



Chemical Composition of the Mesocarp of *Garcinia kola Heckel* (*Clusiaceae*) Fruit

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Abstract

The chemical composition of *Garcinia kola Heckel* (*Clusiaceae*) mesocarp was determined. The results of proximate analysis have showed that the mesocarp of *Garcinia kola Heckel* contained seven (7) chemical families: flavonoids, tannins, alkaloids, anthraquinones, saponosids, terpenoids, steroids and reducing compounds. The average value of total phenols, flavonoids, anthocyanins in the mesocarp at the last stage of maturity was: 68.33 ± 0.85 ; 14.67 ± 1.04 ; 2.92 ± 0.34 mg/l, respectively. The average percent in water content, crude proteins, carbohydrates and total lipids was: 84.40 ± 1.27 ; 5.20 ± 0.03 ; 27.77 ± 0.59 ; and 18.70 ± 0.85 %, respectively. The mean value of ascorbic acid and total acidity was 29.26 ± 0.99 mg and 64.48 ± 1.89 méq.g H_2SO_4 /l. The physical and mineral element composition were: pH 2.91 ± 0.02 ; E.C $1855.33 \pm 55.41 \mu S/cm$, T.D.S 1006.33 ± 5.86 mg/l and Ca 4.30 ± 0.14 ; Mg 2.40 ± 0.14 ; Na 0.26 ± 0.09 ; K 31.04 ± 1.53 ; P 59.32 ± 1.83 ; Fe 126.53 ± 15.05 ; N 19.54 ± 0.17 ; Zn 8.79 ± 0.30 ; Cu 0.93 ± 0.05 ; Mn 4.38 ± 0.17 mg/100g. The ash content was 7.970 ± 0.099 % ($450^\circ C$), respectively.

Keywords: *Garcinia kola Heckel*, mesocarp, chemical families, nutrients.

Introduction

The preventive and curative capacities of foods depend on their organoleptic quality which is related to the chemical composition and mineral elements. Thus, chemical families and the mineral elements found in fruits play an important role in maintaining the organism and this improve its response capabilities against diseases¹.

In Congo, 60% of total surface are occupied by the forest², several species of trees and shrubs produce fruits very snuffed by the rural population and are solded at the markets, thanks to their succulent taste and to certain medicinal virtues. The fruits of *Garcinia kola Heckel* of *Clusiaceae* family^{3,4} belong to the range of the most consumed fruits and whose seeds, barks and sheets are used in traditional medicine in Congo for the treatment of several affections⁵.

Previous studies have demonstrated the medicinal and chemical properties of different parts (leaves, roots, bark, seeds and pericarp) of this species^{6,7}. No investigation in traditional pharmacopeia and human consumption was still described on the mesocarp of this fruit, in spite of its intense consumption. *Garcinia kola Heckel* fruit presents opportunities for food and medicinal use. The aim of this study was to determine the chemical composition of *Garcinia kola Heckel* mesocarp.

Material and Methods

The matter constituting this study was composed by mesocarp of *Garcinia kola Heckel* collected at Boya in the district of Makoua, north Congo Brazzaville, around 670 km from Brazzaville, between - 4000 and 18000 UTM north latitude and 1242000-1258000 UTM east longitude (figure 1).

The matter was collected between February and September 2011 following different stages of growing and maturation. Six (6) stages were determinates and every stage was composed by five fruits (table 1). The analysis of the mesocarp takes in account the following characteristics.

Water content: 50 g of fresh mesocarp in stage 6 were heated at $60^\circ C$ in an oven dry during 2 days. After that, the sample was weighted again. The water percent was calculated following the relation:

$$\% W = \left[\frac{W_f - W_d}{W_f} \right] \times 100 \quad (1)$$

With, W_f : weight of fresh mesocarp (g), W_d : weight of dry mesocarp (g).

Chemical screening: The chemical screening of *Garcinia kola Heckel* mesocarp was determined according to some methods^{8,9} with all stages of growing and maturity. Phenols level were determined using Folin-Ciocalteu reactive, flavonoids by adapted method¹⁰ and anthocyanins using the method based on discoloration by sulphuric acid and bisulfite¹¹.

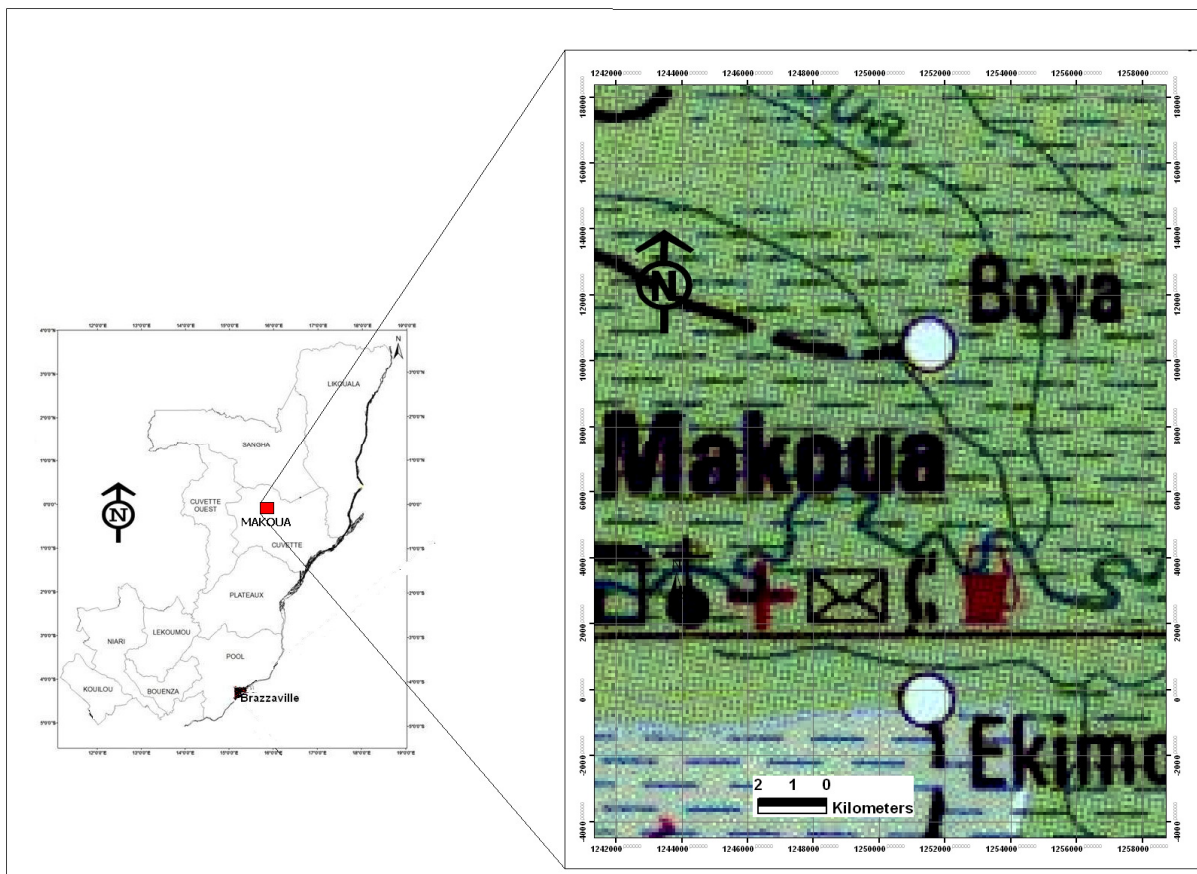


Figure-1
 Localization of the study area

Table-1
 Growing and maturation stage of Garcinia Kola fruit

Number of stage	Stage
1	Flowering
2	Cores formation
3	Cellular elongation
4	Physiological maturity
5	Gustatory maturity
6	Merchandising

Physical characteristics: Hydrogen ion concentration (pH), electrical conductivity (EC) and total dissolved solids (TDS) were measured using portable Consort C 933 multi-parameters.

Free acidity: Free acidity was determined by titration¹² of 10ml fresh juice from fruit mesocarp at stage 6, the following relation:

$$\text{Total acidity} = 0.49 \times V \quad (2)$$

With, V: volume of added NaOH

Nutrients: The level of ascorbic acid was determined by titration (iodometry)¹³. Total protein has been determined after

the mineralization of organic matter by concentrated sulfuric acid¹⁴. The percent nitrogen and the content of proteins (%) were calculated by the following relations, respectively:

$$\% N = \frac{[V(H_2SO_4) \times 0.07]}{\text{sample weight}} \quad (3)$$

$$\% \text{ protein} = \% N \times 6.25 \quad (4)$$

Carbohydrates content was determined by spectrophotometry¹⁵ and the percent of total lipids content¹⁶ is given by the following relation:

$$\% \text{ lipids} = \left[\frac{(W_1 - W_0)}{100} \right] \times 100 \quad (5)$$

With, W₀: weight of empty beaker, W₁: Weight of the beaker contains the lipid fraction.

Mineral elements: Calcium (Ca), magnesium (Mg), potassium (K) and sodium (Na) were determined using atomic absorption spectrophotometer (AAS-Buck 205 model). Phosphorus (P) and iron (Fe) contents using calorimetric method. The metal contents of Zn, Mn and Cu were determinates by ICP-OES at the SGS Environmental Laboratory (Congo-Brazzaville).The

ash content was also determinate¹⁷. All determinations were done in triplicate and statistical analyses have been performed using Statistica 7.1.

Results and Discussion

The results of table 2 show seven (7) chemical families: alkaloids, flavonoids, anthraquinones, reducing compounds, tannins, terpenes/steroids and saponins with a strong presence of terpenes and steroids followed by the flavonoids. The alkaloids are abundant in stages 3 and 6; saponins in stages 5 and 6; reducing compounds and tannins in stages 4 and 6. Anthocyanins and quinones were not revealed by this method.

However, the same extract with the method based on discoloration of the sulfurous acid and bisulfite, revealed the presence of the anthocyanins. This is certainly justified by the fact that the mesocarp of *Garcinia kola* fruit is very acidic. The average values of pH, ascorbic acid and the total acidity were 2.91 ± 0.02 ; 29.26 ± 0.99 mg/l and 64.16 ± 0.93 meq.g H_2SO_4/l , respectively (table 3). In alkaline medium (NaOH or NH_4OH), the change of color was observed which highlights the presence of the anthocyanins in the juice.

The chromatogram in figure 2 shows at 365 nm, the presence of the fluorescent spots in all the six (6) stages at different frontal ratio (Rf): blue (Rf 0.34 and 0.74), yellow orange (Rf 0.75), yellow (Rf 0.81), yellow green (Rf 0.95) as shown in table 5. The presence of these fluorescent spots are characteristic of phenols (flavonoids and acidic phenols)^{18,19}. The presence of the flavonoids on this chromatogram is in agreement with the results of the phytochemical sifting by coloured reactions. Other authors isolated in these species the flavonoids such as: garcinia biflavonoids GB1 and GB2, kola flavonon, flavon, xanthone and showed that these compounds present anti-inflammatory drug effects, antimicrobial and anti-hepatotoxic activities^{20,21,22}.

The chromatogram in figure 3 shows the presence of the tasks: blue (Rf 0.05 and 0.19); purple (Rf 0.34 and 0.41); green (Rf 0.62 and 0.83); brown (Rf 0.69) as shown in table 6.

These colors were also observed in all the stages of maturation of the fruit. The presence of these spots could be allotted to the terpenoids^{18, 19}. These results are in agreement with those of the phytochemical sifting carried out by coloured reactions.

Quantitative proportioning at the stage of maturity (stage 6) showed that the mesocarp contains 68.33 ± 0.85 mg of total phenols; 14.67 ± 1.04 mg of flavonoids and 2.92 ± 0.34 mg of anthocyanins. Our results are in agreement with other studies^{23,24} which highlighted the flavonoids and the tannins in the barks and the roots of the same species. Other authors have revealed the presence of the saponins, tannins and anthraquinones in the sheets and the seeds²⁵; alkaloids, tannins and reducing carbohydrates in the barks of stem²⁶. These results are in agreement with those of the literature and the mesocarp appears to be the only part of the plant richer in chemical compounds. The water content of the mesocarp was 84.40 ± 1.27 % (table 3), which attests the juicy state of the fruits of *Garcinia kola* Heckel. The same content was obtained with *Opuntia ficus indica* (84.5%)²⁷. The content of lipids was 18.70 ± 0.85 %. This value is higher than that found in the fresh mesocarp of the same fruit in Nigeria (6.9 to 8.7%)²⁸. The state of the matter used could justify this difference. These results confirm the presence of the lipids in the mesocarp of the fruit of *Garcinia kola* of Congo. This fruit seems to be enough sweetened and the soluble sugar content was 27.77 ± 0.59 %, which is higher than the one obtained in other studies²⁹.

The mineral fraction represents approximately 25.73% of weight in 100g of the mesocarp. The conductivity value (E.C) of 1855.33 ± 55.41 $\mu S/cm$ and the total dissolved solids (T.D.S) 1006.33 ± 5.86 mg/l confirm that this fruit is rich in biogenic salts. Iron is the most represented with an average of 126.35 ± 15.05 mg/100g followed by phosphorus 59.32 ± 1.83 mg/100g, potassium 31.04 ± 1.53 mg/100g and nitrogen 19.54 ± 0.17 %. The average content of Zn, Cu, Ca, Mg, and Na was: 8.79 ± 0.30 , 0.93 ± 0.05 , 4.30 ± 0.14 , 2.40 ± 0.14 , 0.26 ± 0.09 mg/100g, respectively. These results show that the mesocarp of this fruit is rich in biogenic salts. The presence of these elements with high contents was already found in other studies³⁰.

Table-2
Chemical screening at different stages

Chemical Family	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Alkaloids	+	+	++	++	++	++
Anthocyanins	-	-	-	-	-	-
Quinones	-	-	-	-	-	-
Anthraquinones	++	+	+	+	+	+
Flavonoids	++	++	++	++	+++	+++
Saponosids	-	++	+	++	+++	+++
Tannins	-	+	++	++	++	++
Terpenes/steroids	+++	+++	+++	+++	+++	+++
Reducing compounds	+	+	++	+++	+++	+++

+++ = Very abundant, ++ = abundant, + = traces, - = absent

Table-3
Chemical compound content in 100 g of mesocarp

Parameters	Mean	Min	Max	S.D
Total phenols (mg)	68.33	67.50	69.20	0.85
Flavonoids (mg)	14.67	13.50	15.50	1.04
Anthocyanins (mg)	2.92	2.72	3.31	0.34
Ascorbic acid (mg)	29.26	28.17	30.10	0.99
Water (%)	84.40	82.65	85.96	1.27
Carbohydrates (%)	27.77	27.10	28.20	0.59
Lipids (%)	19.53	18.70	20.40	0.85
Proteins (%)	5.17	5.14	5.20	0.03

Table-4
Physical parameters and nutrient content in 100g of mesocarp

Parameters	Mean	Min	Max	S.D
pH	2.91	2.89	2.94	0.02
Acidity (meq.H ₂ SO ₄ /l)	64.48	63.11	66.64	1.89
E.C (µS/cm)	1855.33	1793.00	1889.00	55.41
T.D.S (mg/l)	1006.33	1002.00	1013.00	5.86
Ca (mg/100g)	4.30	4.20	4.50	0.14
Mg (mg/100g)	2.40	2.20	2.60	0.14
Na (mg/100g)	0.26	0.20	0.40	0.09
K (mg/100g)	31.04	29.00	33.00	1.53
P (mg/100g)	59.32	57.60	61.80	1.83
Fe (mg/100g)	126.35	99.60	135.50	15.05
Cu (mg/100g)	0.93	0.88	1.00	0.05
Zn (mg/100g)	8.79	8.33	9.10	0.30
Mn (mg/100g)	4.38	4.17	4.60	0.17
N (%)	19.54	19.40	19.80	0.17
Ash (%)	7.90	7.79	7.97	0.09

Table-5
Frontal ratio of hydroethanolic extract of *Garcinia kola* Heckel mesocarp

Spot (colour)	Frontal ratio (Rf)	Possible compounds
Blue	0.34 -0.74	Flavonoids phenol acid
Yellow orange	0.75	Flavonoids phenol acid
Yellow	0.81	Flavonoids phenol acid
Yellow green	0.95	Flavonoids phenol acid

Table-6
Frontal ratio of chloroform extract of *Garcinia kola* Heckel mesocarp

Spot (colour)	Frontal ratio (Rf)	Possible compound
Blue	0.05- 0.19	Terpenoids steroids
Purple	0.34- 0.41	Terpenoids steroids
Green	0.62- 0.83	Terpenoids steroids
Brown	0.69	Terpenoids steroids

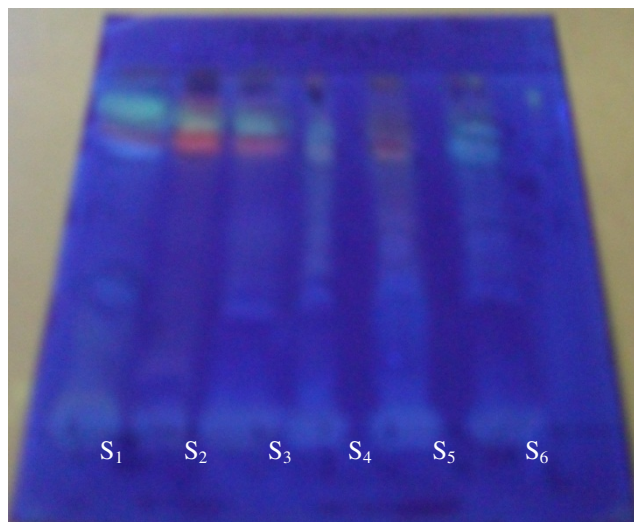


Figure-2

C.C.M hydroethanolic extract of *Garcinia kola Heckel* Mesocarp

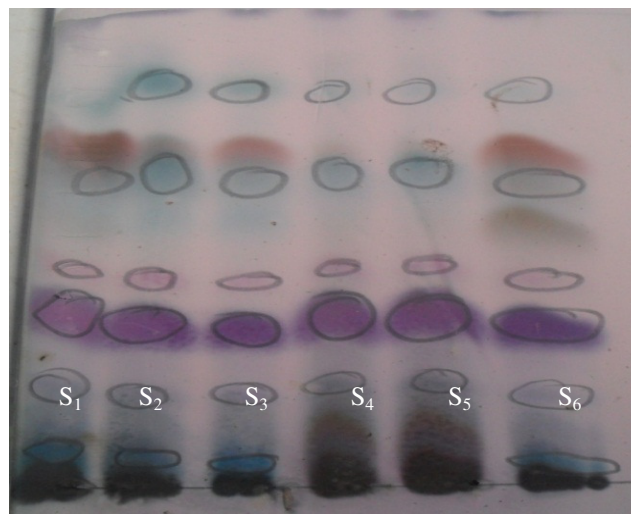


Figure-3

C.C.M chloroform extract of *Garcinia kola Heckel* Mesocarp

Conclusion

This study initiated to characterize the physicochemical parameters of *Garcinia kola Heckel* showed that it contains several chemical compounds as antioxidant and the mineral elements in appreciable quantities. The composition of the fruit shows that it is a good food providing a nutritional of biogenic salts and could also play a role in the prevention and the treatment of certain pathologies with the presence of zinc, magnesium and copper.

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