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Fruits categorization and diagnostic analysis of *Chrysophylum albidum* (G. Don) in Nigeria

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ABSTRACT

The physical characterization and proximate analysis of Chrysophyllum albidum were investigated in Port Harcourt, south-south Nigeria. Three major markets in Rivers State, Nigeria were visited for C. albidum fruits' collection from fruits lots of the same tree sold in tied fruit baskets. Ninety fruits of the same lots were collected and morphologically characterized into fruit types. The fruits morphological parameters of various sizes of C. albidum fruits were significantly different at P< 0.05. The relationship among fruit parameters and fruit types showed different association using regression analyses. The seed width and number of seed per fruit showed significant relationship with the fruit type (seed width R^2=0.3959 and number of seed R^2 =0.8223). Each identified fruit type was also analyzed in the laboratory for proximate and nutrient composition. Nine fruit types were identified based on the ripe fruit size, colour and taste which varied from very sweet to sour. The result of the proximate analysis indicated that all the fruit types contained Carbohydrate (11%), Crude fibre (4%), Lipids (3%), Protein (7%), Calcium (20ppm), Iron (<1ppm), Phosphorus (13ppm), Vitamin C (27ppb), A(12ppb), B1 and B2 (<1ppb).

Keywords: Fruit, characterization, morphology, proximate.

INTRODUCTION

Chrysophylum albidum locally called Udara (igbo) and commonly called African or white apple features prominently in the compound agroforestry system for fruit, food, cash income and other auxiliary uses including environmental purposes (kang, 1992). It belongs to the family sapotaceae, and frequently found in many ecozones of West Africa, Nigeria inclusive (Bada,

1997). Its leaves are used in ethnomedicine (Adewusi, 1997). The fruit pulp is rich in iron and vitamin C and is a good source of raw material for some industries (Centrad, 1999; Adisa, 2000; Akubugwo 2007). According to Keay (1989) the African star apple fruit is a large berry containing 4 to 5 flattened seeds or some times fewer due to seed abortion. The plant has in recent times become a crop of commercial value in Nigeria. The fleshy pulp of the fruits is eaten especially as snacks and relished by both young and old (Cenrad, 1999). The fruit has been found to have the highest content of ascorbic acid with 1000 to 3330µg of ascorbic acid per 100gm of edible fruit or about 100 times that of oranges and 10 times of that of guava or cashew (Akubugwo, 2007).

It has been observed that the tree of *C. albidum* has an efficient nutrient cycling ability; been an evergreen tree that rarely sheds all it leaves in any one season except when it is dead or under stress. The high rate of mineralization of the leaves improves the quality of the topsoil, and on sloppy terrain of compound farm *C. albidum* greatly checks the menace of soil erosion through its root anchorage and binding of soil particles. The tree equally provides shade for domestic animals within the compound farm system (Aduradola *et. al* 2005).

Characterization of fruits in the tropics can never be over-emphasised; particularly the concept of domestication which is highly pertinent and extremely important in determining the commercial potential of the local tree species at local, regional and international markets.

An understanding of fruits characterization and variation help in identifying and giving silvicultural advice to local farmers against the traditional method of propagation for sustainable food and nutritional security. Fruit variation has been recognized as an immeasurable method of identify species characteristics of many tropical fruits.

Many of these traits are heritable and can be passed on to their progeny. In practicing selection, plant breeders choose plants with desirable traits for further propagation and discard plants that are inferior for that trait. By doing so, plant breeders can select and reselect for the trait through successive generations, shifting the population in the desired direction (William, 2008).

ICRAF (2007) identified major methods of propagating *C. albidum* in the nursery; namely by seeds, wilding and direct sowing in the forest. The seedlings require good tending and shade until it's well established. Ekeke (1995) also reported that the work is in progress in determining methods of reducing the germination time of this species but so far depulping of fruits and sowing immediately after, have been found satisfactory for its germination.

In spite of the vast works on fruit domestication and propagation of some tropical fruits, few studies have examined the variations and characterization of fruit of *C. albidum* (Awono et al 2002; Leakey and Ladipo 1996). Similarly, the fruit of *C. albidum* is equally not listed among the fruit and vegetable of the World production of FAO 1992 yearbook (Table 1), and thus making it one of the near endangered fruit species in Africa; particularly for its significant nutritional values. This study therefore identifies the various varieties of *C. albidum* using biophysical and physio-chemical methods in characterizing some of its fruit attributes as well as determining its market value following its taste and dietary composition that may amount to the species subsequent sustainable domestication and propagation in Nigeria.

Table 1: Fruit and Vegetable World Production, 1991

Crop (Fruit)	Production, 1000 T	
	Total World	Developing Countries
Appies	39404	14847
Apricots	2224	1147
Avocados	2036	1757
Bananas	47660	46753
Citrus fruits NES	1622	1231
Cantaloupes and other melons	12182	8733
Dates	3192	3146
Grapes	57188	14257
Grapefruit and pomelo	4655	2073
Lemons and limes	6786	4457
Mangoes	16127	16075
Oranges	55308	40325
Peaches and nectarines	8682	2684
Pears	9359	4431
Papayas	4265	4205
Plantains	26847	26847
Plums	5651	1806
Pineapples	10076	9183
Raisins	1041	470
Tangerines, mandarines, clementines	8951	4379
Watermelons	28943	19038
Currants	536009	
Raspberries	369087	
Strawberries	2469117	342009
Beans, green	3213	1702
Cabbages	36649	15569
Cauliflower	5258	2269
Carrots	13511	4545
Chilies + peppers, green	9145	6440
Cucumbers and gherkins	13619	7931
Eggplants	5797	4608
Garlic	3102	2446
Onions, dry	27977	17128
Peas, green	4856	1038
Pumpkins, squash, gourds	7933	6245

Source: FAO Production Yearbook, 1992

MATERIALS AND METHODS

Seed collection and fruit characterization

A total number of Ninety fruits of differing morphological features were sampled and collected from different parts of Port Harcourt, Nigeria. Port Harcourt lies in the humid tropical zone of Nigeria with annual rainfall which ranges from 2000 – 2470mm, and an annual temperature from minimum 23^{o}C to maximum 32^{o}C (RISADEP, 1995).

The fruits were characterized and identified as fruit types respectively in the Forestry and Environment Department Laboratory, Rivers State University of Science and Technology, Port

Harcourt. The fruit characterization was based on ripe fruit colour, fruit length, fruit diameter, fruit shape, pulp colour, taste, number of seeds per fruit, seed width and seed length. The pulp of each identified fruit type was analyzed for nutrient content in the laboratory. These seeds were measured and the parameters measured were seed width, seed length, colour and average seed number per fruit type (Table 1).

Data analysis

The data obtained were subjected to Analysis of variance (ANOVA) at 95% level of significance, and relationship among fruit parameters and fruit types were determined using regression analyses. Differences among means were separated with Duncan multiple range test (DMRT), while actual comparison of fruit parameters and fruit types was based on their residual plots, coefficient of determination (R^2) and Standard Error of Estimates (SEE).

Proximate analysis

During this study, nutrient content of the pulp was analysed at the Food Science and Technology Laboratory, Rivers State University of Science and Technology, Port Harcourt. The comprehensive analysis was to determine the nutritive value of the fruit. Moisture content was determined by oven drying at 100^{o}C (Pearson, 1980). Crude fibre, Carbohydrate, Protein, Potassium, Calcium, Iron, Nicotinic acid, Vitamin C and A, Thiamin and Riboflavin were determined using Harold *et al.* (1981) method.

RESULTS AND DISCUSSION

The morphological parameters of various sizes of *C. albidum* fruits were significantly different at P< 0.05 *vis-à-vis* the parameters (Table 2). The parameters also showed that the size of the seeds depended on the size of the fruits, with large fruits having large seeds and the small fruits with small seeds. Table 2 indicated that there were variations among seed width, fruit length, number of seeds and mean diameter of seeds per fruits. The mean values of the parameters studied showed significant differences at P<0.05. Morphological characteristics likewise indicated differences ranging from taste; fruit colour and shape differences to seed colouration (Table 3). The relationship among fruit parameters and fruit types showed different association using regression analyses. The seed width and number of seed per fruit showed significant association with the fruit type (seed width R^2=0.3959 and number of seed R^2 =0.8223). This indicated that the sizes of the fruit determine the number of seed per fruit (Figure 1). The fruit characterization and variation of *C.albidum* were examined with the intention of establishing the different types of fruits identified in the study as well as characterizing them according to their sizes and morphological parameters (Table 3). Ekeke *et al*. (2006) reported this trend of variations when they recorded that variations indeed exist in the fruit sizes and the variations also cut across into the seed sizes; that is, the bigger the fruits, the bigger the seeds or the smaller the fruits, the smaller the seeds of the species in consideration, and that the trend appears to be consistent with fruits of particular parent trees. No morphological variations were observed amongst fruits from the same parent tree. The proximate analysis revealed that fleshly harvested *C.albidum* had Carbohydrate (11%), Crude fibre (4%), Lipids (3%), Protein (7%), Calcium (20ppm), Iron (<1ppm), Phosphorus (13ppm), Vitamin C (27ppb), A(12ppb), B1 and B2 (<1ppb). These investigations on fruit characterization collaborate with the work of Amusa *et. al.* who reported

that *C.albidum* consist of crude protein contents (CP) of 8.75 %, carbohydrate content (CHO) of 29.6%, crude fat (CF) of 16.2% and moisture content (MC) of 42.1%.

These analyses agree with the work of Ehiagbanare (2007) who reported that *C.albidum* as a fruit possess plausible economical and cultural significant locally, national and internationally. This therefore poses enough justification about the need for the species' cultivation, regeneration and sustainable management in Nigeria. It could therefore be revealed from this study that the seed sizes of *C.albidum* are dependent on the fruit types, which significantly reliant on different fruit parameters like seed diameter, fruit length, seed width and number of seeds.

Table 2: Fruit morphological parameters of *Chrysophyllum albidum*

Seed	Mean width ± S.E	Mean seed number± S.E	Mean length of ripe fruit ± S.E	Mean diameter of ripe fruit ± S.E	Mean seed length ± S.E
Type 1	1.43 ± 0.011^{a}	3.30 ± 0.15^{b}	4.60 ± 0.10^{a}	4.10 ± 0.02^{a}	2.44 ± 0.02^{a}
Type 2	1.47 ± 0.018$^{a\,d}$	3.80 ± 0.20^{b}	5.84 ± 0.14^{c}	4.10 ± 0.11^{a}	2.60 ± 0.03^{c}
Type 3	1.45 ± 0.015^{a}	3.60 ± 0.16^{b}	4.77 ± 0.10^{a}	3.80 ± 0.05^{b}	2.30 ± 0.03^{b}
Type 4	1.32 ± 0.012^{b}	4.10 ± 0.28^{bc}	4.94 ± 0.10^{a}	4.19 ± 0.06^{a}	2.23 ± 0.02^{b}
Type 5	1.47 ± 0.010$^{a\,d}$	4.75 ± 0.25^{d}	5.83 ± 0.21^{c}	4.43 ± 0.07^{c}	2.54 ± 0.02^{c}
Type 6	1.60 ± 0.018^{c}	4.87 ± 0.13^{d}	6.63 ± 0.14^{d}	4.94 ±0.08^{d}	2.96 ± 0.02^{e}
Type 7	1.62 ± 0.014^{c}	5.00 ± 0.00^{d}	4.61 ± 0.08^{a}	4.34 ± 0.05^{c}	2.78 ± 0.04^{d}
Type 8	1.50 ± 0.014^{d}	4.60 ± 0.16^{cd}	5.11 ± 0.06^{ab}	3.85 ± 0.03^{b}	2.75 ± 0.02^{d}
Type 9	1.44 ± 0.018^{a}	4.12 ± 0.23^{bc}	4.68 ± 0.08^{a}	4.20 ± 0.05^{a}	2.31 ± 0.03^{b}

Means with the same superscript in the same column are not significantly different at P>0.05

Table 3: Morphological characteristics of identified *Chrysophyllum albidum* fruits

Fruit Type	Taste	Local Name	Ripe fruit colour	Ripe fruit shape	Ripe fruit pulp colour	Seed colour
Type 1	Very sweet	Nwannu	Orange	Ovoid with prominent pointed apex	Light yellow	Deep brown
Type 2	Sour	Udara	Deep orange	Oval	Light brown	Deep brown
Type 3	Sour	Udara	Deep orange	Round with short pointed apex	Deep brown	Light brown
Type 4	Bitter sweet	Udara	Orange	Ovoid	Brown	Deep brown
Type 5	Sour	Udara	Light orange	Slightly Elliptical	Brown	Deep brown
Type 6	Sweet	Udara	Orange	Oval	Light brown	Deep brown
Type 7	Sweet	Udara	Orange	Round	Light brown	Deep brown
Type 8	Sour	Udara	Light orange	Ovoid with pointed apex	Light brown	Deep brown
Type 9	Bitter sweet	Udara	Light orange	Round with short pointed apex	Light brown	Brown

Table 4: Regression equations and Adj. R^2 values of *Chrysophyllum albidum* variables

No of variable	Independent variable	Regression model	Coefficient of determination R^2
1.	Seed length	$Y = 0.5209e^{0.8196x}$	0.0837
2.	Diameter of ripe fruit	$Y = 0.4105^{e0.5501x}$	0.0616
3.	Length of ripe fruit	Y = -0.1062x + 5.5528	0.0007
4.	Number of seeds per fruit	Y = 0.1347e0.8229x	0.8223
5.	Seed width	Y = 57.061x2 - 153.94x + 107.66	0.3959

Table 5: C*hrysophyllum albidum* fruit nutrient composition

Proximate composition								Minerals				Tonic Materials		Vitamins (µg/100g)			
	Samples	% Moisture	% ASH	% Fibre	% CHO	% Lipid	% Protein	Energy Value(Kcal)	Ca Mg/100g	Fe+ mg/100g	P+ mg/100g	Caffeine cafin	Nicotrinic Acid	Vit. Cµg/100g	Vit. A	Thiamin Vit. B_1	Riboflavin Vit. B_2
1.	Type 1	75	2.5	3.5	10.76	2.2	5.89	86.40	14.30	0.40	8.58	Nil	0.92	24.5	10.2	0.03	0.04
2.	Type 2	75	2.55	4.2	10.38	2.4	6.43	88.84	14.25	0.42	8.50	Nil	0.74	25.5	10.6	1.03	0.04
3.	Type 3	70	2.5	3.5	10.76	2.6	6.45	92.24	15.75	0.46	9.40	Nil	0.74	24.4	10.1	0.04	0.04
4.	Type 4	75	2.6	3.55	10.38	2.4	6.38	88.64	14.80	0.52	10.3	Nil	0.69	23.75	11.2	0.03	0.03
5.	Type 5	70	3	3.00	10.96	3.0	7.27	99.92	19.00	0.46	13.2	Nil	0.63	26.34	12.5	0.06	0.05
6.	Type 6	77.5	2.7	4.20	10.76	2.3	7.27	92.82	18.40	0.75	9.72	0.0001	0.47	25.8	10.6	0.04	0.04
7.	Type 7	72.5	2.6	3.5	10.00	2.5	7.45	92.30	19.45	0.50	9.83	Nil	0.58	24.7	10.2	0.04	0.03
8.	Type 8	72.5	2.7	3.55	10.38	2.4	6.43	88.84	18.50	0.50	9.98	0.002	0.63	25.25	11.2	0.04	0.03
9.	Type 9	72.5	2.65	3.50	10.00	2.6	6.60	89.80	19.50	0.48	9.75	0.0001	0.74	25.10	10.10	0.03	0.03

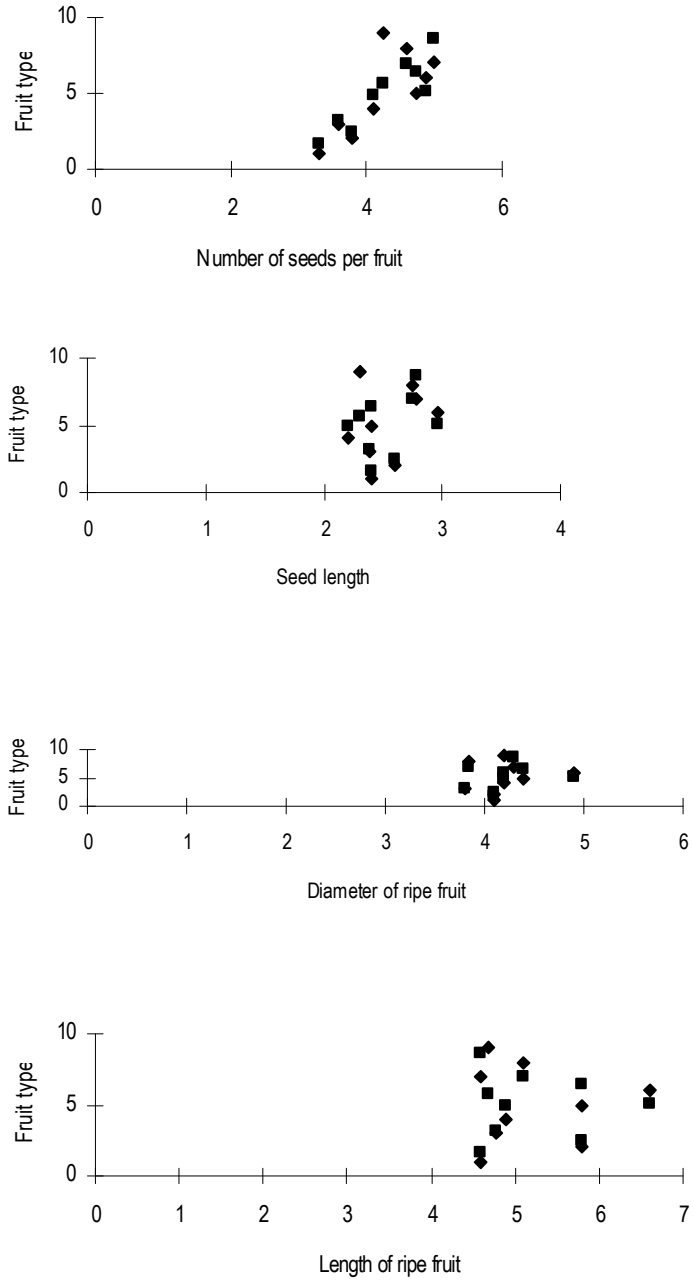

Figure 1: Relationships between fruit types and various parameters of *Chrysophyllum albidum*

CONCLUSION

The study has investigated physical categorization of different parameters of *Chrysophyllum albidum* fruits. The research revealed that fruit characterization in *Chrysophyllum albidum* is paramount in identifying different types of the fruit as well as providing relevant information on morphological descriptions that may significantly affect people choice and selection of the fruit species. The number of seeds per fruit was considerably distinguishable among the fruit types, and can assist in determining their characterization into categories which might be valuable in its economic analyses and marketing. The proximate analysis indicated nutrients value of the fruit and thus proffering information on the need for more research and critical exploration of the fruit into different by-products and derivatives. This will enable more revelation on the significant importance and benefits of the species to common man and its wide utilizations that may guarantee sustainable socio-economic development and management of the species among many other non timber forest products (NTFPs) in Nigeria and other Sub- Saharan African countries.

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