

Spectroscopic analysis of phytochemical compounds in *Garcinia kola* leaf extract

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ABSTRACT

Garcinia kola leaves were collected, washed, dried and powdered. The ethanol extracts were first prepared by the simple method of cold extraction. The extracts were then characterized by the Phytochemical analysis, Fourier transform infrared spectroscopy (FTIR), and Gas chromatography mass spectroscopy (GC-MS) to identify the fatty acids and heterocyclic compounds present in the leaf extracts. The FTIR analysis shows a variation of the peaks that indicate there is a synergy among the functional groups of the extract. Moreover, the phytochemical analysis revealed the presence of alkaloids, flavonoids, phenol, saponins, tannins, and steroids. The study reveals that the chemical constituents of *Garcinia kola* leaf may be behind their medicinal values in phytomedicine.

Keywords: FTIR Analysis, *Garcinia kola* leaf, GC-MS, Phytochemical Analysis

1. INTRODUCTION

Considerable attention has been focused on dietary and medicinal phytochemicals that inhibit reverse or retard disease caused by oxidative and inflammatory processes. Medicinal plants are the sources of many important drugs of the modern world. Studies have shown that plants are embodiments of important chemicals which are bioactive in nature and are very essential to the health. Among such groups of chemicals are carotenoids, amino acid, mineral phytoestrogens, vitamins, and dietary fibre [1, 2]. It has been noted by other researchers that plant derives their medicinal property from these phytochemical compounds.

Garcina kola is a perennial herb belonging to *Asteraceae* family. Extracts of the plants have been used in various folk medicine as bacterial infections drugs [3], the leaf and seed played an important role in African ethno-medicine and traditional hospitality. It is used locally to treat illness like cold, bronchitis, and viral infections. A number of phytochemicals have been isolated from the leaf and seed, with the most prominent of them - *Garcinabio-flavonoids* mixture called *kolaviron*.

Garcina kola is highly valued because of its medicinal use as the bark, root, leaf, and seed, serving as the raw material with pharmaceutical properties [4]. *Garcina kola* is popular in south-eastern Nigeria as it is extensively used in herbal medicine [5].

2. EXPERIMENTAL

2. 1. Materials and Methods

Fresh leaves of *Garcina kola* were collected from Uli in Anambra State of Nigeria. The leaves were sun-dried for four days and then ground into powder form to increase its surface area. During the extraction process, 30 grams of *Garcina kola* leaf powder were measured and soaked in 1000 ml of ethanol for 48 hours. The mixture was filtered. The filtrate obtained is a mixture of the plant extract and the ethanol. Distillation process was applied to separate the solvent from the extract by evaporating to dryness. The stock solution of the extract was weighed and stored under refrigeration for further study.

2. 2. Phytochemical Analysis

Quantitative analysis for the presence of saponins, tannins, flavonoids, cyanogenic glycosides, alkaloids, phenols, and steroids were carried out using the methods presented in [6].

2. 3. FTIR Analysis of *Garcina kola* Leaf Extract

After the extraction process, the extract was collected with sample bottles which comprised the pure extract with little quantity of ethanol. Fourier transform infrared spectrophotometer (SHIMADZU Model IR affinity-1, S/N A213747013651) was used to identify functional groups of the pure extract of *Garcina kola* leaf. Variations of the FTIR peak numbers were analyzed so as to identify appropriate functional groups in the extract .

2. 4. GC- MS Analysis of *Garcina Kola* Leaf Extract

GC-MS analysis was carried out on a Mass Spectrophotometer Model No QP2010 Plus Shimadzu, Japan. The carrier gas used was Helium at a flow rate of 0.5 ml/min. 1- μ l sample injection volume was utilized. The inlet temperature was maintained as 250 °C. The oven temperature was programmed initially at 80 °C for 4 min, then it increased to 240 °C. And then it was programmed to increase to 280 °C at a rate of 20 °C ending with 5 min. Total run time was 90 min. The MS transfer line was maintained at a temperature of 200 °C. The source temperature was maintained at 180 °C. The peaks in the chromatogram were integrated and were compared with the database of spectrum stored in the GC-MS library. The analysis was carried out at National Research Centre for Chemical Technology, Zaria, Nigeria.

3. RESULT AND DISCUSSION

Table 1. Phytochemical constituents of *Garcinia kola* Leaf.

Constituents	Qualitative Analysis	Quantitative Analysis
Alkaloids	+++	1666
Cardiac Glycosides	+	223
Flavonoids	+	965
Phenolics	+++	69
Saponins	+	96
Steroids	++	768
Tannins	++	1258

+++ = highly concentrated, ++ = concentrated, + = in trace; - absent or too little to identified qualitatively

Phytochemicals are essential chemicals found virtually in plants and their different parts and at a different concentration. **Table 1** above shows the presence of alkaloids in good quantity, alkaloids and their derivatives are used as medicinal agents for their analgesic and bactericidal effects [7]. Cardiac glycosides are important due to their hydrogen cyanic acid poison in the body [6]. Flavonoids are very important, they are called the free radical scavengers. They prevent oxidative cell damage, protect against all levels of carcinogenesis with anticancer activity [8]. They reduce the rate of heart disease and are distributed groups of phenolic compounds. Flavonoids in leaves are high and could be behind anti-inflammatory, with anticancer property of the plant which is in agreement with previous literature [9-12]. Saponins are known for the formation of foam in aqueous solution, with cholesterol binding properties and haemolytic activity [13]. Steroids are regarded as antioxidants *in vitro* and have link with reproduction in human [14]. Tannins were noted for astringency and bitter taste, fasten healing of wounds and inflame muscus membrane [15].

Fourier transform infrared spectrophotometer (SHIMADZU, Model: IR affinity-1; S/N A 2137470136 SI) was used to characterize the plant extract (**Figure 1**). The analysis on the extract shows the variation of the peaks which was used for the determination of the functional groups of the extracts. The wave bands 3601.14 cm^{-1} and 3547.1 cm^{-1} are for sharp free hydroxyl bonds from alcohols and phenols. Wave numbers 3450.6 cm^{-1} , 3384.98 cm^{-1} , 3234.0 cm^{-1} are for medium primary and secondary amines. 3168.82 cm^{-1} , 3045.3 cm^{-1} , 2960.38 cm^{-1} wave bands are for very broad hydroxyl bonds from acids or carboxylic.

The wave band 1593.94 cm^{-1} is confirming the N-H bond from amines or amides. The wave bands 2856.16 cm^{-1} and 2732.64 cm^{-1} are from medium or strong C-H stretching mode of alkyl groups and aldehydes, respectively.

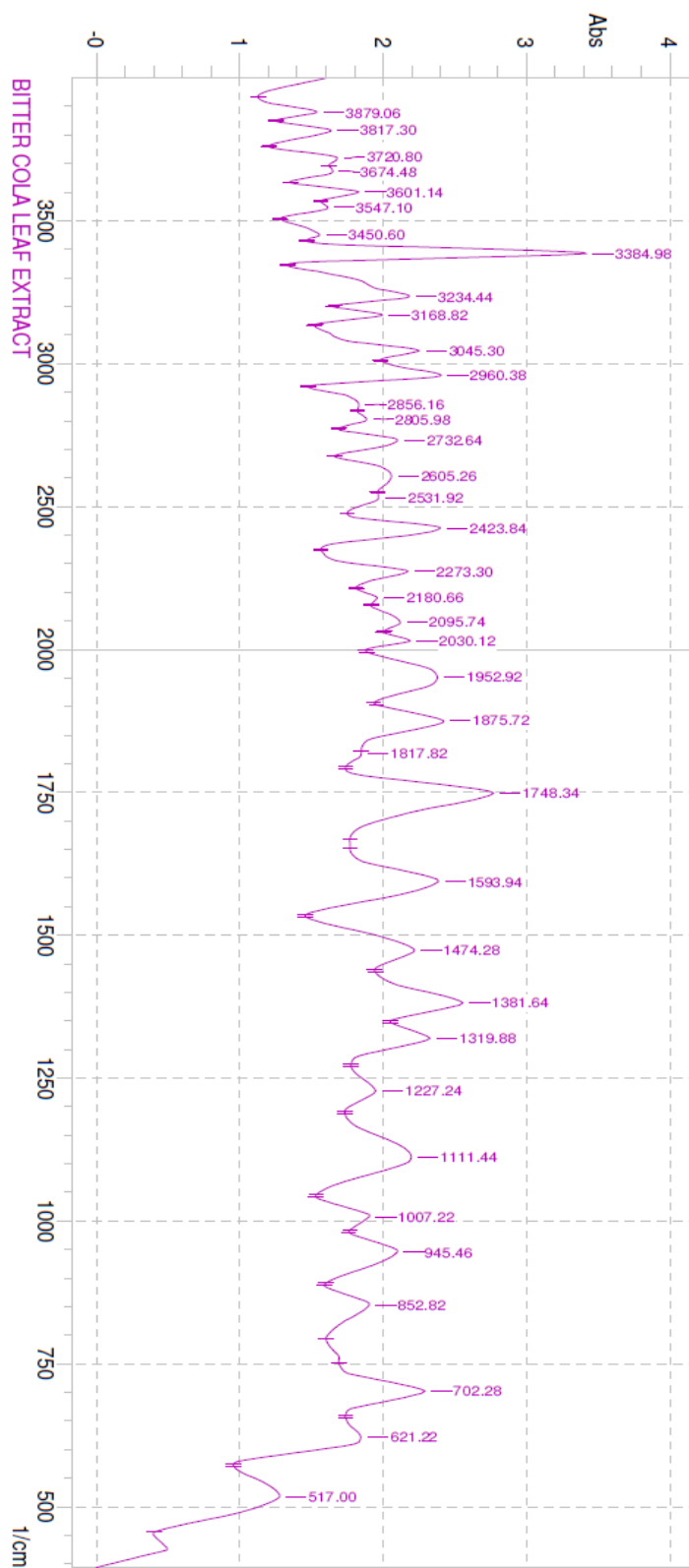


Figure 1. FTIR Analysis of the *Garcinia kola* leaves extract

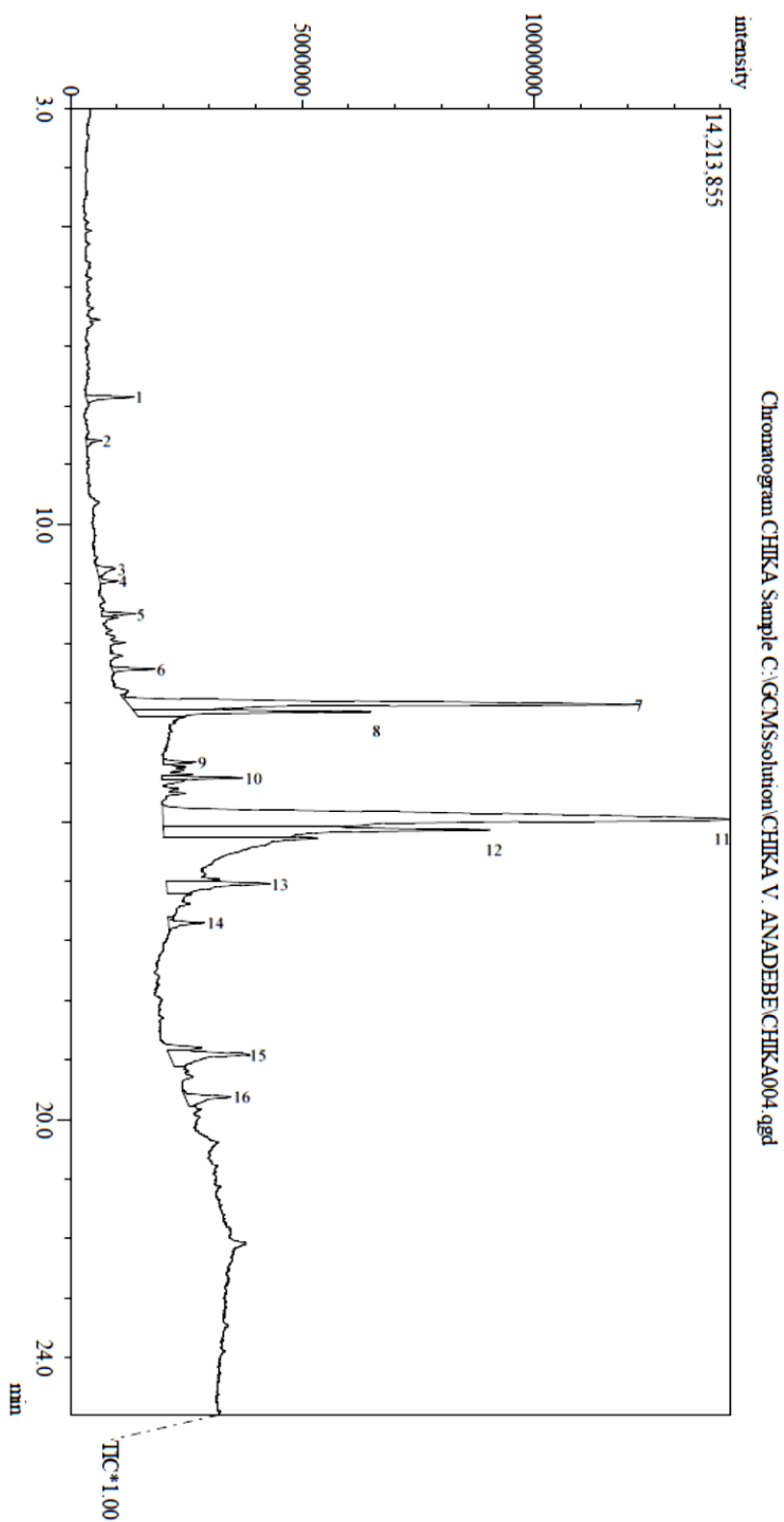


Figure 2. GC-MS Analysis of *Garcinia kola* leaf extract

The wave bands 2180.66 cm^{-1} is for sharp, variable unsaturated alkynes or nitriles while 1474.28 cm^{-1} is for variable stretching mode of unsaturated arenes. The wave bands 1817.82 cm^{-1} and 1227.24 cm^{-1} are for very strong or strong stretching bonds from acids, esters or anhydrides. Wave band 1111.44 cm^{-1} is for strong stretching mode of ethers. From the above discussion, *Garcinia kola* leaf extract contains chemical components, such as alcohols, phenols, aldehydes, esters, ethers, etc., which are primary for essential oils, also having good inhibiting abilities.

Gas Chromatography mass spectroscopy was carried out on the ethanol extract of *Garcinia kola* leaf (**Figure 2**). The peaks in the chromatogram were integrated and were compared with the database spectrum of known components stored in GC-MS library. Phytochemical analysis revealed the presence of different fatty acids and heterocyclic compounds. The analysis of the concentrated ethanol extract resulted with many compounds which have a diverse use. Compounds having anti-inflammatory, antibacterial, antifungal, skin conditioning properties have been identified. The peak 1 shows the presence of Phenol, 3,5-bis(1,1-dimethylethyl), formula: $\text{C}_{14}\text{H}_{22}\text{O}$, mol weight 206; peak 2 shows 1-Hexadecene, formula: $\text{C}_{16}\text{H}_{32}$, mol weight 224; peak 3 indicates the presence of Pentadecanoic acid, formula: $\text{C}_{15}\text{H}_{30}\text{O}_2$, mol weight 242; peak 4 reveals the presence of E-14-Hexadecenal, formula: $\text{C}_{16}\text{H}_{30}\text{O}$, mol weight 238; peak 5 stands for Pentadecanal, formula: $\text{C}_{15}\text{H}_{30}\text{O}$, mol weight 226; peak 6 represents Hexadecanoic acid, formula: $\text{C}_{18}\text{H}_{36}\text{O}_2$, mol weight 284; peak 7 reveals the presence of n-Hexadecanoic acid, formula: $\text{C}_{16}\text{H}_{32}\text{O}_2$, mol weight 256; peak 8 indicates the presence of Hexadecanoic acid, formula: $\text{C}_{18}\text{H}_{36}\text{O}_2$, mol weight 284; peak 9 represents Allyl nonanoate, formula: $\text{C}_{12}\text{H}_{22}\text{O}_2$, mol weight 198; peak 10 represents 16-Octadecenoic acid, formula: $\text{C}_{19}\text{H}_{36}\text{O}_2$, mol weight 296, peak 11 stands for Hexadecenoic acid, formula: $\text{C}_{16}\text{H}_{30}\text{O}_2$, mol weight 254; peak 12 shows the presence of n-Hexadecanoic acid, formula: $\text{C}_{16}\text{H}_{32}\text{O}_2$, mol weight 256; peak 13 represents Trifluoroacetic acid, formula: $\text{C}_{17}\text{H}_{31}\text{F}_3\text{O}_2$, mol weight 324; peak 14 indicates Hexadecanoic acid, formula: $\text{C}_{19}\text{H}_{38}\text{O}_4$, mol weight 330.

4. CONCLUSION

This research explores the goodness of *Garcinia kola* leaf which has a commendable sense of purpose and can be advised as a plant of phytopharmaceutical importance.

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