Phytochemical Profile, Proximate Composition and Utilization of Garcinia Kola in Ikwuano LGA of Abia State, Nigeria

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ABSTRACT

Background: Garcinia kola is utilized locally based on traditional knowledge which is at the risk of being lost due to modern lifestyle necessitating documentation and more research.

Objective: To determine the phytochemical profile, proximate composition and utilization of Garcinia kola in Ikwuano LGA of Abia State.

Methods: Survey design was adopted for assessment of utilization using questionnaires administered to 156 respondents sampled across Ndoro, Ariam and Oloko strata of Ikwuano via stratified random sampling, while the leaves, barks, roots and seeds were analyzed for phytochemical and proximate composition using standard analytical methods. Data were analyzed using analysis of variance and descriptive statistics.

Results: Results showed that the highest number of respondents were female (64.1%), married (61.5%), aged 41–50 years (42.3%) and business men/women (51.9%). Meanwhile, the seeds were the most utilized with 100% of the respondents using it for medicinal (80.1%) and other purposes (19.9%); but the majority of the respondents never used the leaves (66.6%), bark (59.6%) and roots (50.6%) for any purpose. The leaves (33.4%) were the least utilized. Results also revealed that the seeds had the highest ($p<0.05$) moisture (14.76%), and protein (2.89%) while the roots had the highest ($p<0.05$) fibre (27.06%), ash (3.05%) and fat (6.06%). Only the seeds had all the phytochemicals detected with its flavonoids (2.10 g/100g), saponins (2.13 g/100g) and glycosides (3.26 g/100g) ranking the highest ($p<0.05$).

Conclusion: This study suggests that Garcinia kola particularly the seeds are utilized for various purposes especially medicine as affirmed by their phytochemical composition.

INTRODUCTION

Garcinia kola (Bitter kola) is a flowering plant of the Guttiferae family referred to as wonder crop as every part of the plant has been found to be of medical importance [1]. However, the crop is regarded as underutilized [2, 3] and classified as vulnerable in red list of threatened species by the International Union of Conservation of Nature (IUCN) [4]. It has also been selected as one of the priority species for conservation in the Sub-Saharan Forest Genetic Resources Programme (SAFORGEN) [5] and as one of the six preferred tree species by the International Council for Research in Agroforestry (ICRAF) for domestication in West and Central Africa

[6, 7]. The trees are naturally found in humid tropical forests of West and Central Africa encompassing countries such as Benin, Cameroon, Democratic Republic of the Congo, Ivory Coast, Gabon, Ghana, Liberia, Nigeria, Senegal and Sierra Leone. Garcinia kola is a common snack in Southern Nigeria and an important part of every welcome meal (called kola) for visitors as a sign of peace and acceptance especially during ceremonies, mainly among the Igbo tribe in South East - Nigeria. The most valued products are the seeds, commonly chewed by both rural and urban populations simply for their astringent taste and for

therapeutic purposes such as the treatment of cough, common cold, gastric problems, and bronchitis.

The role of indigenous food trees in the society is now widely accepted. The wild and cultivated species contribute to human health by improving food security and nutrition. A range of useful forest products such as spices, honey, leaves, roots, fruits and twigs are continuously being sourced mainly by rural dwellers for human use. Forest products are necessary for food security, health and socio-economic wellbeing of communities especially those living around forest areas. Non–timber forest products (NTFP) contribute significantly in creating varieties of delicious food particularly during drought and famine. Forest products are increasingly being recognized for the important cultural, subsistence and market values that they add to rural forests and different households globally. Communities world over particularly those around forest areas rely on non-timber forest products for household income, food, healthcare, and materials for ceremonial purpose [8]. In Africa, medicinal plants such as Garcinia kola constitute a rich pool of natural products known to be rich in chemical substances such as antioxidants, phytochemicals, and minerals. The different parts of Garcinia kola contain these compounds which are responsible for the medicinal and pharmacological functions. The role of the forests and particularly trees in providing man with food and medicine is not new, it has been there from the outset of humankind. In 2011, the value of non-timber forest products (NTFPs) worldwide reached 88 billion USD [9]. However, traditional knowledge of these valuable tree species has been disappearing due to the pressures of modern lifestyle and effects of rampant deforestation [10]. There is the need for more research effort towards not only ensuring the preservation of these forest trees but in documenting their current traditional uses and in discovering better uses.

The objective of this work was therefore to determine the phytochemical profile, proximate composition and utilization of Garcinia kola in Ikwuano LGA, South-East Nigeria.

MATERIALS AND METHODS
Study area
This study was carried out in Ikwuano Local Government Area, Abia State, South East - Nigeria. The Local Government lies within latitude 5241E and 5301E and longitude 7321N and 7371N. The Local Government has a land area of 1,818 km² and a population of 155,351 [11]. Ikwuano shares boundaries with Akwa Ibom State and also hosts Michael Okpara University of Agriculture, Umudike and National Root Crops Research Institute, Umudike which actually result to the high level of commercial activities in the Local Government. And within the state (Abia), the area shares boundaries with Umuahia North and South, Bende and Isialangwa North Local Government Areas.

Data collection
Primary data were collected from respondents randomly sampled from different places including markets, homes and schools across Ikwuano Local Government Area using the stratified random sampling approach. The survey study design was adopted as the research design while questionnaire administered interview served as the instrument for data collection. Ikwuano Local Government Area was divided into three strata based on the three major markets, Ndoro, Ariam and Oloko. Fifty two (52) respondents were randomly sampled from each strata and administered well-structured questionnaires making a total of 156 respondents. There was no exclusion except children or those unwilling to participate. Collected data included socioeconomic characteristics of respondents and uses of Garcinia kola.

Raw material collection and sample preparation
The raw materials included Garcinia kola seeds, bark, leaves and roots. The seeds were bought from Ndoro market while the roots, bark and the leaves were sourced from Umugbalu Oboro all in Ikwuano Local Government Area, the location where the tree was found. The identity of the samples were confirmed by the Department of Forestry and Environmental Management, Michael Okpara University of Agriculture, Umudike, Nigeria. The collected parts of Garcinia kola were washed in a potable water several times to remove dirt then air dried and cut into pieces. They were then pulverized with mortar and sieved with 0.5mm sieve into fine powder before storing in well labelled airtight plastic containers for the determination of the phytochemical and proximate composition.

Proximate analysis
Proximate analysis was carried out using the methods described in [12]. The determination of moisture was by the loss on drying method while ash was by the conventional dry ashing method involving sample incineration at high temperatures in the muffle furnace. Crude protein and ether

extract analyses were carried out using the Kjeldahl and soxhlet methods respectively whereas crude fiber followed the gravimetric method. Available carbohydrate content was calculated by difference.

Phytochemical analysis
The spectrophotometric method of [12] was used for saponin analysis while the quantitative determination methodology by [13] was applied in the estimation of glycoside. Flavonoid composition was determined via the method of [14] whereas alkaloid was estimated by the gravimetric method of [15]. The amount of tannins present was determined using the Follin-Dennis method for the total phenolic materials [14].

Statistical analysis
The survey (collected) data was analyzed using descriptive statistics (frequency and percentage) while the proximate and phytochemical composition were subjected to Analysis of Variance (ANOVA) as well as the determination of their mean and standard deviation. All statistical calculations were carried out using the computer program, Statistical Package for Social Sciences (SPSS) version 16.

RESULTS
The demographic distribution of respondents studied are presented in Table 1. Utilization of Garcinia kola (bitter kola) by the respondents are shown in Table 2. Table 3 shows the mode of use of Garcinia kola. The proximate composition of the various parts (seeds, leaves, roots and bark) of Garcinia kola is presented in Table 4. Table 5 shows the phytochemical composition of the various parts of Garcinia kola.

Table 1 Demographic distribution of respondents

Variables	Label	Frequency (n=156)	Percentage (%)
Age	≤ 30years	10	6.4
	31 – 40 years	50	32.1
	41-50years	66	42.3
	51-60years	25	16.0
	61 & above	5	3.2
Sex	Male	56	35.9
	Female	100	64.1
Marital status	Single	39	25
	Married	96	61.5
	Divorced	10	6.4
	Widowed	11	7.1
Occupation	Farmer	37	23.7
	Civil servant	24	15.4
	Business	81	51.9
	Unemployed	8	5.1
	Others (e.g. artisans)	6	3.9

Table 2   Utilization of *Garcinia kola* (bitter kola) by the respondents

Parts	Uses		Frequency	Percentage (%)	
	Broad	Specific	(n =156)	Specific uses	Broad uses
Seed	Medicinal	Cough	67	42.9	
	Purposes	Hernia	5	3.2	
		Rheumatism	14	8.9	
		Toothache	22	14.1	
		Hypertension	17	10.9	80.1
	Others (e.g. snack)	Others (e.g. snack)	31	19.87	19.9
Leaves	Medicinal Purpose	Bathing baby	16	10.3	
		Malaria	36	23.1	33.4
	No utilization	No utilization	104	66.6	66.6
Root	Medicinal Purpose	Cough	28	17.9	
		Hernia	15	9.6	
		Malaria	16	10.3	
		Rheumatism	7	4.5	
		Toothache	11	7.1	49.4
	No utilization	No utilization	79	50.6	50.6
Bark	Medicinal Purpose	Easy delivery	10	6.4	
		Malaria	36	23.1	
		Rheumatism	17	10.9	40.4
	No utilization	No utilization	93	59.6	59.6

Table 3   Mode of usage *of Garcinia kola*

Condition	Mode of use of *Garcinia kola*
Malaria	The leaves of *Garcinia kola* is ground with pepper and cooked with black fish. The mixture is taken half tea-cup morning and evening
Cough	*Garcinia kola* seeds are either eaten raw or ground, mixed with honey and licked.
Colic, pains	Leaves are boiled and used in bathing new born baby.
Ceremonies	*Garcinia kola* seeds are traditionally used in ceremonies such as wedding to welcome visitors and other and show friendship and good relationship ceremony.
Cough and toothache	*Garcinia kola* seeds are added to local alcoholic beverage.

Table 4 Proximate composition of various parts of *Garcinia kola*

Composition	Moisture %	Protein %	Fibre %	Ash %	Fat %	Carbohydrate %
Seed	14.76± 0.06[a]	2.89± 0.10[a]	3.66± 0.08[d]	2.36± 0.06[a]	0.90± 0.02[c]	75.43± 0.00[b]
Leaves	11.07± 0.04[b]	2.08± 0.11[b]	6.27± 0.10[c]	1.43± 0.76[b]	2.08± 0.04[c]	77.07± 0.75[a]
Roots	2.42± 0.11[d]	1.46± 0.08[d]	27.06± 0.08[a]	3.05± 0.07[a]	6.06± 0.08[a]	59.95± 0.04[c]
Bark	6.76± 0.71[c]	1.76± 0.78[c]	19.10± 0.45[b]	1.60± 0.02[b]	4.44± 0.16[b]	66.34± 0.26[b]

Data are mean ± SD of two replicates. Means in the same column with different superscript letters are significantly different (p<0.05).

Table 5 shows the phytochemical composition of the various parts of Garcinia kola.

Parts	Flavonoids g/100g	Alkaloids g/100g	Tannins g/100g	Saponins g/100g	Glycosides g/100g
Seeds	2.10 ± 0.00^a	0.75 ± 0.01^b	0.31 ± 0.04^c	2.13 ± 0.02^a	3.26 ± 0.18
Leaves	1.38 ± 0.08^b	0.69 ± 0.05^c	0.50 ± 0.05^b	0.61 ± 0.10^c	Not detected
Roots	0.71 ± 0.08^d	0.72 ± 0.06^b	0.31 ± 0.01^c	0.44 ± 0.04^d	Not detected
Bark	0.97 ± 0.08^c	0.83 ± 0.03^a	1.03 ± 0.04^a	1.21 ± 0.04^b	Not detected

Data are mean ± SD of two replicates. Means in the same column with different superscript letters are significantly different (p<0.5).

DISCUSSION

The demographic indices of the respondents (Table 1) revealed that the highest proportion of respondents (42.3%) were between 41 to 50 years of age while the lowest (3.2%) were 61 years and above. They were more female (64.1%) respondents than male (35.9%) which agreed with the report of [16] that the use of Garcinia kola (bitter kola) is gender based as 89.1% of the respondents were female.

Equally shown was the spread of respondents across the different marital groups viz single (25%), married (61.5%), divorced (6.4%) and widowed (7.1%) as well as occupational groups, the highest percentage (51.9%) belonged to business men/women group while the lowest percentage (3.9%) belonged to others (group) such as the artisans. Data on the utilization of parts of Garcinia kola by the respondents (Table 2) shows that the various parts are used mainly for medicinal purposes as the percentage utilization of each part by the respondents for medicinal purpose alone summed up to 80.1% while utilization for other purposes was only 19.9%. Also shown was that the highest percentage (42.9%) of the respondents used the seed for the treatment of cough which was in agreement with the report of [17]. The majority of the respondents (66.6%) did not use the leaves for any purpose which agrees with [16] whose findings also showed the majority (60%) of the respondents not using the leaves for any purpose. Only 33.4% specified their use of the leaves, 23.1% as anti-malaria and 10.3% for bathing of babies. A total of 49.4% of the respondents indicated their use of the root for various medicinal purposes including the treatment of cough, toothache, hernia, malaria and rheumatism but the majority (50.6%) of the respondents did not utilize the roots for any purpose. The manner in which the different parts of the plant are utilized are shown in Table 3 some (cough and malaria as well as colic and pains) of which are in agreement with the report of [16].

The proximate composition of the various parts of Garcinia kola (Table 4) showed that the seeds contains the highest (p<0.05) carbohydrate, moisture and protein. Carbohydrates are known to be readily accessible fuel for physical performance and the regulation of nerve tissue [18]; that of the seed (75.43%) compares with those of carbohydrate foods. High moisture content of the seeds indicates increased microbial activity as well as intense biochemical and physiological reactions. Garcinia kola seed had 2.79% protein which compares with that of the FAO/INFOODS Food Composition Table for Western Africa [19]. The value was the highest (p<0.05) but quite low compared to the protein level of some commonly consumed nuts in Nigeria such as groundnut and cashew nut which according to [19] are 25g/100g and 16.1g/100g respectively. The crude fibre content of the root was the highest (27.06%) indicating high amount of indigestible components such as cellulose, hemicellulose and lignin.

The phytochemical composition of the various parts of Garcinia kola presented in Table 5 reveals that the seeds had the highest (p<0.05) levels of flavonoids and saponins while the roots had the lowest (p<0.05) values of all the phytochemicals studied exception of alkaloid which had the least value in the leaves. However, the highest (p<0.05) levels of alkaloids and tannins were observed in the bark. Phytochemicals are biologically active non-nutritive substances produced by plants in small amounts as secondary metabolites which contribute significantly in preventing or fighting diseases [20]. Flavonoids have protective effects including anti-inflammatory, antioxidant, antiviral, and anti-carcinogenic properties. Certain alkaloids act as pain relievers, some as tranquilizers while others possess antimicrobial properties. These array of phytochemicals may be responsible for the numerous medicinal applications of Garcinia kola.

CONCLUSION

This study suggests that the parts of Garcinia kola are still being utilized locally on the basis of indigenous knowledge and technology for various purposes especially medical. The work also reveals that the seeds are the most utilized far above other parts particularly the leaf which besides having below average utilization, was the least utilized. The presence of phytochemicals in Garcinia kola further affirms the medicinal properties of the plant. There is need therefore for more research both on the cultivation of the tree in order to keep the pace of increasing demand and economic contribution to the society, and on its processing into forms that are in tune with modern lifestyle to command acceptability and far-reaching uses.

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