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PROXIMATE ANALYSIS AND SENSORY EVALUATION OF FRESHLY PRODUCED APPLE FRUIT JUICE STORED AT DIFFERENT TEMPERATURES AND TREATED WITH NATURAL AND ARTIFICIAL PRESERVATIVES.

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ABSTRACT

The Proximate composition, Vitamin C and the organoleptic properties of freshly produced apple juice were investigated. The proximate analysis of the test fruit revealed it to be a poor source of protein (0.05%) but with a high moisture content (87.73%). The results showed low concentrations of ash (0.30%), lipid (0.13%) and fibre (1.21%). The juice was a good source of vitamin C (22.15mg/100).

Organoleptic parameters like colour, flavour, and taste of the apple juice with the various preservatives (garlic, ginger and sodium benzoate) were acceptable throughout the 8 days storage periodat refrigerating temperature (4^{o}C) except for juice stored at room temperature(23^{o}C) which showed deterioration in taste, flavour and overall acceptance after the 3rd day of storage. There was variation in color and flavor in prepared juice with the three different preservatives and shows that variation in temperature has great effect on storage quality of food products.

KEYWORDS: Preservatives, Proximate, Apple Juice, Storage, Organoleptic

INTRODUCTION

Fruit juices are commonly consumed for their refreshing attribute, nutritive values and health benefits. They contain several important therapeutic properties that may reduce the risk of various diseases. They contain large amounts of antioxidants, vitamins C and E, and possess pleasant taste and aroma (Abbo et al., 2006). Fruit juices are easy to process and may be prepared in the home.

One of the many popular fruit juice products is the apple (Malus domestica) juice.

Apple juice is widely consumed by both adult and children. Apple juice is a nonalcoholic drink and the demand continues to rise mainly due to increasing consumer awareness of its health benefits.

Apple juice is the second most popular fruit juice consumed in the United States only behind orange juice. In 2007-2008, over 535,000 metric tons of concentrated apple juice was consumed (USFAS, 2008).

The nutritional benefits of apple juice are often underestimated. It contains 83.1% moisture, 9.2% sugar, 1.87% protein, 2.0 mg sodium, 8.7 mg potassium, 2.7 mg calcium, 0.22 mg iron, 0.11 mg copper, 5.1 mg phosphorous and 4.5 mg vitamin C per 100 g of whole fruit (Anonymous, 2006). When closely evaluating the nutritional composition of apple juice and other apple products, it becomes apparent that the lack of fat, cholesterol and sodium are just a few of the many reasons these products are an important part of a healthful dietary routine.

Benzoic acids and its salts are among the most commonly used antimicrobial agents for improving storage ability of fruit juices. Their wide usage is due to their broad-spectrum activity against yeasts, moulds and bacteria, as well as their non-alteration of food flavor (Fleet, 2003).

The food market has stimulated the development of new products that present good sensory acceptance and of high nutritional value. 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 (Ameh et al., 2015).

MATERIALS AND METHODS

Study area: The study was carried out in Uyo (latitude 5^{o}03' 4.57"N and longitude 7^{o}45' 0.60"E), a Local Government Area in South-South Nigeria which is the capital of Akwa Ibom State.

Collection and processing of fruit: The garlic bulbs, ginger rhizomes and Mature, ripe healthy Apple fruits were purchased from different sales point in Uyo metropolis, Akwa Ibom State, Nigeria and transported to the Food Processing and Analytical Laboratory of the Department of Food Science and Technology, University of Uyo, where the research work was carried out.

The Apple fruits were washed with distilled water to remove adhering soils, dirt and extraneous materials.

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The apples were sorted, trimmed, peeled and cut to small pieces before the extraction of juice.

Preparation of fruit additive/ preservative

The ginger rhizomes and garlic bulbs were washed with potable water repeatedly. Their outer covering was peeled off with a sterile knife and then sliced into cutlets (0.5cm) and dried using a hot airoven at 65°C for 48 hrs. Using a sterile electric blender, the dried ginger or garlic bulb was pulverized into powder.

Production of Apple juice: The pieces of apple were introduced into sterile juice extractor and the juice extracted. The juice was filtered using clean muslin cloth into sterile conical flasks.

Treatment of apple juice with natural and chemical preservatives

Natural preservative: Exactly 0.5g of ginger powder was added into 100ml of apple juice and 0.5g of garlic powder was added into another 100 ml of the apple juice. Similarly, a combination of 0.25g of ginger powder and 0.25g of garlic powder were added to 100ml of apple juice.

Chemical preservative: 0.05% (w/v) sodium benzoate (Sigma chemical company) was aseptically added to another 100ml of apple juice with another 100 ml of apple juice container serving as a control (without preservative).

Determination of pH: Ten milliliters of the juice was dispensed into a beaker and the pH was determined with a previously standardized pH meter. The pH meter was calibrated using phosphate buffer of pH 4.0 and 7.0 (AOAC, 2005).

Moisture determination:

Ten ml of sample was measured in a clean crucible using sensitive balance. The crucible with the sample was placed in an air-dry oven at 105°C and left to stay overnight. Then crucible was transferred to oven again and weighted after 2 hours, this was repeated until constant weight was obtained.

Calculation:

$$\text{Moisture Content\%} = \frac{(W_2-W_1)-(W_3-W_1) \times 100}{W_2-W_1}$$

Where:

W_1= weight of empty crucible

W_2= weight of crucible + sample

W_3= weight of crucible +dry sample

Determination Total Titratable Acidity (TTA): Standard method of Antony and Chandra (1997)and Ferrati et al. (2005), was used to measure the titratable acidity. Five grams of concentrated fruit juice was homogenized in distilled water (20ml) and filtered through what man No. 1 filter paper. Phenolphthalein was added to 20ml of the filtrate as indicator and titrated against 0.05 M NaOH. Titratable acidity was calculated using the equation:

$$\mathrm{TA} = \frac{\mathrm{MNaOH} \times \mathrm{NaOH} \times 0.09 \times 100}{\text{Juice sample}}$$

Where:

TA = Titratable acidity

MNaOH = Molarity of NaOH used

NaOH = Amount (in) of NaOH used

0.09 = Equivalent weight of lactic acid

Determination of Ascorbic Acid (vitamin C)Contents: Thirty grams of the sample blended with reasonable amount of 0.4% oxalic acid. (4g/liter) and filtered by What man (No.1) filter paper. The ample volume completed to 250 ml with 0.4 oxalic acid. Twenty ml of filtrate pipeatted into a conical flask and titrated with a known strength 2-6-dichlorophenol indophenol until a faint pink color appeared. The dye strength determined by taking 5 ml oxalic acid 10%(50mg/00ml) and added to a standard ascorbic acid (0.05/250ml) oxalicacid 10% titrated with 2-6-dichloerophenol indophenol (0.2g/500ml) till faint pink color expressed in mg/100g (AOAC, 2005).

$$\text{Ascorbic acid} = \frac{\text{Titer (ml) X dye strength X 100}}{\text{Factor}}$$

Determination of Total Solids: Total solids content was determined by evaporating a known weight of juice in an oven (Fisher Isotherm 175) at 105°C for 2-3 h. The solid left after evaporation was weighed and used to calculate the total solids. The total solids content is a measure of the amount of material remaining after all the water has been evaporated (AOAC, 2005)

$$\%\text{Total solids} = \frac{W_2}{W_1} X\ 100 = (100 - \%\ \text{moisture})$$

Where, W_1 = Initial weight
W_2 = Dried weight

Determination of Total Ash: According to (AOAC, 2005), an empty crucible was accurately weighed, and then 10ml of sample were weighed in it using sensitive balance. The sample in crucible was placed in muffle furnace at 550°C for more than 3 hours until white to grey ash was obtained, then crucible was removed from furnace to a desiccators to cool, then weighed.

$$\text{Ash content } \% = \frac{W_2 - W_1 \text{ x } 100}{W_3}$$

where : W_1= weight of empty crucible
W_2= weight of crucible with ash.
W_3 = weight of sample

Determination of Fat: This was carried out using the method of AOAC (2005). Clean and dried thimble was weighed (W_1) and 5 g oven dried juice concentrate was added and re-weighed (W_2). Round bottom flask was filled with petroleum ether (40-60°C) up to ¾ of the flask. Soxhlet extractor was fixed with a reflux condenser to adjust the heat source so that the solvent boiled gently, the sample was put in the thimble and inserted into the soxhlet apparatus and extraction under reflux was carried out with petroleum ether for 6 h. After that, the barrel of the extractor was emptied, the condenser and the thimble was removed, taken into the oven at 100°C for 1 h and later cooled in the desiccator and weighed again (W_3):

$$\text{Fat } (\%) = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Determination of Crude Protein: Crude protein content was determined using Kjeldahl method and calculated by multiplying the amount of nitrogen by 6.25 .10ml of sample was weighed in kjeldahl flask, half a tablet of catalyst mixture (10 partsK_2SO_4 to one part of $CuSO_4$) and 25 ml of concentrated H_2SO_4 were added. The ash content of the flask was digested under boiling at maximum heat for 2-3 hours till clear, and then the flask was distilled using NaOH 40% ,the ammonia was received in 100ml conical flask containing 10ml of 0.1NHCl and crude protein percentage was calculated as follows (AOAC, 2005).

$$\text{Crude Protein } \% = \frac{\text{N x T x.10ml x14x100 x6.2}}{1000}$$

Where:
N= Normality of HCl for sample titration.
T= Titration figure.
10ml= weight of sample.
1000: Number of milligrams in one gram.
14: Equivalent weight of nitrogen.
6.25: Protein conversion factor.

Sensory Evaluation

Sensory evaluation is unique source of product information concerned with measuring the response of people to products in terms of appearance, aroma, taste, texture and after taste without benefit of label, pricing or other imagery (Iwe, 2002).

The sensory evaluation was carried out by 10 panelists composed of 5 males and 5 females selected within the Department. There was a comparison test between the apple juice stored in the refrigerator (4^{O}C) and that stored at room temperature (23^{O}C). Apple juice preserved with ginger/garlic was compared with apple juice preserved with benzoic acid and finally comparing juice preserved with both ginger/garlic and benzoic acid. The evaluation was based on quality parameters such as taste, flavor, colour and overall acceptance (using questionnaire) by the panel of 10 testers (Hashimi et al., 2007).The test panelists were asked to rate the different juices presented to them on a 9 point hedonic scale with the ratings of: 9 = like extremely; 8 = like very much; 7 = Like moderately; 6 = Like slightly; 5 = Neither like nor dislike; 4 = Dislike slightly; 3 = Dislike moderately; 2 = Dislike very much and 1 = Dislike extremely. All the ten panelists tasted the different combinations of the apple fruit juice at both $4^{O}C$ and $23^{O}C$. The means of the scores by the judges were analyzed for significant differences between their respective juice samples.

RESULTS

Proximate and Physicochemical Composition of the Apple Juice

The fresh juice extracted from the apple fruit showed high concentration of moisture (87.73%) and carbohydrates (11.79%). The results showed low concentrations of ash content (0.30%), protein (0.05%), lipid (0.13%) and no fibre content. The titratable acidity composition was 2.47%, while the pH was 4.90, brix (12.27%) and vitamin C (22.15 mg/100g) as presented in Table 1.

Table 1: Proximate and physicochemical composition of apple fruit juice

Proximates	%
Moisture	87.73
Ash	0.30
Protein	0.05
Lipid (fat)	0.13
Titratable Acidity	2.47
Total solids	12.27
pH	4.90
Vitamin C (mg/100g)	22.15

Table 2a: Mean Sensory Evaluation Score for Apple Juice Stored at $4^{o}C$

Parameter	No of Panelist	Treatment type	Day0	Day2	Day4	Day6	Day8
Taste	10	pure juice	8.3	7.1	7.2	6.3	6.2
	10	Juice &ginger	7.9	6.7	6.4	5.8	6.4
	10	Juice & garlic	7.5	6.2	6.6	6.8	6.0
	10	Juice & garlic/ginger	7.4	6.1	6.0	6.4	6.1
	10	Juice & Na benzoate	7.7	6.3	6.5	6.2	6.4
Flavor	10	pure juice	8.4	7.3	6.5	5.3	5.3
	10	Juice &ginger	7.1	6.3	6.2	5.6	6.2
	10	Juice & garlic	6.8	5.2	5.7	6.1	6.2
	10	Juice & garlic/ginger	7.0	7.2	7.1	6.3	4.3
	10	Juice & Na benzoate	7.9	7.0	6.1	5.5	4.7
Colour	10	pure juice	7.8	6.8	6.6	5.5	4.8
	10	Juice & ginger	7.3	6.9	6.8	6.5	5.0
	10	Juice & garlic	7.7	6.4	5.4	5.2	4.9
	10	Juice & garlic/ginger	7.7	6.1	5.8	5.5	4.6
	10	Juice & Na benzoate	8.1	7.0	6.7	5.1	5.0
Overall acceptance	10	pure juice	8.4	8.2	6.8	6.2	5.5
	10	Juice &ginger	7.6	6.5	6.5	5.4	5.7
	10	Juice & garlic	7.5	6.9	6.8	4.7	5.0
	10	Juice & garlic/ginger	7.5	6.8	6.1	5.6	4.5
	10	Juice & Na benzoate	8.3	8.0	7.5	6.9	5.9

Table 2b: Mean Sensory Evaluation Score for Apple Juice Stored at 23°C

Parameter	No of Panelist	Treatment type	Day0	Day2	Day4	Day6	Day8
Taste	10	pure juice	7.3	6.4	4.2	3.0	2.1
	10	Juice &ginger	5.9	4.7	5.6	4.7	3.7
	10	Juice & garlic	5.9	6.4	3.5	2.9	2.5
	10	Juice & garlic/ginger	5.9	5.0	3.6	3.8	2.1
	10	Juice & Na benzoate	6.8	3.9	3.2	3.2	2.4
Flavor	10	pure juice	7.4	6.3	4.8	3.1	2.1
	10	Juice &ginger	7.1	5.4	4.9	5.6	5.1
	10	Juice & garlic	6.8	6.0	3.5	2.8	2.4
	10	Juice & garlic/ginger	6.0	5.3	2.7	2.4	2.2
	10	Juice & Na benzoate	6.0	5.7	3.7	2.2	2.2
Colour	10	pure juice	6.8	6.5	5.8	5.4	5.3
	10	Juice &ginger	7.3	5.8	6.0	5.2	5.6
	10	Juice & garlic	6.7	5.6	5.8	5.7	4.4
	10	Juice & garlic/ginger	7.2	6.5	6.1	5.8	5.8
	10	Juice & Na benzoate	6.3	5.7	5.8	5.7	5.2
Overall acceptance	10	pure juice	8.2	6.0	4.5	3.4	2.8
	10	Juice &ginger	7.6	6.3	4.1	3.6	3.3
	10	Juice & garlic	7.5	6.1	3.8	2.8	3.0
	10	Juice & garlic/ginger	7.8	7.4	4.4	4.3	2.5
	10	Juice & Na benzoate	8.2	7.5	4.8	3.5	2.4

DISCUSSION AND CONCLUSION

The experiment was conducted to examine the proximate content and the effect of three different treatments (ginger, garlic and sodium benzoate) on the sensory parameters of apple juice locally produced and stored at room temperature (23°C) and refrigerating temperature (4°C). The effects of the varying treatments were investigated with a view to prolong the shelf-life of apple juice. Biodeterioration of the fruit is influenced by factors like temperature, pH, chemical composition and microbial load.

Moisture content of the samples was very high. This is in agreement with the report of Hashimi et al. (2007) which reported very high moisture contents in various species of apple. The high content of moisture in the samples suggested that they have high perishability (Adeleke and Abiodun, 2010). The moisture content of any food is an index of its water activity (Frazier and Westhoff, 1988) and is used as a measure of the stability and susceptibility to microbial contamination (Scott, 1980). This implies that apple fruit juice may have a short shelf-life due to its high moisture content.

The Ash content was low compared to the report of Limand Rabeta.(2013) that examined apple varieties and found ranges slightly above what is obtained in this report. The amount of ash present can be translated to the quantity of minerals present in the samples (Coimbra and Jorge, 2011).

The Protein content of the apple juice was low compared to the report of Limand Rabeta. (2013) between three apple varieties and that of Thai seedless guava juice as reported by Shamsudin et al. (2005) at 0.80%.

Lipid content in the apple juice samples was very low which is common for fruits. They were lower compared to the lipid content in Dragon Fruit (Hylecereuspolyhizus) reported by Ruzainah et al. (2009), which was 4.5% for freeze-dried sample and 5.5% for oven dried sample and lower than the values reported by Edem et al. (1984) for the peel and pulp of C. albidum (12.4 and 15.1 g/100 g respectively).

However, the apple juice has a high titratable acidity and this correlates with the pH value as well. This could be as a result of the much lower pH (higher acidity) of apple juice (Ameh et al., 2015).

The Total solid was high in the apple juice which is in agreement with the work reported by Ijah et al. (2015) who compared juice produced using local sieving process of Muslin cloth to high filtration methods used in packaged juice. This agrees with the report of The Federal Institute of Industrial Research, Oshodi, FIIRO (2005) that most differences in juice quality are as a result of differences in production processes.

The vitamin C of the freshly made apple juice samples was high. This is of great health significance and implies that the juice can take care of vitamin C deficiency related ailment like scurvy (Edem and Miranda, 2011).

Organoleptic parameters like colour, flavour, and taste of the apple juice were acceptable throughout the period of storage except for juice stored at room temperature which showed deterioration in taste, flavour and overall acceptance after the 3rd day of storage. There was variation in color and flavor in prepared juice with the three different preservatives and shows that temperature has great effect on storage quality of food products. Safdar et al. (2010) showed that tomato paste with sodium benzoate as additive remains acceptable for longer period when stored at lower temperature.

Sensory evaluation showed that there was no significant difference among the juices with three different chemical additives considering color and overall acceptability.

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