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Nutrient and Anti- Nutrient Compositions of Raw and Cooked Species of Cucurbita Maxima Fruit Consumed in Nigeria

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ABSTRACT

The nutrient and anti- nutrient compositions of the raw and cooked species of Cucurbita maxima fruit consumed in the eastern part of Nigeria were determined. The proximate compositions of the fruit samples showed that the fruit was high in moisture (87.1±0.38%) but low in protein (1.87±0.1%), fat (0.8±0.62%) and carbohydrate (3.96±0.17%). The low fat and protein contents appear to be a common feature of the fruits of the Cucurbitacae family. The fruit of C. maxima sample was found to be poor in the mineral elements. However, it had higher values of magnesium, calcium and phosphorus but very low values of potassium and sodium. The compositions of the mineral elements were also reduced after boiling. The fruit sample had low values of vitamins A (42.39±1.05 mg/100g), E (14.25±0.18 mg/100g) and C (25.67±1.27 mg/100g). Vitamins A and E were not significantly affected by boiling. The fruit sample was found to be rich in some phytochemicals with established medicinal values as well as some anti-nutrients (tannins, HCN and oxalates). However, boiling which is a normal food preparation technique was found to be able to reduce these anti-nutrients to safe levels.

Introduction

Nigeria has favouable agricultural conditions with respect to land and climate. These conditions support the growth and production of a wide range of tropical and sub-tropical crops [1]. These plant species come in different families such as: Leguminoceae, Moraceae, Euphorbiaceae, Cucurbitaceae and several others. Unfortunately, most of these plant species are under exploited and as such, underutilized.

Squashes (Cucurbita spp.) are members of the economically important Cucurbitaceae. There are three economically important Cucurbita species, namely Cucurbita pepo L., Cucurbita maxima Duch. and Cucurbita moschata Duch., which have different climatic adaptations and are widely distributed in agricultural regions worldwide [2-4]. C. maxima plant is the most diverse Cucurbita species after Cucurbita pepo. Cucurbita maxima plantis found in the South American temperate zones. However, many landraces of this species are also found in North America, Australia, Asia (China, India, and Iran) and Europe (Spain and Turkey) [5].The plant is grown in all West African territories and its consumption period is between October and March. It may be found in village cultivated areas and around houses.

Cucurbita maxima plant is generally characterized by climbing herbaceous vine with tendrils [6]. The fruits vary in size, colour, shape and weight and have a moderately hard rind, with a thick edible flesh, and numerous seeds which are either plump and tan or soft and white [2].

The young leaves and shoots and even the flowers are used as pot-herbs at the end of the season. Leaf shoots and undeveloped fruits are eaten by all tribes in Nigeria. The young boiled shoots are commonly pickled in Vinegar in Gabon [7]. The fruit is cooked as a vegetable when immature, while when mature it is used in the manufacture of beverages such as pumpkin apple soup. The fresh fruit is sometimes roasted, baked as cakes and pies, among varieties of filler uses. In drier climate of the northern region of Nigeria, the pulp is also sliced and dried for storage [8]. Cucurbita maxima fruit is being regarded as a 'poor man's' food and as an orphaned crop and hence, under-utilized. In recent times, increased attention has been focused on under-utilized indigenous crops and their promotion would help maximize the available resources, eradicate the dearth in food supply and be useful in food industries in the formulation of value added products and thus, cater for the daily needs of the citizens nutritionally.

Therefore, the objective of this study is to evaluate the nutritional and anti-nutritional compositions of the pulps of the raw and cooked fresh C. maxima fruit sample consumed in the eastern part of Nigeria. This information will highlight the potential usefulness of the fruit of C. maxima plant to alleviate widespread food and nutritional insecurity in Nigeria.

Materials and Methods

Four fruit samples of the Cucurbita maxima were obtained from Umuahia Central Market, Abia State, Aba Central Market, Abia State, Ogbete Market, Enugu State and Owerri Central Market, Imo State. Each of the four fruit samples was divided into two portions. One portion was boiled in water while the other portion was not boiled (raw). The pulps of both the boiled and raw samples were separately scooped out with a clean table spoon, mixed together and separately dried in the oven at 65^{O}C. The dried pulps were subsequently milled to obtain the representative powdery samples of both the boiled and raw fruit samples used for the study.

Analysis of Sample

The moisture and crude protein contents of the sample were determined according to A.O.A.C. method [9].The ash, crude fat, crude fibre, total carbohydrate as well as sodium, potassium and phosphorus were determined [10]. The Vitamins A and E [11], C, thiamin, riboflavin and niacin were also determined [12].

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Table 1. Proximate Compositions of Raw and Boiled *Cucurbita maxima* Fruit (%)

Parameters	C. maxima (Raw)	C. maxima (Boiled)
% Moisture	87.10±0.383	91.71±2.739
% Ash	2.15±0.012	1.66±0.028
% Protein	1.867±0.10	1.167±0.21
% Crude fibre	4.12±0.04	3.87±0.13
% Fat	0.8±0.62	0.03±0.084
% Total CHO	3.96±0.17	1.06±0.17

Table 2. Mineral Compositions of Raw and Boiled *Cucurbita maxima* Fruit (%)

Minerals	C. maxima (Raw)	C. maxima (Boiled)
Magnesium (%)	0.17±0.12	0.16±1.30
Calcium (%)	0.79±1.12	0.64±0.23
Potassium (%)	0.086±0.19	0.041±1.02
Sodium (%)	0.018±0.12	0.009±1.06
Phosphorus (%)	0.36±0.46	0.28±0.50
Na/K Ratio	0.21	0.22
Ca/P Ratio	2.19	2.28

Table 3. Vitamin Compositions of Raw and Boiled *Cucurbita maxima* Fruit

Vitamins	C. maxima (Raw)	C. maxima (Boiled)
Vitamin A (mg/100g)	42.39±1.05	42.27±1.90
Vitamin E (mg/100g)	14.25±0.18	14.17±0.12
Vitamin C (mg/100g)	25.67±1.27	8.667±0.27
Thiamine (mg/100g)	0.26±2.055	0.12±0.20
Riboflavin (mg/100g)	1.582±0.526	0.57±0.01
Niacin (mg/100g)	76.87±2.52	4.45±2.21

Table 4. Phytochemical Compositions of Raw and Boiled Cucurbita maxima Fruit

Phytochemicals	C. maxima (Raw)	C. maxima (Boiled)
Tannins %	0.356±0.61	0.11±0.04
Saponins %	4.027±0.012	2.753±0.012
Flavoniods %	0.37±0.045	0.27±0.045
Alkaloids %	0.306±0.024	0.16±0.02
Oxalates %	1.483±1.239	0.32±0.00
HCN(mg/kg)	17.82±3.850	6.85±0.00

Calcium and magnesium ions were determined using EDTA titrimetry methods [13]. The alkaloids, saponins and flavonoids contents were determined by the gravimetric methods [14]. The cyanogenic glycoside, as HCN, was determined by the A.O.A.C method (1975) [15].The oxalate content was also determined [16].

Results and Discussion

Result of the proximate compositions of raw and boiled Cucurbita maxima fruit sample is presented in table 1. The result shows that the fruit is a high moisture fruit (87.1±0.38% The fruit is low in protein (1.87±0.1%),fat (0.8±0.62%) and carbohydrate (3.96±0.17%). The high moisture content is not peculiar to the fruit. It compares equally well with some fruits of the Cucurbitacae family which have been reported to have moisture contents above 90% [17-18].

Again, the low fat and protein contents appear to be a common feature of the fruits of the Cucurbitacae family. Boiling was found to reduce the nutrient content. The ash was reduced perhaps, due to solubilisation in the boiling water. The reduction in the crude fibre content from 4.12±0.04% (raw) to 3.87±0.13% (boiled) was possibly due to heat effect.

Result of the mineral compositions of raw and boiled Cucurbita maxima fruit sample is presented in table 2. The fruit of C. maxima is not rich in the mineral elements. However, it has higher values of magnesium, calcium and phosphorus but very low values of potassium and sodium. The compositions of the mineral elements were also reduced after boiling. The reduction in the compositions of the mineral elements was perhaps, due to leaching and solubilisation of the minerals in the boiling water.

Magnesium has been reported as an activator of many enzyme systems and maintains the electrical potentials in nerves [19].Calcium in conjunction with phosphorus, magnesium, manganese, vitamins A, C and D, chlorine and protein are all involved in bone formation [20].Calcium is also important in blood clothing, muscle contraction and in certain enzymes in metabolic processes. Calcium and phosphorous are important in the diets of children and adults for effective bone development. Food is considered 'good' if the Ca/P ratio is above one and 'poor' if the ratio is less than 0.5 [21]. The Ca/P ratios of the C. Maxima (2.19 for raw and 2.28 for boiled samples) indicate that the raw and boiled C. Maxima fruit would serve as good sources of minerals for bone formation.

The deleterious effect of high sodium intake that frequently increases blood pressure has been severally reported. Potassium has a beneficial effect on sodium balance. A high intake of potassium has been reported to protect against increasing blood pressure and other cardiovascular risks [22-23]. The sodium to potassium (Na/K) ratio in the body is of great concern for the prevention of high blood pressure. A Na/K ratio less than one is recommended. Hence, the C. Maxima fruit sample used for the study with Na/K ratios of 0.21(raw) and 0.22 (boiled) would probably reduce blood pressure disease since it has Na/K ratios less than one.

Result of the Vitamin compositions of raw and boiled Cucurbita maxima fruit sample is presented in table 3. The vitamin A content of 42.39±1.05 mg/100g (raw) is higher than the reported values for water melon and marrow [17]. Vitamins A and E were not significantly affected by boiling. Vitamins A and E are fat soluble vitamins and could not have been leached out by the boiling water. It is low in Vitamins C and E both in the raw and boiled states. It is not a good source of vitamins C and E. Considering the B series, niacin has a higher value than riboflavin and thiamine in the raw sample. However, boiling reduced the niacin content from 76.87±2.52 mg/100g to 4.45±2.21 mg/100g. The values for thiamine, riboflavin as well as vitamin C also decreased when boiled. As with thiamine, ascorbic acid is very sensitive to heat and oxidation [24]. Loss of vitamins and minerals from vegetables is mainly because of extraction into the cooking liquid rather than their destruction [25].These B-vitamins act as coenzymes and catalyze numerous important biological oxidation-reduction reactions in the body [26].

Result of the phytochemical compositions of raw and boiled Cucurbita maxima fruit sample is presented in table 4. Result shows the presence of tannins, saponins, alkaloids, flavonoids at varying values. Oxalates were also found present in the samples. Saponins are useful in the treatment of cardiovascular diseases and other health-related problems [27].

Most (but not all) alkaloids are toxic to animals. Many have been exploited as drugs. In spite of the medicinal uses of alkaloids, they cause gastrointestinal upsets and neurological disorders [26]. Flavonoids act as anti-oxidants and have strong anti-cancer activities, and even help to lower the risk of heart disease [27]. The value of 0.356±0.61 mg/100g tannin (raw) is very insignificant and not likely to present any anti-nutritional effects in food products of the fruit. However, boiling is a normal food preparation method, which was found to reduce the phytochemical contents considerably.

Comparatively, not much information is available on the phytochemical compositions of other Cucurbita fruits. Again, the presence of oxalates in the fruit sample raises strong concern since oxalate can interfere with the absorption of minerals in the body.

The toxic substances (anti-nutrients) like hydrogen cyanide and alkaloids were reduced considerably by boiling. HCN was reduced from 17.82% to 6.88% (61.56% reduction) while alkaloids and oxalates were reduced from 0.31% and 1.48% to 0.16 and 0.32% respectively. These values represent 47.71% reduction for them.

Oxalic acid is a naturally occurring chemical in plants and animals and is also consumed in a variety of different foods such as leafy greens, nuts, seeds, most berries, certain fruits, soy and soy products, meat and dairy products. In large amounts, oxalic acid is poisonous, but toxic levels are not found in foods that we normally eat.

The nutrient loss observed with boiling are in agreement with the findings of Oguntona (1988) [28] who reported varying degrees of nutrient loss in green leafy vegetables due to boiling. The losses in HCN and oxalates also reflect the findings of Arntfield et al., 1985) [29] who eliminated the toxins, HCN by boiling.

Conclusion and Recommendation

It is concluded therefore, that the Cucurbita maxima fruit sample used for this study is a high moisture fruit and has low protein and fat contents. However, it is rich in some phytochemicals with established medicinal values. The fruit also contains some anti-nutrients (tannins, alkaloids, HCN and oxalates). However, boiling which is a normal food preparation technique was found to be able to reduce these anti-nutrients to safe levels.

It may be concluded therefore, that the consumption of boiled Cucurbita maxima fruit will pose no real health danger to consumers. On the strength of the above, it is hereby recommended that the consumption of raw Cucurbita maxima fruit is not advisable whereas consumption of the boiled fruit should not be discouraged. Further work may be necessary on the fruit especially, in terms of amino acid profile, the result of which may inform its utilization in diverse forms.

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