

# Phytochemical and antibacterial screening of crude extracts from leaves of wonderful kola

**Ejikeugwu Chika<sup>1</sup>, Umeokoli Blessing<sup>2</sup>, Iroha Ifeanyichukwu<sup>3</sup>, Ugwu Malachy<sup>1</sup>, Esimone Charles<sup>1</sup>**

<sup>1</sup>Department of Pharmaceutical Microbiology and Biotechnology, Nnamdi Azikiwe University, P. M. B 5025, Awka, Nigeria

<sup>2</sup>Department of Pharmaceutical and Medicinal Chemistry, Nnamdi Azikiwe University, P. M. B 5025, Awka, Nigeria

<sup>3</sup>Department of Applied Microbiology, Ebonyi State University, P.M.B 053, Abakaliki, Nigeria

## Email address:

[ejikeugwu\\_chika@yahoo.com](mailto:ejikeugwu_chika@yahoo.com) (E. Chika)

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**Abstract:** The several antibacterial activities of wonderful kola plant (i.e. *Buchholzia coriacea*) has necessitated the need for a high-throughput and molecular characterization of all the bioactive components from the plant as a panacea to discovering bioactive compounds which could serve as lead compounds in developing potent and novel antibacterial agents. Microbial resistance to some available antimicrobial agents necessitates the need to search for newer antimicrobial agents that will not be easily amenable to the attack of resistant strains of microorganisms (many of which remain active even in the face of antimicrobial onslaught). This study investigates the phytochemical constituents and antibacterial activity of leaf extracts of wonderful kola on pathogenic *Staphylococcus aureus* strains. Antibacterial activity of the wonderful kola plant extract was evaluated by the agar well diffusion method to determine the zones of inhibition and minimum inhibitory concentration (MIC). Phytochemical analysis revealed that wonderful kola leaf contains phlobatannins, carbohydrates, proteins, tannins, saponins, alkaloids and flavonoids. Varying zones of inhibition was produced by the ethanol extract (10-14 mm) and methanol extracts (13-15 mm) against the *S. aureus* strains. MIC for both the ethanol and methanol extracts was recorded at 50 mg/ml and 100 mg/ml for some strains of the *S. aureus*. The results of this study have shown and contributed to the potential of wonderful kola leaf extracts in inhibiting pathogenic strains of *S. aureus*. Further high-throughput technologies are required 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 in this part of the world.

**Keywords:** Wonderful Kola, Gram Negative Bacteria, Resistance, Nigeria

## 1. Introduction

The search for potent novel antimicrobial agents has been stepped up and encouraged owing to the growing trend of microbial resistance to the arsenal of available synthetic agents i.e. antimicrobial agents used in clinical medicine today. Medicinal plants such as wonderful kola, garlic, and moringa amongst others have been used as alternative medications to promote health for people in Nigeria, Africa and other parts of the world for decades; and this ancient practice of healing (i.e. traditional medicine) that makes of herbs is still invoke even till date. Natural products especially those of plant origin with

recognized medicinal efficacy hold-sway in providing bioactive lead compounds for the development of novel antimicrobial agents owing to the realities and untoward effects of resistant strains of pathogen organisms. The use of medicinal plants as an alternative form of healing or treatment is well documented and practiced worldwide [1,2,3]. A wide variety of medicinal plants abound which contain innumerable bioactive compounds with potential antimicrobial efficacy; and these plants no doubt are the richest source of lead agents for the development of some drugs. Wonderful kola as it is locally and popularly called is known botanically as *Buchholzia coriacea*; and it belongs to the plant family *Capparaceae* [4]. The parts of

herbal plants (inclusive of wonderful kola leaves) have been recorded to possess medicinal value which is why they are used in many traditional medicine practices to meet the primary health needs of people especially those living in rural areas [4,5,6]. Wonderful kola is a forest tree with large, glossy and leathery leaves; and conspicuous leaves at the end of its branches [6]; and it is used as concoctions by most rural communities in Nigeria to solve some health needs. Wonderful kola is widely distributed in most African countries; and its parts (e.g. bark, leaf and stem) have been used to treat a variety of sicknesses in most rural communities in Nigeria. Fever, gonorrhea and gastrointestinal infections are some of the infections treated locally with wonderful kola plant parts [2,4,6]. The use of wonderful kola plant parts in some traditional medicine practices have been credited to some bioactive compounds such as saponins, tannins, alkaloids amongst others which they contain in rich amounts [4,6]. Unorthodox forms of treatment which is founded on the use of plant parts (e.g. bark, stem, roots, seeds, and leaves) with potent medicinal efficacy is a normal practice in most rural Nigerian communities even though the practice is yet to be given a formal acknowledgment by the authorities. Due to their potency and diverse antimicrobial agents, medicinal plants and other forms of traditional medicine that makes use of herbs as an alternative source of medication has enjoyed popularity in recent times; and this is due to the high cost of some available conventional drugs (which may not be available and affordable by most people in rural Nigerian communities) as well as the development of resistance to drugs. This study is aimed at elucidating the phytochemical components and antibacterial activities of wonderful kola seeds on clinical isolates of *S. aureus*.

## 2. Materials and Methods

**Microorganisms:** Clinical isolates of pathogenic *Staphylococcus aureus* were obtained from the culture collection unit of the laboratory of Department of Pharmaceutical Microbiology & Biotechnology, Nnamdi Azikiwe University, Awka, Nigeria. The isolates were subcultured, purified on nutrient agar plates and re-characterized by standard microbiological identification techniques [7].

**Collection and preparation of plant:** Wonderful kola leaves were obtained from the plant section of the school of pharmacy, Nnamdi Azikiwe University, Awka, Nigeria. The leaves were washed with distilled water, dried and grinded into powder using a blender.

**Phytochemical analysis:** Phytochemical analysis for the qualitative detection of biologically important compounds including saponins, alkaloids, tannins, flavonoids, phlobatannins proteins, and carbohydrates from a portion of the plant were undertaken according to previously described methodology [4,5,8].

**Crude extract preparation and determination of medicinal efficacy:** Two hundred grams (200 g) powder of

wonderful kola leaves were percolated with 250 ml each of ethanol and methanol on beaker for 5 days. Extracts were filtered and concentrated in rotary evaporator at 40°C and stored in the refrigerator until use. Antibacterial activity of the plant extracts were determined by the agar well diffusion method at a concentration of 100 mg/ml [4,9,10]. Minimum inhibitory concentration (MIC) which is the lowest concentration of the plant extract that inhibited the growth of pathogenic *S. aureus* was evaluated at concentrations of 100, 50, 25, 12.5 and 6.25 mg/ml according to a previous methodology [3,4].

## 3. Results and Discussion

*Table 1. Results of phytochemical analysis*

Bioactive compounds	Methanolic extracts	n -hexane extracts	Chloroform extracts
Alkaloids	++	Weak+	++
Saponins	++	+	+
anthraquinones	NT	NT	NT
phlobatannins	++	—	—
Flavonoids	+++	—	—
Tannins	++	Weak+	—
Cardiac glycosides	Weak+	—	—
Glycosides	NT	NT	NT
Resins	—	—	—
Protein	+++	—	—
Carbohydrates	++	—	—
Steroids	NT	NT	NT
Steroids	NT	NT	NT

Key:

+ = present

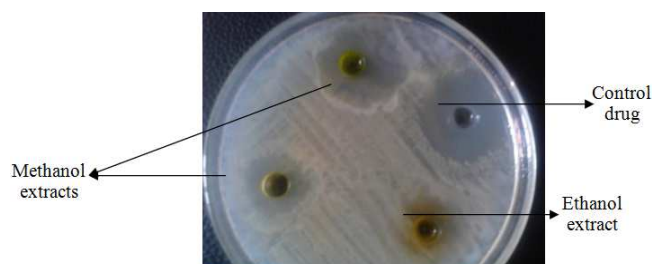
— = absent

NT = Not typable

Traditional medicine involving the use of plant parts with medicinal or healing effect has been the mainstay of meeting most primary health care needs in rural parts of Nigeria and even in a few metropolitan cities. It is no longer news that herbal plants possess in them great healing effects, which is why they are often resorted to for treatment due to the emergence of resistant strains of bacterial pathogens which has rendered most available synthetic drugs inefficacious. The use of natural products from herbal plants for various curative measures has continued to play significant roles as alternative sources of medication in many parts of the world (Nigeria inclusive); and these compounds originating from natural products including medical plants have also served and are being considered as lead agents in the development of novel and potent antimicrobial agents to solve some of the mysteries of drug resistance which is prevalent in our health

institutions across the world. In this study, the phytochemical screening and preliminary *in vitro* antibacterial activity of wonderful kola leaves were evaluated. The results of phytochemical analysis of wonderful kola leaves (Table 1) showed that the plant contain saponins, phlobatannins, proteins, carbohydrates, tannins, flavonoids and alkaloids as phytochemicals. However, the presence of steroids and phenols was not detected in the wonderful kola leaves used in our study (Table 1).

Phytochemicals including tannins, saponins, and alkaloids amongst others are important components of natural products such as herbal plants; and they possess in them numerous bioactive activities which are well documented [4,5,8]. Our findings are in agreement with other reports that showed the presence of tannins, saponins, alkaloids, and flavonoids as phytochemicals present in wonderful kola leaves as well as in other medicinal plants [5,6,8,10]. Tannins, saponins, alkaloids, proteins, carbohydrates and flavonoids are some of the many phytochemicals that are found in natural products including those of plant origin; and they have contributed to the healing effect of these natural materials. Studies have reported that plant parts contain numerous phytochemicals, and the presence of these compounds in herbal plants is strong indications that they have both medicinal and pharmacological values [1,3,8,9]. The ethanol and methanol crude extracts of wonderful kola leaves produced considerable antibacterial activities against the test organisms included in our study (Table 2). Notably, methanol extract had better inhibition zones on the *S. aureus* strains than the ethanol extract (Table 2). Ethanol extract was active against the test pathogenic *S. aureus*, and the zones of inhibition recorded were 12 mm (S1), 11 mm (S2), 10 mm (S3), 13 mm (S4), and 14 mm (S5). Similarly, the methanol extract of wonderful kola leaves showed zones of inhibition against S1 (13 mm), S2 (14 mm), S3 (13 mm), S4 (15 mm) and S5 (14 mm) strains. The crude leaf extracts of wonderful kola used in this study showed relatively large zones of inhibition against the test pathogenic *S. aureus* (Figure 1); and this suggest that the plant extracts could be used for the effective treatment of some bacterial related infections. Mbata *et al* [6], in a similar work also reported the antibacterial activity of wonderful kola plant on some pathogenic bacteria including pathogenic *S. aureus*.



**Figure 1.** Plate showing the effect of crude extracts of wonderful kola leaves on pathogenic *S. aureus*

**Table 2.** Results of antibacterial activity

Isolate No	Zones of inhibition (mm)		Control drug (Ampicillin, 1 mg/ml)
	Ethanol extract	Methanol extract	
S1	12	13	18
S2	11	14	18
S3	10	13	18
S4	13	15	18
S5	14	14	18

Key:

S = *Staphylococcus aureus*

**Table 3.** Results of minimum inhibitory concentration

Isolate No	Ethanol extract (mg/ml)	Methanol extract (mg/ml)
S1	100	50
S2	50	ND
S3	ND	100
S4	50	50
S5	ND	100

Key:

ND = MIC not determined at concentrations used

S = *Staphylococcus aureus*

The antibacterial activities of crude extracts of wonderful kola leaves against pathogenic bacteria (as reported in our study) are agreeable with previous reports that have also reported the medicinal efficacy of wonderful kola plants [2,4,6,10]. The bioactive compounds synthesized by medicinal plants are active, powerful and limitless; and these compounds could be well exploited to solve the mysteries of microbial resistance to some available synthetic drugs since these herbs (as exemplified in our study) actually possess antimicrobial activity. Elsewhere, wonderful kola plant has been reported to possess potent antibacterial activities against pathogenic microorganisms, and thus justifies the reason why they are used in most rural Nigerian communities to solve some medical ailments [2,4,6]. Table 3 shows the results of the minimum inhibitory concentration (MIC) of wonderful kola leaf extracts against the test isolates (pathogenic strains of *S. aureus*). The MICs for the ethanol extract were 100 mg/ml against S1; and 50 mg/ml against S2 and S4 strains of *S. aureus*. MICs were not determined for S3 and S5 strains of pathogenic *S. aureus* at the concentrations used (Table 3). The methanol crude extracts of wonderful kola inhibited the growth of pathogenic *S. aureus* at 50 mg/ml (S1), 100 mg/ml (S3), 50 mg/ml (S4) and 100 mg/ml (S5). However, S2 strain of the pathogenic *S. aureus* was not inhibited at the concentrations used in our study. The antibacterial activities of crude extracts of wonderful kola leaves against pathogenic bacteria (as is obtainable in our study) gives impetus to the traditional use of the plant and other medicinal herbs to meet certain primary health needs in Nigerian rural communities. Plant extracts especially those

of wonderful kola could be formulated into traditional antibiotics and other forms of antimicrobial agents that will be used to manage some infectious diseases. Therefore, pharmaceutical industries should turn the search light on herbal plants to discover lead compounds for the development of novel antimicrobial agents owing to the obvious threat of resistant microbes to some available synthetic and conventional drugs.

## 4. Conclusion

This study has presumptively reported the antibacterial activity of crude extracts of wonderful kola leaves on pathogenic strains of *S. aureus*. Wonderful kola leaves contain phytochemicals such as carbohydrates, phlobatannins, proteins, tannins, alkaloids, saponins, and flavonoids; and they possess substantial antibacterial activities. Further molecular characterization using high-throughput technologies is required to typify their bioactive compounds with a view to developing novel and potent antimicrobials from them.

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