International Journal of Pharmacology

ISSN 1811-7775

science alert

ansinet
Asian Network for Scientific Information

International Journal of Pharmacology 4 (3): 230-232, 2008
ISSN 1811-7775

Potential Antimicrobial Activity of Various Extracts of *Bacopa monnieri* (Linn.)

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Abstract: The present study was carried out to evaluate the antimicrobial potential of ethanolic, diethyl ether, ethyl acetate and aqueous extracts of aerial parts of *Bacopa monnieri* (L.). The antimicrobial activity of ethanolic, diethyl ether, ethyl acetate tested for the *Staphylococcus aureus*, *Proteus vulgaris*, *Candida albicans* and *Aspergillus niger*. Diethyl ether extracts of *Bacopa monnieri* showed an antibacterial activity against gram positive and ethyl acetate extract was active against gram negative organism. The extract of diethyl ether having potent antimicrobial activity against *Staphylococcus aureus* at higher concentrations (300 μg mL^{-1}). Ethanolic extract of *Bacopa monnieri* has more antifungal activity against *Candida albicans* and *Aspergillus niger*. Diethyl ether extract and Ethyl acetate extract has slight antifungal activity but have broad spectrum of antibacterial effect against the entire tested organisms, whereas ethanolic extract showed marked inhibitory activity against fungal species. Aqueous extract of the different concentration showed no inhibitory effects on the tested microorganisms due to loss of some active compounds during extraction processes of the sample.

Key words: Antibacterial activity, antifungal activity, crude extracts, *Bacopa monnieri* (Linn.)

INTRODUCTION

The medicinal properties of several herbal plants have been documented in ancient Indian literature and the preparations have been found to be effective in the treatment of diseases. Therefore to meet the increasing demand of manufacturing modern medicines and export, the need of the medicinal plants have enormously increased. This demand is generally met with by cultivating and uprooting medicinal plants (Singh and Dhawan, 1997).

During the last 10 years pace of development of new antimicrobial drugs has slowed down while the prevalence of resistance has increased astronomically (Akinpelu and Onakoya, 2006). The problem of microbial resistance of growing and the outlook for the use of antimicrobial drugs in the future is still uncertain. Therefore, actions must be taken to reduce this problem, such as controlling the use of antibiotics and carrying out research for the better understanding of the genetic mechanism of resistance. This prompted us to evaluate plants as the source of potential chemo therapeutic agent, antimicrobial agent and their ethno medicinal use (Prashanth *et al*., 2006).

S. aureus infections can be spread through contact with pus from an infected wound, skin to skin contact with an infected person by producing hyaluronidase that destroy tissues. *Proteus vulgaris* can cause many different types of infection to humans such as urinary track infection, wound infections. *Proteus vulgaris* can be deadly when in the sinus or respiratory tissues, if left untreated or is treated with antibiotics that have only an intermediate effect on *Proteus vulgaris* (Partrick *et al*., 1998). *Candida albicans* becomes an infectious agent when there is some change in the body environment that allows it to grow out of control. Most of the time, Candida infections of the mouth, skin, or vagina occur for no apparent reason. Among fungal pathogens *Candida albicans* is known to cause serious systemic infections including opportunistic infection in patients infected with HIV virus (Srinivasan *et al*., 2001). Aspergillosis is a large spectrum of diseases caused by members of the genus *Aspergillus* (Stevens *et al*., 2000). *Aspergillus* spp. are frequently secondary opportunistic pathogens in

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patients with bronchiectasis, carcinoma, other mycoses, sarcoid and tuberculosis (Fujimura *et al*., 1998).

Bacopa monnieri, also referred to as Herpestis monniera, water hyssop. The name Brahmi has been used in the Ayurvedic system of medicine for centuries (Mukherjee and Dey, 1966). *Bacopa monnieri*, a member of Scrophulasiaceae family, is a small, creeping herb with numerous branches, small long leaves and produces light purple or white colour flowers (Bone, 1996). The purpose of the present study was to evaluate the anti microbial activities of various extracts of *Bacopa monnieri*.

MATERIALS AND METHODS

Collection of plant sample: *Bacopa monnieri* plant material was collected from Pondicherry University, Pondicherry, India during December 2007. The Aerial parts of plant materials were shade dried and powdered.

Extraction: Approximately 75 g of the sample was taken and extracted using Soxhlet apparatus (Alade and Irobi, 1993) with ethanol and ethyl acetate for approximately 6-8 h. The extracts were vacuum evaporated, dried and stored. The leaf powder was cold extracted with 50% diethyl ether with occasional stirring and kept as such for 24 h. The pooled extracts were concentrated and evaporated to dryness under pressure (Kumar *et al.,* 1998). The leaf powder was mixed with 200 mL of distilled water and boiled. Filtered through of Whatmann No. 40 filter paper and taken to dryness to obtain the extract (Seema *et al*., 1996).

Antibacterial sensitivity test: The plant extracts were tested for anti bacterial activity by the well diffusion method using bacterial strains, *Staphylococcus aureus* and *Proteus vulgaris*. Antibacterial activity was expressed as the ratio of the inhibition zone (mm) produced by the plant extract.

Antifungal sensitivity test: The extracts thus prepared were tested separately for their fungal toxicity against *Aspergillus niger* and *Candida albicans*. The leaf extracts were added separately to the cooled sabourauds dextrose agar medium to give the concentrations of 0.1, 0.2 and 0.3 mL. The amended SDS medium was dispersed in Petri plates and allowed to solidify. After solidification 10 mm agar block cut from the actively growing margin of the pathogen viz., *Aspergillus niger* and *Candida albicans* were inoculated at the centre of the plates. The plates were incubated at 30°C for 7-14 days. The radial growth was measured periodically and the mean growth rate was calculated. Control was maintained.

RESULTS

The problem posed by the high cost, adulteration and increasing side effects of synthetic drugs coupled with their inadequacy in diseases treatment found more effective especially in the developing country cannot be over emphasized (Shariff, 2001).

Diethyl ether extract of *Bacopa monnieri* have maximum (18.00±1.00 mm) inhibitory effect against *Staphylococcus aureus* at a concentration of 300 µg. Ethyl acetate and ethanolic extract has the moderate effect over *Staphylococcus aureus* (Table 1). The aqueous extract does not show any inhibitory effect. Table 1 presents the inhibitory effects of various extracts of *Bacopa monnieri* against *Proteus vulgaris*. This reveals the potency (15.00±1.73 mm) of ethyl acetate at 300 µg. Ethanolic and diethyl ether extract showed lesser inhibitory effect when compared with ethyl acetate extract. Table 1 also denotes the antifungal ability of various extracts of *Bacopa monnieri* against *Candida albicans* and *Aspergillus niger*. Ethanolic extract was found to have maximum activity (11.00±1.00 and 11.67±0.57 mm, respectively) followed by diethyl ether extract. Aqueous extract of *Bacopa monnieri* does not show any inhibitory effect against the organisms studied.

Table 1: Inhibitory effect of various extracts of *Bacopa monnieri* (Linn.) against pathogenic organisms

	Zone of inhibition in different concentration (mm)											
	Ethanol (µg mL^{-1})			Diethyl Ether (µg mL^{-1})			Ethyl acetate (µg mL^{-1})			Aqueous (µg mL^{-1})		
Microorganisms	100	200	300	100	200	300	100	200	300	100	200	300
Staphylococcus aureus	9.00±1.70	10.3±2.30	14.30±3.70	12.90±1.15	15.00±1.00	18.00±1.00	7.70±0.570	8.70±0.57	9.70±0.73	NA	NA	NA
Proteus vulgaris	6.70±0.57	8.0±0.00	9.30±0.57	9.70±0.57	10.70±0.57	11.70±0.57	11.70±1.520	13.70±2.08	15.00±1.73	NA	NA	NA
Candida albicans	9.00±1.00	10.3±1.52	11.00±1.00	6.33±0.57	7.33±0.57	8.00±0.00	4.70±0.570	5.67±0.57	6.00±0.00	NA	NA	NA
Aspergillus niger	9.67±0.57	10.3±1.23	11.67±0.57	6.33±1.52	7.33±1.52	8.33±1.52	4.67±0.57	5.67±0.57	6.67±0.57	NA	NA	NA

*Inhibition zones excluding well: mean±SD, n = 3 (three replicates), NA→No. Activity found at this concentration

DISCUSSION

The results showed that all the extracts of *Bacopa monnieri* (aerial part) possessed antimicrobial activity except aqueous extract. The growth of *Staphylococcus aureus* was inhibited successfully by diethyl ether extract at higher concentration at 300 μg. It is clear that ethyl acetate and diethyl ether have antibacterial activity against the tested bacterial species.

On the other hand ethanolic extract, exhibited an elevated antifungal activity against both the fungal species. Antimicrobial activity from plant source can be assumed to be useful. The extracts produce anti-infective agent, which could be active against human pathogens (Prashanthkumar *et al*., 2006). Apart from antimicrobial activity exhibited by tannins, they also lead with proteins to provide the typical turning effect. Medicinally, this is important for the treatment of inflammed tissues (Mota *et al*., 1985). Several flavanoids and phenolic acids may present which exhibit interesting antimicrobial properties. Numerous reports have been published in the past three decades that focused on the antimicrobial properties of herbs, species of their derivatives such as essential oils, extracts and decoctions (Kivanc and Akgul, 1986). Aqueous extract of the different concentration showed no inhibitory effects on the tested microorganisms due to loss of some active compounds during extraction processes of the sample. Despite many published reports dealing with treatment for neurological disorders little was known about the antimicrobial activity of *Bacopa monnieri* prior to our investigation. Further studies on the activity directed fractionation for the isolation of respective pure compounds result in interesting results.

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