

## ANTIOXIDANT AND ANTIBACTERIAL ACTIVITY OF ALKALOID EXTRACT OF *CUCUMIS TRIGONUS* ROXB

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### ABSTRACT

**Objective:** To evaluate the antioxidant and antibacterial efficiency of alkaloids of root, leaf, and fruit of *Cucumis trigonus*.

**Methods:** The antioxidant and antibacterial properties of alkaloid extracts were assessed by ferric thiocyanate (FTC), 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay, hydrogen peroxide radical scavenging assay, superoxide radical scavenging activity and ferric reducing power were analyzed separately for its inhibition percentage at different concentration (20µg, 30µg, 40µg and 50µg/ml) and antibacterial activity by agar disc diffusion and minimum inhibitory concentration (MIC) against *Staphylococcus aureus* (MTCC Code-9886), *Pseudomonas aeruginosa* (MTCC Code-6458).

**Results:** The highest percentage of extraction yield was observed in fruit followed by leaf and root. The maximum content of alkaloid was found in fruit and root compared to leaf. The scavenging efficiencies of the extracts increased with the increasing concentrations. Appreciable levels of total antioxidant activity by FTC (2.112±0.011%), DPPH radical scavenging activity (1.912±0.001%), superoxide radical scavenging activity (0.955±0.021%) and hydrogen peroxide radical scavenging activity (0.914±0.087 %) were observed at 50µg/ml of fruit extract. However, ferric reducing power was more in the root (0.893±0.0870%) compared to fruit (0.791±0.023%) and leaf (0.520±0.00 %) at 50µg/ml. The alkaloid extracts of root and fruit exhibited more antibacterial activity against *Staphylococcus aureus* (16.51±0.05 and 19.68±0.03 mm) and *Pseudomonas aeruginosa* (12.2±0.03 and 14.2±0.06) at 100µg/ml than leaf. The minimum inhibitory concentration (MIC) of the root, leaf, and fruit was in the range of 3.125µg/ml to 35µg/ml for the pathogenic bacteria.

**Conclusion:** Data from the present results revealed that the alkaloid extracts of fruit and root of *C. trigonus* show good antioxidant and antibacterial potential than leaf. Hence, may be explored for the formation of new antibacterial with antioxidant drugs.

**Keyword:** Antioxidant, Antibacterial, Alkaloid, DPPH, Disc diffusion assay

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### INTRODUCTION

Natural antioxidants are known to exhibit a wide range of biological effects including antimicrobial, hepatoprotective, anti-inflammatory, anti-allergic, anti-thrombic, anti-carcinogenicity, anti-immunogenicity, and anti-aging activity. The benefit of using natural drugs is their easy availability, economic and no side effects [1]. So, the compounds from natural sources such as phenol, flavonoids, alkaloids etc are capable of protecting against ROS mediated damage may help for the prevention and treatment for various complex diseases. Therefore traditional medicine is an important source of potentially useful new compounds for the development of chemotherapeutic agents.

*Cucumis trigonus* Roxb. a perennial tendrillar herb of the family *Cucurbitaceae* commonly called as bitter guard in english, jangal indrayan in hindi, mekke kai in kannad, indraravuni vishala in sanskrit and kattummatti in tamil. It is native to India and is distributed throughout India and also found in Ceylon, Afghanistan, Persia and Northern Australia [2]. In the traditional system of medicine *C. trigonus* root, fruit and seeds have great medicinal values [3]. The roots of the plant are used as purgative and liver tonic. The fruits are used in the treatment of leprosy, fever, jaundice, diabetes, cough, bronchitis, anaemia, constipation, other abdominal disorders and amentia [4]. Further, fruit pulp is bitter, acrid, thermogenic, anthelmintic, liver tonic, cardiogenic, appetizer, expectorant and intellect promoting [2]. Unsaturated lipids are the major constituents of seeds and acts as a coolant and astringent. The plant is reported to possess proteolytic and serine protease activity [5]. The aqueous fruits extract of *C. trigonus* had beneficial effects in reducing the elevated blood glucose level and lipid profile of STZ-induced diabetic rats [6] and also therapeutic and prophylactic value in the treatment of myocardial infarction [7]. The alcoholic fruit extract of *C. trigonus* could afford highly significant protection against CCl<sub>4</sub> induced hepatocellular injury [8]. It is a wild vegetable

plant with nutritional value is similar to that of cucumber [9]. Due to its wide application in traditional medicine evident from the available literature that the search for natural drugs of plant origin with antibacterial and antioxidant studies has become a central focus of research. Thus, the present study was carried out to provide the scientific evidence by examining the antibacterial and antioxidant activity of alkaloid extract from root, leaf and fruit of *C. trigonus* plant using *in vitro* assays.

### MATERIALS AND METHODS

#### Collection of plant materials

*Cucumis trigonus* ROXB (Cucurbitaceae) root, leaf, and fruit were collected in the month of November and December from field of Vijayapur district, Karnataka, India. The plant was identified with the help of 'The Flora of the Presidency of Bombay' [10]. The voucher specimen No. 504 has been deposited in the department of Botany, Government college Kalburgi district, Karnataka, India. The plant parts such as root, leaf and fruit were dried in the shade at room temperature between 25-30°C for 15-30 d, after drying the plant were chopped and grinded made into fine powder.

#### Alkaloid extraction

Alkaloids were extracted from different parts of the selected plant by the well-established method of Ramawat *et al.*, [11]. Finely 100g powdered sample of plant parts were extracted in 20 ml methanol after shaking of 15 min. After filtration, filtrates kept for drying then residual mass were treated with 1% H<sub>2</sub>SO<sub>4</sub> (5 ml, 2 times). Extraction was then done in 10 ml of chloroform (CHCl<sub>3</sub>) by using separating funnel. Organic layer of chloroform was rejected and aqueous layer was basified with 30% NH<sub>4</sub>OH (pH 9-10). Now again, extraction was done in 10 ml of chloroform and organic layer of chloroform (lower layer) was collected in a flask and repetition of

step was done with fresh chloroform. The extracts obtained were dried at 40 °C for further use.

### Yields of extracts

The yields of the extracts were calculated using the following formula [12, 13].

$$\text{Percentage of extractive value} = \frac{\text{Weight of the residue obtained}}{\text{Weight of the plant material taken}} \times 100$$

### Estimation of total alkaloid

The alkaloid was estimated by the method of Harborne [14]. The acetic acid (5%) extract of the plant material was warmed up to 70 °C and the pH-10 was made by NH<sub>4</sub>OH and centrifuged at 5000rpm. The precipitate was dissolved in ethanol (95%) and H<sub>2</sub>SO<sub>4</sub>. The alkaloid solution was mixed with 5 ml of 60% H<sub>2</sub>SO<sub>4</sub> after 5 min, 5 ml of the solution of formaldehyde in H<sub>2</sub>SO<sub>4</sub> was added. The solution was read at 565 nm absorbance after 15 min the amount of alkaloids was calculated using the standard curve of brucine.

### Analysis of *in vitro* antioxidant activity

The different concentration of alkaloid extract (20µg, 30 µg, 40 µg, 50 µg) of root, leaves and fruit samples of *C. trigonus* were tested for their *in vitro* antioxidant activity as follows.

### Evaluation of antioxidant activity by ferric thiocyanate (FTC) method

FTC method used to determine the amount of peroxide formed and that react with ferrous chloride (FeCl<sub>2</sub>) pigment, the concentration of peroxide decreases the same as the antioxidant activity increases. The antioxidant activities of extracts were determined by ferric thiocyanate method [15]. The sample mixture contains 0.5 ml of extract, 2.5 ml of linoleic acid emulsion in potassium phosphate buffer (0.05M pH 7.0) and 2 ml phosphate buffer (0.05M pH 7.0) in a test tube and incubated in darkness at 37 °C. The peroxide level was measured at 500 nm in a spectrophotometer. Ascorbic acid was used as positive control.

### Evaluation of free radical scavenging activity by DPPH method

The DPPH (1, 1-diphenyl-2-picrylhydrazyl) method allows a direct investigation of the ability for the extractor antioxidant to donate hydrogen and/or electrons to quench the DPPH radical. The potential antioxidant activity of extract was determined on the basis of scavenging activity of the stable DPPH free radicals by the method of Blois [16]. 0.1 ml of sample at various concentrations was mixed with 2.9 ml of methanolic DPPH (60µM) solution. The mixture was left in the dark for 30 min and absorbance was measured at 517 nm.

### Assay of superoxide radical scavenging activity

The method by Martinez *et al.*, [17] for determination of the superoxide dismutase was followed with modification in the riboflavin-lightnitroblueretrazolium (NBT) system. Each 3 ml reaction mixture contained 50 mmol sodium phosphate buffer (pH 8.8), 13 mmol methionine, 2µM riboflavin, 100µM EDTA, 75µM NBT and 500 µl sample solution of various concentrations alkaloid extracts was measured at 560 nm and compared with ascorbic acid as a standard compound. The percentage of inhibition was calculated according to the following equation

$$\text{Percentage of inhibition} = [(A_0 - A_t) / A_0] \times 100,$$

Where A<sub>0</sub> was the absorbance of the control (blank) and at was the absorbance in the presence of each extract.

### Hydrogen peroxide radical scavenging activity

Hydrogen peroxide radical scavenging ability of alkaloid extracts were assessed by adopting the method given by Ruch *et al.* [18]. A solution of hydrogen peroxide (2 mmol) was prepared in phosphate buffer (0.2M, pH 7.4). Extracts in different concentrations were added to a hydrogen peroxide solution (0.6 ml, 2 mmol). The absorbance of hydrogen peroxide at 230 nm was determined 10 min later against a blank solution containing the phosphate buffer without hydrogen peroxide. The percentage of hydrogen peroxide scavenging of both extracts and standard compounds were calculated using formula.

$$\text{Percentage of inhibition} = \frac{\text{Abs (control)} - \text{Abs (test)}}{\text{Abs (control)}} \times 100$$

Where Abs (control): Absorbance of the control and

Abs (test): Absorbance of the extract/standard

### Determination of ferric reducing power

The reducing power of the prepared extracts was determined using ferricyanide trichloroacetic acid method according to Oyaizu [19]. Each sample extract was mixed with 200 mmol phosphate buffer (pH 6.6) and with 1% potassium ferricyanide in the ratio of 1:1(v/v) and the mixture was incubated at 50 °C for 20 min. After 2.5 ml of 10% trichloroacetic acid (w/v) was added, the mixture was centrifuged at 659rpm for 10 min. The upper layer was mixed equally with deionized water and 1 ml of 0.1% ferric chloride and the absorbance was measured at 700 nm. A higher absorbance indicates a higher reducing power.

### Antimicrobial activity

#### Pathogens used

The pure axenic culture of bacteria *Staphylococcus aureus* (MTCC Code-9886), *Pseudomonas aeruginosa* (MTCC Code-6458) (microbial type culture collection) were obtained from institute of microbial technology, Chandigarh. All the cultures were maintained at 4 °C on the slants of nutrient agar medium for further use.

#### Reconstitution of the extracts

The alkaloid extracts were dissolved in dimethyl sulfoxide (DMSO) and the final concentrations of the crude extract solution were obtained as 50µg/ml and 100µg/ml respectively

#### Antibacterial activity

The extracts were screened for their antibacterial activity in comparison with standard Streptomycin (10 mg/ml) *in vitro* by agar well diffusion method [20]. The petri plates containing 15-20 ml of Muller Hinton Agar (MHA) medium was inoculated with 200µl of 18h old bacterial culture was evenly spread with a sterile bent glass rod. The inoculated plates are kept aside for few minutes. A sterile cork borer was then used to make four wells (8 mm diameter) for different concentrations of the extract, on each of the plates containing cultures of the different test organisms. The four peripheral wells were filled with 100µl of each crude extracts of the concentration 50 and 100µg/ml respectively. In the similar way, one agar plates for each microorganism were prepared for studying the antibacterial activity of reference compound Streptomycin (100µg/ml). For assaying antibacterial activity, plates were incubated at 37 °C for 24h. The diameter of the zone of inhibition (in mm) was recorded.

#### Minimum inhibitory concentration (MIC)

The MIC of the extracts was determined according to the macro broth dilution technique [21]. Standardized suspensions of the test organisms were inoculated into a series of sterile tubes of nutrient broth containing two-fold dilution of leaf extracts and incubated at 37 °C for 24h. MICs were read as the least concentration that inhibited the growth of the test organisms.

#### Statistical analysis

The data of all measurements are means from three replications. Data and statistical significance of difference were evaluated with analysis of variance (ANOVA) using SPSS 10.0 package.

## RESULTS

### Extractive values and total alkaloid contents

The percentage of the extractive value of root, leaf and fruit of *C. trigonus* were recorded in the table 1. The yield of alkaloid extracts were 5.14% to 11.36% and could be ranked from high to low *i.e.*, fruit>root>leaf respectively. Further, the results shows that the fruit contain higher amount of total alkaloid (193.22±0.82 mg/g) compared to root (162.02±0.23 mg/g) and leaf (76.34±0.03 mg/g) (table 1).

Table 1: Extractive value and total alkaloids of *C. trigonus*

Plant part	% yield of extract	Total alkaloid mg/g brucin equivalent
Root	9.34±0.12	162.02±0.23
Leaf	5.14±0.10	76.34±0.03
Fruit	11.36±0.05	193.22±0.82

Each value is expressed as mean±SD (n=3) and means are different from each other by ANOVA ( $P<0.05$ ).

#### Total antioxidant activity by FTC method

Total antioxidant activity by FTC method of root, leaf, and fruit of alkaloid extracts increased readily along the increased concentration (table 2). At higher concentration of 50µg/ml antioxidant activity was in the order; fruit extract (2.019±0.022 %)>root extract (1.08±0.023%)>leaf extract (0.724±0.034%). The maximum antioxidant activity was observed in fruit extract (2.019±0.022 %) and most nearer to the standard ascorbic acid (2.112±0.011%) at 50 µg/ml concentration.

#### DPPH radical scavenging activity

Results show that the free radical scavenging activity of root, leaf and fruit of alkaloid extracts of *C. trigonus* increased with the increasing concentration were presented in table 3. Radical scavenging activity at

higher concentration 50µg/ml of root, leaf and fruit extracts were found to be 0.830±0.005%, 0.634±0.003% and 1.598±0.002% respectively. Root and leaf extract shows much lower radical scavenging activity. The significant free radical scavenging activity was observed in fruit extract (1.912±0.001%) and it was higher than the standard ascorbic acid (1.598±0.002%) at 50µg/ml concentration.

#### Assay of superoxide radical scavenging activity

Superoxide radical scavenging activity of root, stem and leaf of *C. trigonus* increases with increasing concentration (table 4). The maximum superoxide radical scavenging activity was observed in fruit (0.955±0.021 %) compared to root (0.734±0.007%) and leaf (0.571±0.002%) at 50µg/ml similarly, the scavenging activity of ascorbic acid at the same concentration was 1.451±0.012%.

Table 2: Total antioxidant activity by FTC method of alkaloid extract of *C. trigonus*

Plant parts	% of inhibition			
	20µg	30µg	40µg	50µg
Root	0.453±0.023	0.725±0.018	0.798±0.009	1.08±0.023
Leaf	0.298±0.012	0.392±0.015	0.478±0.022	0.724±0.034
Fruit	0.632±0.015	0.895±0.032	1.378±0.018	2.019±0.022
Standard ascorbic acid	0.814±0.022	0.923±0.045	1.626±0.014	2.112±0.011

Each value is expressed as mean±SD (n=3) and means are different from each other by ANOVA ( $P<0.05$ ).

Table 3: DPPH radical scavenging activity of alkaloid extract of *C. trigonus*

Plant parts	% of inhibition			
	20µg	30µg	40µg	50µg
Root	0.289±0.005	0.602±0.003	0.710±0.001	0.830±0.005
Leaf	0.193±0.005	0.361±0.008	0.423±0.004	0.634±0.003
Fruit	0.398±0.004	0.821±0.003	1.206±0.008	1.912±0.001
Standard ascorbic acid	0.543±0.002	0.886±0.005	1.426±0.004	1.598±0.002

Each value is expressed as mean±SD (n=3) and means are different from each other by ANOVA ( $P<0.05$ ).

#### Hydrogen peroxide radical scavenging activity

Results show that the hydrogen peroxide radical scavenging activity of root, leaf and fruit of *C. trigonus* alkaloid extracts increased with the increasing concentration and were high for fruit and root, the leaf

extract shows much lower radical scavenging activity (Table-5). Radical scavenging activity at a concentration of 50 µg/ml of root, leaf and fruit extracts were found to be 0.751±0.023 %, 0.318±0.010% and 0.984±0.087% respectively however, the scavenging activity of ascorbic acid at the same concentration was 2.05±0.028 %.

Table 4: Superoxide radical scavenging activity of alkaloid extract of *C. trigonus*

Plant parts	% of inhibition			
	20 µg	30 µg	40µg	50 µg
Root	0.131±0.002	0.446±0.004	0.602±0.002	0.734±0.007
Leaf	0.114±0.003	0.297±0.006	0.410±0.007	0.571±0.002
Fruit	0.422±0.006	0.780±0.002	0.984±0.005	0.955±0.021
Standard ascorbic acid	0.650±0.001	0.723±0.012	0.989±0.023	1.451±0.012

Each value is expressed as mean±SD (n=3) and means are different from each other by ANOVA ( $P<0.05$ ).

Table 5: Hydrogen peroxide scavenging activity of alkaloid extracts of *C. trigonus*

Plant parts	% of inhibition			
	20µg	30µg	40µg	50µg
Root	0.426±0.005	0.631±0.011	0.730±0.003	0.751±0.023
Leaf	0.145±0.012	0.234±0.021	0.285±0.008	0.318±0.010
Fruit	0.508±0.005	0.669±0.005	0.848±0.034	0.984±0.087
Standard ascorbic acid	0.780±0.021	0.812±0.009	1.35±0.013	2.05±0.028

Each value is expressed as mean±SD (n=3) and means are different from each other by ANOVA ( $P<0.05$ ).

**Determination of ferric reducing power**

Reducing the power of root, leaf and fruit extracts from *C. trigonus* increased readily along the increased concentrations (table 6). At concentration of 50µg/ml, reducing power were in the order; root

(0.893±0.087 %)>fruit (0.791±0.023%)>leaf (0.520±0.005 %). However, reducing the power of ascorbic acid at 50µg/ml was 1.451±0.012 %. The maximum percentage of reducing power was detected in root compared to fruit and leaf.

**Table 6: Ferric reducing power of alkaloid extract of *C. trigonus***

Plant parts	% of inhibition			
	20µg	30µg	40µg	50µg
Root	0.526±0.005	0.631±0.011	0.830±0.003	0.893±0.087
Leaf	0.212±0.007	0.344±0.015	0.405±0.001	0.520±0.005
Fruit	0.408±0.005	0.569±0.005	0.748±0.034	0.791±0.023
Standard ascorbic acid	0.650±0.001	0.723±0.012	0.989±0.023	1.451±0.012

Each value is expressed as mean±SD (n=3) and means are different from each other by ANOVA ( $P<0.05$ ).

**Antibacterial activity**

The antibacterial efficacy of alkaloid extracts from root, leaf and fruit of *C. trigonus* was determined by screening extracts against Gram-positive bacteria of *Staphylococcus aureus* and Gram-negative bacteria of *Pseudomonas aeruginosa*. All the extracts were found active against all the test bacterial strains (table 7). In this assay, the leaf extract shows less inhibition zone against *Staphylococcus aureus* (1.36±0.04 mm) and *Pseudomonas aeruginosa* (1.2±0.03 mm) at 50µg/ml. The root extract shows moderate inhibition zone against *Staphylococcus aureus* (10.51±0.05 mm) and *Pseudomonas aeruginosa* (12.2±0.03 mm). However the fruit extracts exhibited higher antibacterial activity against *Staphylococcus aureus* (19.68±0.03 mm) then *Pseudomonas aeruginosa* (14.2±0.06 mm) at 50µg/ml this is a significant activity compared with the activity of

the standard streptomycin which show zone of inhibition of 22.0±0.05 mm (against *Staphylococcus aureus*) and 20.0±0.07 mm (against *Pseudomonas aeruginosa*) at 50µg/ml.

**Minimum inhibitory concentration**

The MIC method was applied on extracts has proved their high efficacy against microorganisms by the disc diffusion method. The MIC of root, leaf and fruit extract as shown in table 8. The extract had MIC values of 3.125 to 35µg/ml against both strains. The fruit and root extracts of *C. trigonus* showed highest sensitivity at 3.125µg/ml and 5.125±0.5µg/ml against *Staphylococcus aureus* and at 4.5µg/ml and 7.35µg/ml against *Pseudomonas aeruginosa*. The leaf extract had weak activity with MIC values of 35µg/ml against *Staphylococcus aureus* and 32µg/ml against *Pseudomonas aeruginosa*.

**Table 7: Antibacterial activity of alkaloid extracts of *C. trigonus***

Plant parts	Conc. (µg/ml)	Diameter of the zone of inhibition (mm)	
		<i>Staphylococcus aureus</i>	<i>Pseudomonas aeruginosa</i>
Root	50	10.3±0.03	8.5±0.02
	100	16.51±0.05	12.2±0.03
Leaf	50	0.87±0.02	0.48±0.05
	100	1.36±0.04	1.2±0.03
Fruit	50	15.3±0.05	11.5±0.08
	100	19.68±0.03	14.2±0.06
Streptomycin	100	22.0±0.05	20.0±0.07

Each value is expressed as mean±SD (n=3) and means are different from each other by ANOVA ( $P<0.05$ ).

**Table 8: Minimum inhibitory concentration of alkaloid extracts of *C. trigonus***

Microorganism	Gradient of extract µg/ml		
	Root	Leaf	Fruit
<i>Staphylococcus aureus</i>	5.125±0.5	35±0.12	3.125±0.15
<i>Pseudomonas aeruginosa</i>	7.35±0.8	32±0.15	4.5±0.6

Each value is expressed as mean±SD (n=3) and means are different from each other by ANOVA ( $P<0.05$ ).

**DISCUSSION**

The result of our study showed that the alkaloid extract of fruit gives the highest yield and total alkaloid content than root and leaf extract. This can be explained by the distribution of compounds in the plant part. Bousselessela *et al.*, [22] have reported yield of neutral alkaloid extract 12.07% and basic alkaloid extract (3.07%) in leaf of *Euphorbia granulate*. The researchers have recorded total alkaloid contents of 0.87 mg/kg of fruit of *C. trigonus* [23]. Alkaloids have a wide range of pharmacological activities including anticancer and antibacterial activities and hence responsible for many healing properties in natural medicine.

Total antioxidant assay using FTC, which indicates the ability of the phytomedicines to minimize oxidative damage to vital organs and tissues *in vivo*. The results of total antioxidant activity by FTC

method revealed that alkaloid extract of fruit had maximum antioxidant activity than the other extract. There are reports on the alkaloid extracts of two Algerian species of *Fumaria capreolata* and *Fumaria bastardii* had more antioxidant activity by FTC method [24]. Results of the investigation revealed that alkaloid fruit and root extract showed a relatively high DPPH radical scavenging activity than leaf at 50µg/ml. Similarly Gill *et al.*, [25] have reported the highest free radical scavenging activity of methanolic extract of seeds of *C. trigonus*. The reports has shown that alkaloids extracts of *Euphorbia granulate* leaf was shown a great antiradical activity by the characterization of several substances which inhibit free radical DPPH [22]. Further, Rosidah *et al.*, [26] have reported that alkaloid fractions of *Z. acanthopodium* DC. fruit have very strong antioxidant potential by DPPH method. Superoxide radical is known to be very harmful to cellular components as a precursor of more reactive

species. One risk of the superoxide generation is related to its interaction with nitric oxide to form peroxynitrite [27] which is a potent oxidant that causes nitrosative stress in the organ systems. Scavenging of H<sub>2</sub>O<sub>2</sub> by the extract may be attributed to the compounds, which can donate electrons to H<sub>2</sub>O<sub>2</sub>, thus neutralizing it to water [28]. Gill *et al.*, [25] have reported the maximum H<sub>2</sub>O<sub>2</sub> scavenging effect of methanolic extract of seeds of *C. trigonus*. The reducing power increased with increasing the concentration of the extract. The reducing ability of the compound may provide a significant indicator of its effective antioxidant activity [29]. The absorbance values of the extract at different concentrations was found to be less than that of the reference compound and this is in accordance with the report of Gulcin *et al.*, [30].

From the results of our study, the maximum inhibition zone was shown by the alkaloid extract of fruit against *S. aureus* and *P. aeruginosa* at a concentration of 100µg/ml than root and leaf extract. Bousselessela *et al.*, [22] have reported the largest zone of growth inhibition was shown by the neutral alkaloids extract *Euphorbia granulate* against *S. aureus* at a concentration of 10 mg/ml. The Gram-positive bacteria are much more sensitive than Gram-negative bacteria this sensibility can be attributed to the structure of bacteria [31].

## CONCLUSION

The alkaloid extract of root, leaf and fruit of *C. trigonus* exhibited moderate to high antioxidant and antibacterial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The alkaloid fruit and root extract of *C. trigonus* is more active than leaf extract. It further exhibited good electron donating ability, which implies that alkaloids may be inhibiting some redox pathways in the bacterial cell, thereby slow the growth or even cause death of a microbe. This antioxidant property adds value to the potential antibacterial efficacy of the alkaloids from the fruit and roots of *C. trigonus* hence, the need to explore further pharmacological effects and safety

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## AUTHORS CONTRIBUTIONS

All the author have contributed equally

## CONFLICT OF INTERESTS

The authors of this article declare that we have no conflict of interest in this study

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