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Nutrient, Phytochemical Composition and Consumption Pattern of Soursop (*Annona muricata*) Pulp and Drink among Workers in University of Nigeria, Nsukka Community

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Abstract: Micronutrient malnutrition is a public health problem. This study evaluated the nutrient, phytochemical composition and consumption pattern of soursop (*Annona muricata*) pulp and drink. The soursop fruits were purchased from local market and a farm in Enugu State, Nigeria. The mature fruits were ripened for five days at room temperature. The ripen soursop fruits were peeled, the pulp handpicked, blended with 400mls of water to make the soursop drink. The soursop drink was then flavoured with four teaspoons of sugar syrup. The proximate composition, vitamin, mineral and phytochemical contents of the samples were determined using standard methods. The carbohydrate content of soursop pulp and drink was 72.71 and 83.47% respectively. The fibre content was 6.26 and 3.47%; retinol 192.50IU and 63.76IU; ascorbic acid was 22.59mg/100g and 34.71mg/100g for the pulp and drink respectively. The pulp and drink also contained a good amount of anthocyanin 6.44 and 7.35 mg/100g; flavonoids 9.32 and 5.24mg/100g and tannin 65.98 and 53.96mg/100g, respectively. It was concluded that soursop pulp and drink contained appreciable amount of micronutrients and can be incorporated into the diets for the vulnerable groups to improve their nutritional status.

Key words: Nutrient, phytochemicals, consumption pattern, soursop, pulp, drink

INTRODUCTION

Micronutrient malnutrition or "hidden hunger" is a major public health problem. There is a need for a long-term sustainable intervention programme that would combat micronutrient deficiencies. Food-based approach especially dietary diversification to increase consumption of micronutrient-rich locally available foods could be valuable in the fight against hidden hunger (Nnam and Njoku, 2005). Food-based interventions, lack of knowledge not only of available foods but their usage, nutritional and health implications poses a problem especially with micronutrient deficiencies. A significant proportion of indigenous fruits in West African sub region are seasonal forest products, harvested for consumption on site or for sale in urban centers (Smith *et al*., 2006). The knowledge of the nutrient composition of some of these fruits will enhance their use and increase their consumption and improve the micronutrient profile of a good proportion of the population. The availability of fruits is short-lived due to seasonality and highly perishable nature (IFST, 2007).

Soursop tree is a small straggly fruit tree growing up to 8 meters high originated from tropical America and West Indies although is now widely grown in the tropics of both hemispheres. It is grown in a wide range of soils with good drainage and elevations of up to 1000 meters. A warm humid climate is required (Dupriez and De Leener, 1989). The leaves are glossy, oval to lanceolate in shape. The tree flowers and fruits all year round though there is usually a principal ripening season. The fruits are oval, 15-30 cm long, with sparse soft green curved spines. The flesh contain white pulp, stringy and sour with shiny black seeds. It has a pleasing flavour and aroma. The soursop is unrivaled for sherbets, soft drinks, ice-creams, syrups and nectars (Enweani *et al*., 1994). Soursop juice was reported to contain 19-23% sugar and 1.10-1.71% total protein when ripe. The fruit was reported by WHO (1991) to contain 12% sugar, mostly glucose and some fructose, pectin, potassium, sodium, calcium, chloride and citrate. *Annona muricata* is also called prickly custard apple (English), Ebo (Yoruba), Mamphal (Indian), Guanabana (Spanish) and corossol and sappadille (French) (Akubor and Egbekun, 2007).

A sudden rise in the occurrence of several chronic non-communicable diseases like cancer, obesity, cardiovascular diseases, coronary heart disease, diabetes mellitus in developing and developed countries has generated interest on food like soursop which can be of great importance. In contrast, the consumption level of +soursop has dwindled and could become extinct. In Nigeria, little industrial value is attached to this fruit. It is only consumed locally in the fresh state and there are no known commercial products made from Soursop. Little or no commercial value is attached to this fruit because it is rarely displayed for sale in the market.

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Utilization of fruits in Nigeria and most developing countries is limited due to inadequate processing and preservation methods (Akubor and Egbekun, 2002). The quantity that can be consumed by eating the fruit is less compared with the quantity that can be consumed from the juice. To this end, the juice offers opportunity for most of the micronutrients present in the fruit to be consumed and the consumers can meet their micronutrient requirements. To increase the demand and reduce the wastage of this fruit, juice could be produced. However, minimal work has been done on this fruit.

The aim of this work was to:

- Determine the nutrient and phytochemical composition of soursop (*Annona muricata*) pulp and drink
- Study the consumption pattern of soursop (*Annona muricata*) fruits

MATERIALS AND METHODS

Collection of materials: Mature soursop fruits were sorted from a selection of several mature fruits. The fruit's maturity was determined by its dark green skin with smooth numerous fleshy spines.

Preparation of pulp and formulation of drink: The pulp was obtained by allowing the mature fruits for five (5) days at room temperature to ripen. The drink was formulated with the use of the pulp. Below is the recipe for the drink and a flow chart showing the steps involved in the formulation of Soursop drink.

Procedure:

- The sugar syrup was prepared by dissolving 100g of sugar in 200mls of water and boiling over a source of heat for 3 minutes than left to cool
- Two hundred grams of soursop pulp was weighed out into an electric blender
- Four hundred millimeters of water was added into the blender, then blend for 4 minutes to formulate the drink
- Four tables of sugar syrup was added into the blender and then blended for 2 minutes
- The formulated drink was poured in different sterilized bottles and then cooled

Chemical analysis: The moisture, ash, fat, protein and crude fibre content of the samples were determined using the method of AOAC (2005) methods. Carbohydrate content was obtained by difference. Beta carotene, thiamin, riboflavin and vitamin C content of the samples were determined using the method of Pearson (1976). The AOAC (2005) method was used to determine calcium, phosphorus, potassium and magnesium using the atomic absorption spectrophotometric method. Flavoniods and alkaloids were determined using the Pearson (1976) method, saponin was determined using the Obadoni and Ochuko (2001) method, anthocyanin and tannin content was determined using the method of Harborne (1983).

Statistical analysis: The mean and standard deviation were calculated. The mean and standard error of mean was calculated using Analysis of Variance separated by Duncan's new multiple range test. Significance would be accepted at ($P<0.05$). All these were done using SPSS (Statistical Packaged for Social Science) version 17.

RESULTS

Table 2 presents the proximate composition of soursop pulp and soursop drink with sugar syrup. The crude protein content of soursop pulp and drink was 2.89% and 5.85% respectively which was significantly ($P<0.05$) different. Fat was not present in both the soursop pulp and drink. The ash content for soursop pulp and drink was 0.92% and 0.95% respectively and was significantly ($P>0.05$) similar. The fibre content of the soursop pulp (6.26%) was significantly ($P<0.05$) higher than the drink (3.47%). The moisture content was significantly ($P<0.05$) higher in the pulp compared in the drink. The carbohydrate content of the soursop drink (83.47%) was significantly ($P<0.05$) higher than that of the drink (72.71%).

Table 3 shows the vitamin composition of soursop pulp and soursop drink with sugar syrup. The retinol content of soursop pulp and soursop drink with sugar syrup were 192.00IU and 63.73IU which varied significantly ($P<0.05$). The thiamin content of the soursop pulp

Table 1: Ingredients used for the formulation of soursop (Annona muricata) drink

Ingredients	Quantity
Syrup	4 table spoons
Water	400mls
Soursop pulp	200g

Table 2: Proximate composition of Soursop (Annona muricata) pulp and drink (%)

Parameter	AMP	AMJ
Protein	$2.89^{d}\pm0.04$	$5.85^{d}\pm0.04$
Fat	-	-
Ash	$0.92^{a}\pm0.02$	$0.95^{b}\pm0.01$
Fibre	$6.26^{a}\pm0.06$	$3.47^{a}\pm0.04$
Moisture	$17.22^{c}\pm0.03$	$6.23^{c}\pm0.04$
Carbohydrate	$72.71^{b}\pm0.04$	$83.47^{b}\pm0.06$

Mean and standard deviation values. Values with different superscripts are significantly similar at the same row ($P<0.05$)
Key:
AMP = Soursop pulp
AMJ = Soursop drink with sugar syrup

Table 3: Vitamin composition of Soursop (Annona muricata) pulp and drink

Parameter	AMP	AMJ
Retinol (IU)	192.50^{d}±0.70	63.76^{d}±1.07
Thiamin(mg/100g)	2.10^{a}±0.35	1.25^{b}±0.14
Riboflavin(mg/100g)	0.20^{d}±0.01	0.14^{c}±0.01
Niacin(mg/100g)	0.21^{b}±0.01	0.95^{b}±0.08
Ascorbic acid(mg/100g)	22.59^{c}±1.41	34.71^{c}±2.58

Mean and standard deviation values. Values with different superscripts are significantly similar at the same row (P<0.05)
Key:
AMP = Soursop pulp
AMJ = Soursop drink with sugar syrup

Table 4: Mineral composition of Soursop (Annona muricata) pulp and drink

Parameter (mg/100g)	AMP	AMJ
Potassium	0.81^{b}±0.04	0.68^{d}±0.06
Calcium	0.01^{a}±0.00	0.02^{b}±0.00
Magnesium	0.04^{d}±0.00	0.02^{e}±0.00
Phosphorus	0.30^{b}±0.01	0.22^{c}±0.02

Mean and standard deviation values. Values with different superscripts are significantly similar at the same row (P<0.05)
Key:
AMP = Soursop pulp
AMJ = Soursop drink with sugar syrup

(2.10mg/100g) was significantly (P>0.05) similar with the drink (1.25mg/100g). The riboflavin content in soursop pulp was significantly (P>0.05) similar with that of the drink. The niacin content of the soursop drink (0.95 mg/100g) was significantly (P<0.05) higher than the soursop pulp (0.21mg/100g). The ascorbic content of the soursop drink (34.71mg/100g) was significantly (P<0.05) higher than the soursop pulp (22.59mg/100g). Table 4 shows mineral composition of Soursop (Annona muricata) pulp and drink. The potassium content of the soursop pulp (0.81mg/100g) was significantly (P>0.05) similar to that of soursop drink (0.68mg/100g). The calcium content of the pulp (0.01mg/100g) was significantly (P>0.05) similar to that of soursop drink (0.02mg/100g). The magnesium of the soursop pulp (0.04mg/100g) was significantly (P>0.05) similar to that of soursop drink (0.02mg/100g). The phosphorus content of the soursop pulp (0.30mg/100g) was significantly (P>0.05) similar to that of soursop drink (0.22mg/100g).

Table 5 presents the phytochemical composition of soursop pulp and soursop drink with sugar syrup. The anthocyanin content of the soursop drink (6.44mg/100g) was significantly (P>0.05) similar to that of the pulp (7.35mg/100g). The flavonoids content of the soursop pulp (9.32mg/100g) was significantly (P<0.05) higher than the drink (5.24mg/100g). The tannin content was significantly (P<0.05) higher in the soursop pulp (65.98mg/100g) compared to the drink (53.96mg/100g). The alkaloid content of the soursop pulp (1.90mg/100g) was significantly (P>0.05) similar to that of the drink

Table 5: Phytochemical composition of Soursop (Annona muricata) pulp and drink

Parameter (mg/100g)	AMP	AMJ
Anthocyanin	6.44^{b}±0.10	7.35^{b}±0.06
Flavoniods	9.32^{a}±0.45	5.24^{a}±0.45
Tannin	65.98^{e}±2.11	53.96^{e}±1.02
Alkaloid	1.90^{c}±0.04	1.72^{c}±0.05
Saponin	0.17^{a}±0.01	0.22^{a}±0.02

Mean and standard deviation values. Values with different superscripts are significantly similar at the same row (P<0.05)
Key:
AMP = Soursop pulp
AMJ = Soursop drink with sugar syrup

Table 6: Frequency of consumption of soursop (Annona muricata)

	Frequency	Percentage
Would eat as often as seen	39	58.2
Would rarely eat it	21	31.3
Would never eat it	7	10.5
Total	67	100.0

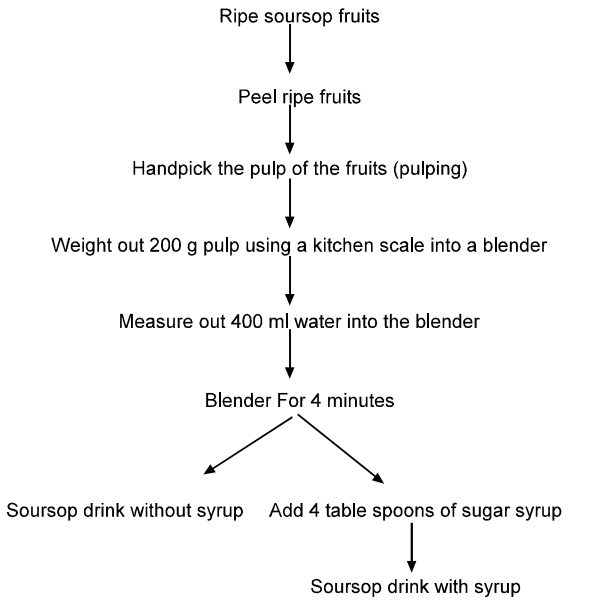

Fig. 1: A flow chart showing the steps involved in the formulation of soursop drink

(1.72mg/100g).The saponin content of the soursop pulp (0.17mg/100g) was significantly (P>0.05) similar to that of the drink (0.22mg/100g).

Table 6 shows the frequency of consumption of soursop among the respondents. More than half (58.2%) of the respondents said they would eat soursop as often as seen, 31.3% said they would rarely eat it and 10.5% said they would never eat it.

DISCUSSION

The result of the study showed that the moisture content of soursop pulp (17.25%) was higher than the soursop drink (6.20%). This indicated that the soursop pulp is

more exposed to spoilage than the soursop drink. The pulp can be preserved through processing it into different forms to improve its availability and diet diversification for man. The low moisture content of the soursop pulp and its drink could also have affected some of the value of other nutrients present. The moisture content obtained in this study was higher than that of conventional fruits such as pineapple (0.86%) and banana (0.03%) (USDA, 2012). The comparable ash values of soursop pulp (0.92%) and soursop drink (0.95%) indicated that both are good sources of minerals and therefore can be used in diet supplementation which will improve the mineral quality of diets. Soursop pulp and its drink do not contain fats, an indication that both had low risk of rancidity and thus offer better nutritional benefits. The higher protein content of soursop drink was an indication that the soursop drink had more protein concentrates than the pulp. The low moisture content of the soursop pulp and its drink suggested that the level of other nutrients might be high. This accounted for the high fibre content (3.43% and 6.26% for soursop drink and pulp respectively) and the carbohydrate content (83.47% and 72.71% for soursop drink and pulp respectively).

The lower vitamin A content of the soursop drink (63.71IU) compared to the soursop pulp (192.50IU) suggested that the processing technique reduced the retinol content, though it was higher than the values reported by the USDA (12) for pineapple (57IU) but lower than that of banana (248IU). There were also the presence of thiamin, riboflavin, niacin and ascorbic acid in the soursop pulp and drink. This suggested that consumption of soursop pulp and drink could provide a lot of health benefits. β-carotene and vitamin C are very powerful antioxidants. Antioxidants are known to protect the cells by reacting with oxidizing factors and neutralizing their effects (Nnam, 2011). They help to protect the body from cell damage caused by free radicals and peroxides. The enhancing effect of ascorbate has been attributed to its reducing and chelating properties during the digestion of food (Hurrel and Egli, 2007). The presence of ascorbate in foods overcomes the negative effects of all major inhibitors of iron absorption, including phytate and polyphenols to increase iron absorption two to three folds (Siegenberg *et al*., 1991). Ascorbate also enhances iron absorption by reducing the iron III ions to ferrous (Fe^{2+}) state, a form in which iron is absorbed. β-carotene improves absorption of iron possibly by forming a complex with iron, keeping it soluble in intestinal lumen and preventing the inhibitory effect of phytates and polyphenols on iron absorption (Nnam *et al*., 2012). β-carotene is precursor of vitamin A which is important in strengthening and boosting the immune system to fight infection. Vitamin A is necessary for good eye health. It improves iron status possibly by reducing levels of infection, improving production and proliferation of red blood cells in bone marrow, increasing the absorption of iron from food in the intestine and mobilization from body store (Waterlow, 1992).

The potassium, calcium, magnesium and phosphorus contents of soursop pulp and drink were quite low when compared with the values obtainable from conventional fruits (USDA). Potassium is useful in the prevention of hypertension. Calcium and phosphorus are known to be helpful in the formation of strong bones and teeth, preventing osteoporosis and osteomalacia. A study revealed that magnesium functions as a co-factor of many enzymes involved in energy metabolism, protein synthesis and maintenance of the electrical potential of nervous tissues and cell membranes (Adeyemi *et al*., 2008).

The presence of flavonoids in the soursop pulp and drink is desirable. Flavonoids are large group of compounds widely distributed in plant foods. They have antioxidant properties to protect the body against cardiovascular diseases and some form of cancer (Nnam *et al*., 2012). Other phytochemicals found in soursop pulp and drink has been shown to be beneficial to human health. Saponins identified in the soursop pulp and drink has the potential to lower cholesterol levels in humans due to their hypocholesterolemic effect (Nnam, 2011). Saponins form complexes with cholesterol to reduce plasma cholesterol levels. The other compounds such as anthocyanin, alkaloids and tannins have been studied especially for their potential of anti-parasitic, anti-rheumatic, astringent and emetic effect and anti-hyperglycemic property (Adeyemi *et al*., 2008).

A greater percentage of the respondents (58.2%) said they would eat soursop as often it is made available. This indicates that seasonal variation had made this fruit not sufficiently available all year round.

Conclusion: The soursop pulp and its drink contain appreciable quantities of nutrients that are of health benefits. These include vitamin A (β-carotene), ascorbic acid, thiamin and potassium. The phytochemicals identified include anthocyanin, flavonoids, alkaloids and saponins. They help to protect the body from nutrition related diseases. Further work is recommended to standardize portion sizes for dietary management of diet related diseases based on the nutrients and health promoting substances of soursop. Processing of soursop in the powdered form will ensure its availability all year round.

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