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Full Length Research Paper

Comparative studies on consumption preference, mineral contents and proximate composition of five ecotypes of *Gnetum aficanum* Welw. from Northwest Cameroun and Southeast Nigeria

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A comparative study on the consumption preference, mineral contents and proximate composition of five ecotypes of the edible vegetable, *Gnetum africanum* Welw. was carried out. The five ecotypes were Umuahia ecotype, Calabar ecotype, Ikom ecotype, Eket ecotype (Nigeria) and Limbe ecotype (Cameroun). These five ecotypes were chosen because they represent a wide consumption range of the vegetable. The minerals investigated were nitrogen, potassium, phosphorous, sodium, calcium and magnesium. The results showed that there was significant (P<0.01) difference in the mineral contents of *Gnetum* across the different ecotypes. Results of the questionnaires administered agreed with the laboratory investigations. The consumption preferences were: Umuahia (24%), Limbe (18%), Eket (31.5%), Calabar (11.5%) and Ikom (15%). Proximate analyses of the percentage crude protein, ether extract (crude fat), crude fibre, ash and nitrogen free extract (NFE - carbohydrate) content of the leafy vegetable were also investigated. From the results, *G. africanum* is rich in NFE, with the Calabar sample scoring the highest value of 49.44% dry weight. Umuahia and Eket ecotypes had the highest protein contents. The proximate compositions were not significantly different (P>0.01) except between Umuahia (Abia State) and Ikom (Cross River State) ecotypes (P<0.01). This investigation showed that the consumption preference, mineral contents and proximate composition of five ecotypes of the edible vegetable, *G. africanum* were affected differently in the ecotypes studied. Future efforts to domesticate this nutritiously rich African vegetable should be guided by the results of this investigation.

Key words: Ecological impact, consumption preference, mineral contents, proximate composition, ecotypes, *Gnetum africanum.*

INTRODUCTION

Gnetum aficanum Welw. is one of the most popular green leafy vegetables in Nigeria and is gaining equal popularity as a delicious food leaf in other African countries such as Cameroun, Gabon, Congo and Angola (Eyo and Abel, 2002). *G. africanum* leaves are widely consumed in the Southern parts of Nigeria due to its palatability. Some tribes especially the Igbos and some tribes in the Northern parts of Cross River State, eat it as a salad mixed with dry fish or meat, certain spices and palm oil. The popularly known 'Afang' soup, native to the Efik/Ibibios is prepared with this leafy vegetable. One common way of preparing Afang (Efik/Ibibio), Ókazi (Igbos), Ero (Cameroun), Saka-saka (Congolese), Koko (French) or Nkoko (Portugese) is to cut it into small stripes and pound or grind into a paste (Domenyang et al, 2001). The paste is then used in addition with other condiments, to make soup (Bahunch, 1999).

G. africanum belongs to the kingdom Plantae; division Gnetophyta; class Gnetopsida; order, Gnetales; family Gnetaceae; Genus, Gnetum belongs to the order, Gnetales and family Gnetaceae (Dutta, 2000). The Genus

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Figure 1. Study area: Cross River State, Nigeria.

Gnetum, comprises between 20 to 30 species of tropical trees and climbers, two of which are native of the African continent.

It grows as a wild, ever-green climbing plant in the rainforest of Nigeria, where it is searched for and sold in the regional markets. Efforts at domesticating the plant are still being investigated. Shiembo et al. (1996) examined the vegetative propagation of the leafy herb using a low- technology non-mist propagation system and concluded that these methods could be used for domestication of *Gnetum*. However, field trials are yet to commence. It is found throughout tropical Africa where it grows wild in the rainforest. It extends in distribution from SE Nigeria to Congo and as far as Angola to the south (Orwa et al., 2009).

Apart from being popular as a culinary delight, the leaves of *G. africanum* are also employed for certain medical purposes. They are used in the treatment of enlarged spleen, sore throats and as a cathartic, in Nigeria (Burkill, 1999). In Ubangi (DR Congo), it is used to treat nausea caused by some form of poison. In Congo – Brazzaville, *Gnetum* is used as a dressing for warts and boils. The cut-up stem is also chewed to reduce the pain of childbirth (Shiembo, 1984).

G. africanum is also reported to be used for medical purposes in Mozambique (Watt, 2000). However, the plant is mostly popular for its' culinary value. The vegetable has very high nutritional values and constitutes an important source of vitamin C (Ovabonzi et al., 2010), protein (Eyo et al., 2002), essential amino acids and mineral elements (Ndam et al., 2001). The seeds are specially used as fungicide for dressing fresh and septic wounds. It is also chewed raw in the management of excessive urination by infantile diabetic patients in Traditional Medical practice (Smith, 1983; Shiembo, 1984; Mialoundama, 1993). Ekop (2007) recorded a high caloric value in *G. africanum* seeds.

Orwa et al. (2009) documented mealy bugs as the main pest in the nursery. When this leafy vegetable is grown along dead poles attacked by termites, these insects will damage adjacent stems. Diseases have not been found to reduce productivity of *G. africanum*. The aim of this research is to investigate and compare the mineral contents and proximate composition as well as the consumption preference of the leaves of *G. africanum* among consumers in Southeast Nigeria and across the border in Northwest Cameroun.

MATERIALS AND METHODS

Study area

This research was carried out in Calabar South Local Government Area of Cross River State, Nigeria (Figure 1). This area serves as collection center (General Market) for *G. africanum* brought from the different locations where their ecotypes are understudied.

Collection and preparation of plant samples

The test plant was bought from a Beach Market in Calabar South which serves as a bulk sales centre for traders drawn from the five locations of research interest. These locations are: Ikom and Calabar (Cross River State), Umuahia (Abia State) and Eket (Akwa Ibom), Nigeria and Limbe (Cameroun). They were authenticated by the Curator in the Botany Department Herbarium, of the University of Calabar, Calabar. The leaves were cut into tiny stripes and then air-dried at room temperature for 48 h. The dried leaves were then pulverized to powder using an electric blender (Lapriva, 3000). 100 g of each powdered sample was stored in well labeled plastic containers and preserved at 4°C for subsequent use.

Administration of questionnaire

Two hundred questionnaires were administered to a cross-section of *G. africanum* sellers and consumers. The qualities addressed by the questionnaires were: leaves with highest scent, leaves that cause stooling after consumption, leaves that cause internal heat after consumption and most bitter tasting leaf. The preference ranges were A (high), B (medium) and C (low).

Mineral content analysis

Minerals analyzed were Nitrogen, Sodium, Potassium, Calcium and Magnesium (Evans and Trease, 1999). 10 g of each sample of the powdered leaves was acid digested and then made up to 50 ml in a volumetric flask. Nitrogen was distilled from the digest using Kjeldhal distillation set; Sodium and Potassium were determined in the digest using flame photometer, while Calcium and Magnesium in the digest were determined by EDTA titration.

Proximate composition analysis

This involved measuring the ash and crude fibre contents using the AOAC protocol (1995), crude protein content (Kjeldhal nitrogen method, using a conversion factor of 6.25), Ether extract content (using the semi-continuous Soxhlet extraction method) and nitrogen

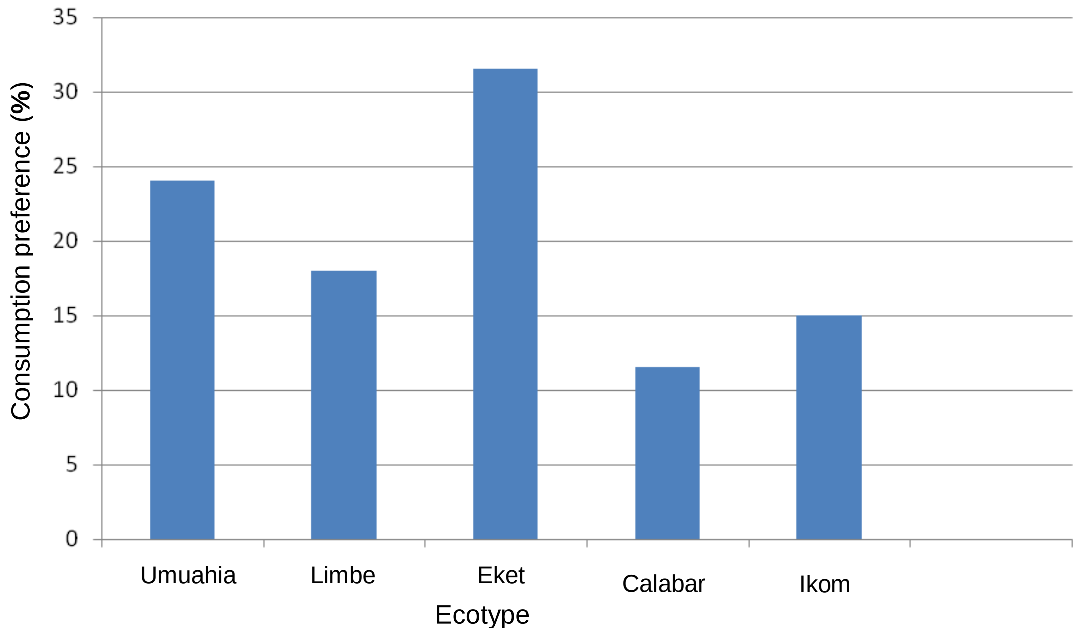

Figure 2. Consumption preference (%) of *G. africanum*.

free extract (NFE) Carbohydrates by subtracting the percentage crude protein, ash and fibre from 100% dry matter.

Data collection and statistical analysis

All data collected were based on the consumption preferences, mineral content analysis and proximate composition analysis of samples. Complete randomized design (CRD) was used to analyze these results. Results were recorded as percentage dry matter. Statistical analysis involved Analysis of Variance and Student's T-test using the EXCEL(7) statistical package.

RESULTS AND DISCUSSION

Consumption preference

Results of the consumption preference are presented in Figure 2. The consumption preference was as follows: Umuahia (24%), Limbe (18%), Eket (31.5%), Calabar (11.5%) and Ikom (15%). The most preferred *Gnetum* leaves were those from Eket in Akwa Ibom state, followed by the Umuahia leaf sample. These two samples scored the highest Nitrogen contents (dark leaf colour), highest loose- stool- causing leaves (laxative property), highest bitter tastes (old leaves) and the strongest scent (typical *Gnetum* scent). The quality mostly preferred was leaf with highest scent. It appears that most consumers of the leafy vegetable prefer the strong aroma of the leaves while eating any of the delicacies prepared with this vegetable. The bitter tasting quality was not very popular among the respondents as this was attributed to long storage and subsequent loss of freshness of the leaves in storage.

Mineral contents

Results of mineral contents of the five ecotypes are recorded in Figure 3. The figure shows that the Umuahia and Eket samples had the highest Nitrogen contents of 3.50% dry matter. This may account for the high crude protein content as shown by the proximate analysis results (Figure 4), since high nitrogen content indicates high protein content (Smith,1983). The Ikom ecotype produced the highest Phosphorus content of 0.41%, while the Calabar ecotype produced the lowest (0.12%). Potassium, Sodium, Calcium and Magnesium contents of the Eket ecotype were the highest (1.40, 0.74, 2.24 and 1.34% respectively). The calcium content of the Eket sample stood out among all the other samples. Generally, the Akwa Ibom State sample had the highest mineral contents, followed by the Abia State sample. This perhaps may be due to the fact that the 'afang' found in these ecotypes are mostly from virgin forests with rich soil nutrient compositions due to litter turn-over. Isong et al. (2003), showed that of three varieties studied, (two within Akwa Ibom State; Asutan and Oron and Ikom in Cross River State), the Asutan variety had the richest mineral contents. The Calabar sample had the lowest mineral content. This may be due to the fact that most of the afang cultivated in Calabar are domesticated in home gardens with poor soil element contents. It is speculated,

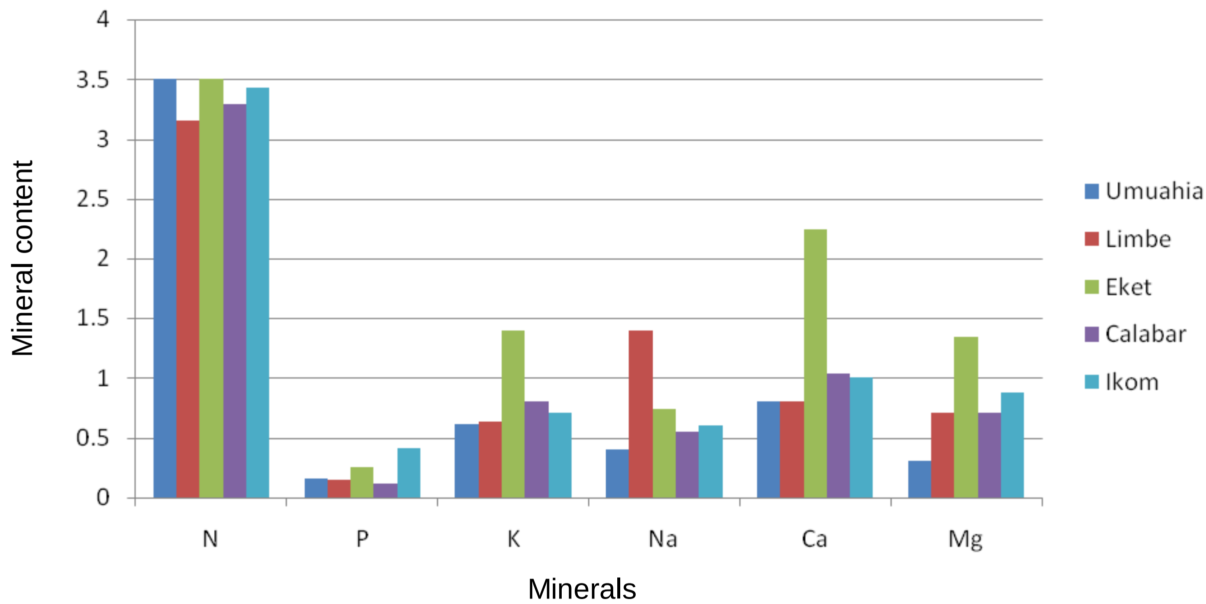

Figure 3. Mineral contents of five ecotypes of *G. africanum.*

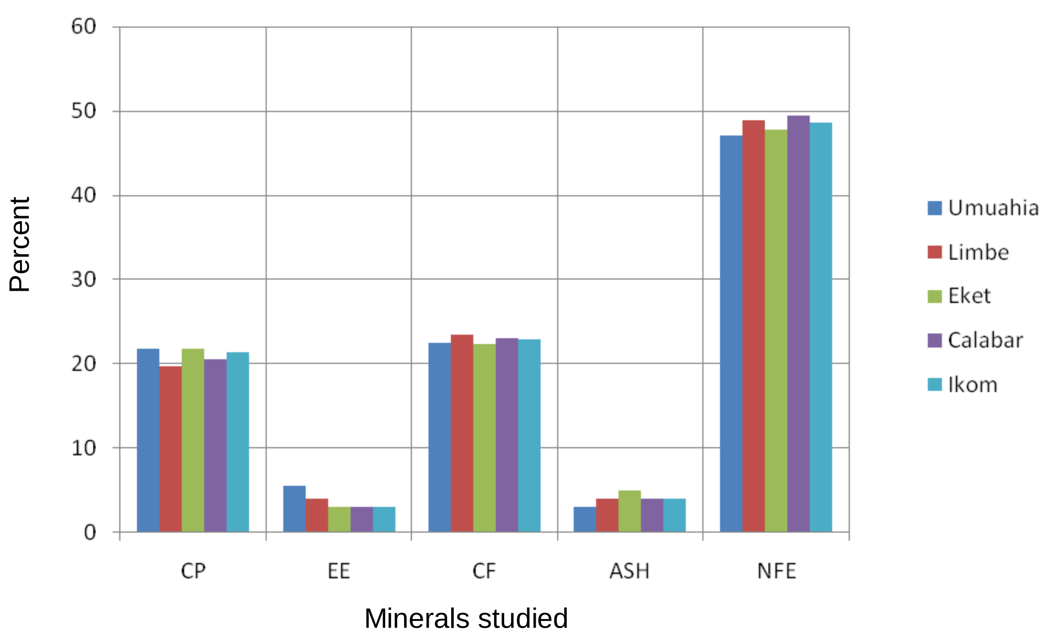

Figure 4. Proximate analyses of five ecotypes of *G. africanum.* CP-Crude protein, EE-Ether extract (crude fat), CF-Crude fibre, ASH-Ash, NFE-Nitrogen-free extract (carbohydrate).

though, that with adequate and appropriate manuring, the soil conditions can be improved but if this will have improved effects on the domestication of Gnetum in Calabar, is yet to be ascertained (Isong et al., 2003). Analysis of variance results showed significant difference ($P < 0.01$) in the mineral contents of *G. africanum* across the five ecotypes. Several factors may be responsible for this, including those already discussed. Micro-environmental conditions prevalent around a certain ecotype may predispose the plant to certain conditions that will affect the mineral content of the leafy vegetable (Isong and Eko, 2000). The soil type is another factor that may impose its influence on the mineral contents of *G. africanum.* Soil rich in mineral nutrients will produce plants with leaves that are richer in mineral contents than those with low nutrient profile.

Proximate analyses

The proximate analysis of the samples from the five ecotypes were not significantly (P>0.05) different. The only significant (P<0.05) difference observed was between the Ikom and Umuahia samples. These results could be attributed to the geographical area where the samples were obtained. Apart from the Ikom and Umuahia samples, the others were obtained from within the same ecological area. This could account for there not being any significant difference in their proximate composition. In agreement with Ekop (2007), ‘afang’ leaves have a high carbohydrate content (NFE) as shown in Figure 4. The carbohydrate contents were 47.13, 48.82, 47.82, 49.44 and 48.67% for the Umiahia, Limbe, Eket, Calabar and Ikom ecotypes respectively. Our findings revealed a rich presence of magnesium (Mg) in the samples with high carbohydrate contents. This could be an indication that the high magnesium level found in the leaves aided the metabolism of carbohydrates in the leaf samples. This presents *Gnetum* leaves as a good source of energy especially when eaten raw. The sense of satiety experienced after eating ‘afang soup’ might be attributed to its high caloric value, too. From our findings, Calabar sample scored the highest NFE value showing active nutrient uptake and photosynthetic activity in this ecotype. On the whole, the carbohydrate content of the leaves were appreciably high in agreement with findings of Orwa et al. (2009). Ash contents were low, though relatively higher than the results recorded by Ekop et al. (2005). Values recorded were 3, 4, 5, 4 and 4% for Umuahia, Limbe, Eket, Calabar and Ikom samples respectively. Crude protein contents were highest in both Eket and Umahia samples (21.87%). This coincides with the Nitrogen content results as Nitrogen is believed to be important for protein uptake in plants (leaves). Protein makes up 1/4th of the nutrient profile of *G. africanum* leaves thus the more the plant protein the better the leaf quality. This must account for the high consumption preference of these ecotypes over the other ecotypes. The other ecotypes had crude protein values of 19.68, 20.56 and 21.43% for Limbe, Calabar and Ikom ecotypes respectively.

The high values of the crude fibre content recorded in the five ecotypes may account for the loose stool often passed after consumption of “afang”. This property may well account for the laxative quality of *G. africanum*. Hence, the Limbe ecotype followed by the Calabar ecotypes had the highest laxative quality of all the ecotypes studied. The crude fibre content also indicates the high energy level of the leaves as crude fibre is known to be a rough indicator of energy content of leaves (Dutta, 2000).

The ether extract (crude fat) content of the five ecotypes was seen to be very low, the highest being that of the Umiahia ecotype (5.5%). This is similar to results presented by Ekop (2007), on the seeds of *G. africanum*. The low fat content in Gnetum may be implicated in its non fattening characteristics.

Conclusion

Investigations of the consumption preferences, mineral contents and proximate analysis of five ecotypes of *G. africanum* leaves showed a preference that favored the Eket, Akwa Ibom State ecotype; a rich source of minerals which include nitrogen (N), phosphorus (P), potassium (K), sodium (Na), calcium (Ca) and magnesium (Mg) and a proximate analyses which showed the presence of crude fibre, ash, carbohydrate, ether extract and nitrogen free extract across the five ecotypes. These proximate contents also qualify the leaves as being suitable for both human and animal consumption. It can therefore be concluded that the consumers preferred the Eket ecotype of the leafy vegetable *G. africanum* for culinary purposes. From our results too, the metabolic contents of the leaves should be considered when purchasing them for consumption. These findings should influence the cultivation and hitherto domestication of the vegetable for both local and international trade. Before harvesting the leaves for commercial purposes, the ecotype under cultivation should be considered. Further research in this area is highly recommended as there are still many aspects of the study, ranging from domestication (to save Gnetum from extinction) to cultivation of the herb; nutritional profile and medicinal efficacy.

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