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Influence of Processing and Packaging on the Nutrients of Fresh Fruits from Local Markets of Ogun State, Nigeria

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Abstract:
A study of the effect of processing on the nutritional values of fresh fruit juices of orange, mango and pineapple was conducted and the results show that apart from the carbohydrate content in orange juice, other values were lowered to different extents as a result of processing. The processed orange juice showed a carbohydrate value of 2.960mg/ml as against the fresh orange juice showing 2.030mg/ml amounting to over 30% increase possibly from fortification using supplements. All other values dropped to varying amounts like total protein 28%, titrable acidity 27% and pH 13%. There was no significant difference in the carbohydrate content of the fresh and processed mango juice about 1.0% whereas the total protein lowered from 12.41mg/cm^3 to 6.041mg/cm^3 equal to 51%. The titrable acidity also showed a fall from 1.05g/1000ml to 0.66g/1000ml equal to 37% while the pH dropped from 4.92 to 3.44 equal to 30%. Also there was no significant change in the carbohydrate content of fresh and processed pineapple juice. The slight drop from 2.100mg/ml to 2.030mg/ml amounted to 3.3%. However, the total protein dropped from 10.48mg/cm^3 to 5.161mg/cm^3 equal to 41.2% while the titrable acidity dropped from 2.22g/1000ml to 2.01g/1000ml equivalent to over 9.45%. The pH only dropped from 3.85 to 3.07 equal to 2.0%

Keywords: *Carbohydrate, Protein, Packaged Fruit, Orange, Pineapple, Mango*

1. Introduction

Packaged fruit juices are good sources of refreshing fluids, carbohydrates (sugars), vitamins and minerals and are often compared to fresh fruit juices (USDA, 2003).these packaged fruit drinks are prepared from fruit juices like pineapple, apple, orange, mango, pawpaw, lemon, guava, black currant, peach etc. and these fruits have been a part of human dietary and constitute food supplement over the years. These fruit juices are known to contain nutrients like carbohydrate, protein, vitamins, minerals like calcium, magnesium, potassium, zinc and iron (Okwu and Emenike, 2006). They also contain fibers, fruit essence compounds which impact taste and flavor and recommended supplements.(Klee, 2010). However, packaged fruit drinks have become more acceptable now than before as result of convenience, low cost and other socio-cultural factors thereby leading to cutting-edge competition. (Marsh and Bugusu, 2007).

Companies have been marketing packaged fruit juices and branding them “100% fruit nutrients” and “no sugar” just to address the concern of exceeding the daily recommended sugar intake. The numerous advertisement by producers claiming that their packaged fruit drinks contain 100% fruit juice nutrients go a long way to entice unsuspecting consumers into buying more packaged fruit drinks than the fresh fruits which are even of higher cost. (Dimari and Hati, 2010).

The grasp of the knowledge of the nutritional values of fruits to human health has in recent times led to the huge demand of fruit juices all over the world today. (Dietpal, 2013). However the nutritive values of fruits are measured by the amount of Vitamin C (ascorbic acid) present in the fruit which has been observed to deteriorate due to storage and some processing techniques. (Olorunsogo and Adgidzi, 2010). This vitamin however is an essential nutrient for humans since it employs its high antioxidant power to provide protection against free radicals which causes diseases like cancer, tumors etc. It is also an essential requirement in collagen biosynthesis, iron adsorption, immune response activation, healing of wounds (both at sub-cutaneous level), oesteogenesis and cancer prevention. Fructose is one of the most abundant sugars present in fruit juices and it is believed that this sugar is of a more health benefit than sucrose since it is found naturally in fruits even though it has its own harmful effect. (Briffa, 2006). Fruits, vegetables and honey however are all natural sources of fructose but an excessive consumption of fructose has been tied to some negative health implications. (Gabu, 2005). The prevalence or rather ever-increasing incidence of obesity, diabetes and non-alcoholic fatty liver

disease could be associated to the excessive fructose intake. This excessive intake of fructose may also promote the formation of toxic advanced glycation-end products which may contribute to diabetes, the aging process as well as the thickening of the walls of the artery. (Gaby, 2005).

All fruit juices contain sugar in varying amounts as sucrose, fructose, glucose and sorbitol. (Smith and Davis, 1995). Fruits that are considered very high in sugar content include tangerine, cherry, grape, pomegranate, mango, fig and banana. (Jasmine and Serpen, 2012).

A number of studies has in the past evaluated the health related impact of fruit juices in different forms such as bottled, pasteurized freshly extracted, fortified etc. (Birkhead, 1984; Bolton, Heaton and Burroughs, 1986; Dennison, Rockwell and Baker, 1997; O'Neil, Nicklas, Zanovec and Falgoni, 2011; Neilson, 2012; Eng, 2012;). In one of such studies it was suggested that daily fruit requirement could be met by the consumption of "100% fruit juice" (O'Neil et al, 2011).Another study reported the impact of the concentration of fructose, glucose and sucrose, pH and acid levels in fresh fruit juices as well as packaged fruit drinks in dental health. Packaged fruit drinks showed the highest amount of acid, often times approximating to twice that of fresh fruit juices. (Birkhed, 1984).

It has been widely acclaimed that insulin must be regulated and not suppressed. This is pertinent because insulin causes sugars to enter the cells which then provide the brain with satisfactory feeling. (Neilson, 2012). One such study reports that for fresh fruit juices, there was a smaller insulin response than the packaged fruit juices. (Bolton et al, 1986). In orange juices for instance, the insulin response to packaged fruit juices showed greater values than those of fresh fruit juices indicating that they stimulate the production of insulin to a larger extent.

The contribution of "100% fruit nutrient" to the epidemiology of obesity was analyzed in a study (Eng, 2012). It was seen that when fruits are juiced, part of the nutritional portion-the fiber is often discarded and researchers claim that the calories and sugars obtained from the liquid extracted from the fresh fruit do not entirely provide the feeling of fullness as obtained when the fresh fruit is eaten. This in turn may result in the individual consuming excessive amounts.

Over the last decade, packaged fruit drinks have become more acceptable due to a number of factors such as convenience, low cost, environmental factors and manufacturer's competition style (Marsh et al, 2007). However, during the processing and concentration, the quality of the packaged fruit juices undergoes remarkable modification which could reduce the nutritional value of packaged fruit juices. Even the additives used to preserve the shelf life of the drinks may go a long way reducing the potency of some of the nutrients.

This work aim at comparative quantization of the parameters that constitute the nutritional values such as carbohydrates, proteins, titrable acidity, total lipids and ascorbic acid in packaged 100% nutrient fruit drinks and fresh fruit juices.

2. Experimental

2.1. Sample Preparation

Orange, pineapple and mango fruits obtained from a local market in Agbara, Ogun State were washed clean with running water and later with saline for sterilization. A juice extraction was used to thaw the fruits and the juice extract filtered with muslin cloth. The processed and packaged analogues were purchased from a local supermarket also in the same location. All samples were placed under the same temperature condition before the analysis.

2.2. Sample Analysis

The total carbohydrate in both the fresh fruit juice and the processed fruit juice samples were determined using the Anthrone method. In this method, 200mg of the Anthrone (an aromatic ketone $C_{14}H_{10}O$) reagent was dissolved in 100ml of conc. H_2SO_4 and 2.0ml of the resulting solution placed in a test tube containing 2 drops of the sample under investigation. The test tube after stirring was then heated for 10minutes in a water bath. The carbohydrate molecules will be dehydrated by the concentrated H_2SO_4 to form furfural (an aldehyde). The furfural in turn condenses with the Anthrone reagent to form a blue coloured complex whose intensity was measured spectrophotometrically at 620nm (or red filter). The total protein was determined by the Lowry's method. 5.0ml of the Lowry's alkaline solution (Na_2CO_3, $CuSO_4$ and potassium titrate) was added to 1.0ml of the test samples. The mixture was then allowed to stand at room temperature for 10 minutes. 0.5 ml solution of dilute Folin Ciocalteu reagent (a mixture of phosphomolybdate and phosphotungstate used for the colorimetric *in vitro*assay of phenolic and polyphenolicantioxidants) was added and allowed to homogenize thoroughly. The absorbance was read after 30 minutes against a blank at 720 nm. The titrable acidity was determined using the AOAC (Association of Official Analytical Chemists) method (AOAC, 1990). In this method, 100ml of the sample were placed in 250ml conical flask in triplicates with 3 drops of phenolphthalein indicator and finally titrated against standard 0.10M NaOH solution to end point. The total acidity was calculated as citric acid.

- *Titrable acidity = toml + 0.0064g; where to = titre value*

. The ascorbic acid content was determined using the 2, 4-Dinitrophenylhydrazine (DNPH) Method in which the ascorbic acid presents in the watermelon samples is oxidized to dehydro-5-ascorbic acid. The dehydro-5-ascorbic acid then couple with the 2, 4-Dinitrophenylhydrazine to form oxazone. By treating the oxazone formed with 85% H_2SO_4, causes the rearrangement which yields a red coloured complex. Thiourea added to the 2, 4-Dinitrophenylhydrazine prevents the oxidation of the 2, 4-Dinitrophenylhydrazine by interfering substances. The red coloured complex so formed was measured spectrophotometrically at 520nm using the UV-2401 PC. The pH was determined using the HANNA digital Bench top pH/ORP/HI2210, standardized with buffer solution of pH 4.0 to 7.0.

3. Results

The fresh fruit juices and packaged, processed fruit juices of Citrus sinensis, Mangifera indica and Ananas comosus mer, were analyzed for their total carbohydrate content (mg/ml), total protein (mg/cm^3), ascorbic acid (mg/ml), titrable acidity (g/100ml) and pH and the following results were obtained.

Sample	Brand	Total carbohydrate (mg/ml)	Total protein (mg/cm^3)	Titrable acidity (g/1000ml)	pH
Fresh Orange	Citrus sinensis	2.030 ± 0.0817	8.582 ± 0.008165	1.23± 8.287 x 10^{-6}	3.96± 0.00817
Processed orange	Fruitta Orange	2.960 ± 0.0817	6.182± 0.008165	0.90 ± 8.287 x 10^{-6}	3.46 ± 0.00817
Fresh Mango	Magnifera indica	2.040 ± 0.0817	12.41± 0.008165	1.05 ± 8.287 x 10^{-6}	4.92± 0.00817
Processed mango	Fruitta Mango	2.020± 0.0817	6.041 ± 0.008165	0.66 ± 8.287 x 10^{-6}	3.44 ± 0.00817
Fresh Pineapple	Ananas comosusmerr	2.100± 0.0817	10.48 ± 0.008165	2.22± 8.287 x 10^{-6}	3.85± 0.00817
Processed Pineapple	Fruitta Pineapple	2.030 ± 0.0817	5.161 ± 0.008165	2.01 ± 8.287 x 10^{-6}	3.07 ± 0.00817

Table 1: Result of carbohydrate, protein, acidity and pH of fresh and processed fruit juices

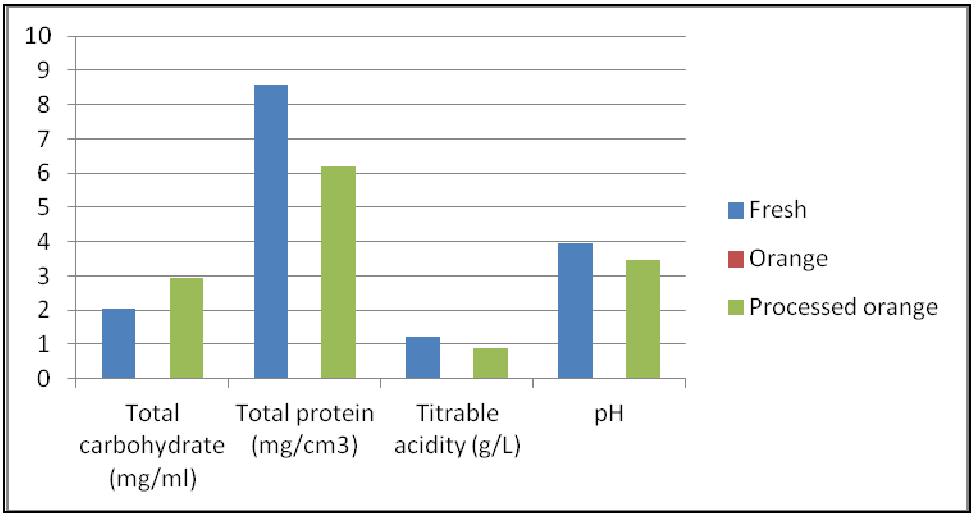

Figure 1: A histogram showing the qualities of fresh and processed orange fruit juices

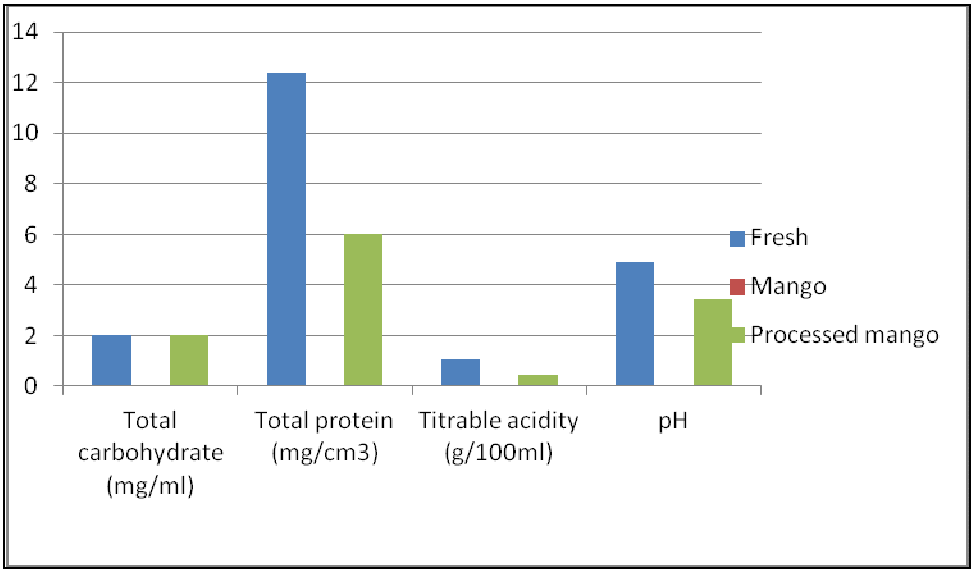

Figure 2: A histogram showing the qualities of fresh and processed mango fruit juices

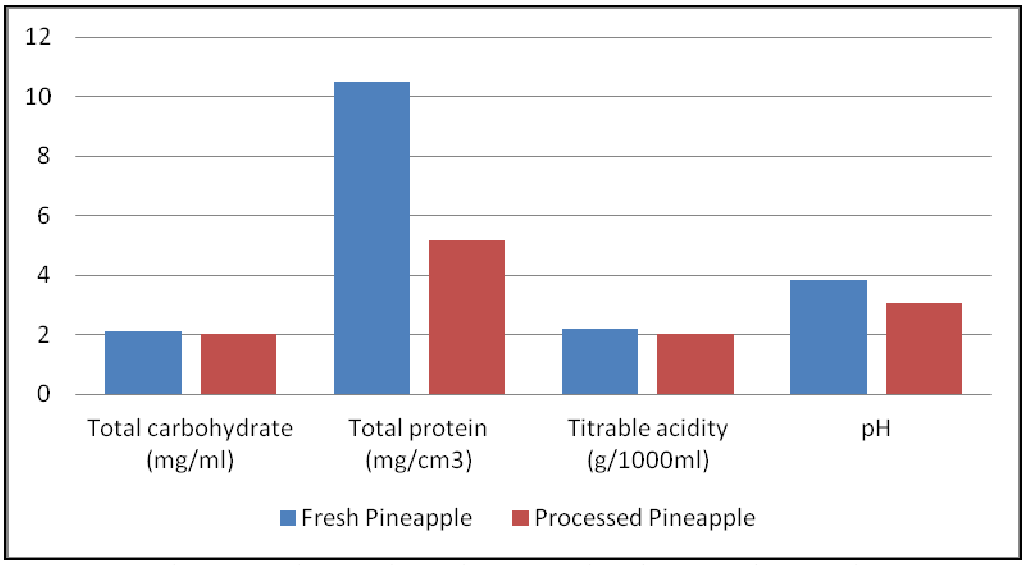

Figure 3: A histogram showing the qualities of fresh and processed pineapple fruit juices

4. Discussion

The results show that for the fresh and processed orange fruit juices, the total carbohydrate for the processed orange fruit juice indicated higher values than the fresh orange fruit juice by over 30% whereas the total protein lowered for the processed orange fruit juice by nearly 30%. The observed increase in the carbohydrate level for the processed orange juice could have been as a result of fortification using supplements. The drop in the total protein for the processed orange juice could possibly be due to the processing technique as proteins in fruits are very sensitive to thermal conditions. The titrable acidity and pH were lowered slightly by less than 10%.

The results for fresh and processed mango fruit juices showed a slight drop in the total carbohydrate content for the processed mango fruit juice less than 1% but the total protein again dropped by over 50% for the processed mango fruit juice though the values for the titrable acidity and pH was minimal to about 30%. Again the reason for the significant drop in the total protein can be adduced to the processing technique.

The results for the fresh and processed pineapple fruit juices showed a minimal decline in the total carbohydrate content for the processed pineapple fruit juice to the extent of 3.3% whereas the total protein of the processed pineapple fruit juice showed a significant drop to the extent of 50%. The values of the titrable acidity showed a significant drop in the processed pineapple fruit juice to the extent of over 80% while the pH dropped slightly for the processed pineapple juice to the extent of about 20%.

5. Conclusion

The primary aim of preservation and packaging of fresh fruit juices was to make them readily available for consumption long after the season as most fruits are seasonal. However it is expected that a few values will be lost during handling, preservation, packaging and even shelf storage. A lot of manufacturers are aware that the losses are inevitable and always make provision for fortification whereas a lot others outside the eyes of regulatory authorities are oblivious of these. This work has shown that apart from carbohydrate which obviously would have been compensated for, other parameters were affected as a result of processing. For the samples studied, the difference between the fresh and processed fruit juices was not much showing that the producers took some time to compensate for the losses. Efforts should be made to study other products especially in the local market as regulatory authorities may not extend their search light to them.

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