Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Plant Sciences 7 (3): 260-267, 2008
ISSN 1682-3974

Antimicrobial Activity and Ethnomedicinal Uses of Some Medicinal Plants from Similipal Biosphere Reserve, Orissa

[1]H.N. Thatoi, [2]S.K. Panda, [1]S.K. Rath and [2]S.K. Dutta
[1]P.G. Department of Biotechnology,
[2]P.G. Department of Zoology, North Orissa University, Baripada-757003, Orissa, India

Abstract: In this study, antimicrobial activity and ethnomedicinal uses of 40 medicinal plants along with medicinal properties has been reported from Similipal Biosphere Reserve, Orissa, India. Aqueous extracts of different parts of the plant (leaf, stem, bark, bulb, fruit and root) reported to have medicinal properties were tested for their antimicrobial activity against gram positive and gram negative human pathogenic bacteria such as *Staphylococcus aureus* MTCC 1144, *Bacillus licheniformis* MTCC 7425, *Bacillus brevis* MTCC 7404, *Bacillus subtilis* MTCC 7164, *Staphylococcus epidermidis* MTCC 3615, *Streptococcus aureus* (Lab. isolate), *Pseudomonas aeruginosa* MTCC 1034, *Escherichia coli* MTCC 1089, *Vibrio cholerae* (Lab. isolate), *Shigella flexneri* (Lab. isolate) and one fungal species *Candida krusei* (Lab. isolate). Results showed that 23 out of 40 medicinal plants have antimicrobial activity of which, 14 medicinal plants have outstanding antimicrobial activity. Prominent species with antimicrobial activity are *Urginea indica* (bulb), *Croton roxburghii* (bark), *Melastoma malabathricum* (leaf), *Diospyros melanoxylon* (bark), *Pterospermum acerifolium* (leaf), *Nyctanthes arbortristis* (bark), *Oroxylum indicum* (bark), *Agava sisalana* (leaf), *Clausena excavate* (root) *Vitex negundo* (leaf), *Glycyrrhiza glabra* (fruit), *Enhydra fluctuans* (leaf), *Hemidesmus indicus* (leaf) and *Flemingia nana* (root) with inhibition zones more than 20 mm where as 9 other plants were found to have moderate antimicrobial activity with inhibition zones of less than 20 mm. Rest 17 plants did not show any antimicrobial activity.

Key words: Medicinal plants, antimicrobial property, ethnomedicine and similipal biosphere reserve

INTRODUCTION

Medicinal plants constitute a very important 'natural resource used by indigenous medicinal systems for the last 300 years. The Central Council of Research on Ayurveda and Sidha medicine have drawn a list of 243 commonly used medicinal plants having greater demand for manufacture of gelanicals, mixtures, compound formations and potent medicines (Gupta, 1998). There is a great demand of medicinal plants in the global market. As per an estimate, international export of medicinal plants is dominated by China, which exports 1, 21,900 tons of materials a year, whereas India, exports 32,600 tons annually (Anonymous, 1997). The medicinal plants provide raw materials for modern medicines and pharmaceutical industries. But, due to biotic interferences of various categories and different magnitudes, there is considerable amount of depletion of plant resources including medicinal plants. It is imperative, therefore that before we stand to loose valuable economic resource and we need to document the existing medicinal plants, their ethnomedicinal uses and explore their medicinal potential for biotechnological exploitation.

Thus there is continuous and urgent need to discover new antimicrobial compounds with diverse chemical structures and novel mechanisms of action. Another big concern is the development of resistance to antibiotics in current clinical use (Erturk *et al*., 2006) and there has been an alarming increase in the incidence of new and re-emerging infectious diseases. Screening of medicinal plants for antimicrobial agents has gained much importance because lately World Health Organization (WHO) is keenly interested in the development and utilization of medicinal plant resources in the traditional system of medicine in the developing countries, so as to extend the health care to maximum number of population in these countries (Goud *et al*., 2005). Similipal Biosphere Reserve is situated in Mayurbhanj district of Orissa (India), a unique habitat of mixed tropical forest and harbors varied flora and fauna. The ecosystem is enriched with variety of medicinal plants. The total number of species comprising the flora of Similipal is 1076, representing 168 families of wild and cultivated plants (Saxena and Brahmam, 1989).

Corresponding Author: Dr. S.K. Dutta, Department of Zoology, North Orissa University, Baripada-757003, Orissa, India
Tel: 91-6792-253908 Fax: 91-6792-255127

Survey made by Saxena and Brahmam (1989) and Pandey *et al.* (2002) have reported on occurrence of medicinal plants of Similipal Biosphere Reserve. So far, not much work has been done on ethnomedicinal uses of these medicinal plants. Antimicrobial study on medicinal plants from Similipal Biosphere Reserve is altogether lacking. Hence, in this study an attempt has been made, to compile the information on ethnomedicinal uses and evaluate antimicrobial activity of 40 medicinal plants occurring in Similipal Biosphere Reserve.

MATERIALS AND METHODS

Study area: The Similipal Biosphere Reserve massif lies between 20°17-22°10 N latitude and 85°57-86°47 E longitude is situated in Mayurbhanj district of northeast Orissa, India. Within the Mahanadian bio-geographic region, Similipal presents feature of four biotic provinces for which Orissa is the junction. These provinces are: Eastern Plateau, Chotanagpur Plateau, Lower Gangetic plains and the Coast Line.

Survey and collection of medicinal plants: The present work is based on explorations made in Similipal Biosphere Reserve during 2006. Field trips to Similipal Biosphere Reserve were undertaken, medicinal plants were collected and their identification was authenticated at the Post Graduate Department of Botany, North Orissa University, Baripada. Ethnomedicinal uses and medicinal properties of the plants were also collected during field trip as well as from literature survey (Table 1).

Processing: Stems, leaves and roots of plants have separately been collected during field trip from different places of Similipal Biosphere Reserve. The roots are dug out from the soil and the adhering soils were removed by shaking and washing. The leaves were plucked from the trees, washed properly and the leaves infected with fungus were discarded. After collection, the healthy leaves were dried at low temperature to maintain their green color and volatile oils, if present. The material is completely shed dried so long it does not allow for the growth of any type of fungi, molds, bacteria and other microorganisms. The dried leaves, roots and stems are powdered separately by using mortar and pestle and then they were passed through sieve so that uniform powders are maintained.

Preparation of plant extracts: Twenty grams of powder from each sample was dissolved in 100 mL of sterile distilled water separately in wide mouth bottle and were steamed for 30 min in a pressure cooker. Then all the treated samples were incubated at room temperature for 48 h. The suspension was filtered (Whatman No. 40) separately and the filtrate made up to 100 mL with sterile distilled water. The filtrate was used for studying their antibacterial properties.

Screening of antimicrobial properties

Media used: Muller Hinton Broth (MHB), Muller Hinton Agar (MHA) and Potato Dextrose Agar (PDA) procured from HI-Media, Mumbai, were used in the study and prepared as per manufacturer's instructions.

Agar cup method: The agar cup method of Bauer *et al.* (1966) was followed to doubly ensure the antibacterial activity of the extracts. Over night Muller Hinton Broth culture of the test organisms were firmly seeded over the MHA plates. Wells of 0.8 mm diameter was punched over the agar plates using a sterile borer. The bottoms of the wells were sealed by pouring 50-100 μL of molten MHA into the scooped out wells. One hundred microliters of extracts were poured into the wells. The water was allowed to evaporate and the plates were incubated at 37°C for 18-24 h. A zone of clearance around the wells, after the incubation period confirms the antibacterial activity of the respective extracts. The same procedure was followed for each strain and extract. Each experiment was carried out in triplicates. The average diameter of the inhibition zone was taken for evaluating the antibacterial activity of the extracts.

RESULTS AND DISCUSSION

In total 40 medicinal plants belonging to 30 families were collected from Similipal Biosphere Reserve. The botanical and local names of the plants, the parts used along with their medicinal properties and ethnomedicinal uses are given in Table 1. Selection of the plants was based mainly on potential ethnomedicinal uses and possible antimicrobial and anticarcinogenic properties. Each of the 40 plants was prepared in the form of aqueous extracts and was tested against both gram +ve (6) and gram -ve (4) bacteria viz., *Staphylococcus aureus* MTCC 1144, *Bacillus licheniformis* MTCC 7425, *Bacillus brevis* MTCC 7404, *Bacillus subtilis* MTCC 7164, *Staphylococcus epidermidis* MTCC 3615, *Streptococcus aureus* (Lab. isolate), *Pseudomonas aeruginosa* MTCC 1034, *Escherichia coli* MTCC 1089, *Vibrio cholerae* (Lab. isolate), *Shigella flexneri* (Lab. isolate) and one fungus *Candida krusei* (Lab. isolate). Table 2 represents that out of the 40 medicinal plants 23 plants found to posses antimicrobial activity. Among these 14 plants such as *Urginea indica* (bulb), *Croton roxburghii* (bark),

Table 1: Some important ethnomedicinal plants from Similipal Biosphere reserve, Orissa

Botanical name	Family	Local name	Parts used	Cure for diseases	Medicinal properties antimicrobial, anticarcinogenic/Ethnomedicinal uses
Acorus calamus L.	Araceae	Bacha	Rhizomes	Flatulent colic, diarrhoea, dysentery, asthma, sore throat, chest pain, snake bite and fever. Leprosy, cough	Antimicrobial, antimycotic Rhizome of the root powder along with old jaggery is given against obesity caused due to diabetes.
Adhatoda vasica Nees	Acanthaceae	Basanga	Leaves	Cough, asthma and leprosy bronchitis, tuberculosis	Antimicrobial decoction of leaves is given with honey twice for 7 days in asthma and cough
Agava sisalana Perr.	Agavaceae	Nalimurga	Leaf	Ulcer, Inflammatory condition, irritation, tuberculosis, jaundice and liver diseases,	Antimicrobial, Juice of leaves ecbolic
Andrographis paniculata (Burm.f.) Nees	Acanthaceae	Bhuineem	Whole plant	Fever, dysentery, blood purifier, skin disease, diabetics, itches, piles, dysentery and cholera	Antimicrobial activity Anticancerous activity (Rajagopal *et al*., 2003). Infusion of leafy twigs is given in empty stomach in the morning for prevention from malaria and also for stomach troubles
Argyreia speciosa Sweet	Convolv-ulaceae	Budhadaraka	Leaves, Root	Eczema, Diuretic, aphrodisiac, rheumatism, nervous diseases	Decoction of root mixed with sugar candy is taken by old people and it is believed that they would become young
Asparagus racemosus Willd.	Asparag-araceae	Satabari	Root	Tonic and demulscent, Leprosy, bronchitis, cough	Antiulcerogenic activity on rats (Datta *et al*., 2002), inhibitory effect on mammary carcinigenesis in rats (Rao, 1981). Immunostimulant Tuberous powder along with honey is given daily for one month to restore potency.
Buchnania lanzan Spreng.	Anacardiaceae	Chara	Seed, bark, leaves	Diarrhoea, mouth sores and chronic constipation	The ripe fruits are eaten as tonic for strength. The root and bark made into paste is applied to chronic wounds.
Careya arborea Roxb.	Lecythidaceae	Kumbhi	Fruit, bark	Fish poison, Indigestion and flatulence	Antidiarrheal, antileishmanial activity, Brine shrimp lethality activity (Krishnaraju *et al*., 2005)
Casia fistula Linn.	Caesal-piniaceae	Sonari	Leaves, fruit	Constipation, fever	Leaves made into paste is orally taken to purify blood. Leaves are used in skin diseases. Dried fruits used as a purgative, laxative for habitual constipation. Root is used in common cold.
Centella asiatica Linn.	Apiaceae	Thalkudi	Leaves, stem and root	Leprosy, tuberculosis, measles, Leucorrhoea, jaundice, Dysuria, Fracture and sprains	Prevents gastric ulceration in Wistar rats (Sairam *et al*., 2001), *in vitro* anti hepatoma activity (Lin *et al*., 2002). Immunomodulatory activity Decogtion of plant is given in treatment of leprosy and tuberculosis.
Cissampelos pareira L.	Menisper-maceae	Akanbindu	Roots, leaves	Dropsy, cough, urinary trouble, inflammation and colic,	Alkaloid cissapareine has tumor inhibitor activity (Kupchan *et al*., 1965) Antifertility, antiallergic
Cissus quandrangularis L.	Vitaceae	Hadajoda	Roots, stem and leaves	Dyspepsia, indigestion, rejoining broken bones, swelling	Antigastriculcerogenic in rats (Jainu and Shyamala Devi, 2005), antineoplastic activity on HepG2 cell line (Opoku *et al*., 2000) Powdered root is used for specific fractures. Plants on oral administration was found to posses analgesic activity in animals.
Clausena excavata Burm. F.	Rutaceae	Agnijhal	Root, leaves	Fever, indigestion, malaria, colic and cold	Antimycobacterial Antitumor activity of furanone on cell lines (Ito *et al*., 2000) immunostimulatory
Coccinia grandis (L.) Voigt	Cucurbitaceae	Bana kunduri	Leaf, root	Ear pain, antipyretic, vomiting, boils and carbuncles, blood dysentery and	Antimicrobial (Dewanjee *et al*., 2007a) Antihelminthic activity (Dewanjee *et al*., 2007b) diabetes
Croton roxburghii Balak.	Euphorbiaceae	Putuli	Root, bark	Sore throat, dysentery, snake bite and antifertility,	Seeds and oils are considered as pugative, also used for insecticidal purpose
Curcuma angustifolia Roxb.	Zingiberaceae	Palua	Rhizome	Dysentry, Diarrhoea and Stomach pain	Powdered tubers are used in stomach trouble
Diospyros melanoxylon Roxb.	Ebenaceae	Kendu	Leaves, bark	Diuretic, Laxative, Carminative, urinary, skin trouble and Styptic	Dried flowers used in urinary and skin troubles. Decoction of the bark used in diarrhoea and dyspepsia.
Enhydra fluctuans Lour.	Asteraceae	Hidimicha	Leaves	Headache, eye diseases, hook worm infection and bile disorder	Antimicrobial
Eryngium foetidum L.	Apiaceae	Banadhania	Stem, leaf	Stomach trouble	Plant used as galactogogue
Flemingia nana Roxb.	Fabaceae	Sabalabhanga	Root	Ulcer and swellings	Antimicrobial
Glycyrrhiza glabra Linn.	Fabaceae	Jyestha madhu	Roots, stem	Tuberculosis, cough, leprosy, asthma and bronchitis	Rhizomes and roots tonic, expectorant, demulcent and laxative, used for allaying coughs catarrhal affections and irritable conditions of the membranes of urinary organs. Antiulcerous on rats (Khayyal *et al*., 2001) antiproliferative on Ehrlich ascites tumor cells (Sheela *et al*., 2006)

Table 1: Continued

Botanical name	Family	Local name	Parts used	Cure for diseases	Medicinal properties antimicrobial, anticarcinogenic/Ethnomedicinal uses
Grewia elastica Royle	Tilliaceae	Mirgchara Dhaman	Bark, leaves	Cough, burning sensation, skin disease, wounds, ulcer, seminal weakness and general debility	Antibacterial
Hemidesmus indicus (L.) Schult..	Asclepiad-aceae	Anaantamula	Root	Rheumatism, urinary diseases and skin diseases	Antimicrobial Antihepatocarcinogenic in rats (Iddamaldeniya *et al*., 2006), Cytotoxic on Human hepatoma HepG2 cells (Thabrew *et al.*, 2005)
Holarrhena antidysenterica Wall.	Apocyan-aceae	Kuluchi	Bark, leaves, seeds	Dysentry, cough, cold, fever, stomach pain, antipyretic, scabies and malaria	Antimicrobial activity Decoction of bark and leaf of *Gymnema sylvestre* is given to reduce blood sugar content
Ichnocarpus frutescens (L.) R.Br.	Apocyanaceae	Badadudhi, Swanlata	Roots, leaves	Bleeding of gums, cough, dysentery, measles, night blindness, rheumatism	Fresh juice of leaves and fruits with pepper given in morning in empty stomach
Kaempferia rotunda L.	Zingiberaceae	Bhuin Champa	Rhizomes	Stomach pain, gastric, wounds and swellings	Rhizomes considered stomachic and used in gastric complaints. They help to remove blood clots and other purulent matter in the body. Tubers are widely used as a local application on tumours, swellings and wounds.
Limnophila heterophylla (Roxb.) Benth	Scrophulari-aceae	Ambuja	Leaf	Cirrhosis of liver	Leaf extract taken everyday for some days will prevent liver cirrhosis. Helps in preventing graying of hair.
Litsea monopetala (Roxb.) Pers.	Lauraceae	Pajo	Bark, seeds	Astringent, Diarrhoea, Dysentery and rheumatism	Antibacterial Paste of bark is used to cure boils
Melastoma malabathricum L.	Melastomat-aceae	Koroli	Bark, leaves	Skin trouble, diarrhoea and dysentery	Cytotoxicity on murine and human cancer cell lines (Lohézic-Le Dévéhat *et al*., 2002)
Nyctanthes arbortristis L.	Oleaceae	Gangasiuli	Leaves	Fever, malaria and rheumatism	Decoction of shoot tips mixed with honey is taken once in a day in empty stomach for 7 days to cure malaria fever
Opeculina turpethum Silva	Convolvul-aceae	Tihudi	Root	Purgative, Vomiting, Giddiness and fainting	Used for vomiting, giddiness and even fainting. Roots with fruit juice of Phullanthus emblica given to check weight loss caused due to diabetes
Oroxylum indicum Vent.	Bignoniaceae	Phenphenia	Root, bark	Diarrhoea, Rheumatism and stomachache	Antiproliferative on HL-60 cell line, anticancerous on CEM, B-16 and HCT-8 cell lines (Costa-Lotufo *et al*., 2005) Decogtion of leaves given in stomachache and rheumatism Root-bark used in diarrhea and dysentery The bark grounded into a paste is locally applied and tied for 28 days in bone fracture
Pergularia daemia Chiov.	Asclepiad-aceae	Uturuchi	Whole plant	Catarrahal infection, infantile diarrhea, rheumatism	The leaves are useful in leprosy and haemorrhoids. Fruits are digestive and thermogenic. Plant extract is useful in uterine and menstrual disorders and in facilitating parturition
Pongamia glabra Vent.	Fabaceae	Karanja	Bark, seeds	Skin diseases, itches and flatulence, leprosy, gonorrhea, cough, diabetes, hydrocele and carminative	Antibacterial activity, antimycobacterial activity. The juice of the bark is touched with an hot iron and then the juice is orally given to mother immediately as a precaution to tetanus. Seed oil is used in skin diseases and rheumatism
Pterospermum acerifolium (L.) Willd.	Sterculiaceae	Muchukunda Kanakachampa	Flowers	Inflammation, ulcer, tumor and leprosy, Antidiabetic	The dried flowers are powdered and smoked like tobacco as an antispaodic.
Stychnos nux-vomica L.	Loganiaceae	Kochilakhai	Leaf	Cirrhosis of liver and cataract	Pasty mass of stem (3 g) with Kusum (*Schleichera oleosa*) seed oil (1 mL) is prescribed twice a day after food for 10 days continuously for the treatment of Leucoderma. Seeds are used in gastric trouble and dyspepsia.
Tinospora cordifolia Miers.	Menisper-maceae	Guluchi	Stem, roots	Diarrhoea and dysentery, antipyretic, anti-inflammatory, digestive, stomachic, cardiotonic, dyspepsia and chronic fever	Antineoplastic activity in *Ehrlich ascites carcinoma* bearing mice (Jagetia and Rao, 2006) Stem powder with pepper powder given to cure oral ulcers of diabetes
Urginea indica Kunth	Liliaceae	Bana Piaja	Bulb	Cardiotonic, diuretic, stimulant, dropsy and rheumatism, deobstruent and skin troubles	Antifungal, Anticancer alcoholic extract of bulbs possesses anticancer activity against human epidermoid carcinoma (Ambasta, 1986) Bulb extracts are used in curing heart ailment

Table 1: Continued

Botanical name	Family	Local name	Parts used	Cure for diseases	Medicinal properties antimicrobial, anticarcinogenic/Ethnomedicinal uses
Vitex negundo L.	Verbanaceae	Begunia	Leaves, bark	Headache, ulcer and sinus problem, Catarrhal and headache, dysentery and piles. Diarrhoea, fever and liver complains.	Antifungal cytotoxicity on human cancer cell line extract of leaves showed anticancer activity against Ehrlich ascites tumor cells (Ambasta, 1986) Young leaves are heated with mustard oil and applied in ear to cure ear ache. The root of the plant is made into a fine paste and is applied on the fore head during the labor pains for easy delivery
Woodfordia fruticosa Kurz.	Lythraceae	Dhatiki	Flowers	Astringent, menorrhagia, leprosy, burning sensation, haemoptisis and liver disorders	Host mediated anti tumor activity, *in vitro* and *in vivo* antitumor activity of Woodfordin C (Kuramochi-Motegi *et al*., 1992) Immunomodulatory

Melastoma malabathricum (leaf), *Diospyros melanoxylon* (bark), *Pterospermum acerifolium* (leaf), *Nyctanthes arbortristis* (bark), *Oroxylum indicum* (bark), *Agava sisalana* (leaf), *Clausena excavate* (root) *Vitex negundo* (leaf), *Glycyrrhiza glabra* (fruit), *Enhydra fluctuans* (leaf) *Hemidesmus indicus* (leaf) and *Flemingia nana* (root) exhibited outstanding antimicrobial activity with inhibition zones greater than 20 mm. A total of 9 plants were found to have moderate antimicrobial activity. However, 17 medicinal plants did not have any antimicrobial activity. In the present study the results were encouraging as 23 out of 40 plants appeared to contain substances with antimicrobial property. It is clear from the present study that not all medicinal plants posses antimicrobial properties. Similar observations were also made by different workers in different parts of India (Prakash *et al*., 1995; Ahmad *et al*., 1998; Perumal Samy *et al*., 1998).

World Health Organization has listed over 21,000 plant species used around the world for medicinal purposes. In India, about 2, 5000 plant species belonging to more than 1000 genera, are used in indigenous system of medicine. India is tenth among the plant rich counties of the world and fourth among the Asian countries. About 250 plant species are used in regular production of Ayurvedic, Unani, Sidha and tribal medicines. Analysis of distribution shows that medicinal plants are distributed across, diverse habitats. Around 70% of India's medicinal plants are found in tropical forests while less than 30% of the medicinal plants found are in temperate forests. As Similipal Biosphere Reserve belongs to tropical forest and harbors about 500 medicinal plants (Saxena and Brahamam, 1989), because of its diverse physiographic and climatic condition.

With regard to antimicrobial activity of gram + ve and gram -ve bacteria it is found that out of 23 medicinal plants, 21 plants showed antibacterial activity against gram positive bacteria while 20 plants have activity against gram negative bacteria. Among the microorganisms *Staphylococcus aureus* is more sensitive to about 17 medicinal plant extracts, *Shigella flexneri* is sensitive to about 15, *Bacillus licheniformis*, *Pseudomonas aeruginosa*, *Bacillus brevis* and *Bacillus subtilis* is about 12, *Vibrio cholerae* is sensitive to about 13, *Candida krusei* is about 8, *Escherichia coli* is 5 where as *Streptococcus aureus* and *Staphylococcus epidermidis* is sensitive to about 6 plant extracts. Medicinal plants have been widely used for treatment of many types of chronic and acute diseases in Asia and plants with antimicrobial activity have been reported by for new sources specially natural products by plants have been investigated (Cowan, 1999). There is an increase in antimicrobial resistance of some pathogens for which new types of effective and non toxic antimicrobial compounds, plant metabolites etc are being widely used in recent years as natural antimicrobial and antioxidant agents (Sobhy and El-Fefy, 2007).

Out of 40 medicinal plants studied, some plants have already been shown to have antimicrobial properties viz., *Adhatoda vasica* (Grange and Snell, 1996) *Andrographis paniculata* (Singha *et al*., 2003), *Argyreia speciosa* (Shukla *et al*., 1999), *Casia fistula* (Duraipandiyan and Ignacimuthu, 2007) and *Vitex negundo* (Sathiamoorthy *et al*., 2007). However, the extracts used and microorganisms tested in the present study may not be same as followed by earlier works. It is clear from Table 1 and 2, that the ethnomedicinal uses of some of the plants have fairly good degree of correlation with their specific antimicrobial activity. Further work is needed to isolate the active principles from the various extracts and evaluate their phytochemical properties. The preliminary results of this investigation appear to indicate that a number of medicinal plants belonging to Similipal Biosphere Reserve have high potential antimicrobial activity. It is expected that plants with high antimicrobial activity may contain anticancerious properties. The novel bioactive compounds from three plants need to be isolated and screened for their pharmaceutical and biotechnological applications for curing chronic and infectious diseases.

Table 2: Antimicrobial activity of aqueous extracts of collected ethnomedicinal plants

				Zone of inhibition (200 µL of crude extract) in mm										
Scientific name	Local name	Family	Parts used	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
Acorus calamus L.	Bacha	Araceae	Stem	-	-	-	-	ND	-	ND	-	ND	ND	ND
Adhatoda vasica Nees	Basanga	Acanthaceae	Leaf	16	18	14	16	16	14	ND	ND	ND	17	ND
Agava sisalana Perr.	Nalimurga	Agavaceae	Leaf	-	20	-	-	-	-	ND	-	-	-	ND
Andrographis paniculata	Bhuin nimba	Acanthaceae	Stem	14	15	ND	ND	13	17	ND	ND	ND	13	ND
(Burm.f.) Nees			Leaf	ND	ND	ND	ND	12	13	ND	ND	ND	13	ND
Argyreia speciosa Sweet	Budhadaraka	Convolvulaceae	Stem	-	ND	ND	-	-	-	-	-	-	-	-
Asparagus racemosus	Satabari	Asparagaraceae	Root	-	-	-	-	-	-	-	-	-	-	-
Willd.														
Buchnania lanzan	Chara	Anacardiaceae	Leaf	-	-	15	-	-	-	-	ND	ND	ND	ND
Spreng.			Bark	-	-	15	-	-	-	-	ND	ND	ND	ND
Careya arborea Roxb.	Kumbhi	Lecythidaceae	Bark	-	-	-	-	-	-	ND	-	-	-	-
Cassia fistula	Sonari	Caesalpiniaceae	Leaf	-	-	-	-	-	ND	ND	ND	ND	12	ND
Centella asiatica Linn.	Thalkudi	Apiaceae	Root	ND	12	ND	ND	ND	ND	ND	ND	ND	12	-
			Leaf	12	16	ND	ND	ND	18	ND	18	ND	16	19
Cissampelos pareira L.	Akanbindu	Menispermaceae	Root	-	-	-	-	-	-	-	-	-	-	ND
Cissus quandrangularis	Hadajoda	Vilaceae	Leaf	-	-	-	-	-	-	-	-	-	-	ND
L.			Stem	-	-	--	-	-	-	-	-	-	-	ND
Clausena excavata	Agnijhal	Rutaceae	Leaf	-	-	-	20	-	-	-	-	-	-	ND
Burm.f.			Root	15	15	13	14	16	-	-	-	-	-	ND
Coccinia grandis (L.)	Bana kunduri	Cucurbitaceae	Leaf	ND	_	_	ND	ND	-	ND	-	-	-	ND
Voigt														
Croton roxburghii Balak.	Putuli	Euphorbiaceae	Leaf	-	-	-	15	-	-	-	-	-	-	-
			Bark	14	17	20	15	-	21	17	-	-	-	-
Curcuma angustifolia	Palua	Zingiberaceae	Rhizome	-	-	ND	-	-	-	ND	-	-	-	ND
Roxb.														
Diospyros melanoxylon	Kendu	Ebenaceae	Leaf	15	14	13	-	-	18	14	ND	14	-	-
Roxb.			Bark	-	16	17	16	-	22	14	-	-	-	ND
Enhydra fluctuans	Hidmicha	Asteraceae	Leaf	17	-	20	-	15	16	ND	15	12	13	ND
Lour.														
Eryngium foetidum L.	Banadhania	Apiaceae	Stem	12	15	ND	ND	16	15	ND	ND	ND	12	14
			Leaf	14	14	ND	ND	14	17	ND	ND	ND	11	19
Flemingia nana Roxb	Sabalabhanga	Fabaceae	Root	27	-	18	19	22	18	-	15	15	-	ND
			Leaf	-	-	-	-	-	-	-	-	-	-	ND
Glycyrrhiza glabra (L.)	Jyestha madhu	Fabaceae	Seed	-	-	-	-	-	-	-	-	-	-	ND
			Bark	-	-	-	-	18	-	-	-	-	-	ND
			Leaf	-	-	-	-	-	-	-	-	-	-	ND
			Fruit	23	18	22	17	31	-	30	-	-	12	ND
Grewia elastica Royle	Mirgchara	Tilliaceae	Leaf	-	-	-	13	-	-	-	13	-	-	ND
			Root	-	-	25	22	28	-	-	12	-	-	ND
Hemidesmus indicus (L.)	Anaantamula	Asclepiadaceae	Stem	-	ND	ND	ND	-	-	ND	ND	-	14	-
Schult.			Leaf	12	ND	ND	ND	13	18	ND	16	12	16	19
Holarrhena	Kuluchi	Apocynaceaea	Leaf	-	ND	ND	-	-	-	-	-	-	-	-
antidysenterica Wall.														
Ichnocarpus frutescens	Badadudhi,	Apocyanaceae	Stem	ND	-	-	ND	ND	-	ND	-	-	-	ND
(L.) R.Br.	Swanlata		Leaf	-	-	-	-	-	-	-	-	-	-	ND
Kaempferia rotunda L.	Bhuin Champa	Zingiberaceae	Root	-	14	-	19	-	-	-	-	-	-	-
			Leaf	-	11	-	-	-	-	-	-	-	-	ND
Limnophila heterophylla	Ambuja	Scrophulariaceae	Leaf	-	-	-	-	-	-	-	-	-	ND	ND
(Roxb.) Benth.														
Litsea monopetala	Pojo	Lauraceae	Bark	14	-	-	16	-	-	-	-	-	-	-
(Roxb.) Pers.														
Melastoma	Koroli	Melastomataceae	Leaf	-	-	-	21	20	-	-	13	-	13	ND
malabathricum L.			Bark	16	-	-	16	20	-	-	-	-	-	ND
Nyctanthes	Gangasiuli	Oleaceae	Leaf	22	18	ND	ND	13	15	15	ND	21	20	20
arbortristis L.			Bark	14	15	ND	ND	18	22	18	ND	22	22	23
Opeculina turpethum.	Tihudi	Convolvulaceae	Leaf	-	ND	-	-	ND	-	-	-	-	-	-
Silva			Stem	-	ND	-	-	ND	-	-	-	-	-	-
Oroxylum indicum Vent.	Phenphenia	Bignoniaceae	Bark	-	20	-	-	-	-	ND	-	-	-	ND
Pergularia daemia	Uturuchi	Asclepiadaceae	Root	-	ND	-	-	ND	-	-	-	-	-	-
Chiov.			Leaf	-	ND	-	-	ND	-	-	-	-	-	-
Pongamia glabra Vent.	Karanja	Fabaceae	Leaf	ND	-	-	ND	ND	-	ND	-	-	-	ND
Pterospermum	Muchukunda	Sterculiaceae	Leaf	11	19	21	-	-	-	-	-	-	-	-
acerifolium (L.) Willd.														
Strychnos nux-vomica L.	Kochilakhai	Loganiaceae	Seed	-	-	ND	-	-	-	ND	-	ND	-	ND
Tinospora cordifolia	Guluchi	Menispermaceae	Stem	-	-	-	-	-	-	-	-	-	-	ND
Miers.														

Table 2: Continued

Scientific name	Local name	Family	Parts used	Zone of inhibition (200 µL of crude extract) in mm										
				S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
Urginea indica Kunth	Bana Piaja	Liliaceae	Bulb	25	22	26	24	23	21	19	21	-	28	ND
Vitex negundo L.	Begunia	Verbenaceae	Leaf	16	18	-	-	14	21	-	20	18	18	21
			Bark	13	12	17	17	16	-	14	-	-	14	18
Woodfordia fruticosa. kurz.	Dhatiki	Lythaceae	Root	-	-	-	-	-	-	ND	-	-	-	ND

***: S1: *Staphylococcus aureus*, S2: *Shigella flexneri*, S3: *Bacillus licheniformis*, S4: *Bacillus brevis*, S5: *Vibrio cholerae*, S6: *Pseudomonas aeruginosa*, S7: *Streptococcus aureus*, S8: *Candida kruesi*, S9: *Staphylococcus epidermidis*, S10: *Bacillus subtilis*, S11: *Escherichia coli*, ND: Not Detected

ACKNOWLEDGMENTS

The present research has been funded by the Department of Science and Technology, Government of Orissa (Grant No. 2596/17.6.2006). We are also grateful to the authorities of North Orissa University for providing necessary facilities to carry out this research.

REFERENCES

Ahmad, I., Z. Mehamood and F. Mohammad, 1998. Screening of some Indian medicinal plants for their antimicrobial properties. J. Ethnopharmacol., 62: 183-193.

Ambasta, S.P., 1986. The useful plants of India. 1st Edn. Publication and Information Directorate, CSIR, New Delhi .

Anonymous, 1997. Medicinal plants of India. Guidelines for national policy and conservation programme. Ministry of Environment and Forests, Govt. of India. New Delhi. FRLHT. Bangalore-560024

Bauer, A.M., W.M.M. Kirby, J.C. Sherris and M. Turk, 1966. Antibiotic susceptibility testing using a standard single disc method. Am. J. Clin. Pathol., 45: 493-496.

Costa-Lotufo, L.V., M.T.H. Khan, A. Ather, D.V. Wilke, C.P. Jimenez, C. Pessoa, M.E. Amaral de Moraes and M. Odorico de Moraes, 2005. Studies of the anticancer potential of plants used in Bangladeshi folk medicine. J. Ethnopharmacol., 99: 21-30.

Cowan, M.M., 1999. Plant products as antimicrobial agents. Clin. Microbiol. Rev., 12: 564-582.

Datta, G.K., K. Sairam, S. Priyambada, P.K. Debnath and R.K. Goel, 2002. Antiulcerogenic activity of Satavari mandur-an Ayurvedic herbo-mineral preparation. Indian J. Exp. Biol., 40: 1173-1177.

Dewanjee, S., M. Kundu, A. Maiti, R. Majumdar, A. Majumdar and S.C. Mandal, 2007a. *In vitro* evaluation of antimicrobial activity of crude extracts from plants *Diospyros peregrine*, *Coccinia grandis* and *Swietenia macrophylla*. Trop. J. Pharma. Res., 6: 773-778.

Dewanjee, S., A. Maiti, M. Kundu and S.C. Mandal, 2007b. Evaluation of antihelminthic activity of crude extracts of *Diospyros peregrine*, *Coccinia grandis* and *Schima wallichi* Dhaka Univ. J. Pharm. Sci., 6: 121-123.

Duraipandiyan, V. and S. Ignacimuthu, 2007. Antibacterial and antifungal activity of *Casia fistula* L.: An ethnomedicinal plant. J. Ethnopharmacol., 112: 590-594.

Erturk, O., H. Kati, N. Yayli and Z. Demirbag, 2006. Antimicrobial properties of *Silene multifida* (Adams) Rohrb. plant extract. Turk. J. Biol., 30: 17-21.

Goud, P.S.P., K.S.R. Murthy, T. Pillaiah and G.V.A.K. Babu, 2005. Screening for antibacterial and antifungal activity of some medicinal plants of Nallamalais Andhra Pradesh, India. J. Econ. Taxon. Bot., 29: 704-708.

Grange, J.M. and N.J.C. Snell, 1996. Activity of bromhexine and ambroxol, semi-synthetic derivatives of vasicine from the Indian shrub *Adhatoda vasica*, against *Mycobacterium tuberculosis in vitro*. J. Ethnopharmacol., 50: 49-53.

Gupta, R., 1998. Genetic resources of medicinal plants. Indian J. Plant Genet. Resour., 1: 98-102.

Iddamaldeniya, S.S., M.I. Thabrew, S.M. Wickramasinghe, N. Ratnatunge and M.G. Thammitiyagodage, 2006. A long-term investigation of the anti-hepatocarcinogenic potential of an indigenous medicine comprised of *Nigella sativa*, *Hemidesmus indicus* and *Smilax glabra*. J. Carcinog., 5: 11-17.

Ito, C., M. Itoigawa, S. Katsuno, M. Omura, H. Tokuda, H. Nishino and H. Furukawa, 2000. Chemical constituents of *Clausena excavata*: Isolation and structure elucidation of novel furanone-coumarins with inhibitory effects for tumor-promotion. J. Nat. Prod., 63: 1218-1224.

Jagetia, G.C. and S.K. Rao, 2006. Evaluation of the antineoplastic activity of guduchi (*Tinospora cordifolia*) in *Ehrlich ascites carcinoma* bearing mice. Biol. Pharm. Bull., 29: 460-466.

Jainu, M. and C.S. Shyamala Devi, 2005. Attenuation of neutrophil infiltration and proinflammatory cytokines by *Cissus quadrangularis*: A possible prevention against gastric ulcerogenesis. J. Herb. Pharmacother., 5: 33-42.

Khayyal, M.T., M.A. El-Ghazaly, S.A. Kenawy, M. Seif-el-Nasr, L.G. Mahran, Y.A. Kafafi and S.N. Okpanyi, 2001. Antiulcerogenic effect of some gastrointestinally acting plant extracts and their combination. Arzneimittelforschung, 51: 545-553.

Krishnaraju, A.V., T.V.N. Rao, D. Sundararaju, M. Vanisree, H. Tsay and G.V. Subbaraju, 2005. Assessment of bioactivity of Indian medicinal plants using Brine shrimp (*Artemia salina*) lethality assay. Int. J. Applied Sci. Eng., 3: 125-134.

Kupchan, S.M., A.C. Patel and E. Fujita, 1965. Tumor inhibitors. VI. Cissampareine, new cytotoxic alkaloid from *Cissampelos pareira*. Cytotoxicity of bisbenzylisoquinoline alkaloids. J. Pharm. Sci., 54: 580-583.

Kuramochi-Motegi, A., H. Kuramochi, F. Kobayashi, H. Ekimoto, K. Takahashi, S. Kadota, Y. Takamori and T. Kikuchi, 1992. Woodfruticosin (woodfordin C), a new inhibitor of DNA topoisomerase II. Experimental antitumor activity. Biochem. Pharmacol., 44: 1961-1965.

Lin, L.T., L.T. Liu, L.C. Chiang and C.C. Lin, 2002. *In vitro* anti-hepatoma activity of fifteen natural medicines from Canada. Phytother. Res., 16: 440-444.

Lohézic-Le Dévéhat, F., A. Bakhtiar, C. Bézivin, M. Amoros and J. Boustie, 2002. Antiviral and cytotoxic activities of some Indonesian plants. Fitoterapia, 73: 400-405.

Opoku, A.R., M. Geheeb-Keller, J. Lin, S.E. Terblanche, A. Hutchings, A. Chuturgoon and D. Pillay, 2000. Preliminary screening of some traditional Zulu medicinal plants for antineoplastic activities versus the HepG2 cell line. Phytother. Res., 14: 534-537.

Pandey, A.K., S.D. Rout and N. Pandit, 2002. Medicinal Plants of Siomilipal Biosphere Reserve-I. In: Perspectives of Plant Biodiversity, Das, A.P. (Ed.). Bishen Singh Mahendra Pal Singh, Dehra Dun, pp: 681-696.

Perumal Samy, R., S. Ignacimuthu and H. Sen, 1998. Screening of 34 Indian medicinal plants for antibacterial properties. J. Ethnopharmacol., 62: 173-182.

Prakash, P., P.H. Kulkarni and P. Paranjpe, 1995. Comparative efficacy of four ayurvedic formulation in the treatment of *Acne bulgaris*. J. Ethnopharmacol., 49: 127-132.

Rajagopal, S., R.A. Kumar, D.S. Deevi, C. Satyanarayana and R. Rajagopalan, 2003. Andrographolide, a potential cancer therapeutic agent isolated from *Andrographis paniculata*. J. Exp. Ther. Oncol., 3: 147-158.

Rao, A.R., 1981. Inhibitory action of *Asparagus racemosus* on DMBA-induced mammary carcinogenesis in rats. Int. J. Cancer, 28: 607-610.

Sairam, K., C.V. Rao and R.K. Goel, 2001. Effect of *Centella asiatica* Linn. on physical and chemical factors induced gastric ulceration and secretion in rats. Indian J. Exp. Biol., 39: 137-142.

Sathiamoorthy, R., P. Gupta, M. Kumar, A.K. Chaturvedi, P.K. Shukla and R. Maurya, 2007. New antifungal flavonoid glycoside from *Vitex negundo*. Bioorganic Med. Chem. Lett., 17: 239-242.

Saxena, H.O. and M. Brahmam, 1989. The Flora of Similipahar (Simlipal), Orissa: Regional Research Laboratory, Bhubaneswar.

Singha, P.K., S. Roy and S. Dey, 2003. Antimicrobial activity of *Andrographis paniculata* Fitoterapia, 74: 692-694.

Sheela, M.L., M.K. Ramakrishna and B.P. Salimath, 2006. Angiogenic and proliferative effects of the cytokine VEGF in Ehrlich ascites tumor cells is inhibited by *Glycyrrhiza glabra*. Int. Immunopharmacol., 6: 494-498.

Shukla, Y.N., A. Srivastava, S. Kumar and S. Kumar, 1999. Phytotoxic and antimicrobial constituents of *Argyreia speciosa* and *Oenothera biennis*. J. Ethanopharmacol., 67: 241-245.

Sobhy, E.A. and S.S. El-Feky, 2007. Chemical constituents and antimicrobial activity of *Helichrysum stoechas*. Asian J. Plant Sci., 6: 692-695.

Thabrew, M.I., R.R. Mitry, M.A. Morsy and R.D. Hughes, 2005. Cytotoxic effects of a decoction of *Nigella sativa*, *Hemidesmus indicus* and *Smilax glabra* on human hepatoma HepG2 cells. Life Sci., 77: 1319-1330.