSING THE QUALITY OF JUICE PRODUCTS FROM AFRICAN STAR APPLE FRUIT

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ABSTRACT

The quality attributes and consumer acceptability of juice made from African Star Apple (*Chrysophyllum albidum*) were investigated using a panel of twenty eight (28) people. The chemical and sensory properties of the juice were determined. The physico-chemical properties such as pH, total titratable acidity (TTA), vitamin C, colour at an interval of 7days were determined over a 3-week period. All the physical and chemical properties with the exception of ascorbic acid were within acceptable range. African Star Apple fruits had 23^{o}B (soluble solids) and pH of 3.40.The sensory evaluation by twenty eight assessors, which was statistically analyzed, indicated that fresh African Star Apple Juice was accepted. However, as the period of storage progresses, the juice becomes more acidic, while the level of acceptance decreases. There were significant differences in colour, flavour, taste and general acceptability and could be said that the juice was conveniently preserved for two weeks.

Keywords: *African Star Apple fruit, physico-chemical properties, shelf life, juice extraction, Quality attributes.*

INTRODUCTION

Juice production has been a household name all over the world. In our nation Nigeria, many organizations from both the governmental and non-governmental sectors are actively promoting the processing of fruits and vegetables. Many fruits, however, have been cultivated since ancient times (Waderiboldaji *et al*., 2008). Fruits and vegetables are among the most important foods of mankind, as they are not only nutritive but are also indispensable for the maintenance of health (Wong *et al*., 2003). They are valued for their attractive appearance, characteristic flavour and taste. They play important roles in the diet of most people in the tropics, providing essential minerals and vitamins and adding colour, flavour and variety to monotonous diet (Ragaert *et al*., 2004).

Fruits and vegetables are abundant during their various seasons, with over 50% lost to wastage as a result of deterioration under tropical conditions due to high ambient temperatures and humidities, pest and diseases infestation, poor handling and storage facilities (Pantastico, 1975; Levi *et al*., 1983; Aworh and Olorunda, 1988). In 1998, World Resources Institute reported that not only are losses clearly a waste of food, but they also represent a similar waste of human effort, farm inputs, livelihood, investments and scarce resources such as water. It implies that fruits, most often, do not attain their maximum market value thereby leading to less return to the grower as an individual and economic loss to the nation as a whole. As a result of these abundant wastages, processing of these fruits and vegetables into juice and other valuable products are being developed, and they are the ways these abundant fruits and vegetables can be utilized to reduce the wastage and equally bring economic returns to farmers.

Apart from consuming these fruits fresh, the act of processing led to the production of various products such as jam, jellies, stewed fruit, marmalade, syrup and several types of soft drinks. Aside the various products made from fruits and vegetables, they are equally used for medical purposes due to the properties of their stalk and fruits. The leaves and seeds of some of these fruits and vegetables are used in the pharmaceutical industries. Some of the trees are also valuable for ornamentation as an ever green brood leaf plant (Islam, 2002). The fruits commonly used for making juice are orange, grape, apple, lemon, mango, pineapple etc. Many of the tropical fruits and some other fruits have had little or no utilization in the area of fruit juice. Indigenous tropical fruits, in this case, African Star Apple (*Chrysophyllum albidum*) fruits are often left unexploited and are allowed to waste due to their excess supply in their season. Due to this, rural producers are often forced to give away their produce or allow most of them to rot away due to the fact that the fruit has very short life span after ripening. To prevent or reduce these losses to the bearest minimum, processing into other valued products to be sold in urban areas is of importance. Processing of the gluts from these fruits has received less attention until recently where research work on the suitability of this fruit into food preserves, drinks is being looked into.

African Star Apple (*Chrysophyllum albidum*), an indigenous plant, is an edible tropical fruit, which is classified as a wild plant, and belong to the family sapotaceae. The fruit which is known as “Agbalumo” by the Yorubas, “Udara” by the Igbos (Keay, 1964) , is seasonal and glaborous when ripe, ovoid to subglobose, pointed at the apex and up to 6cm long and 5cm in diameter. The skin or peel is orange to golden yellow when ripe and pulp within the peel may be orange, pinkish, bricked or light yellow. The fruit grows naturally in the forest habitat of parts of Africa extending from Sierra Leone through Guinea, Sudan to East African countries such as Kenya, Uganda. It is distributed in all forest types (low and tropical rain forest) in southern Nigeria and also in compounds and outlaying farms in most villages, in part of South-Western Nigeria. The tree mostly flowers between the months of April and June and fruits between December and March.

Studies have been carried out on the physical, chemical, pomological and nutritional properties of fruits such as sweet cherry (Naderiboldaja *et al*., 2008; Radicevic *et al*., 2008; Polat *et al*., 2008; Vursasas *et al*., 2005), Plum (Diaz–Mula *et al*., 2008; Ertekin *et al*., 2006), Wild plum (Calisir *et al*., 2005), Malatya apricot (Akin *et al*., 2008), Cornelian Cherry (Tural *et al*.,2008; Demir and Kalyoncu, 2003; Guleryuz *et al*., 1998), Oleaster (Akbolat *et al*., 2008), hazelnut (Oliveira *et al*., 2008; koksal *et al*., 2006; Ozdemir and Akinci, 2004), Orange (Topuz *et al*., 2004) and berries (Molina *et al*., 2008; Khazaei and Mann, 2004), but less work has been done on the utilization of indigenous fruits, such as African Star Apple, for various processed and packaged products.

This study however, tends to investigate the production of juice from *Chrysophyllum albidum*, evaluate some of the chemical and physical properties of the pulp and juice, as well as assessing the consumer acceptability of the juice products, with a view to commercializing it.

MATERIALS AND METHODS

Procurement and Processing of Juice from African Star Apple: African Star Apple fruits

(*Chrysophyllum albidum*) were collected from a local farm at Ajibode village in Ibadan. Fresh, juicy, good quality African Star Apple fruits were sorted for processing. The fruits were washed thoroughly under tap water, followed by distilled water to remove foreign extraneous materials. The fruits that had been properly washed were hand peeled using kitchen knives. The pulp was separated from the seeds and peels. The pulp was reduced in size to increase the rate of extraction of liquid components and also for ease of blending. The blended pulp was extracted using sterilized white muslin cloth. Juice obtained was cloudy as some suspended particles were present. The juice was further filtered using keiselghur powder. The clearer juice obtained was stored for further use.

Juice Packaging: 200ml each was poured in sterilized plastic bottles and sealed before pasteurization and storage at ambient temperature (27ºC ± 2°C).

Shelf-life Study: The shelf life of the juice was studied in terms of sensory and physico-chemical quality.

Sensory Analysis: Sensory evaluation of the juice was judged for colour, taste, flavour and general acceptability on a nine point hedonic scale, varying from "dislike extremely" (score 1) to "like extremely" (score 9), was used according to the method of Stone and Sidel (1992). An informal panel of twenty eight (28) untrained assessors, but regular consumers of juice, carried out the acceptance test. Samples were served in transparent glass cups.

Physico-Chemical Analyses

Moisture Content (%): A.O.A.C method of 2005 was used, in which 5g of the pulp was weighed in duplicate into the cans to be used for drying. The samples were then dried at a temperature of 70^{0}C for 6hours, because the sample thickness was small and to reduce burning. The samples were re-weighed at every 2-hour interval until constant weights were obtained. The dried samples were cooled in a desiccator to prevent moisture uptake. The losses in weight were consequently reported as moisture content loss and calculated in percentage with equation (1).

$$\% MC = \frac{T_1 - T_2}{T_1} \times 100\% \qquad (1)$$

Where:

T_1= Original sample weight

T_2= Final sample weight

Colour/browning Index Determination: The colour/browning effect on samples was determined as the optical densities of the concentrated solution. 5mls was pipetted into a cuvette and measured in a spectrophotometer at 420nm. It was carried out in triplicates.

pH: 10g of the fruit and of juice (V/W) was weighed into a clean Erlenmeyer. The pH was separately determined using electrode and potentiometer standardized with buffer solutions of pH 9.18 and 4.01 at temperature of 25ºC± 2ºC.

Total Soluble Solids (TSS): The TSS for the juice and pulp was determined in Degree Brix using a hand refractometer (Alago, Tokyo model Leica 10431) with a scale of 0 - 50 degree Brix.

Ash Content Determination: 10g of the pulp was weighed and placed inside a muffle furnace with temperature adjusted to between 525±15ºC and was heated for 6 hours or more to burn off all the nutrients and fibre present in order to obtain a white ash in hot plate. Ash content in percentage was then calculated with the method of AOAC, 2005 (see equation 2 below).

$$\% Ash = \frac{\text{Final weight}}{\text{Sample weight}} \times 100 \qquad (2)$$

Total Titratable Acidity (%TTA): TTA of the sample was determined by titrating 10ml of the juice with 0.1N NaOH. 1ml of the juice was diluted into 100ml volumetric flask and one drop of 1% phenolphthalein was added and shaked properly to give a pink colour. The result was expressed as percentage citric acid and calculated using equation (3) below.

$$\% \text{ TTA} = \frac{T \times M \times A \times DF}{V} \text{ x } 100 \quad \ldots (3)$$

Where:

T= Titre Value

M= MNaOH (0.1)

DF: Dilution factor

A= Acid equivalent- 0.75 (for tartaric acid)

V= Vol. of aliquot taken

Total Sugars: The method by Wong *et al*., 2002 was adopted to determine the total sugar in the pulp, in which 0.025g of the pulp was weighed into a centrifuge tube. The sample was prepared accordingly and read at an absorbance of 490nm wavelength in a spectrophotometer. A prepared glucose standard curve was then used to estimate the concentration of total sugar in the pulp. Percentage sugar was then calculated as thus:

$$\% \text{ Total Sugar} = \frac{K \times DF}{0.025 \times 10^6} \text{ x } 100 \quad \ldots\ldots (4)$$

Where:

K= mls taken

DF: Dilution factor

Ascorbic Acid (mg/100ml): The ascorbic content was determined using Dichlorophenol Indo Phenol.

RESULTS AND DISCUSSION

Nutritional Composition of African Star Apple: Table 1 shows the chemical composition of African Star Apple Fruit sourced for the research work. It was noticed from the analyses carried out that the fruit contained 23% soluble solids and 29.50% total solids, with the difference attributed likely to insoluble pectin and fibres. According to Radicevic *et al., (*2008), who worked on some other species of cherry, reported a range of 13.5% to 18.3% for nine cherry varieties they analyzed in Canada. It was equally reported by Radicevic *et al.,* (2001) that the best cherry sourced by the team had soluble solids content of 18.33%, which was less than the value recorded for African Star Apple used for this research work. The sweetness level of the fruit used for the research work reflected in the values obtained for its soluble solids.

The fruit had ash content of 3.13% and a low citric acid of 0.78. The value of the citric acid reflected in the high pH recorded (3.40). The results obtained in this research were comparable to that reported by some other researchers such as that of Radicevic *et al., (*2008) and Radicevic *et al., (*2001).

Table 1: Chemical Composition of African Star Apple Fruit

Parameters	African Star Apple
Moisture (%)	71.0±0.17
Total Solid (%)	29.50±0.32
Total Acidity (%)	0.78±0.22
Total Soluble Solids (%)	23.00±0.57
pH	3.40±0.49
Ash%	3.13±0.16
Ascorbic Acid (mg/100ml)	13.20±0.21
Total Sugars (%)	8.55±0.13

Means ±SD. Data are means of three readings

Table 2: Result of Hedonic Test for Stored Juice Samples

Juice Sample	Colour	Taste	Flavour	General Acceptability
1st Week	4.16± 0.87a	3.82±0.96a	5.16± 0.71a	4.32± 0.66a
2nd Week	4.03± 0.89b	3.31± 0.86b	4.32± 0.78b	3.34± 0.69b
3rd Week	3.84± 0.90c	2.83± 0.73c	3.74± 0.83c	3.16± 0.68c

Means ±SD down a column with different alphabets are significantly different at 5% level of Tukey with a>b>c. Data are means of triplicates.

Table 3: Result of Colour Index Determination

Juice Sample	Colour
1st Week	2.00± 0.02a
2ndWeek	1.96± 0.04a
3rdWeek	1.90± 0.01b

Means ±SD down the column with different alphabets are significantly different at 5% level of Tukey with a>b. Data are means of triplicates.

Table 4: Chemical Composition of the Juice

Day /Parameters	TSS (%)	AA (mg/100g)	TTA (%)	pH
1stWeek	23.00± 0.52a	13.00± 0.02a	1.08± 0.23b	3.40± 0.21a
2ndWeek	22.85± 0.23a	12.62± 0.00a	1.12± 0.31a	3.32± 0.00a
3rdWeek	22.81± 0.01a	11.34± 0.00b	1.19± 0.22a	3.27± 0.01b

Means ±SD down a column with different alphabets are significantly different at 5% level of Tukey with a>b. Data are means of triplicates.

Sensory Analysis: The Hedonic scale test as seen in table 2 showed that over the period of three weeks of storing the juice, the colour, taste, flavour and general acceptability were decreasing gradually with each passing week. The mean sensory scores of the samples measured in triplicates over the period of storage were significantly different from each other (at $p<0.05$) for the parameters measured. The sample gave the best result on the first week of the measurement. It could be seen that all the parameters measured were significantly different, which could be attributed to some physical and chemical changes in the juice. There was no additive in the juice sample, but was preserved naturally by its acidic nature and the pasteurization process. The acceptance of the juice waned as weeks passed by due to its high acidic nature.

Colour Index Determination and Chemical Analysis of the Juice: Table 3 showed the colour index determination of the juice sample. It was seen that over the period of storage (3 weeks), the colour change was negligible, depicting stability of the colour of the juice sample over the period.

Table 4 showed the chemical properties of the juice within the 3 weeks of analysis. The pH value of the juice was between 3.27 and 3.40, which showed stability, most especially in the first two weeks before experiencing significant difference in the third week. The slight decrease experienced in the pH could be attributed to the action of the citric acid leading to slight degradation of its sugar content and this might be due to microbial growth that produced lactic acid, which could then be traced to the absence of a known preservative. Most bacteria will not grow at low pH, which could have contributed to the shelf stability of the juice at the early stages of storage, and thus maintaining good keeping quality (Ranganna, 1986). Evaluation of pH and/or acidic nature of the food product was very important as it influenced palatability. The total titratable acidity of the juice increased from 1.08 to 1.19 over the period of storage. These results were similar to that reported by Braddock, (1999), for orange (0.7-0.8%) and grape fruits (1.1-1.3%) respectively. Its stability might be due to the stable concentration of the organic acid in the juice judging by the report of Fasoyiro *et al*., (2005) that says that increase in titratable acidity could be due to presence of preservatives, and in this work, no preservative was added to the juice produced.

Total soluble solids (TSS) of juices indicate maturity of the fruits sourced. TSS of the juice was in the range of 22.81 – 23%. The stability which is an indication of the maturity of the fruits used might be part of the reason the juice was palatable and acceptable, as it can be deduced that reducing sugars are the main constituents of soluble solids. The slight reduction noticed in the values of TSS might be due to the utilization of sugars by fermenting organisms, which could have led to the slight degradation noticed. This corroborated the report of Costa *et a*l., (2003) for juice stored after hot fill and aseptic processing.

Ascorbic Acid (AA) is one of the major nutrients that were obtained mainly from fruits. Apart from the sweet sensation, aroma, and flavour of the ripe fruits, the nutritional aspect should also be of importance to the consumers. The value of AA obtained in the research work over the period ranged from 11.34mg/100ml to 13mg/100ml. Taylor in 1987, reported 47.6mg/100g for African Star Apple pulp. After the 3 weeks of analysis, the values of AA recorded were stable (i.e with a slight decrease of 12.77%), referring to juice samples that were without an added additive and/or preservative. The slight decrease could be attributed to oxidation that normally occurs in fruit juices during storage period, which is highly dependent on the pressure of oxygen in the head space or dissolved in the juice (Costa *et al*., 2003). AA is highly sensitive to a lot of conditions such as heat, light, oxygen, pH. The low AA recorded and its stability over the period could have been caused by factors such as cultivar, oxygen, soil, some other environmental factors that might have led to its loss and the stable pH.

CONCLUSION

It can be concluded from the research work that juice can be produced from African Star Apple fruit and could give a satisfactory and acceptable product, which can compare favourably with any commercial juice products. The juice produced has the advantage of its high acidic level to be shelf stable for two to three weeks, which can be conveniently extended for a longer period with the addition of a suitable preservative coupled with production under proper hygienic condition. The low AA content observed in this juice could be boosted through fortification during large scale production to take care of any short fall. Based on the sensory evaluation by the panelists, the juice was accepted. Though there was slight reduction in some chemical properties of the juice after two weeks, which probably may be due to the increasing acidic nature of the juice.

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