



Phytochemical and antibacterial activity of some extracts of *Garcinia cola* fruits

Sulaiman A Alsalamah*

Department of Biology, Faculty of Science, Imam Mohammed Ibn Saud Islamic University (IMSIU), Riyadh, Kingdom of Saudi Arabia

Abstract

The goal of the current study was investigation phytochemical and efficiency of the aqueous, ethanol, and ethyl acetate extracts of *Garcinia Cola* fruits for antibacterial effects on the bacteria *E. coli*, *Staphylococcus aureus*, and *Streptococcus mutans*. *Garcinia Cola* fruit was purchased in a market in Macao City in 2022. Preliminary phytochemical screening of the aqueous extracts of *Garcinia kola* was done to identify the chemical components. Aqueous ethanol, and ethyl acetate extracts were prepared in and used in a pure culture of *E. coli*, *Staphylococcus aureus*, and *Streptococcus mutans*. Paper Standard Disc Diffusion Assay was used to test the antibacterial activity of aqueous ethanol, and ethyl acetate extracts. Phytochemical analysis of the aqueous, *Garcinia kola* found that the presence of high alkaloids, saponins, flavonoids, tannins, and low cardiac glycosides, cardenolides, steroidal ring, and phlorotannins, Sugar, phlobatanins. The efficacy of water, ethanol, and ethyl acetate extracts of *Garcinia Cola* fruits against *E. coli*, *Staphylococcus aureus*, and *Streptococcus mutans* was compared, ethanol demonstrated a high inhibition zone in all tested organisms at both concentrations of 250 l/mg and 500 l/mg, followed by ethyl acetate, and finally water extract. The results of this investigation showed that *Garcinia Cola* fruit was potent against test organism.

Keywords: phytochemical, antibacterial activity, extracts *Garcinia cola*, fruits

Introduction

Garcinia kola, often known as bitter kola, is primarily found in the tropical rain forest regions of Central and Western Africa. Because of its antiviral, anti-inflammatory, anti-diabetic, bronchio-dilator, and anti-hepatotoxic properties, *garcinia kola*, also known as bitter cola, is widely used for medical purposes [1, 2, 3]. It is considered that western tropical Africa is the tree's native habitat. *Garcinia Cola* is a member of the *Sterculiaceae* *cocoa* family, which produces nuts. Fruit with a capsule shape, the cola nut has fleshy, unusually shaped seeds inside [4]. Cola seeds are initially pink, crimson, or white before turning brown and becoming tough. Indigenous people from Western and sub-Saharan Africa have a widespread habit of chewing raw coca nuts.

The fundamental social and economic value of Coca-Cola comes from the fact that drink contains a high concentration of the CNS stimulant caffeine, which may be useful in treating migraines. It is now understood that *garcinia kola* contains a significant amount of bioflavonoid chemicals [5]. *In vitro* research was done on the antimicrobial properties of *Garcinia kola* seed extracts. Water, 70% ethanol, and petroleum ether were used in turn to extract the seeds. The ethyl acetate fraction of the ethanolic extracts, which was obtained with a weight-to-weight yield of 2.4 percent, was shown to have the highest antibacterial activity. *G. kola* seeds were extracted with petroleum ether, ethanol, milky layer, and ethyl acetate, and it was shown that these solvents have antibacterial effects [6]. The emergence of multidrug-resistant bacteria has increased the demand for anti-pathogenic and anti-infective bacterial infection strategies. Natural products offer an alternative treatment for developing bacterial infections that does not outcome in resistance to antibiotics [7]. The current study's objective was to investigate phytochemical and efficiency of the aqueous, ethanol, and ethyl acetate extracts of *Garcinia Cola* fruits for antibacterial effects on the bacteria *E. coli*, *Staphylococcus aureus*, and *Streptococcus mutans*.

Metrials and Methods

Collection and preparation of the fruit extracts

Garcinia Cola fruits were collected from a market in Macca City) in 2022. The fruits were taken to the biology laboratory of the Imam Mohammed Ibn Saud Islamic University in Riyadh, Saudi Arabia, where they are now being studied. They were then cleaned with sterile distilled water before being air dried on a bench to prevent any adverse reactions from direct sunlight. Using a commercial spice grinder, the fruits were ground into a powder and stored in brown bottles until used.

A conical flask was filled with 10 grams (10 g), a powdered apples of Equal fruit's original weight (IW). The flasks were then filled with 100 ml of distill water and shaken by a mechanical shaker for 24 hours at room temperature (27 3 °C) (160 rpm). A measuring cylinder was used to calculate the final volume (FV) of the water extract for the fruits.

The solvents ethanol and ethyl acetate were used to prepare the plant extracts. 10g of each sample was homogenized in 100ml of the respective solvents. The crude preparation was shaken at room temperature overnight before being centrifuged at 4000rpm for 20 minutes. The plant extract-containing supernatant was transferred to a beaker, and the extract was concentrated by evaporating the solvent at 60°C. The crude extract was weighed and dissolved in a known volume of distal water, yielding final concentrations of 250 and 500ul/mg.

Phytochemical screening of the extract

The fruit of *Garcinia kola* was subjected to preliminary phytochemical screening to identify the chemical constituents. The method described by AOAC (1990) [8] was used for screening alkaloids, saponins, tannin, sugar, phlorotannins, flavonoids, glycosides, steroids, and terpenoids.

Antimicrobial activity assay

Test microorganisms

Pure culture of *Streptococcus mutans*, *Staphylococcus aureus* and *E.coli* were obtained from the Microbiology laboratory, Department of Biology, Faculty of Science, Imam Mohammed Ibn Saud Islamic University, Riyadh, kingdom of Saudi Arabia.

Paper Disk Diffusion Assay

The Muller Hinton Agar (MHA) medium was smeared with the test microorganisms. According to Abdel Moneimet *et al.* (2017) [9], after the agar plates are inoculated with the examined microorganisms and 250 and 500ul/mg of plant extracts, the obtained plant extracts were impregnated on the filter paper discs (5 mm in diameter). The plates are then incubated at 37°C for the subsequent 24 hours. After incubation, the diameter of the zone of inhibition, measured in millimeters, was used to determine the size of the growth inhibition zone [10].

Statistical Analysis

Data were subjected to a descriptive analysis was done using Microsoft excel 2019.

Result

Phytochemical analysis

Phytochemical analysis of the fruit of *Garcinia kola* found that the presence of high alkaloids, saponins, flavonoids, tannins, and low cardiac glycosides, cardenolides, steroidal ring, and phlorotannins, Sugar, phlobatanins Show table 1.

Table 1: Phytochemical screening of aqueous extracts *Garcinia kola*

Phytochemicals	<i>Garcinia kola</i>
Alkaloids	++
Cardiac glycosides	+
Deoxy sugar	+
Flavonoids	+++
Phlobatanins	+
Saponins	++
Steroidal ring	+
Tannins	++

+: present, -: absent

The results obtained demonstrates the antibacterial efficacy of *Garcinia Cola* fruit extracts against *E. coli*, *Staphylococcus aureus*, and *Streptococcus mutans*. Figure 1 displays visually the outcomes of the aqueous extract of *Garcinia Cola's* antibacterial efficacy against several tested microorganisms growth was suppressed by every microbe that was examined. *E. coli* was [9 mm] then came *Streptococcus aureus* [7.8 mm] and *Staphylococcus mutans* [5.2 mm] at concentration 250 µl/mg. hence, at concentration 500 µl/mg recorded *E. coli* was [25.4 mm] then came *Streptococcus aureus* [18.31 mm] and *Staphylococcus mutans* [15.3 mm]. While ethanol extract figure 2 was *E. coli* [17 mm], *Streptococcus aureus* [18 mm] and *Staphylococcus mutans* [12 mm] in concentration 250 µl/mg. however, at concentration 500 µl/mg recorded *E. coli* was [31mm], *Streptococcus aureus* [23 mm] and *Staphylococcus mutans* [19 mm]. Finally, ethyl acetate extract figure 3 was *E. coli* [15 mm] then *Streptococcus aureus* [11 mm] and *Staphylococcus mutans* [9 mm] at concentration 250 µl/mg. Moreover, at concentration 500 µl/mg recorded *E. coli* was [27mm], *Streptococcus aureus* [21 mm] and *Staphylococcus mutans* [16 mm]. When the efficacy of water, ethanol, and ethyl acetate extracts of *Garcinia Cola* fruits against *E. coli*, *Staphylococcus aureus*, and *Streptococcus mutans* was compared, ethanol demonstrated a high inhibition zone in all tested organisms at both concentrations of 250 l/mg and 500 l/mg, followed by ethyl acetate, and finally by water extract show figure 4.

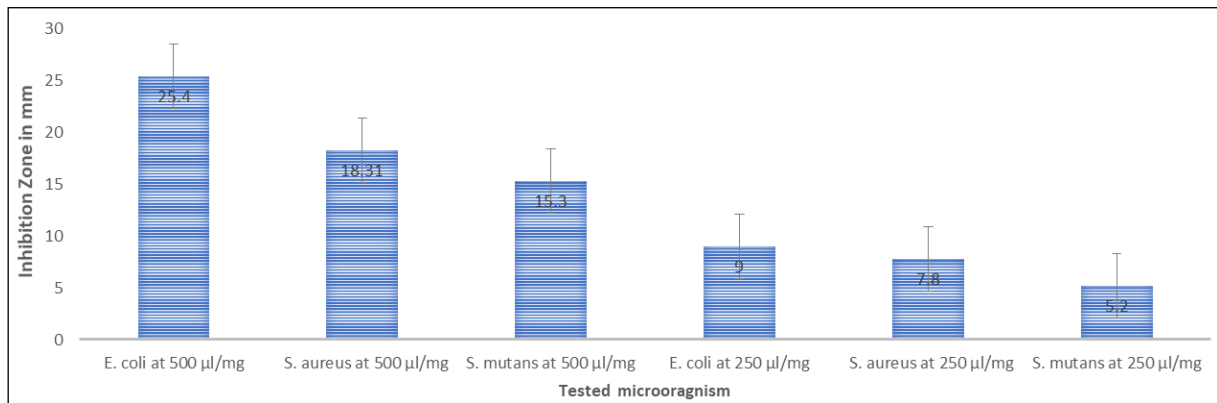


Fig 1: Antibacterial activity of water extract of *Garcinia Cola* fruits against *E. coli*, *Staphylococcus aureus*, and *Streptococcus mutans*

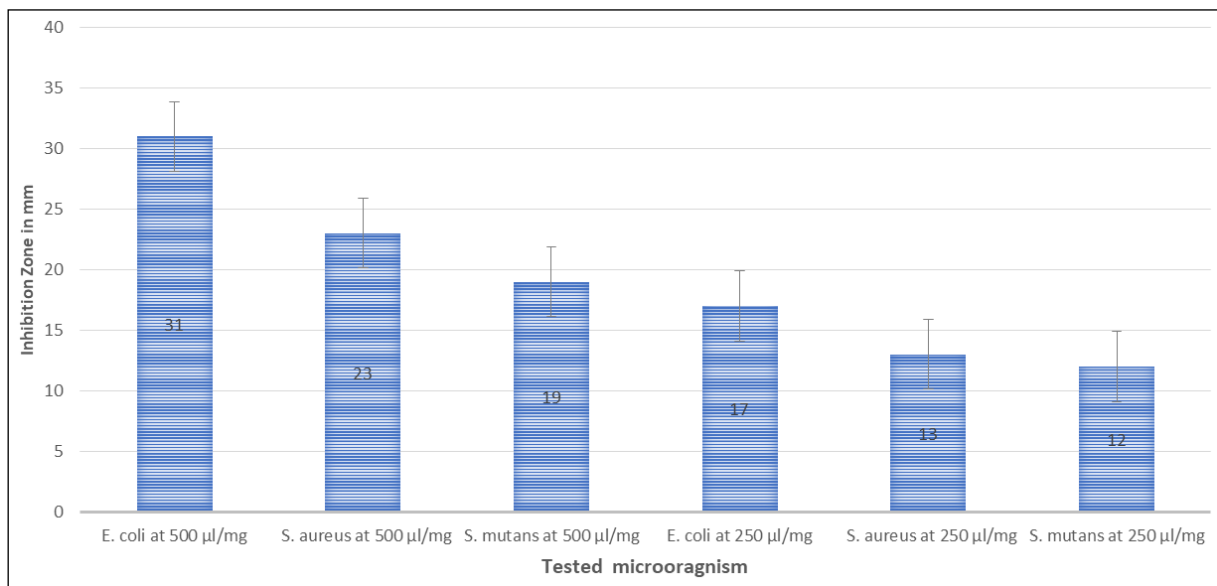


Fig 2: Antibacterial activity of Ethanol ethyl acetate extract of *Garcinia Cola* fruits against *E. coli*, *Staphylococcus aureus*, and *Streptococcus mutans*

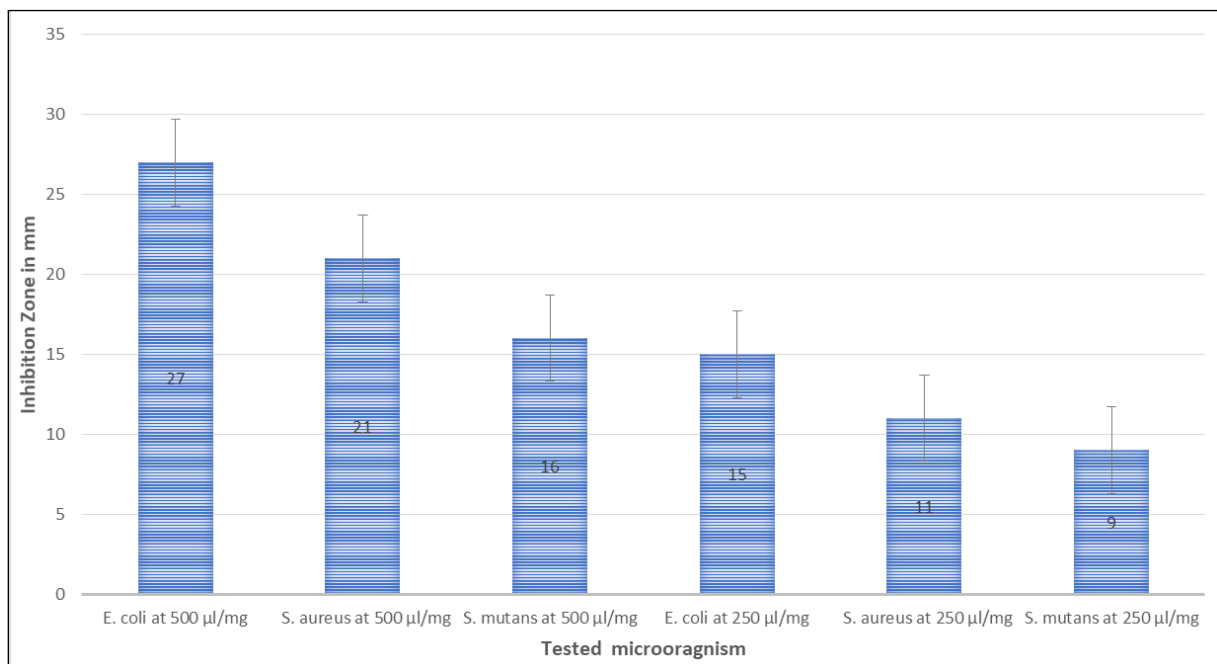


Fig 3: Antibacterial activity of ethyl acetate extract of *Garcinia Cola* fruits against *E. coli*, *Staphylococcus aureus*, and *Streptococcus mutans*

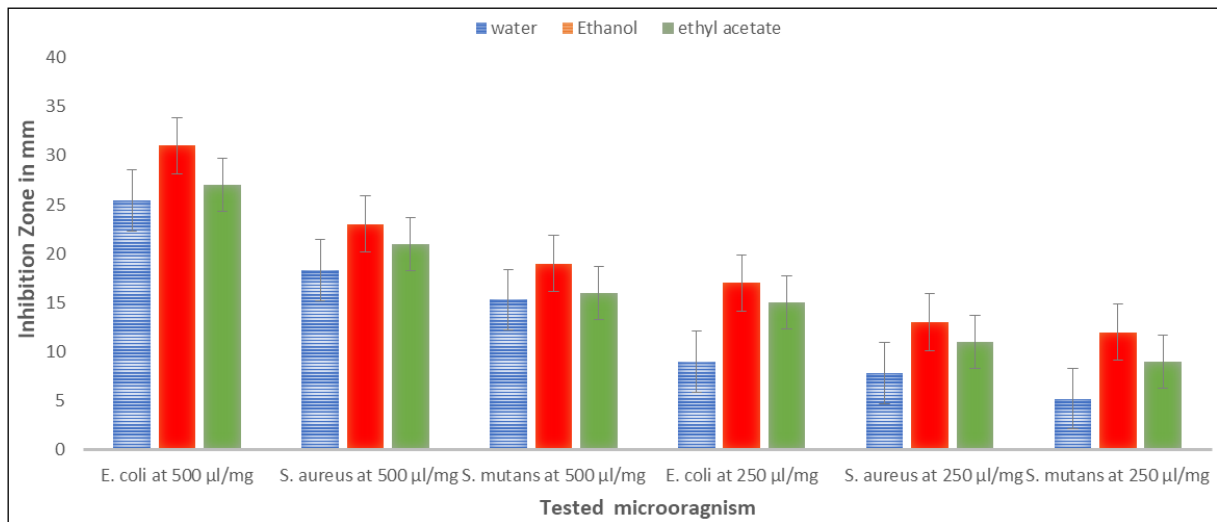


Fig 4: Comparison efficiency of water, Ethanol and ethyl acetate extracts of *Garcinia Cola* fruits against *E. coli*, *Staphylococcus aureus*, and *Streptococcus mutans*

Discussion

Natural products offer an alternative treatment option for antibiotic innovation [7]. The result obtained from *Garcinia kola* was similar with result presented by Adesuyi, *et al.* (2012) [11] who found that the flavonoids, phenol, alkaloids, saponin, and tannins used in the phytochemical tests. It is now well recognized that *Garcinia kola* contains significant amounts of biflavonoid chemicals [5]. The phytochemical components of the plant have a major role in the therapeutic value of bitter kola. The plant is known to contain numerous phytochemicals with medicinal use, from its roots to its leaves [5]. Aphrodisiac and hepatoprotective effects have also been linked to *G. kola*. Due to their large antioxidant properties, these flavonoids have been primarily blamed for its amazing bioactivities [12, 13, 14]. In his results of the phytochemical screening demonstrated the presence of phenol, alkaloid, saponin, tannin, and phlobatanins as well as flavonoids. The previous results were consistently with the finding obtained by current study. The antimicrobial properties of *Garcinia kola* seed extracts were studied *in vitro*. The seeds were extracted using water, 70% ethanol, and petroleum ether in that order. The highest antibacterial activity was found in the ethyl acetate fraction of the ethanolic extracts, which had a weight-to-weight yield of 2.4 percent. The seeds of *G. kola* were extracted using petroleum ether, ethanol, milky layer, and ethyl acetate, and it was discovered that these solvents have antibacterial properties [6]. The study investigates the potential antibacterial activity of *Garcinia kola* (Aku-inu) against *Candida albicans*, *Staphylococcus aureus*, and *Escherichia coli*. *Candida albicans* exhibited finding that no response, however in both preparations, *Staphylococcus aureus* indicated wider zones of inhibition than *E. coli*. Zones of inhibition were barely visible at 40% ethanol, and the zones' diameter grew. The *Candida albicans* lacked an inhibitory zone. Zones of least inhibition in 1 ml of aqueous solution for varied weights of *Garcinia kola* nuts/disc [15]. *Garcinia kola*'s antibacterial effects on *Klebsiella pneumoniae*, *Staphylococcus aureus*, and *Salmonella typhi*. The other organisms exhibited sensitivity to the *Cola nitida* alcohol extract, but a greater sensitivity was seen with the plant's hot water extract. Some of the findings offered empirical support for the traditional herbalists' use of the plants to treat microbiological infection [16]. However, the ethanolic and aqueous extracts of the test plants were used in comparison to other test bacterial isolates, the extracts were more efficient against *Staphylococcus aureus*. However, the antibiotic activities were discovered to be depending on concentration. Plant extracts may be used as a therapy option for infection with *Staphylococcus aureus* in the closest future. Additional effort must be done to determine the proactive elements in Coca-Cola preparations of *nitida* and *Garcinia kola* for potential application [13]. The zones of inhibition for the aqueous mixture of both plants (*G. kola* and *C. nitida*) ranged from 20.00 mm to 11.66 mm and exhibited activity against *P. vulgaris*, *E. coli*, *K. pneumoniae*, and *P. aeruginosa*, but not *S. aureus*. This result was consistency to result obtained by current study in *E. coli* and not similar in *S. aureus* [2]. The examination of the antibacterial properties of *Garcinia kola* fractions on clinical isolates of drug-resistant gram-negative bacteria and *Candida* Aqueous *G. kola* fractions inhibited growth more than butanol fractions overall, with chloroform fractions having the least impact. These extracts' antibacterial properties may be helpful in the treatment of *A. baumannii*, which is multidrug resistant. Compared to the other examined fractions, the aqueous fraction had better activity [17]. The previous result was supporting the finding obtained by current study. As efficiently as streptomycin and tetracycline, the various doses of the aqueous extract suppressed the growth of *E. coli* and *P. aeruginosa*, with *P. aeruginosa* appearing to be most responsive to the extract. However, compared to the clearly defined zone of inhibition recorded for the standard test medicines, *Proteus mirabilis* and *Staphylococcus aureus* displayed reduced susceptibility at the lower concentration (25 mg/ml) of the extracts than at the higher concentrations (50 mg/ml and 100 mg/ml) [18]. The previous results were supported our finding obtained in current study.

Conclusion

According to the current research, the fruits of the *Garcinia Cola* plant may contain volatile aromatic substances that affect the microorganism under study. The efficacy of water, ethanol, and ethyl acetate extracts of *Garcinia Cola* fruits against *E. coli*, *Staphylococcus aureus*, and *Streptococcus mutans* was compared, ethanol demonstrated Greater sensitivity against all tested organisms at both concentrations of 250 l/mg and 500 l/mg, followed by ethyl acetate, and finally by water extract. The observed with the plant's extracts, which could be one of the future solutions due to antibiotic-resistant bacteria. In *Garcinia kola* fruit, the presence of high alkaloids, saponins, flavonoids, tannins, and low cardiac glycosides, cardenolides, steroidal ring, and phlorotannins, Sugar, phlobatanins was observed.

Conflict of Interest

The author declared that there is no conflicts of interest in publishing this article.

References

1. Abdulrahman Mahmoud Dogara, Saber Hamad W, Harmand Hama A, Sarwan Bradosty W, Soran Kayfi, Sawsan Al-Rawi S, *et al.* Biological Evaluation of *Garcinia kola* Heckel. *Advances in Pharmacological and Pharmaceutical Sciences*,2022:3837965:15. <https://doi.org/10.1155/2022/3837965>
2. Anyiam IV, Mounmbegna PPE. Free radical scavenging potential and antibacterial activity of *Cola nitida* and *Garcinia kola* extracts against bacterial strains isolated from patients with urinary tract infections. *Ruhuna Journal of Science*,2020:11(2):98-117. DOI: <http://doi.org/10.4038/rjs.v11i2.90>
3. Obi, Adaiph. Gravimetric and Biochemical Effects of Orally Administered Congo Red Dye on Rat Testes. *Journal of Medical Sciences*,2004:4:90-94.
4. Shama Adam IY, IAhmed Yahya AN, Wala Salih MM, Warda S. Abdelgadir. Antimicrobial Activity of the Masticatory *Cola acuminata* Nut (Gooro). *Current Research Journal of Biological Science.*,2011:3(4):357-362.
5. Iwu M. Biflavanones of *Garcinia*: Pharmacological and biological activities. In *Plant Flavonoids in Biology and Medicine*, V. Cody, E Middleton and J.B. Harbone eds. Alan R. Liss, New York, 1986, 485-488.
6. Madubunyi, Asuzu IU. Antimicrobial Activities of the Constituents of *Garcinia Kola* Seeds. *International Journal of Pharmacognosy*,1996:33(3):232-237.
7. Ebu B, Ijebor F, Mustapha H, Yusuf H. An incidence of aflatoxins in some selected vegetable oils commonly sold in Gadan Maiwa open market place of Ningi, Bauchi state, Nigeria. *International Journal of Biotechnology and Microbiology*,2021:3(2):54-55.
8. AOAC. Association of Official Analytical Chemists. *Official Methods of Analysis*. 15th Edition, Washington DC, 1990.
9. Abdel Moneim E. Sulieman Sherif M. Shaarawy Ahmed A. Alghamdi, Vajid N. Veettil,MohanadAbdelgadir and Nasir A. Ibrahim. Evaluation of antimicrobial and synergistic effects of selected medicinal plants of Hail area with antibiotics, Ha'il Region, Saudi Arabia. *Biosci. Biotech. Res. Comm.*,2017:10(1):46-52.
10. Kumar V, Alla SR, Krishnan KS, Ramaswami M. Syndapin is indispensable for synaptic vesicle endocytosis at the *Drosophila* larval neuromuscular junction. *Mol. Cell. Neurosci*,2009:40(2):234-241.
11. Adesuyi Elumm AO, IK Adaramola FB, Nwokocha AGM. Nutritional and Phytochemical Screening of *Garcinia kola*. *Advance Journal of Food Science and Technology*,2012:4(1):9-14.
12. Adaramoye OA, Nwaneri VO, Anyanwu KC, Farombi EO, Emerole GO. Possible anti-atherogenic effect of kolaviron (*Garcinia kolaseed* extract) in hypercholesterolaemic rats. *Clin. Exp. Pharm. Physiol*,2005:32:40-46.
13. Emerole GO, Farombi EO, Adaramoye OA, Adeyemi EO. Comparative study on the antioxidant properties of flavonoids of *Garcinia kola* seeds. *Pak. J. Med. Sci.*,2005:21:331-339.
14. Afolabi BT, Agu GC, Onajobi I. B. PHYTOCHEMICAL SCREENING AND ANTIBACTERIAL ACTIVITY OF GARCINIA KOLA (HACKEL) AND COLA NITIDA (VENT) EXTRACTS. *Nigerian Journal of Technology (NIJOTECH)*,2020:39(2):379-385. DOI: 10.4314/njt.v39i2.8
15. Amalu Paul C, Chukwuezi Fabian O, Ugwu Okechukwu PC. Antimicrobial Effects of Bitter Kola (*Garcinia Kola*) Nut on *Staphylococcus Aureus*, *Escherichia Coli* and *Candida Alibicans*. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*,2014:13(4):5:29-32.
16. Indabawa, Arzai AH. Antibacterial Activity of *Garcinia kola* and *Cola nitida* Seed Extracts. *Bayero Journal of Pure and Applied Sciences*,2011:4(1):52-55.
17. Badger-Emeka LI, Hany EK, Emeka PM. Evaluation of Different Fractions of *Garcinia kola* Extracts against Multidrug Resistant Clinical Bacterial and Fungal Isolates. *Pharmacogn J.*,2018:10(5):1055-60.
18. Omorefosa Osarenkhoe Osemwegie, Charles Obiora Nwonuma, Abimbola Peter Oluyori, Praise Ocheanya Abraham, Abraham Abayomi Akanbi, Deborah Oluyemisi Opaleke, *et al.* *In vitro* Antimicrobial and *in vivo* Lead Acetate Poison Abatement Study of *Garcinia kola* Heckel, *Journal of Taibah University for Science*,2017:11(6):883-894. DOI: 10.1016/j.jtusci.2017.06.001
19. Murugan R, Kanimozhi G, Sathya M, Anandharaj B. Evaluation of preliminary phytochemical screening of five important medicinal plants in euphorbiaceae family. *International Journal of Botany Studies*. 2022;7(1):277-80.