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Phytochemical and antibacterial potentials of *Tecoma stans* and *Costus afer*

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Abstract

Phytochemical composition and antibacterial potential of ethanolic extract of leaves/roots of *Tecoma stans* and leaves of *Costus afer* evaluated were collected at Malabo Campus, University of Calabar, Calabar and from Eman-Uruan local government area, Akwa Ibom, Nigeria respectively. Fresh leaves of both plants and roots of *Tecoma stan* C in the refrigerator.

The result showed that the leaves/roots of *T. stans* and leaves of *C. afer* contain Alkaloids, Flavonoids, Saponins and Glycosides. The MIC of leaves of *T. stans* showed 5.21mg/ml for *S. aureus*, 10.4mg/ml for *E.coli*, 83.3mg/ml for Proteus speies. The roots of *T. stans* showed 75mg/ml for S.aureus. The MIC for *C. afer* showed 5.2mg/ml for *S. aureus* and 312.5mg/ml for *M. morganii*. The results indicate that both plants can be used to achieve significant inhibitory effects as antimicrobial agents for treatment of bacterial infections in the absence of orthodox medication.

Keywords: Antibacterial; natural products; nutrient broth; incubation; inhibition

Introduction

Natural products are commonly understood to refer to herbs, herbal concoctions, and dietary supplements, alternative medicine be it Chinese, African, Philippines, Indian origin [1]. They are of prebiotic origin or they may originate from plants, animal or microbial sources

The cost of drug discovery and drug development continues to increase at astronomical rates and despite the successes the interest in natural products has increased and waned in popularity with various pharmaceutical companies. Natural products have contributed immensely to the development of the pharmaceutical industry and research, and have been widely applied in human medicine with significant promise to target resurgent and emerging diseases [2]. Some pharmaceutical companies have however shown considerable interest in drugs derived from natural sources as they are "greener sources", safe and more dependable compared to synthetic drugs. The research into the use of medicinal plants derived from natural sources alone in the field of medicine covers a broad spectrum of activities which include analgesics, cardioprotectants, antidiabetic, antiviral, antibacterial agents etc [3]. Natural products have been the source of inspiration for numerous pharmaceutical agents utilized for human health; however, the development of many natural product leads is often hindered due to the low quantities of material that can be harvested from plants and microbial sources [4]. Indeed without natural products, medicine would be lacking in therapeutic tools in several important clinical areas such as cardiovascular disease, immunoinflamatory disease, neurodegene rative disease etc. [5, 6]

In the last decade pathogenic microbial infectious agents have exhibited resistance to chemotherapeutics and antibiotic treatments triggering a renewed interest in antibacterial agents from natural sources which are effective against pathogenic bacteria [7]. Nature has provided varied resources for humans over the years including tools for the first attempts at therapeutic intervention [1]. Many medicinal plants have been screened extensively for their antimicrobial potential worldwide [8, 9].

Most plants possess limitless ability to synthesize aromatic substances have been reported to have antimicrobial activity [10].

Tecoma stans (family, Bignoniaceae) commonly known as yellow elder, yellow trumpet is a semi ever green ornamental

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shrub or tree [11]. It is a native of southern Texas, Latin America, Bahamas, and Trinidad. It has naturalised in much of tropical and subtropical Africa, Asia and Australia

Tecoma stans is an ornamental plant. It is planted and managed to enhance beauty of green belts and natural forests for purpose of providing recreation [11]. The leaves of *T. Stans* contain many active substances such as tannins, alkaloids; saponins etc have been shown to effectively reduce the symptoms of *diabetes mellitus* [12]. The plant is traditionally used in parts of Mexico for control of diabetes, digestive and urinary disorders [13]. It has been reported that tecomine an alkaloid present in *T. Stans* is responsible for the hypoglycaemic action [12]. *Costus. afer* Ker-Gawl. (Costaceae) is among 150 species of stout, perennial and rhizomatous herbs of the genus [14]. It can be found in the forest belt of Senegal, South Africa, Guinea, Niger, Sierra Leone and Nigeria [14, 15]. The plant is commonly called bush cane, irekeomode (Yoruba-Western part of Nigerian) and opete (Igbo-Eastern part of Nigeria) and mbritem (Ibibio/ Efik - Southern part of Nigeria). *C. afer* is a useful medicinal plant that is highly valued for its anti-diabetic, anti-inflammatory and anti-anthritic properties in South-East and South-West Nigeria. An infusion of the dried aerial parts is used to treat hypertension; the juice is taken orally for the treatment of cough and stomach-ache while the boiled tender leaves are used as soothing fomentation for rheumatic pains [16].

The pharmacological activities of many plants including *T. Stans* is derived from the presence of its phytochemical constituents such as alkaloids, saponins, flavonoids, tannins, glycosides, antioxidants, flavones, isoflavones, catechins, anthocyanidins, isothiocyanates, carotenoids, allyl sulfides, polyphenols [17].

This study was undertaken to demonstrate phytochemical and antibacterial potentials of *Tecoma stans* and *Costus afer* Kgwal cultivated in the southern part of Nigeria to determine their therapeutic potentials.

Materials and Method

Plant Material

Fresh leaves and roots of *Tecoma stan*s were collected at Malabo campus, University of Calabar, Calabar. *Costus afe*r leaves were collected from Eman Uruan, Uruan local government area of Akwa Ibom State, Nigeria. They were identified by Mr Frank I. Apojoye of Botany Department, University of Calabar and voucher samples were deposited at the herbarium of Botany Department, University of Calabar for reference. The leaves and roots were washed and shade dried for seven and ten days respectively. They were crushed into fine powder. The dried powder of both plant parts were separately soaked in 80% ethanol for 72 hours with occasional agitation after which they were filtered through chess material and the Whatman NO.1 filter paper to obtain a homogenous filtrate. The filtrate was concentrated in vacuum at low temperature 37^o-40^o C to about one tenth of the original volume. The concentrates were allowed in an open water bath 40^o C to evaporate the concentrate to complete dryness. A semi solid brown and dark green colored concentrates were obtained for roots and leaves respectively. They were stored in clean capped bottles in a refrigerator for further use.

Bacterial Isolates

Five (5) bacterial isolates (*Staphylococcu*s *aureu*s, *Escherichia coli, Pseudomonas aeruginos*a, Klebsilla *pneumoniae , P.specei*s, Shigella *sonne*i, Morganella *morganii, and Maraxell*a *catarrhli*s were obtained from the University of Calabar Teaching Hospital, Calabar. They were maintained on nutrient agar at 4^o C in the refrigerator.

Screening for Antibacterial Activity

The agar-well diffusion technique as described by Irobi et al, [18] was employed. Bacterial inocula were prepared by giving each pure culture in nutrient broth for 18-24 hours at 37^o C. Dilutions of the nutrient broth culture were prepared to obtain 0.5 Narfarland turbidity standards. 100ul of the nutrient broth culture was spread plated on the Muller Hinton agar plate. After spread plating 5mm diameter cork burer was used to make wells on the Muller Hinton agar plates. 1gm of the leaf and root extracts of *Tecoma stan*s were dissolved in 2ml of dimethylsulphurdioxide (DMSO) respectively to achieve a concentration of 500mg/ml of extract. 100ul of the dissolved extracts were pipette in the agar wells. 100ul DMSO was also pipette into a separate well to serve as control.10ug disc of gentamicin was also included to serve as antibiotic control. All plates were incubated at 37^o C for 24 hours. Following incubation the diameter of zones of inhibition were measured and recorded in millimetres. The average of three independent determinations was recorded

Results and discussion

Discusion

The results of the antibacterial activity of the ethanol extract of the root of *T. stans* (Table 2) shows inhibitory activity over all selected bacterial organisms at zones of inhibition against 10ug/ml of the standard gentamicin.

The leaf extract (*T. Stans*) 416.7mg/ml exhibited highest inhibition 14.5mm for *S.aureus* against 16.5mm produced by 10ug/ml of the standard.

Table 1 Phytochemical Composition of Ethanolic Extract of *Tecoma stan*s (Leaves/Root) and *Costus afer K gwa*l

Chemical Constituents	**Leaves *T.stans***	**Root *T.stans***	**Leaves *Costus afe*r**
Alkaloids	+	+++	_
Glycosides	++	+	+++
lavonoids	+++	++	+++
Saponins	++	+++	+

+ Slight presence, ++ Presence, +++ Strong presence, _ not detected

Table 2 Antibacterial activity of ethanolic extract of leaves of *Tecoma stan*s on Different bacteria

	Zone of Inhibition (mm)										
Concentration (mg/ml)	**2.6**	**5.2**	**10.4**	**20.8**	**41.7**	**83.3**	**25.0**	**187.5**	**312.5**	**416.7**	**Gentamycin**
Organism											**(10μg/ml)**
S.aurreus	0.00	1.50	4.00	5.00	7.00	9.00	10.00	12.00	12.50	14.50	16.5
E.coli	0.00	0.00	1.00	3.00	5.00	8.00	9.00	11.00	12.00	12.50	18.0
P.aeroginosa	0.00	0.00	0.00	0.00	3.00	6.00	8.00	8.50	8.50	9.00	17.5
Proteus speies	0.00	0.00	0.00	0.00	0.00	1.00	3.00	4.00	5.00	5.00	0.00
K.pneumoniae	0.00	0.00	0.00	0.00	0.50	2.00	4.00	4.00	4.00	5.00	15.00
Moraxella catarrhis	0.00	0.00	2.40	2.60	3.00	3.00	4.20	4.20	8.50	10.20	18.0
Morganella morganii	0.00	0.00	0.00	0.00	2.50	2.50	2.70	3.00	4.10	5.40	0.00
Shigella sonnei	0.00	0.00	0.00	0.00	0.00	0.00	1.50	3.00	4.50	7.40	22.40

Table 3 Antibacterial activity of ethanolic extract of root of *Tecoma stans* on Different bacteria

	Zone of Inhibition (mm)										
Concentration (mg/ml)	**2.6**	**5.2**	**10.4**	**20.8**	**41.7**	**83.3**	**125.0**	**187.5**	**312.5**	**416.7**	**Gentamycin**
Organism											**(10μg/ml)**
S.aurreus	0.00	0.00	0.50	2.00	4.00	5.00	5.50	5.50	6.00	6.00	16.5
E.coli	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.0
P.aeroginosa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.5
Proteus speies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K.pneumoniae	0.00	0.00	1.00	4.00	6.00	6.00	7.00	7.00	7.50	8.00	15.00
Moraxella catarrhis	0.00	0.00	2.40	2.60	3.00	3.00	4.20	8.00	8.50	10.0	18.0
Morganella morganii	0.00	0.00	0.00	0.00	2.50	2.70	3.00	4.00	4.10	5.40	0.00
Shigella sonnei	0.00	0.00	0.00	0.00	0.00	1.50	3.00	4.00	4.50	7.40	22.40

Table 4 Antibacterial activity of ethanolic extract of leaves of *Costus afer* Ker gwal on Different bacteria

	Zone of Inhibition (mm)										
Concentration (mg/ml)	**2.6**	**5.2**	**10.4**	**20.8**	**41.7**	**83.3**	**125.0**	**187.5**	**312.5**	**416.7**	**Gentamycin**
Organism											**(10μg/ml)**
S. aurreus	0.00	4.00	4.20	4.50	5.80	6.20	9.00	10.00	10.70	11.40	16.5
E. coli	0.00	0.00	0.00	0.00	0.00	4.70	5.40	5.50	5.80	6.80	18.0
P. aeroginosa	0.00	0.00	4.00	4.20	5.30	5.40	6.20	7.00	8.00	9.50	17.5
Proteus speies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K. pneumoniae	0.00	0.00	0.00	0.00	0.00	0.00	3.40	4.00	4.00	5.00	15.00
Moraxella catarrhis	0.00	0.00	0.00	2.00	4.00	4.20	4.50	5.00	6.50	7.00	18.0
Morganella morganii	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.80	4.80	0.00
Shigella sonnei	0.00	0.00	0.00	0.00	3.50	3.50	4.00	4.50	4.50	7.20	22.40

The minimum inhibitory concentrations (MICs) of the leaf (*T. Stans*) extract for *S.aureus* was 5.21mg/ml indicating that a small dosage of the leaf extract will eliminate *S.aureus* while 10.4mg/ml was recorded for *E. coli*, 41.7mg/ml for *P. aeruginosa* and *K. pneumonia*e (Table 2). The leaf extract recorded an MIC of 83.3mg/ml for Proteus speies and highest of 416.7 mg/ml at 5mm compared to gentamycin which recorded no inhibitory activity for *Proteus speie*s.

The ethanol extract of the root of *T. Stans* exhibited moderate to significant antibacterial activity against five (5) out of eight (8) tested bacterial organisms as compared to the standard gentamycin (16.5mm) Table 3. Other plant extracts e.g. *Delonix elat*a and *Marrubium vulgar*e have shown to be ineffective against *P. aeruginosa* [10] [19]. The maximum zone of inhibition (23 mm) was observed by Ramesh et al in 225 mg/mL concentration against *Pseudomonas aeruginos*a and the minimum zone of inhibition (16 mm) was observed in 75mg/mL concen-

tration against Staphylococcus epidermidis using methanolic extract of roots of *Tecoma stan*s.

Table 4 show the result of antibacterial activity of *Costus afer* at 20.8mg/ml an indication the plant extract is a potential for respiratory tract infection (RTI).

Both extracts present broad spectrum antibacterial activity against the organisms tested. This suggests the extract of these plants exhibited a broad spectrum activity since it was active against both the Gram-positive and the Gram-negative organisms tested . The antimicrobial activity shown by this extract on the test organisms may be either due to the presence of alkaloids, flavonoids, saponins and glycosides (Table 1) [20]. [21] reports strong presence of flavonoids and saponins in ethanolic extract of *T.stans* leaves. The potentials for developing antimicrobials from plants seem rewarding as it will lead to the development of a phytomedicine against microbes. The ethanol extract of *T. stans* in combination with *C.afer* extract can be used to achieve significant inhibitory activity effects (polyherbal therapy) as antimicrobial agents in the treatment of bacterial infections.

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