World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(RESEARCH ARTICLE)

Check for updates

Phytochemical, nutritional, and antioxidant evaluation of the ethanolic extract of *Buchholzia coriacea* (Wonderful Kola)

Yetunde Oluwafunke Aina [1,*], Kelechi Purity Ezennubia [2], Temitope Banjo [1], Esther Olufunmilade Lateef [1], Rotimi Oluyemi Malomo [1] and Oladapo David Onileowo [1]

[1] *Department of Biological Sciences, College of Natural and Applied Sciences, Crawford University, PMB 2001, Igbesa, Ogun State, Nigeria.*
[2] *Department of Chemistry and Biochemistry, Faculty of Science, Baylor University, Texas, U.S.A.*

World Journal of Biology Pharmacy and Health Sciences, 2025, 22(01), 274-281

Publication history: Received on 01 March 2025; revised on 08 April 2025; accepted on 11 April 2025

Article DOI: https://doi.org/10.30574/wjbphs.2025.22.1.0401

Abstract

This study investigates the phytochemical constituents, proximate composition, and antioxidant potential of the ethanolic extract of *Buchholzia coriacea* (commonly known as wonderful kola). Qualitative screening revealed the presence of bioactive compounds such as alkaloids, flavonoids, tannins, saponins, and phenols. Quantitative phytochemical analysis indicated high concentrations of alkaloids (4.83 ± 0.02%), tannins (4.75 ± 0.01%), and saponins (2.34 ± 0.02%). Proximate analysis showed that the dried sample contained the highest levels of carbohydrates (70.61 ± 0.04%), crude fiber (17.23 ± 0.10%), and moisture (5.31 ± 0.04%), while crude fat and ash contents were more pronounced in the raw and cooked forms, respectively. The ethanolic extract demonstrated significant antioxidant activity in the Ferric Reducing Antioxidant Power (FRAP) assay, exceeding that of standard antioxidants such as ascorbic acid and butylated hydroxytoluene (BHT). These findings highlight the potential of *Buchholzia coriacea* as a functional food and natural antioxidant source, supporting its traditional use in ethnomedicine.

Keywords: Antioxidant; *Buchholcia coreacea*; Bioactive compounds; Proximate composition; Ascorbic acid

1. Introduction

Plants are abundant sources of bioactive compounds with diverse biological activities, including antioxidant properties. Antioxidants are molecules that protect cells from oxidative damage caused by reactive oxygen species (ROS) and reactive nitrogen species (RNS) [1]. Oxidative stress, which results from the imbalance between ROS and antioxidants, has been linked to the development of several chronic diseases, such as cancer, diabetes, and cardiovascular disorders. This has led to a growing interest in identifying natural antioxidants from plant sources. Quantitative analysis plays a crucial role in determining the content and composition of bioactive compounds in plant extracts [2]. This analysis is vital for identifying plants with significant antioxidant activity and for developing products with consistent quality and efficacy. Techniques such as spectrophotometry, high-performance liquid chromatography (HPLC), and gas chromatography-mass spectrometry (GC-MS) are commonly employed for quantitative analysis [3].

Wonderful Kola (Buchholzia coriacea), a plant native to West Africa, has been traditionally used in medicine to treat a wide range of ailments. The plant contains bioactive compounds that offer potential health benefits, including antioxidant and anti-inflammatory properties [4]. Quantitative analysis of Wonderful Kola involves measuring the concentration of its bioactive compounds, which include alkaloids, saponins, flavonoids, and tannins [5]. Several studies have investigated these compounds in the plant. One study found the alkaloid content to be 1.29% (w/w) [6], while

* Corresponding author: Yetunde Oluwafunke Aina.

another measured the saponin content at 7.03% (w/w) [7]. Flavonoids were present at a concentration of 4.17% (w/w), and tannins were found at 3.21% (w/w) [8].

Antioxidants are substances that can neutralize free radicals, unstable molecules produced by the body during natural processes or through exposure to environmental factors such as pollution and radiation [9]. Free radicals can lead to oxidative stress, which is associated with various health conditions, including cancer, diabetes, and heart disease [10]. By neutralizing free radicals, antioxidants help reduce the risk of oxidative stress and its associated diseases. Several studies have examined the antioxidant properties of Wonderful Kola [11]. One of the previous studies demonstrated the plant's significant antioxidant effect, showing its ability to scavenge free radicals. Another study investigated the impact of Wonderful Kola on lipid peroxidation, a process that can damage cells and tissues [12]. The bioactive compounds in wonderful kola have been shown to provide a range of health benefits, including antioxidant and anti-inflammatory effects. These findings suggest that Wonderful Kola may serve as a natural remedy for preventing or treating diseases associated with oxidative stress [13]. This study aims to complement previous research by exploring the nutritional properties of not only the dried parts of the plant but also its cooked and raw forms. Further research is required to determine the optimal dosage and method of administration to maximize the health benefits of Wonderful Kola.

Figure 1 Seed and Leaves of *Bucholzia coriaceae* (Wonderful kola)(Enechi *et al*., 2021).

2. Materials and Methods

2.1. Chemicals and Equipment

Ascorbic acid, gallic acid, Folin-Ciocalteu reagent, aluminum chloride, and all the chemicals were of high-purity analytical-grade reagents. Ethanol (analytical grade), chloroform (analytical grade), and n-hexane (analytical grade) were throughout used for the phytochemical analysis, UV-visible spectrophotometer. All other reagents were of analytical grade. The major equipments used were Soxhlet apparatus and UV-visible spectrophotometer.

2.2. Collection of *Buchholzia Coriacea* Seeds

Fresh seeds of *B. coriacea* were brought from Lusada Market, Ado-Odo Ota Local Government, Igbesa, Ogun State, Nigeria. The seeds were identified and authenticated by a botanist in the department of Biological Sciences, Crawford University, Faith city, Igbesa, Ogun state, Nigeria.

2.3. Processing of the Seeds

The seeds were washed and divided into three parts – namely, raw, cooked, and dried seeds. The raw seeds were chopped into pieces and ground into paste using a mortar and pestle. The seeds meant for cooking was chopped and cooked for 2 hours, while the seeds for drying were sliced and dried in a hot air oven at 45 ℃ for 48 hours. The dried seeds were then cooled in a desiccator and grounded into powder using an electronic blender. The raw, cooked, and dried samples were directly used for the proximate analysis.

2.4. Extraction of Plant Materials

Two hundred grams of *B. coriacea* powdered seed was separately placed in two conical flasks containing 250cm3 of ethanol, followed by mixing and agitation for 6 hours before being allowed to stand for 24 hours. The mixture was

filtered using muslin cloth and filter paper and then concentrated into dry extracts by heating in a water bath at 50 °C. The dry extracts was scraped off with a spatula and then used directly for quantitative analysis.

2.5. Qualitative and Phytochemical Analysis of *B. coriacea*

Qualitative and quantitative screening of phytochemicals in *B. coriacea* was carried out using the standard procedure described by Sofowara et al [14], Trease [15] and and Harborne et al, [16].

2.6. Proximate Analysis

Nutrient composition of the extract was determined using the standard procedures of Association of Official Analytical Chemists. Triplicate samples were used for moisture content in a hot-air circulating oven Ash was determined by incineration (550^{o}C) of known weights of the samples in a muffle furnace (Method No 930.05). Crude fat was determined by exhaustively extracting a known weight of sample in petroleum ether (boiling point, 40 to 60^{o}C) using TecatorSoxtec. Crude fiber was determined after digesting a known weight of fat-free sample in refluxing 1.25% sulfuric acid and 1.25% sodium hydroxide. Carbohydrate content was determined by difference, that is, addition of all the percentages of moisture, fat, crude protein, ash and crude fibre was subtracted from 100%. This gave the amount of nitrogen free extract otherwise known as carbohydrate.

% carbohydrate = 100 - (%Moisture + %Fat + %Ash + % Crude fibre + %Crude protein)

2.7. Ferric reducing antioxidant power (FRAP) of *B. coriacea.*

The ferricyanidetrichloroacetic acid technique was used to determine the produced extract's reducing [17] The extracts (1 mg/mL) were combined with 2.5 mL of phosphate buffer (2 M, pH 6.6) and 2.5 mL of 1% potassium ferricyanide (KF), and the mixture was then heated to 50^{o}C for 20 minutes. After adding 2.5 mL of trichloroacetic acid (10% concentration), the mixture was centrifuged at 1000g for 10 minutes. The supernatant was combined with distilled water (2.5 mL) and 0.5 mL of 0.1% ferric chloride, and the absorbance at 700 nm was measured in comparison to a blank. Under the same circumstances, ascorbic acid absorption was determined. From 0.05g of ascorbic acid, standard ascorbic acid solutions were determined.

2.8. Statistical Analysis

The data were analyzed using SPSS version 21.0. The mean and standard error of means (SEM) of the triplicate analyses were calculated.

3. Results

3.1. Qualitative Phytochemical Screening of *B. coriaceae*

The result for the qualitative phytochemical analysis of the ethanolic extract of *B. coriaceae* wonderful kola seed is shown in Table 1.

Table 1 Qualitative Phytochemical Screening of the ethanolic extract of Wonderful Kola *B. coriaceae*

Constituents	Ethanol extract
Alkaloids	+
Flavonoids	+
Tannins	+
Saponins	+
Glycosides	+
Phenols	+
Terpenoids	+
Steroids	+

Keys: (+) = Present; (-) = Absent

3.2. Quantitative phytochemical Screening of the ethanolic extract of *B.coreaceae*

The result of the quantification of the phytochemicals present in the ethanolic extract of *B. coreaceae* is shown in Table 2.

Table 2 Quantitative Phytochemical Screening of Wonderful Kola seed Extract

Constituents	Ethanol extract
Alkaloids(%)	4.83 ± 0.020
Flavonoids (mg/ml)	0.57 ± 0.025
Tannins(%)	4.75 ± 0.012
Saponins(%)	2.34 ± 0.08
Glycosides (%)	2.18 ± 0.002
Phenols (mg/ml)	0.195 ± 0.0012
Terpenoids(%)	2.39 ± 0.028

Mean ± standard deviation of twodeterminations

3.3. Proximate Analysis of the *B. coriaceae*

Table 3 and Figure 2 show the comparison in the proximate chemical composition of Cooked sample, Dried sample, and Fresh sample of *B. coriaceae*.

Table 3 Proximate Chemical Composition of Wonderful Kola Seed

Chemical composition	Cooked	Dried	Fresh
Moisture	67.68 ± 0.09	4.8± 0.38	64.34 ± 0.09
Ash	3.63 ± 0.01	6.54 ± 0.07	4.42 ± 0.28
Protein	6.18 ± 0.012	11.05 ± 0.04	9.15 ± 0.05
Fat	4.72 ± 0.08	2.1± 0.33	3.27 ± 0.06
Fiber	5.63 ± 0.03	4.9± 0.59	6.59 ± 0.37
Carbohydrate	7.44± 0.08	70.61± 0.92	12.23± 0.08

Mean ± standard deviation of twodeterminations

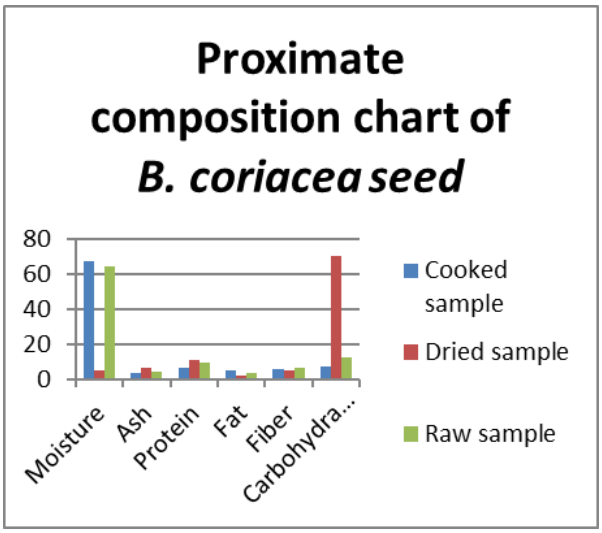

Figure 2 Proximate Chemical Composition of *B. coriaceae* (Wonderful Kola Seed)

From figure 2 above, it shows that the moisture content of the wonder kola (dried) is significantly lower than that of the two samples (cooked and raw sample). This is as a result of the process involved in the production of the dried sample of wonder kola. The carbohydrate content of the wonder kola (dried) is significantly higher than that of the two samples (cooked and raw sample).

3.4. Antioxidant Capacity Assay of the ethanolic extract of *B. coriaceae*

The result of the antioxidant capacity assay showing the total flavonoid and total phenolic content of the ethanolic extract of *B. coriaceae* is shown in Table 4. The result of the ferric reducing potential of *B. coreaceae* is shown in Fig 3.

Table 4 Antioxidant properties of Wonderful Kola seed Extract

Antioxidant constituent	Ethanol extract
Total flavonoid content (mg/ml)	0.57 ± 0.025
Total phenolic content (mg/ml)	0.195 ± 0.0012

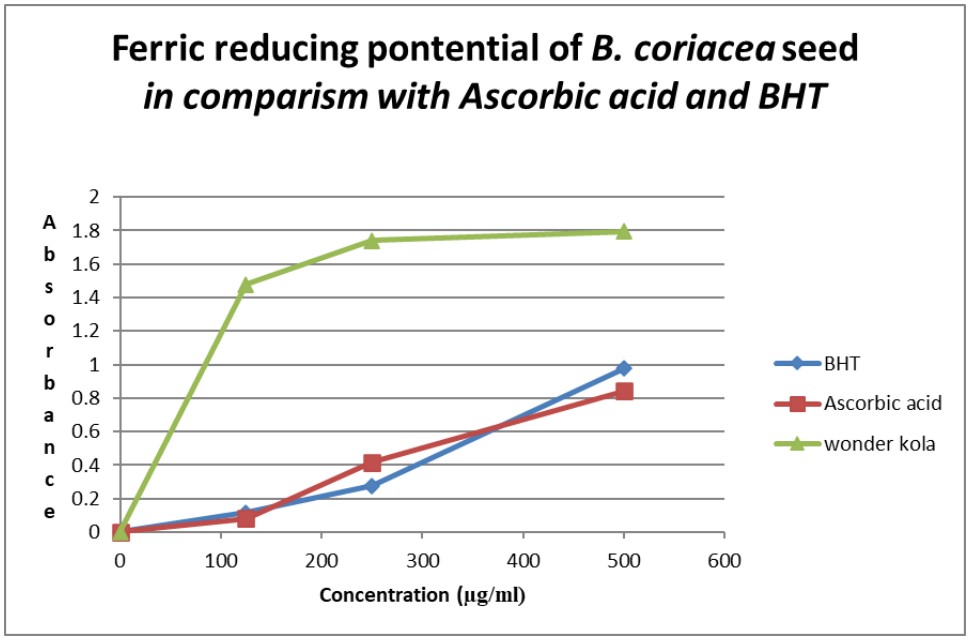

Figure 3 Ferric reducing pontential of *B. coriacea* seed in comparison with Ascorbic acid and BHT

4. Discussion

Plants play an important role as a source of nutrient and natural bioactive compounds (Phytochemicals) which may serve as secondary metabolites in humans. They are rich sources of bioactive compounds that exhibit diverse biological activities, including antioxidant activity. Antioxidants are substances that can prevent or slow damage to cells caused by free radicals, which are unstable molecules produced by the body as a result of natural processes or exposure to environmental factors such as pollution and radiation [9]. Free radicals can cause oxidative stress, which is linked to several health problems, including cancer, diabetes, and heart disease.

Wonderful Kola is a plant that contains several bioactive compounds, including alkaloids, saponins, flavonoids, and tannins. These compounds have been shown to have potential health benefits, including antioxidant and anti-inflammatory properties. It is also rich in some nutrients such as carbohydrate, Fat, Protein and minerals. It is very good for consumption especially for children.

This study investigated the phytochemical and nutritional properties of *Buchholzia coriacea* (wonderful kola). The results obtained in this study provide strong evidence supporting the potential of *B. coriacea* as a source of bioactive compounds and nutrients, as well as its antioxidant properties. The qualitative phytochemical screening of *B. coriacea*

revealed the presence of several bioactive compounds, including alkaloids, flavonoids, tannins, saponins, glycosides, phenols, terpenoids, and steroids as shown in Table 1. These compounds have been reported to have a wide range of biological activities, such as antimicrobial, anti-inflammatory, antidiabetic, and antioxidant effects. The presence of alkaloids, for example, is significant as they have been linked to numerous health benefits, including analgesic and anti-inflammatory properties [18]. Similarly, flavonoids are known for their antioxidant properties, which play a crucial role in protecting cells from oxidative damage, reducing the risk of chronic diseases like cancer and cardiovascular disease [19]. The detection of saponins and glycosides further suggests the potential for *B. coriacea* to be utilized in traditional medicine, as these compounds have demonstrated hypoglycemic and hypolipidemic activities [20].

Quantitative analysis further corroborated the presence of these phytochemicals, with alkaloids, tannins, saponins, glycosides, and terpenoids recorded at significant concentrations. Alkaloids (4.83 ± 0.020 mg/g) and tannins (4.75 ± 0.012 mg/g) were found in relatively high concentrations as shown in table 2. This may contribute to the observed medicinal properties of *B. coriacea*. Tannins are known for their astringent properties, which may aid in wound healing, while saponins have demonstrated immune-boosting effects [21]. The flavonoid content (0.57 ± 0.025 mg/g) and total phenolic content (0.195 ± 0.0012 mg/g) also suggest the plant's potential as a natural source of antioxidants, capable of neutralizing free radicals and protecting against oxidative stress.

Proximate analysis of raw, dried, and cooked *B. coriacea* extracts indicated varying levels of key nutrients such as carbohydrates, proteins, fats, fiber, and moisture content as shown in Table 3 and Figure 3. The dried extract exhibited the highest carbohydrate content (70.61 ± 0.92%), which is considerably higher than the raw (12.23 ± 0.08%) and cooked (7.44 ± 0.08%) extracts. This increase in carbohydrate content may be attributed to the concentration effect during the drying process. Carbohydrates are essential for providing energy, and the high carbohydrate content in the dried extract suggests that *B. coriacea* could be a valuable source of energy in functional food formulations. This study was in comformity with the study of Aremu et al [22]. Protein levels in the dried extract were also higher (5.63 ± 0.03%) compared to the cooked (4.72 ± 0.08%) and raw (2.1 ± 0.33%) extracts, further supporting the nutritional value of this plant. Proteins are vital for the growth and repair of body tissues, and this observation highlights the potential of *B. coriacea* as a protein source, especially in regions where protein malnutrition is prevalent. The fiber content was higher in the raw extract (6.59 ± 0.37%) compared to the dried (4.9 ± 0.59%) and cooked (5.63 ± 0.03%) extracts. The result of the fat content was similar to the fat observed from bitter cola seeds (4.33%) Odebunmi et al [23] but higher than that of kolanut (1.8%) and 0.92% that observed by Aremu et al [22] respectively. Fiber is crucial for digestive health and the prevention of constipation, and the relatively high fiber content in the raw extract suggests its potential role in promoting gastrointestinal health. Interestingly, while the dried extract had the lowest fiber content, it had the highest carbohydrate and protein concentrations, which could be advantageous in energy-dense food applications. Adequate intake of dietary fibre had been reported by Ajayi et al [24] to lower the serum cholesterol level, risk of coronary heart diseases, hypertension, constipation, and diabetes. The seed in this study are not a good source of crude fibre because it doesn't meet RDA value. Fat content in the dried extract was recorded at 2.1 ± 0.33%, while the raw and cooked extracts had slightly higher fat contents (4.72 ± 0.08% and 3.27 ± 0.06%, respectively). These variations could be due to the loss or alteration of fat-soluble compounds during the drying process. Although the fat content is relatively low, it still provides an essential source of fatty acids that contribute to overall health.

The antioxidant potential of the ethanolic extract of *B. coriacea* was assessed using the Ferric Reducing Antioxidant Power (FRAP) assay as shown in figure 2 with results indicating a higher reducing potential compared to standard antioxidants such as BHT (Butylated HydroxyToluene) and ascorbic acid. This is a significant finding, as oxidative stress is a key contributor to the pathogenesis of many chronic diseases, including cancer, cardiovascular diseases, and neurodegenerative disorders. The antioxidant activity observed in *B. coriacea* suggests that it may serve as a natural antioxidant agent, offering potential therapeutic applications for the prevention and management of oxidative stress-related conditions. The observed antioxidant activity may be attributed to the high concentration of phenolic compounds, particularly flavonoids and tannins, which are known for their free radical-scavenging ability.

5. Conclusion

The findings from this study highlight the substantial medicinal and nutritional potential of *Buchholzia coriacea*. The presence of bioactive compounds such as alkaloids, flavonoids, tannins, saponins, glycosides, and phenols underscores its therapeutic applications, while the significant nutritional content particularly carbohydrates, proteins, and fiber suggests that it could serve as a valuable functional food. Additionally, the antioxidant activity demonstrated by the ethanolic extract indicates that *B. coriacea* could be a natural alternative to synthetic antioxidants, offering protective benefits against oxidative damage. Further research is necessary to fully elucidate the mechanism of action of these bioactive compounds and their clinical applications in human health. Nonetheless, the findings from this study provide

a strong foundation for the potential use of *B. coriacea* in both traditional medicine and modern functional food formulations.

Compliance with ethical standards

Acknowledgement

The Authors would like to express their sincere gratitude to the Department of Biological Sciences, Crawford University, for providing laboratory facilities and technical support.

Disclosure of conflict of interest

The authors declare no competing interests. This manuscript has not been submitted to, nor is under review at another journal or other publishing venue.

References

[1] Izah SC, Uhunmwangho EJ, Eledo BO. Medicinal potentials of *Buchholzia coriacea* (wonderful kola). Med Plant Res. 2018; 8(5): 27-42.

[2] Ijarotimi OS, Malomo SA, Fagbemi TN et al. Structural and functional properties of *Buchholzia coriacea* seed flour and protein concentrate at different pH and protein concentrations. Food Hydro. 2018; 74: 275-288.

[3] Ikechukwu EL, Okafor PN, Egba SI. In vitro assessment of the anti-sickling properties of *Buchholzia coriacea* and Mucunapruriens seed extracts. In Vitro Cel & Develop.Biol-Ani. 2020; 56: 773-782.

[4] Adelere IA, Lateef A, Aboyeji DO et al. Biosynthesis of silver nanoparticles using aqueous extract of *Buchholzia coriacea* (wonderful kola) seeds and their antimicrobial activities. Annals Food Sc and Tech. 2017; 18(4): 671-679.

[5] Onohuean H, Adisa RA, Alagbonsi AI. Anti-apoptotic effect of *Buchholzia coriacea* Engl. stem back extracts on AsPC-1 and mechanisms of action. BMC Complem Med Ther. 2021; 21:1-14.

[6] Okolie AC, Kale OE, Osilesi O. Chemoprotective effects of butanol fraction of *Buchholzia coriacea* (Capparidaceae) against type 2 diabetes and oxidative stress in male Wistar rats. Biosc rep. 2019; 39(2).

[7] Kehinde SA, Ore A, Olajide AT et al. Methanolic extract of *Buchholzia coriacea* seed (MEBCS) attenuates lipopolysaccharide-induced perturbations of energy metabolizing enzymes in mice. Food Chem Adv. 2023; 2:100-227.

[8] Omayone TP, Salami AT, Odukanmi AO et al. Diet containing seeds of *Buchholzia coriacea* accelerates healing of acetic acid induced colitis in rats. Asian Pac J of Trop Biomed. 2018; *8*(3):166.

[9] Akunne TC, Ilogu LC, Obi BC et al. Protective effects of *Buchholzia coriacea* seeds extract and fractions on blood glucose and hyperlipidemia in diabetic rats. Int J Basic Clin Pharmacol. 2017; 6-1856.

[10] Abubakar A, Olorunkemi MR., Musa B et al. Comparative in vitro antioxidant activities of aqueous extracts of Garcinia kola and *Buchholzia coriacea* seeds. Tanz J of Sci. 2020; 46(2): 498-507.

[11] Adefegha SA, , Oyeleye SI, Oboh G. African crocus (Curculigopilosa) and wonderful kola (*Buchholzia coriacea*) seeds modulate critical enzymes relevant to erectile dysfunction and oxidative stress. J of Compl and Integr Med. 2018; 15(4).

[12] Ore A, Adeogun AI, Akinloye OA. Hydroethanolic Extract of Defatted *Buchholzia coriacea* Seeds Alleviates Tamoxifen-Induced Hepatic Triglyceride Accumulation, Inflammation and Oxidative Distress in Rat. Med. 2022; 9(1): 1.

[13] Obembe OO, Ojetola, AA, Atere TG et al. *Buchholzia coriacea* seed induce antifertility by interfering with steroidogenic enzymes and inflammatory cytokines in rat testis. J of Reprod Immunol. 2023; 157:103923.

[14] Sofowora EE. Phytochemical Screening of Nigerian medicinal plants Lioydia. J. Integr Med. 2000; 41: 234-246.

[15] Trease GE, Evans WC. Pharmacognosy, 1978; London: Baillière 11th ed.

[16] Harborne JB. Phytochemical methods. 1973; London: Chapman and Hall

[17] Fan X, Tao X, Baiyi L, et al. Guidelines for antioxidant assays for food components. Fd Fron. 2020; 1:60–69.

[18] Augusto LS, Josean FT, Marcelo SS, et al. Anti-Inflammatory Activity of Alkaloids: An Update from 2000 to 2010. Mol. 2011; 16:8515-8534.

[19] Youngyo K, Youjin J. Flavonoid intake and mortality from cardiovascular disease and all causes: A meta-analysis of prospective cohort studies. Clin Nutr ESPEN. 2017; 20: 68-77.

[20] Jagaadeesan J, Nndakumar N, Rengarajan T, et al. Diogsgenin, a steroidal saponin exhibits anticancer activity by attenuating lipid peroxidation via enhancing antioxidant defense system during NMU-induced breast carcinoma. J Environ Pathol Toxicol Oncol. 2012; 31(2): 12-9.

[21] Xiaowen Su, Xiaguang L, Shouyu W, et al. Wound-healing promoting effect of total tannins from Entada phaseoloides (L) Merr. In rats. PubMed. 2017; 43(4): 830-838.

[22] Aremu MO, Passa ODB. Ibrahim H. et al. Chemical composition of wonderful Kola (Bucchozia coriacea) and breadfruit (Artocarpus altilis) seeds grown in south-south, Nigeria. Banglad. J. Sci. Ind. Res. 2018; 53(2):125-132.

[23] Odebunmi EO, Oluwaniyi OO, Awolola GV et al. Proximate and nutritional composition of Kola nut (Cola nitida), bitter cola (Garcinia cola) and alligator pepper (Afromomum melegueta). Afri. Journ. Of Biotech. 2009; 8(2).

[24] Ajayi TO, Moody JO, Anthony CS. Ethnobotanical survey of plants used in the management of hypertension in Ibadan North Local Government Area of Oyo State, Nigeria. Nig J of Pharm Res. 2019; 15(1): 61-73.