SCIENTIFIC NOTE

A Comparative Study of the Nutritive Factors and sensory acceptance of Juices from Selected Nigerian Fruits

Augustine, Chima Ogbonna[1*], Christian Izuchukwu Abuajah[1], Glory, Eyo Ekpe[1]

[1] *Department of Food Science and Technology, University of Uyo, Nigeria*

Summary

The nutritive factors of the juices of three fruits: orange, pineapple and pawpaw were studied and compared using standard methods. Proximate analysis of the samples indicated that the nutritive factors investigated in the three juice samples were significantly different (p≤0.05). Orange juice contained 2.19% and 3.65% more moisture and 11.43% and 38.57% more crude protein than pineapple and pawpaw juices while pineapple juice had 40.16% and 45.08% more ash as well as 4.74% and 19.59% more energy content than the others. However, 40.0% and 65.71% more crude lipid, 22.39% and 14.79% more carbohydrates and 11.11% and 40.74% more crude fibre were observed in the pawpaw juice than orange and pineapple juices, respectively. The minerals and vitamin C content of the juices revealed that orange juice had 75.47% and 58.49% more Ca2+ and 31.42% and 11.33% more vitamin C than pineapple and pawpaw juices while pineapple juice had 16.67% more Mg2+ than orange and pineapple juices. Similarly, sensory evaluation showed a significant difference (p≤0.05) in taste, aroma and general acceptability of the juice samples whereas no significant difference (p≤0.05) was observed in the colour of the juice samples. Overall, pineapple juice had 4.82% and 21.69% more preference rating than orange and pawpaw juice samples.

Keywords: *fruits, juices, nutrition, samples, significant*

1. INTRODUCTION

Botanically, fruits are parts of flowering plants derived from the fertilization of specific tissues such as one or more ovaries of flowers (Mauseth, 2003). They are non-staple foods which make-up about 39% of the food intake of persons living in developing countries of Africa, (Bates *et. al*., 2001). In non-technical usage, such as food preparation, fruits normally represent the fleshy, seed bearing structures of certain plants that are edible in the raw state (Potter and Hotchkiss, 1996).

The nutritional and chemical compositions of various fruits have been reported (Chondhury, 1983; Oguntona and Akinyele, 1995; Nazarudeen, 2010; Auta *et al.,* 2011). Fruits are important sources of sugars, vitamins A, C and B group, low protein and lipid respectively (Tindall, 1990; Potter and Hotchkiss, 1996). Also, they have been shown to contain high amounts of minerals, moisture, low ash and crude fibre (Oguntona and Akinyele, 1995; Wall, 2006). In addition, fruits contain little or no fat or sodium and, being a plant food, no cholesterol (Economos, 1988), thus nutritionally healthy. When consumed with other foods, fruits can nutritionally supplement diets in developing countries (Potter and Hotchkiss, 1996).

Beyond nutrients, fruits also contain high levels of bioactive and other phytochemicals such as antioxidants (e.g. polyphenols), soluble fibre (e.g. pectin and beta-glucanase), prebiotics (e.g. inulin, fructan), vitamins (e.g. vitamins A, B group and C), flavone glycosides (e.g. hesperidin), organic acids: e.g. tartaric acid (Bates *et. al.,* 2001; Setiawan *el al,* 2001; Kurl *et. al.,* 2002; Kurowska and Manthey, 2004; Oyoyede, 2005; Vinson *et al.,* 2005; Bari *et. al.,* 2006; Hernadez *et al,* 2006; MacDonald-Wicks *et al,* 2006; Nitsawang *et. al.,* 2006, Wall, 2006; Guarnieri *et al,* 2007; Tochi *et al,* 2008) which, as functional food materials or nutraceuticals, provide specific health benefits such as prevention of diseases and growth of gut pathogens, enhancement of body immunity, protection against heart diseases, cancer, osteoporosis, hypertension, regulation of ageing, etc., (McCrea, 2001). Unfortunately, most of these beneficial compounds which are found mostly on the peels are often removed while processing fruits into juices (Rapisarda *et al,* 1999).

However, fruits are highly perishable and seasonal in nature. For this reason, they can be eaten fresh or processed and many other fruit products thereby reducing post-harvest losses and supplying consumers with nutrients and diet variety (Bates *et al,* 2001). Recent researches using new technologies such as irradiation, ultrasound, osmotic evaporation, high pressure technology and vacuum drying aimed at overcoming the problems of damage to quality (flavour, colour and nutrients) of processed fruit juices have also been reported (Drouzas *et al.,* 1999; Deliza *et al,* 2005; Hajare *et. al.,* 2006; Chutintrasri and Noomhorn, 2007; Fernadez *et al,* 2008; Hongvaleerat *et al,* 2008; Perez-Tinoco *et al,* 2008).

Sweet orange (*Citrus cinensis*), Pawpaw (*Carica papaya*), and Pineapple (*Ananas comosus*) are popular fruits used for commercial fruit juice and mixed fruit nectar production in Nigeria. Also, they play important role in diets particularly in the rural areas. Hence, this study becomes very significant in imparting knowledge on the juice industry and creating an informed and guided choice of consumption for the benefit of consumers in Nigeria and beyond.

The aim of this study, therefore, is to compare the nutritive factors (moisture content, ash, crude fibre, crude lipid, crude protein, carbohydrates, calorific value, mineral elements, and vitamin C) and sensory properties (colour/appearance, taste, aroma and general acceptability) of juices obtained manually through a laboratory-scale hot press method from three Nigerian fruits: sweet orange (*Citrus cinensis*); Pawpaw (*Carica papaya*); and Pineapple (*Ananas comosus*).

*Corresponding author: acogbonna@yahoo.com

2. MATERIALS AND METHODS

2.1 MATERIALS

2.1.1 Samples

The three types of fruits: sweet oranges (*Citrus cinensis*), pawpaw (*Carica papaya*), and pineapple (*Ananas comosus*) used in this study were purchased at Akpan Andem open market in Uyo, Akwa Ibom State of Nigeria. The fruits were processed into juices at the Food Processing Laboratory, University of Uyo. All chemicals and reagents used for the analyses were of analytical grade and were obtained from the Biochemistry Laboratory, University of Uyo, Nigeria.

2.1.2 Juice extraction

The fruits were processed on a laboratory-scale into three juice samples using a modified method of Bates *et al*, (2001). Matured, firm and ripe samples of each fruit type were used. The fruits were washed, manually peeled, cut into bits and their seeds removed. They were blanched at 60ºC for 40 minutes to check surface contamination and comminute to a pulp with a kitchen blender (Q-Link, Made in China). Thereafter, the juice was extracted hot using a home juice extractor (Phillips juice extractor, model HR2826, Made in China), clarified manually (strained and filtered) with a muslin cloth. The juice samples were packaged in air-tight screw cap sterilized glass bottles and refrigerated at 5ºC for 24 hours prior to analyses. A volume of 1.2±0.2 L of each juice sample was recovered from about 1 kg of each fruit. The natural fresh juices, (with no further treatments), were used for the nutritive factors' analyses and sensory evaluation.

2.2 METHODS

2.2.1 Moisture content

The moisture content of the samples was determined according to AOAC (2000).

2.2.2 Ash

The ash content of the samples was determined according to AOAC (2000).

2.2.3 Crude fibre

The crude fibre of the samples were analysed according to AOAC (2000).

2.2.4 Crude lipid

The crude lipid of the samples was measured according to AOAC (2000).

2.2.5 Crude protein

The crude protein content of the samples was determined by the Kjeldahl method (AOAC, 2000).

2.2.6 Carbohydrates

The total available carbohydrate was obtained by difference by subtracting total sum of moisture, ash, crude fibre, crude lipid, and crude protein from 100% DW(dry weight) sample (AOAC, 2000).

2.2.7 Calorific value

The energy content of the samples was estimated according to Hunt *et al,* (1987) using the modified atwater factors in equation 1:

Energy (Kcal) = XYZ (1)

where:
X = crude protein × 4.
Y = crude lipid × 9.
Z = carbohydrate × 4.

2.2.8 Mineral elements

The mineral elements (Ca^{2+} and Mg^{2+}) content of the samples were determined according to AOAC (2000).

2.2.9 Vitamin C (Ascorbic acid)

The vitamin C content of the samples was determined by AOAC (2000).

2.2.10 Sensory evaluation

Samples of juices processed from sweet oranges, pawpaw and pineapple were presented to a ten-member panel for sensory evaluation. The organoleptic attributes evaluated for were colour/appearance, taste, aroma, and general acceptability using a nine-point Hedonic scale according to Ihekoronye and Ngoddy (1985).

2.3 Statistical analysis

The mean values and the standard deviations (S.D.) for three determinations of properties measured were calculated. Data generated were analysed statistically using a one-way analysis of variance (ANOVA) and Students' T-test was applied to compare the sensory evaluation results of the samples as described by Ubom, (2004). Significant differences were determined at $p \leq 0.05$.

3. RESULTS AND DISCUSSION

3.1 Nutrient composition

The result of the proximate composition of the three juice samples is shown on Table 1. The nutritive factors measured were significantly different ($p \leq 0.05$) in the three juice samples. The proximate composition and calorific values of the fruit juice samples, on the average, compared with those of Anonymous (2012). The moisture content levels of the fruit juice samples were comparatively high, which indicated them as a good source of hydration for the body as well as possessing the ability to quench thirst. Increased moisture content reduces the nutritive factors such as fat, protein and carbohydrate, thereby reducing the energy value. Since an increase in any of these factors alo-

Table 1. *Proximate composition and calorific value of fruit juice samples**

Nutrients	Orange Juice (%)	Pineapple Juice (%)	Pawpaw Juice (%)
Moisture	85.85 ± 0.04^{c}	83.99 ± 0.07^{b}	82.74 ± 0.10^{a}
Crude protein	0.74 ± 0.03^{d}	0.62 ± 0.01^{e}	0.43 ± 0.03^{f}
Crude lipid	0.21 ± 0.01^{g}	0.12 ± 0.00^{h}	0.35 ± 0.02^{i}
Carbohydrates	11.54 ± 0.03^{j}	12.67 ± 0.05^{k}	14.87 ± 0.07^{l}
Crude fibre	0.24 ± 0.01^{o}	0.16 ± 0.03^{n}	0.27 ± 0.01^{m}
Energy (Kcal)	46.22 ± 0.04^{r}	48.54 ± 0.06^{q}	39.01 ± 0.03^{p}

*Values are means of triplicate determinations ± S.D.
[abc]Means with different superscripts on the same row are significantly different at $p\leq0.05$.

ne or together proportionately increases the energy value, they are interrelated with moisture and energy (Nazarudeen, 2010). On the other hand, the low levels of crude proteins and crude lipids indicate that fruits are not good sources of these nutrients (Obizoba *et al,* 2004; Nnam and Njoku, 2005).

However, the value of carbohydrates in the three samples was indicative of the fact that fruit juices are moderate sources of sugars (Achoba, 1993; Nzeagwu and Udugwu, 2009). Similarly, average energy values of the juice sample were also low and compared with those reported by Economos and Clay (1988) and Anonymous (2012). This fact is very important and useful for consumers concerned about putting on excess body weight.

The minerals' (Ca^{2+} and Mg^{2+}) and vitamin C contents of the juice samples is presented in Fig. 1.

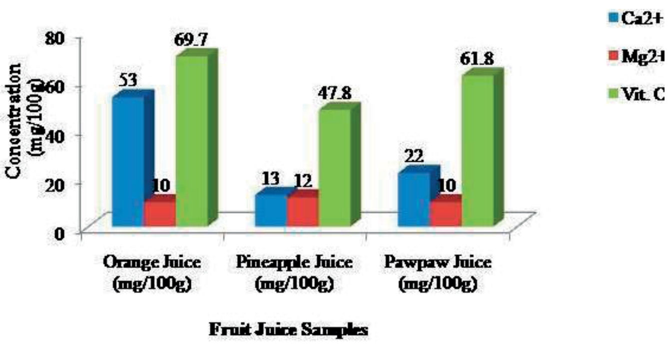

Figure 1. *Content of Juice Samples*

Sweet oranges were confirmed as the best sources of these minerals and vitamin C among the fruits studied in line with in line with the Economos and Clay (1988) and Anon (2012). Essentially, divalent mineral elements function as enzyme stabilizers and transport co-factors in metabolic pathways in addition to other critical and various physiological functions. Similarly, vitamin C is a desirable nutrient which is vital for iron absorption as well as the formation of intracellular protein collagen (Wardlaw *et al,* 2004). In addition, it is instructive to note that fruit juices contain little or no fat or sodium and, being a plant food, no cholesterol (Economos, 1988).

3.2 Sensory properties

The panellists' mean scores for the three juice samples are shown in Table 2. The sensory evaluation results showed a significant difference ($p \leq 0.05$) in taste, aroma and general acceptability of the juice samples whereas no significant difference ($p \leq 0.05$) was observed in their colours.

Overall, the pineapple juice was the most preferred and accepted to the panellists than the other juice samples. However, Matsuura *et al., (*2004) reported a higher sensory acceptance of mixed fruit nectar sample as a result of high amounts of *Papaya* pulp in it. In the contrary, Shaw and Wilson (1988) observed such superior sensory acceptance for orange and passion mixed fruit juice. Comparatively, these results suggest that sensory acceptance of individual fruit juice may be enhanced in a mixed fruit nectar formulation.

4. CONCLUSION

The aim of this study was to comparatively evaluate the nutritive factors and sensory acceptance of juice samples of selected Nigerian fruits (sweet oranges, pineapple and pawpaw). It is observed from the results that fruits are not high in crude fats, crude proteins and calorific value. This fact may be beneficial to individuals who intend to shed some weight as well as persons suffering from heart diseases. On the other hand, fruits are moderate sources of minerals, vitamin C and sugars which offer concomitant nutritional benefits. The pineapple juice was the most preferred and accepted to the panellists than

Table 2*. Sensory properties of juice samples**

Samples	Colour /Appearance	Taste	Aroma	General Acceptability
Orange Juice	7.7 ± 1.89^{a}	7.5 ± 1.05^{c}	7.8 ± 1.00^{c}	7.9 ± 2.01^{c}
Pineapple Juice	7.5 ± 1.65^{a}	8.4 ± 0.97^{b}	8.1 ± 1.30^{b}	8.3 ± 1.21^{b}
Pawpaw Juice	7.8 ± 2.10^{a}	7.8 ± 2.10^{a}	6.3 ± 1.55^{a}	6.3 ± 1.55^{a}

*Values are means of triplicate determinations ± S.D.
[abc]Means with different superscripts on the same column are significantly different at $p\leq0.05$.

the other juice samples. However, reported results suggest that sensory acceptance of individual fruit juice may be enhanced in a mixed fruit nectar formulation.

In the light of this investigation, further studies on ways to improve the taste and aroma of pawpaw juice which would, no doubt, improve its general acceptance considering its relative nutritional qualities is needed. Also, a study into the nutritive factors of mixed fruits juices and nectars is necessary in order to evaluate any composite nutritional advantage over the single juice types.

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