NUTRIENT AND PHYTOCHEMICAL COMPOSITION OF *ANNONA MURICATA* SEED FLOUR (SOURSOP)

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ABSTRACT
This study evaluated the nutrient and phytochemical content of *Annonnamuricata* seeds (soursop seeds). Soursop fruits were purchased within the vicinity of University of Nigeria, Nsukka, Enugu state. The seeds were extracted manually from the pulp. The seeds were sundried and milled whole into fine flour using Glen creston electric miller, the seed flour was used for analysis. The nutrient and phytochemical analysis were done using standard methods. Data obtained was analyzed using Statistical Package for Social Sciences (SPSS) version 15 for descriptive statistics, means and standard deviation. The proximate analysis showed that the percentage (%) moisture, ash, crude protein, crude fibre, fat and carbohydrate content of the seed flourwere 5.85, 2.13, 1.10, 6.19, 16.88 and 67.85 respectively. The seed flour contained 3.24mg of Zinc, 1.04mg of Iron, 1.2mg of Calcium, 17.35mg of Sodium and 3.57mg of Potassium per 100g. The vitamin composition of the seed flour were vitamin A (5.05RE), ascorbic acid (0.90mg/100g), riboflavin (9.06mg/100g), and thiamin (11.50mg/100g). The phytochemical contents of the seed flour were saponin (8.41mg/100g), flavonoid (5.33mg/100g) and alkaloid (3.09mg/100g). The result of the study shows that soursop seed flour contain an appreciable amount of essential nutrients and phytochemicals and could be incorporated into existing foods, to help solve the problems of malnutrition and micronutrient deficiency.

Key Words--Annonamuricata, **nutrients, composition, phytochemicals.**

INTRODUCTION
Most developing countries depend on starch based foods as the main staple food for the supply of both energy and protein. This accounts in part for the deficiency which prevails among the population as recognized by Food and Agricultural Organization [1]. The continuous increase in population has brought about decrease in available food resources thus leading to global malnutrition especially protein energy malnutrition (PEM) and micronutrient deficiency. In Nigeria, indigenous fruits are being neglected simply because there are no best techniques for processing and preserving them. This has led to seasonal and low consumption of fruits. In Nigeria, as in most other tropical countries of Africa, the daily diets are dominated by starchy staple foods. Fruits act as the cheapest and most readily available source of important vitamins, minerals and essential amino acids because they are affordable, available and acceptable [2]. Many of the local fruits and seed materials are under-exploited because of inadequate scientific knowledge of their nutritional potentials [3]. According to [4], malnutrition can only be curbed through dietary diversification and improved production of indigenous food and knowledge of their nutrition content.

Fruit contain a wide variety of substances including phytochemicals which confer medicinal and health attributes to fruits. They are promoted for the prevention and treatment of many health conditions, including cancer, heart disease, diabetes and high blood pressure [5]. However, lack of knowledge of available foods, their usage, nutritional and health implications pose problems 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 [6]. The knowledge of the nutrient composition of some of these fruits will enhance their use and increase their consumption which will in turn help to meet the micronutrient needs of the population. Studies have shown that there are different varieties of wild fruits and lesser known vegetables that are in abundance in Nigeria that could be of health benefit [7]. The availability of fruits is short-lived due to seasonality and the perishable nature [8].It was therefore important to study one of those seasonal fruits and its usefulness in reducing some of the non-communicable diseases in Nigeria. One such fruit is ***Annonamuricata*****(**soursop),this underutilized and unexploited fruit may be of great potential in combating micronutrients deficiency and non-

communicable diseases. However, very little work has been done with soursop to highlight its nutritional potentials.

Soursop tree is a small straggly fruit tree growing up to 8 meters high and it originated from tropical America and West Indies [9]. However, it is now widely grown in the tropics of both hemispheres [10]. It is grown in a wide range of soils with good drainage and elevations of up to 1000 meters and requires warm humid climate [11]. 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 or irregular, 15-30 cm long, with sparse soft green curved spines. The flesh is pulppy white, stringy and sour containing shiny black seeds [12]. It has pleasant flavour and aroma. The soursop is unrivaled for sherbets, soft drinks, ice- creams, syrups and nectars [10]. . The fruit was reported to contain 12% sugar, mostly glucose and some fructose, pectin, potassium, sodium, calcium, chloride and citrate WHO [11]. . Little or no commercial value is attached to this fruit because it is rarely displayed for sale in the market. Utilization of fruits in Nigeria and most developing countries is limited due to inadequate processing and preservation methods

MATERIALS AND METHODS

Mature soursop fruits were sorted from a selection of several mature fruits of Soursop. The fruit's maturity was determined by its dark green skin with smooth numerous fleshy spines. The soursop fruits were washed and cut vertically into two halves; the seeds were carefully extracted from the fruit and sun dried. Then the seeds were milled into flour.

Chemical analysis

The moisture, ash, fat, protein and crude fibre content of the samples were determined using standard methods AOAC [13]. Carbohydrate content was obtained by difference. Vitamin A, thiamin, riboflavin and vitamin C content of the samples were determined using the method of Pearson [14]. The AOAC [13] method was used to determine iron, calcium,zinc, potassium and sodium.Flavoniods was determined using Baham and Kocipia [15]method, alkaloids were determined using the Harbone [16] method, saponin was determined using the Obadoni and Ochuko [17] method. Data obtained was analyzed using Statistical Package for Social Sciences (SPSS) version 15 for Descriptive statistics, means and standard deviation.

Table 1 shows the proximate consumption of the soursop seed flour. The moisture content was 5.85%. The ash content of the sample was 2.13% while the crude fibre content was 6.19%, the fat content of the sample was 16.88% and the protein content was 1.10%, the carbohydrate content was 67.85%

Table 1: Proximate composition of *Annonnamuricata* seeds (Soursop seed flour)

Nutrients	(%)
Moisture	5.85 ± 0.21
Ash	2.13 ± 0.04
Crude fibre	6.19 ± 0.06
Crude protein	1.10 ± 0.04
Fat	16.88 ± 0.04
Carbohydrate	67.85± 0.03

Mean ±S.D of duplicate determinations

Table 2 shows the vitamin composition of soursop. The thiamine value was 11.50mg/100g being the highest value, riboflavin was 9.06mg/100g, vitamin A was 5.05mg and ascorbic acid was 0.90mg/100g.

Table 2: The vitamin composition of*Annonnamuricata* seeds (soursop seed) (mg/100g)

Vitamins	Mg/100g
Thiamine (B_1)	11.50 ± 0.71
Ascorbic acid (C)	0.90 ±0.09
Vitamin A	5.05 ± 1.04
Riboflavin (B_2)	9.06 ± 0.04
Mean ± S.D of duplicate determinations	

Table 3 presents the mineral composition of soursop seed flour. Sodium had the highest value of 17.35mg/100g, followed by zinc (3.24mg/100g), potassium (3.57mg/100g), calcium (1.22mg/100g) and iron (1.04mg/100g).

Table 3:Mineral composition of*Annonnamuricata* seeds (soursop seed flour)(mg/100g)

Minerals	Mg/100g
Iron	1.04 ± 0.00
Calcium	1.22 ± 0.00
Zinc	3.24 ± 0.00
Sodium	17.35 ± 1.47
Potassium	3.57 ± 1.04
Mean ± S.D of duplicate determinations	

Table 4 shows the phytochemical content of the soursop seed. The flavonoid content of soursop seeds was 5.33mg/100g, alkaloid content 3.09mg/100g and saponin was 8.41mg/100g.

Table 4: Phytochemical composition of*Annonnamuricata* seeds (soursop seed flour) (mg/100g)

Phytochemical content	Mg/100g
Flavonoid	5.33 ± 0.11
Alkaloid	3.09 ± 0.05
Saponin	8.41 ± 0.01

Mean S.D of duplicate determinations

DISCUSSION

The moisture content of soursop seed flour was 5.85%. This lowmoisture level implies that the seedflour can be stored for longertime without spoilage [18]. Ash contentwas 2.13%. This value is in agreement with thatreported elsewhere[19]. This content is also an index for the quality of feeding materials used for poultry and cattle feeding [20].The crude protein content was 15.40%, which ishigher when compared with the protein in wheat flour, parboiled rice and eggs with protein content of 8.55%, 7.7% and 12.6%, respectively [21]. This is indication that*A. muricata*seed flour can be used to supplement cereal based diets. The crude fiber content in the seed was 6.19%. This is nutritionally significant because fiber helps to improve gastrointestinal tract functions [22]. This study reveals that the seed of soursop (*Annonamuricata),* is rich in oil(16.88%) and therefore could be harnessed in human and animal nutrition.

The Sodium concentration (17.35mg/100g) was high; Sodium is a major mineral in the extracellular fluid, aids nerve impulse transmission and water balance [23]. Therefore soursop seed flour when incorporated into existing foods would be good in maintaining the homeostasis level in the body. The content of zinc was 3.24mg/100g, the seed flour are to be considered as excellent sources of bioelements. The seedflour could be used to enrich diets for persons with low levels of zinc. Zinc helps in the DNA synthesis and function, protein metabolism, wound healing and growth. It also plays a role in the development of sexual organs and bones, storage, release, and function of insulin, cell membrane structure and function, it is an indirect antioxidant as a component of two forms of superoxide dismutase, an enzyme that aids in the prevention of oxidative damage to cells [23]. Potassium is an essential nutrient and has an important role is the synthesis of amino acids and proteins [24]. The seed flour showed that potassium level was 3.57mg/100g. This is nutritionally relevant considering that potassium plays a principal role in neuromuscular functions. Iron is a component of hemoglobin and other key compounds used in respiration; it helps in immune function and cognitive development. Analysis of the seed flour showed that iron content was 1.0mg/100g therefore; soursopseedflour could be used as a source of iron to enrich existing foods particularly in treating iron deficiency anemia. The calcium content of the seed flour was 1.2mg/100g, and calcium assists in bone development [25]. Therefore soursop seeds can be used in diet supplementation which will improve the mineral quality of diets. Calcium also plays a significant role in photosynthesis, carbohydrate metabolism, nucleic acids and binding agents of cell walls [26]. And in regulating the acid-alkaline balance in the body.

Vitamin composition of soursop seed presented showed that the seed contains appreciable amount of riboflavin (9.06mg/100g), which was greater than (6.05mg/100g) in *A.hybridus*seed [27], this is nutritionally significant because riboflavin helps in the coenzyme of carbohydrate metabolism. Comparing the thiamin content (11.50mg/100g) of the seed to (2.28mg/100g) of amaranth seed shows that the seed has an appreciable amount of thiamine, which also helps in the coenzyme of carbohydrate metabolism and nerve function therefore, soursop seed flour can be used as a source of thiamine to enrich rations particularly in treating vitamin deficiency problems. The vitamin A content of the seed was 5.05mg/100g, this is nutritionally significant because vitamin A performs important functions in light-dark vision, and therefore soursop seed flour could be used as fortificants and in enriching some of the food products that are poor in vitamin A. Vitamin A promotes resistance to bacterial infection and overall immune system function [23]], the Ascorbic acid value was 0.90mg/100g, Ascorbic acid plays a role in synthesizing the protein collagen, it also has antioxidant properties which allow it to reduce the formation of cancer-causing nitrosamines in the stomach, this level implies that the seeds can be used in diet supplementation which will improve the vitamin quality of diets. Ascorbic acid also enhances iron absorption by keeping iron in its most absorbable form, especially as the mineral travels through the small intestine's alkaline environment. Finally, ascorbic acid is vital for the function of the immune system, especially for the activity of certain immune cells [23].

The saponin content of the seed flour (8.41mg/100g) was far greater than (1.68mg/100g) found in *A.hybridus leaf*[28]. Saponin is used in various drug preparations, controlling blood cholesterol level, bone health and building of immune system [29]. Therefore the seed flour can be used in diet supplementation as phytochemical supplements which will improve the saponin quality of diets. The alkaloid content of the seed

flour (3.09mg/100g) was comparable to that of *A. hybridus* seed (3.54mg/100g). Alkaloid plays some metabolic roles and control development in living organisms [30] Theflavonid content of the seed (5.33mg/100g) was higher than (2.00mg/100g) found in *A. hybridus* seed. Flavonoid helps modulate brain function, inhibit cancer cell growth and heart disease [31]. This high phytochemical content of the soursop seed suggests that it may be useful for human consumption just like the fruit.

CONCLUSION

This study shows thatsoursop seed flour contained appreciable amount of proteins, fat, crude fibre, vitamins, minerals and phytochemicals. The high phytochemical contents showed that the seed flour could be useful medically and in pharmacological industries. The soursop seed flour may be incorporated into existing recipes becauses of its high nutrient potentials

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