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Review Article

Ethno-pharmacological Review of *Buchhoizia coriacea* (Wonderful Kola)

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ABSTRACT

Buchholzia coriacea (Wonderful cola), belonging to the family of Capparidaceae is an evergreen shrub, which is distributed in Cameroon, Central African Republic, Gabon, Congo, Angola, Nigeria, Ghana, among others. Traditional medicine had claimed it as a valuable alternative therapy in; diarrhoea, malaria, rheumatism, ulcers, worm infection, asthma and cough, diabetes, hypertension, psychiatric disorders, impotence, among others. Some of its ethno-medicinal information had been scientifically validated ethno-pharmacologically and published in scientific journals. This work is thus focused on an up to date review of its validated ethno-medicinal activities, which would serve as a frontier of research to present and prospective researchers.

KEY WORDS: *Buchholzia coriacea,* Ethno-pharmacological properties, Ethno-medicinal values, Phytochemicals.

INTRODUCTION

Herbal medicine, an alternative form of medicine acceptable worldwide, encompasses the use of plant materials in the diagnosis, prevention and treatment of physical, mental and social diseases [1]. Relevant information on the usefulness of herbal medicine had been traced to past experiences and observations documented since the creation of man [2]. Scientific validation of plants with useful ethno-medicinal information is necessary for the development of alternative therapies to synthetic drugs [3]. Also information of several scientifically proven plants such as; *Citrullus lanatus* [4], *Tridax procumbens*[3], *Xylopia aethiopica* [5], *Ocimum gratissimum* [6], among others, had been gathered from different data base and published in scientific journals. However, there is yet to be an up to date collection of scientifically proven information on *Buchholzia coriacea* for its folklore claims in medicine, which is necessary for the frontier of research and drug development. Thus, this had prompted this review.

Buchholzia coriacea, belonging to the family Capparidaceae was named after RW Buchholz who collected plants in Cameroon in the late 19th century [12-13]. It is an evergreen, small to medium-sized tree growing up to 20 m tall which is distributed in Cameroon, Central African Republic, Gabon, Congo, Angola, Ghana, Nigeria, among others [7-8]. The bark of the plant *Buchholzia coriacea* is smooth, blackish-brown or dark green [9].

BUCHHOLZIA CORIACEA

Figure 1
The pictures of *Buchholzia coriacea* tree, leaves and seeds.

It has a dense crown, large glossy leathery leaves arranged spirally and clustered at the ends of the branches, and conspicuous cream-white flowers in racemes at the end of the branches [10]. In Gabon the plant *Buchholzia coriacea* is sometimes cultivated as a medicinal and fetish plant [11].

Description

Taxonomy Profile

Family: Capparaceae Juss
Order: Brassicales Bromhead
Genus: Buchholzia engl
Class: Eqissetopsida c. Agardh
Specie: Coriaceae

Common and Local Names

Common names of *Buchholzia coriacea* include; wonderful cola, musk tree, Cola pime and Elephant cola. It is called; 'Ndo' in Mende (Sierra Leone), 'Doe-fiah' in Kru-basa (Liberia), 'Eson-bese' in Akan-asante (Ghana), 'Banda' in Munga (West Cameroons), 'Esson bossi' in Central Africa, 'Kola Pimente' in French, '6wi' in Edo State, 'Okpokolo' in Igbo, 'Uwuro' and 'Aponmu' in Yoruba (Nigeria) [13-14].

Ethnomedicinal Uses

Buchholzia coriacea has multiple medicinal values. These seed gave it its common name (wonderful kola) because of its usage in traditional medicine. The plant parts commonly eaten are the seeds which are either cooked or eaten raw [11]. In Africa, it is useful in treatment of hypertension and also prevents premature aging. It is a brain food which promotes memory. In Africa, wonderful kola has the ability to stop migraine headache when applied on the

forehead. The stem bark extract is applied as an enema to treat back pain. Non specified bark preparations are also applied externally against pleurisy, rheumatism, conjunctivitis, smallpox, scabies and other skin complaints. Leaf decoctions are used to treat sterility in women. Leaf infusions are applied to the eyes against filarial nematodes, and powdered or pulped leaves are applied to treat fever, ulcers, boils and haemorrhoids. Ground fruits are applied as anodyne. Fruit kernels are chewed to treat angina and nose bleeding, and fruit extracts are taken as anthelmintic. Fruit scrapings are administered to treat asthma and cough. Seed preparations are taken to treat; fever, diabetes, hypertension, cough, psychiatric disorders and impotence. Seed pulp is applied to snakebites. Seed oil is taken against menstruation problems and gastro-intestinal complaints. The bark is used as an ingredient in the preparation of arrow. The seeds which have a peppery taste are used as a substitute of capsicum pepper. In Côte d'Ivoire the seed is chewed as a substitute for kola nuts. The wood is sometimes used in house construction [13, 15].

ETHNO-PHARMACOLOGICAL PROPERTIES

Anti-diabetic properties

The methanol seed extract of *B. coriacea* had been shown to elicit hypoglycaemic effects, which exhibited synergistic actions with metformin, a standard oral hypoglycaemic agent. Oral administration of *B. coriacea* at 100, 200, 400 mg/kg doses per oral (po) exhibited percentage blood glucose reduction (PBGR) of 37.73, 12.30 and 11.30% respectively after 4 hours treatment. The combination of extract (100 mg/kg) and metformin (100 mg/kg) gave a PBGR at 4th and 7th day treatment of 73.4 and 72.2% respectively [16].

In streptozotocin-induced diabetic rat's model, oral treatment with 150, 300 and 600 mg/kg of methanol fruit extract of *Buchholzia coriacea* caused significant dose dependent decrease in fasting blood glucose values. The serum concentration of catalase and reduced glutathione were significantly higher in rats treated with Glibenclamide (2 mg/kg) and various doses (150, 300 and 600 mg/kg) of the extract in contrast to the values in negative control rats. The extract also decreased serum triglyceride and total serum cholesterol levels. The fruit extract dose dependently reduced lipid peroxidation in diabetic rats [17].

Study carried out by Adisa, *et al.,* (2011) to evaluates the possible hypoglycemic activity and ameliorative effects of oral administration of ethanol extracts (EEBC) and butanol fraction (BFBC) of *Buchholzia coriacea* seeds in streptozotocin (STZ)-induced diabetic mice and rats showed significantly decreased ($P<0.05$) fasting blood glucose (FBG) in hyperglycemic mice and normoglycemic rats within 4 and 12 h, respectively after extract administration. Administration of the extract and glibenclamide caused a significant ($P<0.05$) reduction in FBG and serum alanine aminotransferase and aspartate aminotransferase levels as well as serum creatinine, urea, total cholesterol, triglyceride and thiobarbituric acid reactive species (TBARS) products in STZ-induced diabetic rats in diabetic rats. Treatment with extract and glibenclamide significantly increased serum superoxide dismutase activity. Adisa *et al* (2011) proposed that B. coriacea seeds contain a potent hypoglycemic and antioxidant agent suggested to be a flavone glycoside concentrated in BFBC which may find clinical usefulness in ameliorating diabetes-induced secondary complications [18].

Antimicrobial and Anthelmintic Properties

Ezekiel and Onyeoziri, (2009) carried out a study on the effect of the fresh kola, hexane and methanol extracts of B. coricea on some food borne pathogens (*Escherichia coli*, *Enterococcus faecalis*, *Staphylococcus aureus*, *Trichoderma viride* and *Aspergillus niger*. The fresh kola showed inhibitory zones with the test bacteria: E. coli (62 mm), E. faecalis (40 mm) and S. aureus (50 mm). The growth of the two test fungi T. viride and A. niger was completely inhibited. The hexane extract showed inhibitory zones ranging from 20 to 40 mm with the test bacteria: E.coli (21 mm), E. faecalis (20 mm) and S. aureus (40 mm). It however showed no inhibitory effect on T. viride and A. niger. The extract also ellicited inhibitory zones ranging between 20 to 30 mm with some of the test pathogens: E.coli (30 mm), E. faecalis (25 mm) and S. aureus (20 mm), T. viride (15 mm). It did not show inhibitory effect on A. niger [7].

Study also carried out by Ajaiyeoba *et al.,* (2003) on fractions prepared from the methanol extract of *Buchholzia coriacea* stem bark showed a high concentration-dependent antibacterial and antifungal activity of the fractions when compared to the standard antibiotic, ampicillin and tioconazole. The methanol extract was found to be non-toxic with an LC_{50} of 1031 microg/ml in the brine shrimp lethality (BSL) assay. Lupeol and beta-*sitos2013terol* were the two main compounds present in the most active fraction [19].

Antibacterial activity of the leave extracts of *Buchholzia coriacea* was also evaluated by Chika and co-workers in 2012. Gram positive and Gram negative clinical isolates including ESBL positive E. coli isolates were used in the work. The isolates were treated with n-hexane, methanol and chloroform extracts of B. coriacea leaf for antibacterial activities

by *in vitro* agar well diffusion techniques. The results show that the n-hexane, methanol and chloroform extracts of B. coriacea leaf elicited modest antibacterial activities against the test isolates with E. coli, *Staphylococcus aureus*, *Shigella species*, *Klebsiella pneumoniae* and *Bacillus subtilis* susceptible. N-hexane and methanol extracts showed moderate inhibitory effects, however, chloroform extract did not exhibit activity against the ESBL. The minimum inhibitory concentration (MIC) values ranged between 6.25 mg/ml and 12.5 mg/ml for all the test isolates. MIC values for all the ESBL positive E. coli isolates were 50 mg/ml. Their study unveiled the promising antibacterial potential of B. coriacea leaf extracts which make it to be considered for pharmaceutical and medicinal purposes [20].

In 2011, Nweze and co workers investigated the activity of the methanol seed extract of *Buchholzia coriacea* against a field strain of *Trypanosoma congolense* using experimentally infected mice of both sexes. Treatment with 250, 500 and 1000 mg/kg, (po) does of the extract was carried out for 5 consecutive days. Diminazene diaceturate was administered at 3.5 mg/kg i.p. to the positive control mice. From the study carried out, there was no significant difference ($P<0.05$) in body weights. There was fluctuation in rectal temperatures of infected mice. Packed cell volume (PCV) of infected mice were significantly ($p < 0.05$) reduced than those uninfected. There was no significant difference between the PCV of the extract-treated and untreated animals. There was steady increase in parasitaemia in the extract-treated and untreated mice until all the animals died. Six days after post-treatment with diminazene diaceturate, there was a relapse of infection. At the end of the experiment, a 50% relapse rate was recorded in the diminazene diaceturate-treated group. The methanol extract of *Buchholzia coriacea* seeds did not elicit antitrypanosomal activity against mice infected with *Trypanosoma congolense* at the tested doses [21].

By using parasitized human group O blood, the antiplasmodial activity of aqueous extract of *Buchholzia coriacea* was investigated intraperitoneally in malaria induced albino mice. Experimental control mice received chloroquine while experimental mice received aqueous extracts of *Buchholzia coriacea*. There was reduction from mean value for five determinations of 79 parasites per field on the first day to7 parasites per field on the third day and 81 parasites per field to 5 parasites per field respectively while that treated with 120 mg/kg reduced parasitemia level from 80 parasites per field on the first day to zero by the third day, in parasitemia level of experimental animals that were treated with 40 mg/kg and 80 mg/kg of extract. During treatment, decrease in appetite was observed but this changed as the level of parasitemia decreased [22].

Anthelmintic properties of *Buchholzia coriacea*e and *Gynandropsis gynandra* methanol leaves and stem extracts were investigated against *Fasciola gigantica*, *Taenia solium* and *Pheritima pasthuma*, respectively. Reference drug and control were Piperazine citrate (10 mg/ml) and distilled water respectively. Five concentrations (10–100 mg/ml) of all the extracts exhibited considerable anthelmintic activities, The most active of the extracts were B. coriaceae and G. gynandra stem methanol extracts. [23].

Antihypercholesterolemic activity

In this study, ethanol extract of *Buchholzia coriacea* (EEBC) significantly ($p < 0.05$) reduced serum and liver total cholesterol and LDL – cholesterol levels as well as lipid peroxidation when compared with the untreated hypercholesterolemic rats. The activities of AST and ALT in EEBC – treated hypercholesterolemic rats were not significantly different ($p > 0.05$) from the control. Olaiya and co-workers suggest that *Buchholzia coriacea* seeds contain potent antihypercholesterolemic agent which may find clinical application in ameliorating hypercholesterolemia and its attendant complications [24].

Anti-ulcer and gastric anti-secretory activities

Administration of the 200 and 400 mg/kg of the seed extract of *Buchholzia coriacea* significantly ($P<0.05$) reduced the ulcerogenic effect caused by indomethacin in Wistar rats gastric mucosa when compared to the controls. Also, the extract significantly ($P<0.05$) reduced histamine-mediated gastric acid secretion and also blocked histamine-induced contractile responses, which was comparable to the reference drug, chlorpheniramine in isolated guinea pig ileum. The extract elicited ulcer protective ability [25].

Effects on male reproductive parameters

The effects of methanol seed extract of *Buchholzia coriacea* was evaluated on male reproductive system of albino rats. The administration of 200 mg/kg *b.w.*(p.o.) of extract for a period of 6 weeks caused significant reduction ($P<0.05$) in the weight of the epididymis and seminal vesicle, except the testes and prostate gland. However, the weight of the visceral organs- lungs, liver, heart and kidney were not affected. A significant ($P<0.05$) decrease in sperm motility and volume was also observed. There was no significant alteration in sperm count and morphology. Total tissue protein of the epididymis and testes of the treated rats was significantly increased ($P<0.05$) and there was no fertility observed in the treated rats.

Histological results revealed that the epididymal ducts were mostly empty (although the epithelial lining appeared normal). Fewer spermatozoa and late stage spermatids with normal testicular epithelium were observed in the testes. Obembe and co-workers therefore suggested that the extract of *Buchholzia coriacea* may have anti-infertility effect [26].

Other studies

Phytochemical, antispasmodic and antidiarrhoeal properties of the methanol extract of the leaves of *Buchholzia coriacea* had also been reported [13]. Also, the phytochemical and mineral quality of dried seeds of *Buchholzia coriacea* was also carried out by Ibrahim and Fagbohum in 2013 Proximate analysis showed that the seeds of *Buchholzia coriacea* contained moisture (1.30%), crude fat (2.30%), crude protein (13.34%), Ash content (6.6%), crude fibre (2.19%), carbohydrate (75.43%). The mineral analysis contained sodium (1.22 ppm), potassium (1.34 ppm), phosphorous (0.22mg/g), calcium (0.19%), magnesium (1.62%), zinc (0.18%) iron (1.11 %), and manganese (0.46%). The phytochemicals detected were alkaloids (3.16 and 3.32%), glycoside (2.16 and 2.46%), saponin (2.10 and 2.23%), steroids (0.14 and 0.16%), tannin (6.46 and 6.73%), flavonoids (0.68 and 0.79%), terpenes (0.22 and 0.1 6%), reducing sugars (1.14 and 1.71%) and phenol (1.83 and 1.26%) for ethanol and methanol extract [27].

Phytochemical analysis and antipyretic properties of the methanol extract of the leaves of *Buchholzia coriacea* was also investigated. Phytochemical evaluation of the leaves of *Buchholzia coriacea* revealed the presence of tannins, flavonoids, alkaloids, glycosides, and saponins. *Buchholzia coriacea* leaf extract (50 mg/kg, p.o.) significantly ($p<0.01$) relieved pyrexia which was comparable to that of Aspirin (100 mg/kg). The result of the LD_{50} of the extract showed that the extract is well tolerated at a dose of 5000 mg/kg [28].

Comparative Evaluation of Phytoconstituents, Antibacterial Activities and Proximate Contents of Fresh, Oven Dried Uncooked and Cooked Samples of *Buchholzia coriacea* seed and their Effects on Hepatocellular Integrity.

Results obtained from phytochemical screening revealed the presence of flavonoids, saponins, oxalates, tannins, phytates, cyanogenic glycosides and alkaloids. Results of the proximate contents showed that the shelf-life of the studied seed samples decreased from oven dried uncooked seed sample, fresh seed sample, to cooked sample. Hepatocellular integrity results showed a significant ($P<0.05$) change in the aspertate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) of rats placed on compounded feed of fresh B. coriacea seed and oven dried uncooked seed when compared to the control group. From the observations of this study, the antibacterial potency of the studied seed especially when fresh or in an uncooked form cannot be disputed, however the rate at which any of these forms compromise hepatocellular integrity should be considered [15].

Phytochemical and antibacterial screening of crude extracts from leaves of *Buchholzia coriacea* (wonderful kola).

In this study, phytochemical analysis revealed the presence of phlobatannins, carbohydrates, proteins, tannins, saponins, alkaloids and flavonoids in wonderful kola leaf. The ethanol extract (10-14 mm) and methanol extracts (13-15 mm) elicited varying zones of inhibition against the S. aureus strains. MICs of both extracts were recorded at 50 mg/ml and 100 mg/ml for some strains of the S. aureus. Ejikeugwu and co-workers suggested further high-throughput technologies to characterize the main bioactive constituents of the wonderful kola plant extracts so that they can be compounded into drug formulations for the treatment of some bacterial related infections [29].

Phytochemical Analysis and Antifungal Activities of *Gynandropsis gynandra* (Spider flower) and *Buchholzia coriacea* (Musk tree) (Fam: Capparidaceae) on Some Common Fungal Isolates.

These two plants were screened for the presence of their active constituents. The leaves and the stem were screened separately. *Aspergillus niger*, *Penicillum sp*., *Candida albicans*, *Fusarium oxysporium* and *Aspergillus flavus* were used to test the antifungal activities of the leaves and stem. The activity of the extract at 200 mg/100 ml (0.02 g/10 ml) was compared with methanol as the control and Tioconazole as reference standard. According to Ogunmefun and Ajaiyeoba (2013), the result of the antifungal assay of the plant extracts give explanation for their use in traditional medicine [30].

Conclusion and future relevance

This present evaluation had unveiled the traditional usefulness and clinical potentials of *Buchholzia coriacea*, a medicinal plant commonly used in different parts of the world.

However, yet to be scientifically validated ethno-medicinal claims of this wonderful plant relating to; anti-inflammatory, antihypertensive, antiashmatic-

antitusive, aphrodisiac, among others is therefore recommended for further studies.

From this review, the attention of the general public is hereby drawn to the use of natural product in the management of diseases as well as the development of plant products into standardized, quality-controlled phyto-pharmaceuticals as well as the characterization of its bioactive component, which can be used in the development of more reliable and safer drugs.

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