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In-vitro Experimental Studies on Selected Natural Gums and Resins for Their Antimicrobial Activity.

Sravani P*, Y Kiranmayee, S Narasimha M, VS Reddy, S Asha and R Bharath Kumar.

School of Biotechnology, Vignan University, Vadlamudi, Guntur-522213 Andhra Pradesh, India.

ABSTRACT

The present work will focus on the importance of plant base gums & resins and their antifungal and antibacterial activity. The plants were selected for Extracts to test their broad spectrum of anti microbial activity resistance against for the selected plant gums & resins as per the literature sources [1,2].There are about 7 indigenous gum/ resin yielding plants were selected which are having diversified uses like medicinal, economic, timber, fibre, gum and resin yielding plants like *Acacia nilotica* (from bark), *Azadirachta indica* (from bark), *Bombax ceiba* (from bark), *Boswellia serrata* (from bark), *Cocos nucifera* (from fruit),*Mangifera indica* (from fruit) & Prunus *dulcis* (from bark) etc.viz.of Guntur region (Vadlamudi, Tenali etc.), [3,4]. The Antifungal activity and the anti bacterial activity were tested against 7 plant gums and resins. A total number of 88 plant extracts (gums/resins) were prepared as an individual of 28 ethanol, methanol, acetone and hot water extracts belongs to the 7 individual plant species and another set of 6 plant extracts were prepared in combination of ethanol, methanol, acetone & n-butanol. 6 Plant extracts were prepared in multiple combinations ethanol , methanol, acetone, n-butanol. All these plant extracts were subjected against their antibacterial and anti fungal screening analysis, out of these plant extracts (individual, combination & multiple) 5 plant extracts have been expressed the cognizable zone of expression i.e. 25 mm > 30 mm inhibition. Therefore these combinations were suggested for further analysis of gums &resins for their antimicrobial activity

Keywords: In-vitro studies, selected plant gums & resins, antimicrobial activity.

Corresponding author

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INTRODUCTION

Vignan University (VU) (formerly Vignan's Engineering College is a premier institution affiliated to Jawaharlal Nehru Technological University in Andhra Pradesh). It is having the splendid avenue, imposing buildings and sprawling playgrounds, and the verdure in and around the campus. The college is a virtual haven of rural quiet and idyllic beauty. Since its inception in 1997, VU has been striving to promote high quality standards in technical education & research for the aspirants of Engineering Studies.

Topography

Vignan University is located in the serene environs of Vadlamudi on the Guntur-Tenali highway, about 14 km from Guntur and 11 km from Tenali. The nearest railway station Tenali is located on Chennai – Kolkata trunk line.

Brief enumeration and description of habit &habitat of selected natural gums & resin yielding plant species for their antimicrobial activity:

Acacia nilotica (L.) Wild. (Mimosaceae)
Ln.: Thumma

Tree, it is a native of northern Mediterranean coast, Pantropical. Within India, it has naturalized, often cultivated in gardens [5,6]. Gum *Acacia* consists principally of *Arabin*, a compound of Arabic acid with calcium, varying amounts of the magnesium and potassium salts [3,6]. Gum *Acacia* is a demulcent and serves by the viscidity of its solution to cover and sheathe inflamed surfaces. It is usually administered in the form of a mucilage [7].

Azadirachta indica A. Juss. (Meliaceae)
Ln.: Vepa

Trees, it is probably native to India globally distributed in the Indian subcontinent. The gum exuded by *Azadirachta indica* trees contains of proteinaceous material. The most abundant amino acid is aspartic acid; there are also considerable proportions of serine and threonine, and at least 2% of amino sugars [8].

Neem gum is used as a bulking agent and for the preparation of special purpose food. [9].

Bombax ceiba L. (Bombacaceae)
Ln.: Burugu

Trees, it is native to Pakistan and India, globally distributed from Indo-Malaysia to Australia. In peninsular India, it is found commonly in the dry and moist deciduous forests. [10]

Gum-The bark exudes a gum (morchras) which is insoluble in water and is attributed as astringent, tonic, alterative, styptic, bleeding piles and demulcent [11]. It is used in dysentery, haemolypsis of pulmonary tuberculosis, influenza and in treatment of chicken pox etc [12].

Boswellia serrata Birdw. (Bursaraceae)
Ln.: Guggilam

Trees, it is a native to Africa and yields the truce Frankincense or Olibanum, an oleo-gum-resin [1,20]. It consists of essential oils, gum and terpenoids (boswellic acids) [13]. The Gum Resin is largely used as incense because of its very unique fragrance [14]. *Boswellia* has been shown to be as effective and, in many cases, better than drugs like Phenylbutazone & other anti-inflammatory drugs and preparation of ayurvedic formulations for treating Asthma and Arthritis [15, 20].

Boswellia -Resin

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Cocos nucifera L (Arecaceae)
Ln.: Coconut

Trees, Pantropical, especially along tropical shorelines. guar gum and tender coconut kernel having a beta-(1,4)-linked D-mannose backbone. Depolymerized guar gum has 92% of oligosaccharides [16]. The nature of lauric acid as a fatty acid makes it particularly effective for creating detergents and surfactants [17].

Mangifera indica L. (Anacardiaceae)
Ln.: Mango

Trees, it is globally distributed in the tropics and cultivated for the edible fruits. Within India, it is wild or semi-wild nearly throughout the tropical and sub-tropical hilly forests [18]. Gum- resinous, red-brown gum from the trunk is used for mending crockery in tropical Africa. In India, it is sold as a substitute for gum Arabic [19]. Mango kernel decoction and powder (not tannin-free) are used as vermifuges and as astringents in diarrhea, hemorrhages and bleeding hemorrhoids [20].

Prunus dulcis (Miller) D.A.Webb. (Rosaceae)
Ln.: Badam

Trees, it is globally distributed in West Asia.

The gum exuded from the tree has been used as substitute for tragacanth. The physicochemical components and functional properties of the gum exudates from the trunk of the almond tree (*Prunus dulcis*) have been investigated, along with the emulsification and foaming properties. It consists of proteins, fats and carbohydrates [21].

MATERIALS AND METHODS

Vignan University has campus with a good number of plants. It includes landscaping gardens, exotic elements and natural forest elements, includes rare and endemic categories of trees, shrubs, herbaceous members, climbers and a good number medicinal, gum and resin yielding plants like *Acacia nilotica* (collected from bark), *Azadirachta indica* (collected from bark), *Bombax ceiba* (collected from bark), *Boswellia serrata* (collected from bark), *Cocos nucifera* (collected from fruit),*Mangifera indica* (collected from fruit) & Prunus *dulcis* (collected from bark etc. An inventory experimental studies were conducted on selected most promising plant species which are having utilization of domestic, commercial importance of plant based gums & resins. Methodology was adopted for the above mentioned studies are as per standard literature sources [22, 24].

The present work was conducted in School of Biotechnology, Microbiology lab Vignan University, Vadlamudi to determine the antifungal and antibacterial activity of gums and resins of *Acacia nilotica* (collected from bark), *Azadirachta indica* (collected from bark), *Bombax ceiba* (collected from bark), *Boswellia serrata* (collected from bark), *Cocos nucifera* (collected from fruit),*Mangifera indica* (collected from fruit) & Prunus *dulcis* (collected from bark) etc. against three selected fungal pathogens viz*., Aspergillus niger, Cercospora pongamiae* & *Phytophthora infestans* against two selected bacterial pathogens viz., *Bacillus cereus* and *E.coli* in ethanol methanol and acetone by employing food poisoning technique [27,30].

Preparation of gum resin samples

The powder (or) crystal form of gum resins of selected plant materials were subjected to successive solvent extraction. The extraction was performed using the following solvents acetone, methanol, ethanol & hot water respectively in the first stage of project i.e. just for preparation of gum samples. In further stages we used combinations of these solvents along with n-butanol.1 gm of Sample & 5 ml of solvent are taken in test tube and they are placed in orbital shaking incubator for about 24 hrs [23,24,32]. After 24 hrs they are taken out from the orbital shaking incubator and tested for their solubility. From a group of test tubes with gum samples along with solvents the test samples are selected based on their maximum solubility of gums and resins. The combinations are as follows:

DUAL COMBINATIONS:	MULTIPLE COMBINATIONS:
Acetone + Ethanol (A+E) Ethanol + n-butanol (E+ n-bt) Acetone + Methanol (A+M) Acetone + n-butanol (A+ n-bt) Methanol + Ethanol (M+E) Methanol + n-butanol (M+n-bt)	Acetone + Ethanol + Methanol (A+E+M) Acetone + Ethanol + n-butanol (A+E+n-b) Acetone + Methanol + n-butanol (A+M+n-b) Ethanol+ Methanol + n-butanol (E+M+n-b)

Preparation of Media and Screening of Antimicrobial Activity

Antimicrobial screening was done by the standard procedures described by [22-26] etc.

Media and Microorganisms

The suitable culture media was prepared by dissolving the below mentioned ingredients for the respective microorganisms [24]. The contents were autoclaved at 15lbs for 15 min. microorganisms taken are *Bacillus cereus* & *E.coli* (bacterial species) and *Aspergillus niger, Phytophthora infestans* and *Cercospora pongamiae* (fungal species) for antimicrobial activities of plant extracts[27,29].

Preparation of Sterile Paper Disks

Using an ordinary office two-hole puncher, paper disks with approximate diameter of 6.3 mm. were punched out one by one from a sheet of blotting paper, the disks were placed in boiling test tubes then autoclaved for 15 minutes at 15 lbs. pressure and allowed to cool.

Medium for Bacterial Species

Nutrient Broth/Nutrient Agar Medium (NBM/NAM) composition:

Peptone-5gm
Beef extract-3gm
Agar-5 gm
Distilled water-1000 ml
P^H - 7

Medium for Fungal Species

Potato Dextrose Agar Medium (PDAM) ingredients:

Potato-20 gm
Dextrose-20 gm
Agar-20 gm
Streptomysin-30 gm
Distilled water -1000 ml
P^H - 7

Preparation of Test Plates for Antimicrobial Screening Tests

The Nutrient Agar (NA) and Potato Dextrose Agar (PDA) test plates (Petri dishes) were prepared by pouring about 15 ml of the medium. These test plates were placed under aseptic conditions at 4^0 C for 24 hours to control sterility. After solidifying the media (NA &PDA). The inoculums (bacteria 24 hrs and fungi 48 hrs.) Stock cultures were uniformly spread on their respective test plates. The filter paper discs were prepared in ethanol, methanol (M) and acetone (A) extracts as taken for control [26, 28].

The filter paper discs are carefully placed on the prepared culture test plates and incubated them at appropriate temperature for bacteria at 37 ^{0}C for 24 hrs. and fungi at 30 ^{0}C for 48 hrs. After the incubation period, the test plates are examined for inhibitory zones are recorded. All determinants were made at least in triplicate for each of the test organisms in different extracts was also recorded [32,33].

RESULTS AND DISCUSSIONS

A total no. of 88 ethanol, methanol, Hot water and acetone solvent extracts belongs to the 7 plant species of individual, combinations (Lf.) and multiple were subjected for antifungal and antimicrobial screening, in that all the 80 samples are exhibited positive inhibition zone activity [26,31]. The observations are recorded and they have been categorized into high or maximum zone (cognizable inhibitory zone) (i.e.5-10 mm inhibition zone) in 28 samples of (Ethanol/Methanol/Acetone extracts), moderate inhibition zone of expression in 19 samples of (E/M/A extracts) (i.e. 5-10 mm inhibition zone) and minimal inhibition zone of expression in 75 samples of (i.e. < 15 mm inhibition zone).

The inhibitory activity i.e.5to 25 mm zone of expression for plant samples (Ethanol extracts) for individual in 7 samples, in combination 3samples i.e. in total= 21samples. 25 to 30mm zone of expression for plant samples (Methanol extracts) for individual in 7 samples, in combination 2 samples i.e. in total=14 samples and 25 to 30mm zone of expression for plant samples (Acetone extracts)for individual in 7 samples and combination 2samples i.e. in total =14 samples.(Table:1,2,3,4,5,6,7,8,9,10,11,12,13,14 and 15) Ethanol extracts are comparatively effective more than those of methanol, acetone, hot water and n-butanol extracts.

CONCLUSIONS

The present work will focus on the importance of Gums and Resins and their antifungal and antibacterial activity. The Gums and Resins were collected from different plants to test their antifungal and antibacterial activity

The Anti fungal activity and the anti bacterial activity were tested against 7 plant gums and resins. A total number of 88 plant extracts (gums/resins) were prepared as an individual of 28 ethanol, methanol, acetone and hot water extracts belongs to the 7 individual plant species and another set of 6 plant extracts were prepared in combination of 36 ethanol, methanol , acetone & n-butanol.6 Plant extracts were prepared in multiple combinations of 24 ethanol , methanol, acetone, n-butanol. All these plant extracts were

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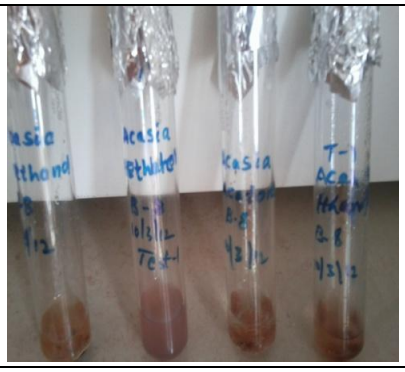
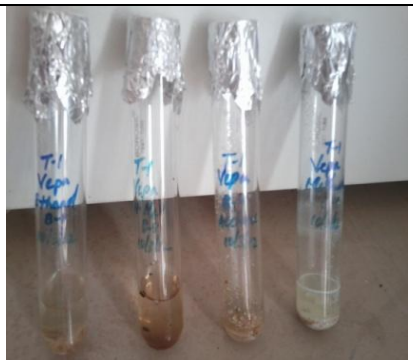
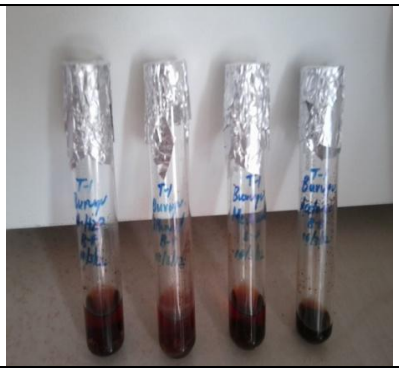
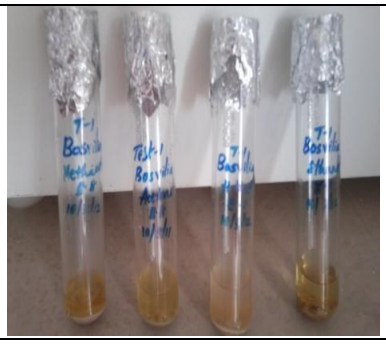
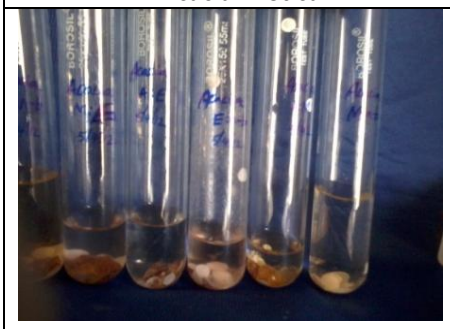
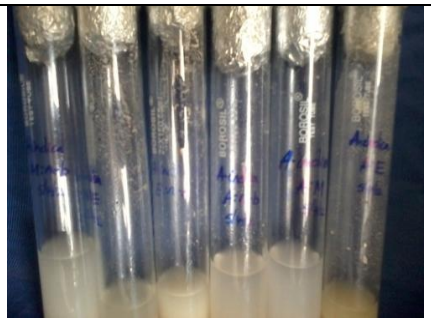
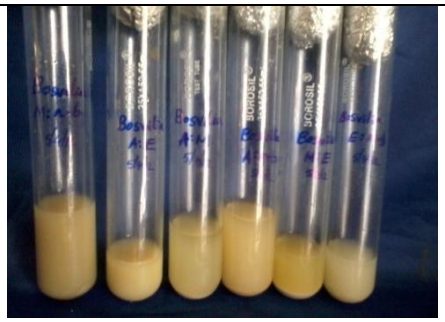
subjected against their antibacterial and anti fungal screening analysis, out of these plant extracts (individual, combination & multiple) 5 plant extracts have been expressed the cognizable zone of expression i.e. 5 mm > 25 mm inhibition (Table: 1,2,3,4,5,6,7,8,9,10,11,12,13,14, and 15). Therefore these combinations were suggested for further analysis of gums &resins for their antimicrobial activity.

INDIVIDUAL - EXTRACTS

Acacia nilotica	*Azadirachta indica*	*Bombax ceiba*
		
Ethanol,Methanol,H.Water, Acetone	**Ethanol,Methanol,H.Water, Acetone**	**Ethanol,Methanol,H.Water, Acetone**

Boswellia serrata	*Cocos nucifera*	*Prunus dulcis*
		
Ethanol,Methanol,H.Water, Acetone	**Ethanol,Methanol,H.Water, Acetone**	**Ethanol,Methanol,H.Water, Acetone**

COMBINATION/S - EXTRACTS

Acacia nilotica	*Azadirachta indica*	*Boswellia serrata*
		
Acetone + Ethanol (A+E) **Ethanol + n-butanol (E+ n-bt)**	**Acetone + Ethanol (A+E)** **Ethanol + n-butanol (E+ n-bt)**	**Acetone+ Ethanol (A+E)** **Ethanol+ n-butanol (E+ n-bt)**

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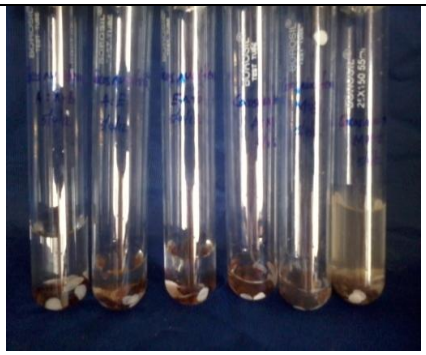
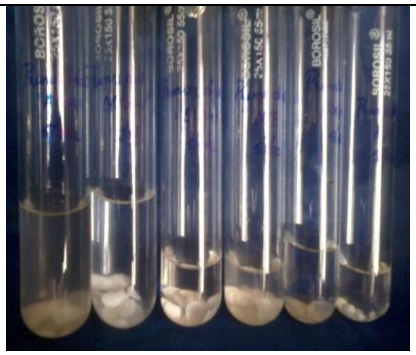
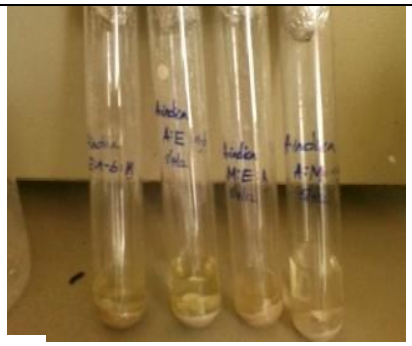
Acetone + Methanol (A+M) Acetone +n-butanol (A+ n-bt) Methanol + Ethanol (M+E) Methanol+n-butanol (M+n-bt)	Acetone + Methanol (A+M) Acetone + n-butanol (A+ n-bt) Methanol + Ethanol (M+E) Methanol +n-butanol (M+n-bt)	Acetone + Methanol (A+M) Acetone + n-butanol (A+ n-bt) Methanol + Ethanol (M+E) Methanol + n-butanol (M+n-bt)
Bombax ceiba	*Cocos nucifera*	*Prunus dulcis*
		
Acetone+ Ethanol (A+E) Ethanol+ n-butanol (E+ n-bt) Acetone + Methanol (A+M) Acetone + n-butanol (A+ n-bt) Methanol + Ethanol (M+E) Methanol +n-butanol (M+n-bt)	Acetone+ Ethanol (A+E) Ethanol+ n-butanol (E+ n-bt Acetone + Methanol (A+M) Acetone + n-butanol (A+ n-bt) Methanol + Ethanol (M+E) Methanol +n-butanol (M+n-bt)	Acetone + Ethanol (A+E) Ethanol +n-butanol (E+ n-bt) Acetone + Methanol (A+M) Acetone +n-butanol (A+n-bt) Methanol + Ethanol (M+E) Methanol +n-butanol (M+n-bt)

MULTIPLE COMBINATIONS

1)ACETONE+N-BUTANOL +ETHANOL (A+n-b+E)
2) ETHANOL+ N-BUTANOL+METHANOL (E+n-b+M)
3) METHANOL +ACETONE+ N-BUTANOL (M+A+n-b)
4) ACETONE+ ETHANOL+ METHANOL (A+E+M)

Acacia nilotica	*Azadirachta indica*	*Bombax ceiba*
		

INDIVIDUAL –EXTRACTS :

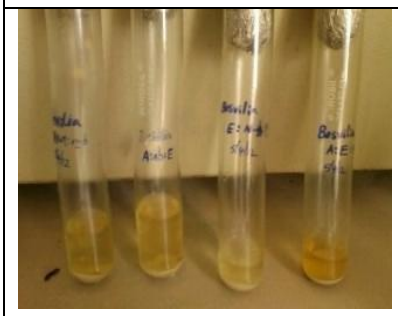
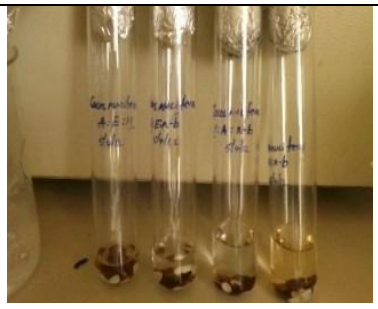
Boswellia serrata	*Cocos nucifera*	*Prunus dulcis*
		

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TABLE: 1- Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Bacillus cereus*

S.No.	Name of the Plant	Name of the organism	5 to10 mm				10 to12 mm				12 to15 mm				>15 mm (15-20mm)			
			A	E	M	H.W	A	E	M	H.W	A	E	M	HW	A	E	M	HW
1.	*Cocos nucifera*	*Bacillus cereus*	+	+	-	-	-	-	+	+	-	-	-	+	-	-	-	-
2.	*Azadirachta indica*	*Bacillus cereus*	-	-	+	+	-	+	+	-	-	+	-	-	-	-	-	-
3.	*Mangifera indica*	*Bacillus cereus*	-	+	+	-	-	-	+	+	-	-	-	+	-	-	-	-
4.	*Prunus dulcis*	*Bacillus cereus*	-	-	+	+	-	+	-	+	-	+	-	-	-	-	-	-
5.	*Bombax ceiba*	*Bacillus cereus*	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-
6.	*Acacia nilotica*	*Bacillus cereus*	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.	*Boswelia serrata*	*Bacillus cereus*	-	-	+	-	+	+	-	-	-	+	-	-	-	-	-	+

A: Acetone, E: Ethanol, M: Methanol, H.W.: Hot Water

TABLE: 2 -Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *E.coli.*

S.No.	Name of the Plant	Name of the organism	5 to10 mm				10 to12 mm				12 to15 mm				>15 mm (15-20mm)			
			A	E	M	HW	A	E	M	HW	A	E	M	HW	A	E	M	HW
1.	*Cocos nucifera*	*E.coli*	-	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
2.	*Azadirachta indica*	*E.coli*	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
3.	*Mangifera indica*	*E.coli*	-	-	+	+	-	+	+	-	-	+	-	-	-	-	-	-
4.	*Prunus dulcis*	*E.coli*	-	+	+	-	-	+	+	-	-	-	-	-	-	-	-	-
5.	*Bombax ceiba*	*E.coli*	+	+	+	-	-	-	+	+	-	-	-	-	-	-	-	-
6.	*Acacia nilotica*	*E.coli*	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
7.	*Boswelia serrata*	*E.coli*	-	-	+	-	-	-	+	+	-	-	-	-	-	+	-	-

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TABLE: 3- Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Aspergillus niger.*

S.No.	Name of the Plant	Name of the organism	5 to10 mm				10 to12 mm				12 to15 mm				>15 mm (15-20mm)			
			A	E	M	H W	A	E	M	H W	A	E	M	H W	A	E	M	H W
1.	*Cocos nucifera*	*A. niger*	-	+	-	-	-	+	+	+	-	-	-	+	-	-	-	+
2.	*Azadirachta indica*	*A. niger*	-	-	+	+	-	+	-	+	-	-	-	-	-	-	-	-
3.	*Boswelia serrata*	*A. niger*	-	-	+	+	-	+	+	-	-	+	-	-	-	-	-	-
4.	*Prunus dulcis*	*A. niger*	+	+	-	+	+	-	-	+	-	-	-	-	-	-	-	-
5.	*Bombax ceiba*	*A. niger*	-	+	+	-	-	-	+	+	-	-	-	-	-	-	-	-
6.	*Acacia nilotica*	*A. niger*	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-

TABLE: 4 -Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Cercospora pongamiae*.

S.No.	Name of the Plant	Name of the organism	5 to10 mm				10 to12 mm				12 to15 mm				>15 mm (15-20mm)			
			A	E	M	H.W.	A	E	M	H W	A	E	M	H W	A	E	M	H W
1.	*Cocos nucifera*	*Cercospora pongamiae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.	*Azadirachta indica*	*Cercospora pongamiae*	-	-	+	+	-	+	-	+	-	-	-	-	-	-	-	-
3.	*Boswelia serrata*	*Cercospora pongamiae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	*Prunus dulcis*	*Cercospora pongamiae*	-	+	+	+	-	+	-	+	-	-	-	-	-	-	-	-
5.	*Bombax ceiba*	*Cercospora pongamiae*	-	+	+	-	-	-	+	+	-	-	-	-	-	-	-	-
6.	*Acacia nilotica*	*Cercospora pongamiae*	-	-	+	-	-	-	-	-	-	+	-	+	-	-	-	-

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TABLE: 5- Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Cercospora pongamiae*.

S.No.	Name of the Plant	Name of the organism	5 to10 mm				10 to12 mm				12 to15 mm				>15 mm (15-20mm)			
			A	E	M	H W	A	E	M	H W	A	E	M	H W	A	E	M	H W
1.	*Cocos nucifera*	*Phytophthora infestans*	-	-	-	-	-	+	+	+	-	+	-	+	-	-	-	-
2.	*Azadirachta indica*	*Phytophthora infestans*	-	-	+	+	-	+	-	+	-	-	-	-	-	-	-	-
3.	*Boswelia serrata*	*Phytophthora infestans*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	*Prunus dulcis*	*Phytophthora infestans*	-	+	+	+	-	+	-	+	-	-	-	-	-	-	-	-
5.	*Bombax ceiba*	*Phytophthora infestans*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
6.	*Acacia nilotioca*	*Phytophthora infestans*	-	-	+	-	-	-	-	-	-	+	-	+	-	-	-	-

COMBINATION/S – EXTRACTS:

TABLE: 6- Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *E.coli.*

S. No.	Name of the Plant	Name of the organism	5 to10 mm						10 to12 mm						12 to15 mm						>15 mm (15-20mm)					
			A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-B
1.	*Boswelia serrata*	*E.coli*	-	-	-	-	-	-	-	-	+	+	+	-	+	+	+	-	-	+	-	-	-	-	-	+
2.	*Azadirachta indica*	*E.coli*	-	-	-	-	-	-	+	-	-	+	+	+	+	-	-	+	+	+	-	-	-	-	-	-
3.	*Cocos nucifera*	*E.coli*	-	-	-	+	+	-	+	+	-	+	+	+	-	+	+	-	-	+	-	-	-	-	-	-
4.	*Acacia nilotica*	*E.coli*	+	-	+	-	+	-	+	+	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-
5.	*Bombax ceiba*	*E.coli*	-	-	-	-	+	-	-	-	+	+	+	-	+	+	-	-	-	+	-	-	-	-	-	-
6.	*Prunus dulcis*	*E.coli*	-	-	-	-	+	-	+	+	-	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-

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TABLE: 7- Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Bacillus cereus* (*B. cereus*)

S.No.	Name of the Plant	Name of the organism	5 to10 mm						10 to12 mm						12 to15 mm						>15 mm (15-20mm)					
			A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-B
1.	*Boswelia serrata*	*B. cereus*	-	-	-	-	-	-	+	-	-	+	-	+	-	+	+	+	+	-	-	-	-	-	-	-
2.	*Azadirachta indica*	*B. cereus*	-	-	+	+	+	-	+	+	-	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-
3.	*Cocos nucifera*	*B. cereus*	+	-	-	+	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	*Acacia nilotica*	*B. cereus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	*Bombax ceiba*	*B. cereus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	*Prunus dulcis*	*B. cereus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE: 8- Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Aspergillus niger*. (*A. niger*)

S.No.	Name of the Plant	Name of the organism	5 to10 mm						10 to12 mm						12 to15 mm						>15 mm (15-20mm)					
			A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-B
1.	*Boswelia serrata*	*A. niger*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.	*Azadirachta indica*	*A. niger*	-	-	-	-	-	+	+	-	-	-	-	+	-	-	-	-	-	+	-	+	-	-	-	-
3.	*Cocos nucifera*	*A. niger*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	*Acacia nilotica*	*A. niger*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	*Bombax ceiba*	*A. niger*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	*Prunus dulcis*	*A. niger*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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TABLE: 9 -Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Phytophthora infestans.* (*P. infestans*)

S.No.	Name of the Plant	Name of the organism	5 to10 mm						10 to12 mm						12 to15 mm						>15 mm (15-20mm)					
			A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-B
1.	***Boswelia serrata***	*P. infestans*	-	-	-	-	-	-	-	+	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-
2.	***Azadirach ta indica***	*P. infestans*	-	+	-	+	-	+	+	-	+	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-
3.	***Cocos nucifera***	*P. infestans*	+	-	+	-	-	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	***Acacia nilotica***	*P. infestans*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	***Bombax ceiba***	*P. infestans*	+	-	-	-	-	-	-	+	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-
6.	***Prunus dulcis***	*P. infestans*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE:10-Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Cercospora pongamiae* (*C. pongamiae*)

S.No.	Name of the Plant	Name of the organism	5 to10 mm						10 to12 mm					12 to15 mm					>15 mm (15-20mm)							
			A+E	E+n-b	A+M	A+n-b	M+E	M+n-B	A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-b	A+E	E+n-b	A+M	A+n-b	M+E	M+n-b
1.	***Boswelia serrata***	*C. pongamiae*	-	-	-	-	-	-	-	+	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-
2.	***Azadirachta indica***	*C. pongamiae*	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
3.	***Cocos nucifera***	*C. pongamiae*	-	-	+	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	***Acacia nilotica***	*C.pongamiae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	***Bombax ceiba***	*C. pongamiae*	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	***Prunus dulcis***	*C. pongamiae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

MULTIPLE COMBINATION/S :

1) ACETONE+N-BUTANOL +ETHANOL (A+n-b+E)

2) ETHANOL+ N-BUTANOL+METHANOL (E+n-b+M)

3) METHANOL +ACETONE+ N-BUTANOL (M+A+n-b)

4) ACETONE+ ETHANOL+ METHANOL (A+E+M)

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TABLE:11-Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Cercospora pongamiae*

S.No.	Name of the Plant	Name of the organism	5 to10mm				10 to 15mm				15 to 20mm				>20mm (20-25mm)			
			A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M
1.	*Boswelia serrata*	*C. pongamiae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.	*Azadirachta indica*	*C. pongamiae*	-	-	-	-	-	+	-	+	-	-	+	+	-	-	+	-
3.	*Cocos nucifera*	*C. pongamiae*	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-
4.	*Acacia nilotica*	*C. pongamiae*	-	-	-	-	-	+	-	+	-	+	-	+	-	+	-	-
5.	*Bombax ceiba*	*C. pongamiae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	*Prunus dulcis*	*C. pongamiae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE: 12 -Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Phytophthra infestens*.

S. No.	Name of the Plant	Name of the organism	5 to10mm				10 to 15mm				15 to 20mm				>20mm (20-25mm)			
			A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M
1.	*Boswelia serrata*	*P. infestans*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.	*Azadirachta indica*	*P. infestans*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.	*Cocos nucifera*	*P. infestans*	-	-	-	-	-	-	-	+	-	-	-	-	-	+	+	-
4.	*Acacia nilotica*	*P. infestans*	-	-	-	-	-	-	-	-	-	+	-	+	+	+	+	+
5.	*Bombax ceiba*	*P. infestans*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	*Prunus dulcis*	*P. infestans*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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TABLE:13-Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Aspergillus niger*

S.No.	Name of the Plant	Name of the organism	5 to10mm				10 to 15mm				15 to 20mm				>20mm (20-25mm)			
			A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M
1.	*Boswelia serrata*	*A. niger*	-	-	-	-	-	+	+	+	-	-	-	+	-	-	-	-
2.	*Azadirachta indica*	*A. niger*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.	*Cocos nucifera*	*A. niger*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	*Acacia nilotica*	*A. niger*	-	+	-	-	+	+	+	+	-	+	-	+	-	+	-	-
5.	*Bombax ceiba*	*A. niger*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	*Prunus dulcis*	*A. niger*	-	-	+	-	-	-	-	-	-	-	+	-	-	-	+	-

TABLE:14 - Showing the antimicrobial activity of (Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *E.coli*.

S.No.	Name of the Plant	Name of the organism	5 to10mm				10 to 15mm				15 to 20mm				>20mm (20-25mm)			
			A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M
1.	***Boswelia serrata***	*E.coli*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.	***Azadirachta indica***	*E.coli*	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-
3.	***Cocos nucifera***	*E.coli*	-	-	+	-	+	-	-	+	-	-	-	-	-	-	-	-
4.	***Acacia nilotica***	*E.coli*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	***Bombax ceiba***	*E.coli*	-	-	-	+	-	+	+	+	-	-	-	-	-	-	-	-
6.	***Prunus dulcis***	*E.coli*	-	+	+	+	+	-	-	-	+	-	-	-	-	-	-	-

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TABLE:15- Showing the antimicrobial activity of(Zone of inhibition 5mm to >/=20mm) gums & resins subjected to *Bacillus.*

S.No.	Name of the Plant	Name of the organism	5 to10mm				10 to 15mm				15 to 20mm				>20mm (20-25mm)			
			A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M	A + n-b + E	E + n-b + M	M + A + n-b	A + E + M
1.	***Boswelia serrata***	*B. cereus*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
2.	***Azadirachta indica***	*B. cereus*	-	-	-	-	+	+	+	+	-	-	+	+	-	-	-	-
3.	***Cocos nucifera***	*B. cereus*	+	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-
4.	***Acacia nilotica***	*B. cereus*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	***Bombax ceiba***	*B. cereus*	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	***Prunus dulcis***	*B. cereus*	-	-	-	-	+	-	+	+	+	-	-	-	-	-	-	-

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REFERENCES

[1] Anonymous, The Wealth of India (Raw Materials).Vol.1-11.CSIR,New Delhi,India (1948-76).

[2] Dhar ML, MM Dhar, BN Dhawan, BN Mehrotra and C Ray. Indian J Exp Biol 1968;6:232-247.

[3] Chopra RN, SL Nayar and IC Chopra. Glossary of Indian Medicinal plants.(1956) CSIR, New Delhi.

[4] Bharath Kumar R. Ethnobotanical Studies of Sriharikota Island, Andhra Pradesh. Ph.D. Thesis.(2000) S.V.University, Tirupati.

[5] Suryanarayana B, Sreenivasa Rao A. Flora of Nellore District, Andhra Pradesh (Eastern Veligonda Hill Ranges & Sriharikota Island) (2002),Pub. Gurudev Prakashan, Shrirampur, Maharastra.1-694 pp.

[6] Benthall AP. Trees of Calcutta and its Neighbourhood.Thacker, Spink, (1946) Calcutta.

[7] Bolza E and NH Kloot. The Mechanical Properties of 56 Fijian Timbers. Technical Paper 62. Division of Forest Products, (1972) CSIRO, Australia.

[8] Bourke RW. Edible indigenous nuts in Papua New Guinea. In: Stevens, Bourke, and Evans, op. cit. (1994)
[9] C Rolin, in RL Whistler and JN Be Miller, eds., Industrial Gums, Academic Press, San Diego, 3rd ed., 1993, pp. 257–293.
[10] Cambie RC, and J Ash. Fijian Medicinal Plants.Commonwealth Scientific and Industrial Research Organisation (CSIRO). (1994) Australia.
[11] Coode MJE. Notes on Terminalia L. (Combretaceae) in Papuasia.Contributions from Herbarium Australiense (1973). 2: 1–33.
[12] Coode MJE. Combretaceae. In: J.S. Womersley (ed.). Handbooks of the Flora of Papua New Guinea, (1978),Vol. 1. Melbourne University Press, Melbourne.
[13] Krishnamurty.T, Minor Forest Products of India, (1993), OXFORD and IBH Publishing Company Pvt. Ltd.
[14] Drury H. The Useful Plants of India, (1873),2nd ed. Allen, London.
[15] Dwivedi AP, Forests, Thenon-wood resources, Pub by Andhra Pradesh Forest Department.(1999).9: vii–xii.
[16] KS Kang and DJ Pettit, in RL Whistler and JN Be Miller, eds., Industrial Gums, Academic Press,San Diego, 3rd ed.,(1993), pp. 341–397.
[17] GH Therkelsen, in RL Whistler and JN Be Miller, eds., Industrial Gums, Academic Press, San Diego, 3rd ed., 1993, pp. 145–180.
[18] Gamble JS. 1957 Flora of the Presidency of Madras, Vols I-II,BSI, Calcutta.
[19] HH Selby and RL Whistler, in RL Whistler and JN BeMiller, eds., Industrial Gums, Academic Press, San Diego, 3rd ed., 1993, pp. 87–103.
[20] Hemadri K. Medicinal Plants from Andhra Pradesh. (1979),Telugu Akademy, Hyderabad.
[21] Rama Rao N. and AN Henry. The Ethnobotany of Eastern Ghats in Andhra Pradesh. India, (1996), pp.1-259. Botanical Survey of India, Calcutta.
[22] Bhakuni DS, AK Goel, Sudha Jain, BN Mehrotra, GK Patnaik and Ved Prakash. Indian J Exp Biol 1988;26: 883-904.
[23] Bhakuni DS, AK Goel, Sudha Jain, BN Mehrotra and RC Srimal. Indian J Exp Biol 1990;28: 619-637.
[24] Ikram M and H Inamul. Fitoterapia 1980;51:281-284.
[25] Mbah CJ, PI Akubue.. Fitoterapia 1993;64: 550-551.
[26] Aladesanmi AJ, Sofowora, JD Leary. Int J Crude Drug Res 1986;24: 147-153.
[27] Ahmad, I, Mushtaq, Ahmad and Ashbaq Ahmad., Antimicrobial activity of Dodonaea viscosa oil. Fitoterapia, (1994), 65: 167-168.
[28] Naqui SAH, Khan and SB Vohra. Fitoterapia 1991;62: 221-228.
[29] Saiprasad Goud P. Ethno-medico-Botanical studies in Kurnool district of Andhra Pradesh and screening of selected species for Biological activity. Ph.D. Thesis,(1995), S.K. University, Anantapur.
[30] M Stephen and SC Churms. in AM. Stephen, ed., Food Polysacchrides, Marcel Dekker, New York, 1995, pp. 377–440.
[31] Neumann RP, Hirsch E, Commercialization of Non- Timber Forest Products:Review and Analysis of Research. Bogor: Center for International Forestry ODI Rural Development. (2000) Forestry Network Paper No. 22c.
[32] Simpson, Ogorzaly, Gums and Resins Howes. F.N, Vegetable Gums and Resins, (1949), Chronica Botanica Co., U.S.A.

ISSN: 0975-8585

[33] Govindachari TR. Chemical and Biological investigation of Indian medicinal plants.(1977), In H.Wagner and P.Wollff (eds)New Natural products and plant drugs with pharmacological, Biological and therapeautical activity. P. 1- 213.Berlin.