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CHEMICAL PROFILE OF THE ENDOCARP AND EXOCARP OF YELLOW MONKEY COLA (COLA LEPIDOTA)

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ABSTRACT

The chemical profile of the Endocarp and Exocarp of yellow monkey cola (Cola lepidota) were investigated using chemical analysis. The results of proximate analysis showed that the endocarp has the following compositions: moisture (20.00±0.10%W/W), ash (4.00±0.11%DM), crude fibre (36.00±0.12%DM), crude fat (16.00±0.11%DM), crude protein (22.84±0.12%DM), available carbohydrate (21.16±0.12%DM) and the energy value (320.00±0.01kcal/100g) while the exocarp contained moisture (22.00±0.12%W/W), ash (8.00±0.11%DM), crude fibre (7.00±0.11%DM), crude fat (12.50±0.10%DM), crude protein (1.58±0.11%DM) available carbohydrate (70.92±0.11%DM) and the energy value (402.42±0.10 kcal/100g). The endocarp mineral elements analysis revealed that sodium (0.033±0.21 mg/100g), lead (0.004±0.12mg/100g) cadmium (0.002 ±0.11mg/100) calcium (78.35±0.12 mg/100g), zinc (55.32±0.12mg/100), phosphorus (0.068±0.12mg/100g), iron (47.45±0.11 mg/100g) and manganese (0.09±0.31 mg/100g) while the exocarp mineral elements analysis revealed that sodium (0.011±0.11 mg/100g), magnesium (0.02±0.11 mg/100g), lead (0.02±0.12mg/100g), cadmium (0.03±00.12mg/100g), zinc (12.16±0.12mg/100g), potassium (17.21±0.12mg/100g), calcium (22.55±0.11mg/100g), iron (11.21±0.32mg/100g) and manganese (0.003±0.12mg/100g). The mineral element concentrations of cobalt, nickel and mercury were not detected in both endocarp and exocarp of cola lepidota. The toxicants composition analysis of endocarp revealed that hydro-cyanide, soluble oxalate and phytic acids contents were 0.54±0.01, 8.65±0.12 and 5.50±0.12 mg/100gDM respectively, while the exocarp revealed 0.09±0.12, 0.01±0.11 and 4.00±0.11 mg/100gDM respectively. The results of phytochemical screening of water extract (WE) of both endocarp and exocarp of cola lepidota shows the presence of polyphenols, reducing sugars, cardiac glycosides and saponins and the absence of phlobatannins, tannins, anthranoids and anthraquinones. The petroleum ether extract (PEE) revealed the presence of cardiac glycosides, saponins, flavonoids, polyphenols, and reducing sugars and also the absence of alkaloids, tannins, phlobatanins, anthranoids and authraquinones.

KEYWORDS: Cola lepidota, Proximate Composition, Minerals, Nutritional and Anti-nutritional

INTRODUCTION

In Africa many studies have indicated that west and central sub-regions have been known to holds a varieties of cola species: cola nitida, red cola, cola acuminate, white cola and cola lepidota, yellow cola (Etonihu et al., 2013). Cola lepidota fruit have long been identified as a primary fruit of the forest region of south-south Nigeria. The fruits are consumed in large quantities by man, woman and children alike largely because of the huge nutritional potentials and tasty pulp (Burkill, 2000). The economic importance of Cola lepidota fruit to local dwellers cannot be over emphasized. Fruit trees in Africa constitute one of the best tools for preventing diseases caused by lack or insufficient supply of vitamins in diet (Lovett et al., 2006). Fruit are good source of protein, fat, carbohydrate and minerals. Nutritionally, they are believed to contain beta carotene which act as antioxidant (Bello et al., 2008). Recent findings have revealed that fruits contain bioactive compounds such as polyphenols, alkaloids, saponins and anthraquinones etc which have some medicinal potential (Mohammed et al., 2011). Fruit also used as food contains a variety of organic compounds which at certain critical levels have anti-nutritional components such as oxalate, phytic acid and hydrocyanic acid (Omorayi and Dilworth, 2007). Therefore, these harmful components must be removed before their consumption. Oladokun (1988) investigated the pod of Cola lepidota fruits and his findings revealed that 85% of the pod contains 0-2 nuts in a pod while the mean nut number per pod was 3.0. Correlation analysis showed highly significant correlation between pot weight and number of other pot characteristic such as length, nut number per pod and tests weight. Regression also showed significant results for the pair of these characteristics. Cola lepidota commonly called yellow monkey cola are identified by various local names in south-south, Nigeria. Achicha or Orchiricha in Igbo speaking states and Ndiya in Efik as well as the Ibibios of Akwa-Ibom State, Nigeria. Cola lepidota is a small tree reaching 20m tall and 20cm in diameter often branching low, leaves are digital and the leaflets are up to 50cm long. (Hatchison and Dalziel, 1958). Consumption of Cola type beverage is not correlated with any heart disease. The bark of Cola gigamteam is

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used to treat yaws while that of Cola lateritica (red monkey cola) is very effective in the treatment of wounds. The bark of Cola nitida is used in the management of excessive appetite and fracture. The cotyledon is used for the treatment of herpers and the bark is used in the treatment of dystocia (Mashana et al., 2000). In the present study the chemical profile of endocarp and exocarp of yellow monkey cola obtained from Cross River State are investigated and reported.

MATERIALS AND METHODS

Sample collection and preparation: Fresh samples of Cola lepidota were collected from Okoroba farm plantation in Ikom Local Government area of Cross River State. The samples were identified by a Herbarium in Botany Department, University of Calabar, Calabar, Nigeria. The samples were cured by the traditional method of wrapping in fresh banana leaves to reduce moisture loss. The fruits were washed with distilled water and the exocarp and endocarp removed. The edible endocarp was separated from the seeds. The endocarp and exocarp were chopped into pieces using knife with steel blades and spread separately on a wooden board and placed in an oven. The dried samples were ground into powder with the aid of a blender, sieved and stored in desiccators until required for analysis.

APPARATUS AND REAGENTS:

A Pye-unican Atomic Absorption Spectrophotometer with acetylene flame was used to analyse for calcium, iron, manganese, magnesium, zinc and copper as described by A.O.A. C. (1990) while sodium and potassium were determined by flame photometer (Gallen Kamp) as described by Vogel (1962) Emack concentrated volumetric solutions were used as standard metallic ions solution for the calibrations. All reagents used were of Analytical grade and the water used was double distilled.

PROXIMATE ANALYSIS:

Proximate analysis was carried on various food parameters in endocarp and exocarp of Cola lepidota samples. Moisture, ash, ether extract (EE), crude fibre (CF) and nitrogen free extract (NFE) were determined by the method of A.O.A.C (1990). The estimation of available carbohydrate (AC) was done by difference as CHO = 100-(%Ash.+% crude protein + % crude fibre + crude fat). The crude protein content was calculated by multiplying the nitrogen content by 6.25 while the energy value (Kcal.) was obtained by (%CHO x 4)+ (%CP x4) + (% CLx9) where CHO stands for carbohydrates, CP stands for crude protein and CL stands for crude lipid (Hassan et al., 2008).

TOXICANT ANALYSIS

Hydrocyanic acid (HCN) was estimated by the alkaline titration method of (A.O.A.C 1975), oxalate was determined by the method of (Dye, 1956) while phytic acid was extracted using 3% trichloroacetic acid. The extracts were prepared according to the method described by Wheeler and Ferrel (1977). The absorbance was read at 480nm, while phytic acid was calculated by employing the method of Saturdi and Suckles (1985). On the basis that six atoms of phosphorus are contained in one molecule of phytic acid giving a 1:3.55 phosphorus: phytic molecule ratio (phytic acid =$C_6H_{18}O_{24}P_6$).

SAMPLES DIGESTION

The pulverized samples (5g) was weighed into a beaker, 30ml of concentrated perchloric acid and 5ml of concentrated nitric acid were added and shaked for few minutes. The content was heated with continuous stirring until the mixture turned white. The digest was diluted with 50ml of deionizer water and heated for few minutes. The mixture was allowed to cool and transferred into a 100ml volumetric flask and made up to the mark (Osabor et al., 2010).

MINERAL ELEMENT ANALYSIS

The mineral elements were determined by first wet ashing the samples (A.OA.C 1990, Osabor et al., 2010). Sodium and potassium were determined by flame photometer (Gallen Kamp). Calcium, manganese, magnesium copper, zinc and iron were determined by Atomic Absorption Spectrophotometer (Pye-Unican). Phosphorus was determined by Vanado molybdate colorimetric method as described by James (1996)

PHYTOCHEMICAL SCREENING

Phytochemical screening includes alkaloids, saponins, flavonoids, phlobatanins, cardiac glycosides, tannins and anthraquinones were screened by the method of and Harborne (1973) and Kotoky et al (2005).

RESULTS AND DISCUSSION

Table I show the results of proximate compositions of the exocarp and endocarp of Cola lepidota. These includes those of moisture, ash, crude fibre (CF), protein, crude fat and carbohydrate content. The moisture content was found to be 22.06$\pm$ 012%W/W weigh/weight for exocarp while the endocarp moisture content was 20.00$\pm$0.10%W/W. The ash content of exocarp was 8.0$\pm$0.11% DM while that of the endocarp was 4.00$\pm$0.11%DM (Dry matter). The crude protein content was 1.58$\pm$0.11%DM for the exocarp while that of the endocarp was 22.84$\pm$.12%DM. The crude fibre value was 7.58$\pm$0.12%DM for the exocarp while that of the endocarp was 36.00$\pm$0.12%DM. The carbohydrate content of the exocarp was found to be 70.92$\pm$0.11%DM while that of the endocarp was reported to be 21.16$\pm$0.12%DM.

Table 2 Show the results of toxicant compositions of exocarp and endocarp of cola lepidota. The levels of toxicant composition of phytic acid, hydrocyanic acid and soluble oxalate in exocarp are 0.09$\pm$0.12, 6.01$\pm$0.11 and 4.00$\pm$0.11 mg/100gDM respectively while that of endocarp are 0.54$\pm$0.11, 8.65$\pm$0.12 and 5.50$\pm$0.12 mg/100gDM respectively. The levels of phytic acid was very low while that of hydrocyanic acid and soluble oxalate were moderately high on both exocarp and endocarp samples studied.

Table 3 Show the results of mineral elements composition of exocarp and endocarp of Cola lepidota samples studied. The exocarp mineral elements composition ranged from 0.003$\pm$0.12 for manganese to

22.55±0.11 mg/100g for calcium while that of endocarp ranged from 0.002±0.11 mg/100g for cadmium to 78.35±0.11 mg/100g for calcium.

Table 4 Shows the results of phytochemical screening of both exocarp and endocarp of cola lepidota samples studied. The results obtained revealed the presence of cardiac glycosides, saponins, flavonoids and reducing sugars in water extract (WE) and petrolcum ether extract (PEE) of exocarp and endocarp of cola lepidota.

Table 1: Proximate compositions of endocarp and exocarp of cola lepidota

Parameters	Exocarp	Endocarp
Moisture(%)	22.00±0.12	20.00±0.10
Ash (%)	8.00±0.11	4.00±0.11
Crude protein(%)	1.58±0.11	22.84±0.12
Crude fibre (%)	7.58±0.12	36.00±0.12
Crude fat (%)	12.50±0.10	16.00±0.11
Carbohydrate (%)	70.92±0.11	21.16±012
Energy value (kcal)	402.42±0.42	320.00±0.01

The data are mean value ± standard S.D deviation of triplicate determinations; % crude protein =%N x6.25

Table 2: Toxicant compositions (mg/100g) of endocarp and exocarp of Cola lepidota.

Parameters	Exocarp	Endocarp
Phytic acid	0.09±0.12	0.54±0.11
Hydrocyanic acid	6.01±0.11	8.65±0.12
Soluble oxalate	4.0±0.11	5.50±0.13

The data are mean value ±S.D of triplicate determinations.

Table 3: Metals content of exocarp and endocarp of cola lepidota (mg/100g).

Metals	**Exocarp**	**Endocarp**
Sodium (Na)	0.01±0.11	0.033±0.21
Magnesium (Mg)	0.02±0.11	ND
Lead (Pb)	0.02±0.12	0.04±0.12
Cadmium (Cd)	0.03±0.12	0.002±0.11
Zinc (Zn)	12.16±0.12	55.32±0.12
Potassium (K)	17.21±0.12	36.32±0.57
Calcium (Ca)	22.55±0.11	78.55± 0.11
Iron (Fe)	11.21±0.32	47.45±0.11
Manganese (Mg)	0.003±0.12	0.09±0.31
Phosphorus (P)	ND	0.068±0.12
Nickel (Ni)	ND	BDL
Mercury (Hg)	BDL	BDL

Data are mean value ±S.D of triplicate determinations.
ND = not detected
BDL =below detectable limit.

Table 4: Phytochemical composition of exocarp and endocarp of Cola lepidota

Parameters	Water extract endocarp (WE)	Petroleum ether extract endocarp (PEE)	Water extract exocarp (WE)	Petroleum ether extract exocarp (PEE)
Cardiac glycosides	+	+	++	+
Alkaloids	-	-	-	-
Saponins	+	++	+	-
Tannins	-	-	-	-
Flavonoids	+	-	-	+
Polyphenols	++	++	++	++
Reducing Sugars	++	+	+	+
Phlobatananins	-	-	-	-
Anthranoids	-	-	-	-
Anthraquinones	-	-	-	-

+ = Present in moderate quantity
++ = Present in large quantity
—= Absent.

DISCUSSION

Present study was carried out to justify the utilization of fruits of cola lepidota for its nutritional potential and physiological utility. The result of the moisture content for Cola lepidota is presented in Table 1. The results obtained was 22.00±0.12% DM for exocarp and 20.00±0.10% w/w for endocarp. The moisture contents of Cola lepidota is low when compared to 62.50±0.08%w/w of Cola nitida (Red kola) and 63.80±0.08% w/w for Cola acuminate (white kola) by Etonihu et al (2013). The moisture contents of food is usually used as a measure of stability and susceptibility to microbial attack (Scott, 1980). The ash contents of cola lepidota is given in table. The Cola lepidota endocarp ash content is 4.00±0.11%DM and exocarp 8.00±0.12% DM. The value of the ash contents obtained in this study is higher than 2.44±0.08%DM reported by Etonihu et al (2013) for cola nitida (red kola). The high ash levels of the exocarp indicates that mineral elements are likely to be concentrated in the exocarp than the endocarp (Oyeyede, 2005).The crude fibre contents were 36.10±0.18%DM and 7.56±0.12%DM for endocarp and exocarp respectively. The endocarp contains high fibre value than the exocarp respectively. Fibre in nutrition helps in the maintenance of health as it expands the internal walls of the colon, eases the passage of waste products and acts as anti constipatory agent. Low fibre intake is recommended for infants and pre-school children as high intake is implicated in the irritation of gut mucosa and gut perturbation (Eromosele and Eromosele 1991, Bello et al., 2008).The crude fat contents of exocarp and endocarp of cola lepidota is presented in Table 1. The results obtained are 16.00±0.11%DM for exocarp and 12.50±DM for endocarp.

The crude fat content is low in the exocarp samples. On the basis of the present investigation, the fat content is higher than 7.80±0.16% reported by Etonihu et al (2013) for Cola nitida (red cola). Fats are essential because they provide the body with maximum energy (Dreon et al., 1990).The crude protein contents were 22.80±0.12% for endocarp and 1.50±0.11% for the exocarp. The protein contents of the endocarp was higher than the exocarp samples. The exocarb results obtained from this study compared favourably well with 1.91±0.01% obtained for Cola nitida reported by Etonihu et al (2013) for Cola acuminate (white kola). Protein are essential components of the diet needed for survival, their basic function in nutrition is to supply adequate amounts of required amino acids (Pugalenthi et al., 2004). Deficiency of protein in diet results in abnormal swelling of the body, growth retardation and muscle wasting (Zarkada and Voldeng, 1997). The daily protein requirement for children and adults are 23-26 and 45-56g respectively (NRC, 1974). The carbohydrate values were 21.16±0.12% for endocarp and 70.92±0.11% for exocarp. The exocarp sample has higher carbohydrate content compared to the endocarp. The value obtained from this study compared favourably well with 23.73±1.07% reported for cola acuminate by Etonihu et al (2013). The results of toxicants composition is presented in table 2. The phytic acid values were 0.09±0.12 and 0.54±0.11 mg/100g for exocarp and endocarp. The phytic acids levels were low in both samples studies. The hydrocyanic acid (HCN) contents were found to be 6.01±0.11 and 8.65±0.12 mg/100g for the exocarp and endocarp which are extremely below

the lethal dose for man 50-60 mg/100g body weight/day. The soluble oxalate contents were relatively low in all the samples studied. The values of 4.00 ±0.11 and 5.50±0.13mg/100g for the exocarp and endocarp samples were very below the toxic levels of 2.5g oxalate (Munro and Bassir, 1969). Eastwood (1986) has reported that consumption of oxalate can result in corrosive gastroenteritis, shock, convulsive symptoms, low plasma and renal disorder. The toxicant constituents such as phytic acid, hydrocyanate and soluble oxalates are known to inhibit complete absorption of many mineral elements (Oguntona et al., 1998). The results of the mineral elements composition of cola lepidota is presented in table 3. The elemental composition showed increased levels in Zinc (Zn), Potassium (K), Calcium (Ca), and iron (Fe) and low levels in sodium (Na), Magnesium (Mg), Cadmium (Cd), Phosphorus (P) and Manganese (Mn). Zinc is the second most abundant element found in the endocarp of the fruit is said to be an essential trace element for protein and nucleic acid synthesis and normal body development. It is also very essential during period of rapid growth in children and recovery from sickness (Mohammed et al., 2011). High levels of potassium in the body has been reported to increase iron utilization (Adeyeye, 2002). Arinathan et al (2003) reported that high concentration of potassium is beneficial to people taking diuretic to control high blood pressure. The result of calcium analysis obtained from this study is represented in table 3. Calcium is the most predominant element in the endocarp of Cola lepidota. Calcium is required in the body for normal growth of bones and teeth (Robinson, 1978). The result of iron analysis that the endocarp contained 47 .45mg/l00g and exocarp 11.21mg/l00g.

NRC(1974) recommended allowance of 10 – 18mg/day for both children and adults. This implies that cola lepidota is comparatively rich in iron. Iron is needed for red blood cells formation and deficiency in iron leads to iron deficiency anaemia. The results of phytochemical screening of exocarp and endocarp of Cola lepidota. Table 4 shows the presence of cardiac – glycosides in moderate quantities in the sample. Ukpong and Akpan (2011) reported the presence of cardiac glycoside in cocoyam inflorescence. Cardiac glycosides are naturally occurring drugs in plants known for their toxic and pharmacological activities especially in the heart (Harborne, 1973). It has been used as active ingredients in herbal medicine in the treatment of a weaken heart. (Trease and Evans, 1996). It is also used therapeutically in the administration of related heart failure disorder. Osabor et al (2010) has reported the presence of cardiac glycosides in the leaves of Diplazium sumatti leaves. Saponins were found in large quantities in the sample studied. Saponins are very useful in medicine and pharmaceutical industries in the manufacture of insecticides, vaccines and synthesis of steroidal hormones (Gee et al., 1989) saponins have outstanding characteristics, the aqueous extract froth greatly. This is the reason for their used in detergents. Reducing sugars were also found in moderate quantities in the samples studied.

Polyphenols was found in large quantity in both water and petroleum ether extract. Polyphenols are compounds that have a hydroxyl group directly attached to the benzene ring. They are structurally similar to alcohol but are much stronger acids. Polyphenols helps in contracting the blood capillaries and prevent certain hemorrhages (Solomon and Crag, 1998).

CONCLUSION

From this research Cola lepidota endocarp contains high amount of fibre, moderate levels of moisture, fat and protein. While the exocarp contains high amount of carbohydrate, moderate levels of moisture, ash, fibre and very low levels of protein.

The toxicants composition analysis revealed low levels of toxicants in both samples studied.

The mineral elements composition showed increased levels in potassium, iron, zinc and calcium. This mineral element are needed by the body for proper functioning.

The phytochemical screening results showed the presence of cardiac glycosides, saponins, flavonoids, polyphenols and reducing sugars in both extracts. These bioactive compounds found in the extract of Cola lepidota are used for therapeutic purposes.

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