Antibacterial Activity of *Pterocarpus santalinus*

B. K. MANJUNATHA*
Department of Botany, S. R. N. M. N. College of Applied Sciences, Shimoga-577 201, India.

Antibacterial activity of leaf and stem bark of *Pterocarpus santalinus* (Fabaceae) was investigated. The antibacterial activity was tested against both Gram-positive and Gram-negative organisms. Among the two extracts tested, stem bark extract exhibited broad-spectrum antibacterial activity against the tested organisms. The stem bark extract showed maximum activity against *Enterobacter aerogenes, Alcaligenes faecalis, Escherichia coli, Pseudomonas aeruginosa, Proteus vulgaris, Bacillus cereus, Bacillus subtilis, Staphylococcus aureus*. The leaf extract showed maximum activity against *Escherichia coli, Alcaligenes faecalis, Enterobacter aerogenes and Pseudomonas aeruginosa*. Both extracts exhibited concentration dependent activity.

Pterocarpus santalinus L.f., commonly known as Red sanders (English), *Raktachandan* (Sanskrit) and *Kempu honne* (Kannada) belongs to the family Fabaceae. It is an endangered and endemic to Andhra Pradesh[1]. The plant is renowned for its characteristic timber of exquisite colour, beauty and superlative technical qualities and ranks among finest luxury in Japan[2]. The red wood yields a natural dye santalin, which is used in colouring pharmaceutical preparations and foodstuffs. The wood is used as an astringent and tonic for external application in inflammation; it is also used in treating headache, skin diseases, fever, boils, scorpion sting and to improve sight[3]. The wood and fruit is used in treating diaphoretics, bilious infections and chronic dysentry[4]. The heart wood contains isoflavone glucosides[5-7] and two anti-tumour lignans, viz., savinin and calocedrin[8]. A triterpene is reported from the callus of stem cuttings[9]. Ethanol extract of stem bark was reported to possess anti-hyperglycaemic activity[10]. Critical review of the literature revealed that *Pterocarpus santalinus* L.f. has remained unexplored for many pharmacological activities claimed. The present paper reports the antibacterial potency of this rare plant genetic resource.

Leaves and stem bark of *Pterocarpus santalinus* were collected during the month of January 2003 from the Ayurvedic medicinal garden at Gajanur, Shimoga district, maintained by the Forest Department of Shimoga Range. The voucher specimens (BKM-430, BKM-431) were deposited in the Department Herbaria, S. R. N. M. N. College of Applied Sciences, Shimoga, for future reference.

Leaf and stem bark was shade-dried and powdered mechanically. About 250 g of powdered materials were subjected to exhaustive extraction using soxhlet apparatus with 70% methanol for about 48 h. The extract was filtered under reduced pressure using rotary flash evaporator (Buchi, Flawil, Switzerland) and dried in the dessicator (yield 16 % w/w and 22% w/w respectively). The extracts were subjected to preliminary phytochemical tests[11].

The bacterial strains obtained from National Chemical Laboratory, Pune, were used for the screening purpose by disc diffusion method. 25 mg, 50 mg and 75 mg of leaf and stem bark extracts were dissolved in 1 ml of DMSO. Filter paper discs (Whatman No. 1) of 5 mm diameter were loaded with 100 ml of crude extracts. Discs were completely dried and sterilized. 100 ml of 24 h broth cultures were spread on sterilized nutrient agar media and impregnated discs were placed on it and incubated for 24 h at 37°. Streptomycin discs (10 mg/disc) were used as a standard drug. The diameter of zone of inhibition in mm was recorded. The sterile discs impregnated with DMSO were used as control. The experiment was performed in triplicate, and average diameter of zone of inhibition was obtained.

In the present investigation, preliminary phytochemical studies of stem bark extract revealed the presence of alkaloids, phenols, saponins, glycosides, flavonoids, triterpenoids, sterols and tannins, whereas the leaf extract showed positive tests to phenols, saponins flavonoids, triterpenoids and tannins. The results of the antibacterial activity of the compounds tested against selected organisms are presented in Table 1. Stem bark extract showed maximum activity against *Enterobacter aerogenes* (21.5 mm), *Alcaligenes faecalis* (20.0 mm), *Escherichia coli* (18.5 mm), *Pseudomonas aeruginosa* (18.0 mm), *Proteus*

***For correspondence**
E-mail: doctor_bkm@yahoo.com

TABLE 1: ANTIBACTERIAL EFFECT OF LEAF AND STEM BARK EXTRACT OF *PTEROCARPUS SANTALINUS*

Tested organisms	Leaf extract			Stem bark extract			Streptomycin
	2.5 mg	5 mg	7.5 mg	2.5 mg	5 mg	7.5 mg	10 µg
	Diameter of zone of inhibition (%)						
Bacillus subtilis NCIM-2063	9.00 (46.39)	11.5 (59.27)	14.5 (74.74)	8.5 (43.81)	13.5 (69.88)	17.0 (87.62)	19.4 (100)
Escherichia coli NCIM-2065	9.5 (46.11)	17.0 (82.52)	19.5 (94.66)	9.0 (43.68)	14.0 (67.96)	18.5 (89.80)	20.6 (100)
Enterobacter aerogenes NCIM-2340	8.0 (35.55)	15.5 (68.88)	17.5 (77.77)	12.6 (56.0)	14.5 (64.44)	21.5 (95.55)	22.5 (100)
Alcaligenes faecalis NCIM-2262	7.0 (35.00)	16.0 (80.00)	18.0 (90.00)	8.0 (40.00)	9.4 (47.00)	20.0 (100)	20.0 (100)
Staphylococcus aureus NCIM-2079	6.0 (30.76)	8.5 (43.58)	11.0 (56.41)	9.5 (48.71)	14.0 (71.79)	16.5 (84.61)	19.5 (100)
Pseudomonas aeruginosa NCIM-2036	6.5 (31.86)	10.0 (49.01)	16.5 (80.88)	10.6 (51.96)	15.0 (73.59)	18.0 (88.23)	20.4 (100)
Proteus vulgaris NCIM-2027	5.5 (28.20)	9.0 (46.15)	11.8 (60.51)	9.5 (48.71)	14.0 (71.79)	18.0 (92.30)	19.5 (100)
Bacillus cereus NCIM-2155	5.5 (28.94)	8.00 (42.10)	11.5 (60.52)	7.5 (39.47)	10.0 (52.63)	17.5 (92.0)	19.0 (100)

Diameter of zone of inhibition in mm (n=9), Figures in parenthesis indicates percentage diameter inhibition

vulgaris (18.0 mm), *Bacillus cereus* (17.5 mm), *Bacillus subtilis* (17.0 mm) and *Staphylococcus aureus* (16.5 mm), whereas the leaf extract showed maximum activity against *Escherichia coli* (19.5 mm), *Alcaligenes faecalis* (18.0 mm), *Enterobacter aerogenes* (17.5 mm) *and Pseudomonas aeruginosa* (16.5 mm).

The secondary metabolites of various chemical types present in the plant species are known to possess antimicrobial activities. Flavonoids are found to be effective antimicrobial substances against a wide range of microorganisms, probably due to their ability to complex with extracellular and soluble proteins and to complex with bacterial cell wall; more lipophilic flavonoids may also disrupt microbial membrane[12]. Phenolics and polyphenols present in the plants are known to be toxic to micro-organisms[13]. Antibacterial activity of tannins may be related to their ability to inactivate microbial adhesins, enzymes and cell envelope transport proteins, they also complex with polysaccharides[14]. Many plant genetic resources have been analyzed for their active constituents possessing antibacterial activities. For example, broad spectrum antibacterial activity of leaf extract of *Bolusanthus speciosus* is due to flavonoids[15]. *Landolphia owrrience* is known to possess glycosides, flavonoids, tannins, saponins, which either individually or in combination, exert antibacterial activity[16]. The broad spectrum antibacterial activity exhibited by *Pterocarpus santalinus* may be attributed to the various active constituents present in it, which either due to their individual or combined action, exhibit antibacterial activity. Hence the present findings provide a scientific base for some of the medicinal claims of *Pterocarpus santalinus* L.f.

ACKNOWLEDGEMENTS

The authors are grateful to National Education Society for their financial support. The authors express their sincere thanks to Prof. T. S. Ramkumar, Principal; Girimaji N. Raj Gopal, Secretary; S. V. Thimmaiah, Joint Secretary; and Prof. Darmanada Rao, Dr. V. Krishna, S. M. Vidya, K. L. Mankani and Jagadeesh Singh for their valuable guidance.

REFERENCES

1. Anuradha, M. and Pullaiah, T., **Taiwania**, 1999, 44, 311.
2. Keshav Reddy, K. and Srivasuki, K.P., **Indian For.,** 1999, 116, 536.
3. Chopra, R.N., Nayar, S.L. and Chopra, I.C., In; Glossory of Indian Madicinal Plants, CSIR Publications, New Delhi, 1956, 206.
4. Anonymous., In; The Wealth of India. Raw materials, CSIR Publications, New Delhi, 1969, 167.
5. Krishnaveni, K.S. and Srinivasa Rao, J.V., **Asian Nat. Prod. Res.,** 2000, 2, 219.
6. Krishnaveni, K.S. and Srinivasa Rao, J.V., **Phytochem.,** 2000, 53, 605.
7. Krishnaveni, K.S. and Srinivasa Rao, J.V., **Chem. Pharm. Bull.,** 2000, 48, 1373.
8. Cho, J.Y., Park, J., Kim, P.S., Yoo, E.S., Baik, K.U. and Park, M.H., **Biol**. **Pharm. Bull**., 2001, 24, 167.
9. Krishnaveni, K.S. and Srinivasa Rao, J.V., **Fitoterapia**., 2000, 71, 10.
10. Kameswara Rao, B., Giri, R., Kesavulu, M.M. and Apparao, C., **J. Ethnopharmacol.,** 2001, 74, 69.
11. Kokate, C.K., Purohith, A.P. and Gokhale, S.B., In: Pharmacognosy, Nirali Prakashan, Pune, 1990, 120.
12. Tsuchiya, H., Sato, M., Miyazaki, T., Fujiwara, S., Tanigaki, S., Ohyama, M., Tanaka, T. and Iinuma M., **J. Ethnopharmacol**., 1996, 50, 27.
13. Mason, T.L. and Wasserman, B.P., **Phytochem**., 1987, 26, 2197.
14. Ya, C., Gaffney, S.H., Lilley, T.H. and Haslam, E., In; Hemingway, R.W. and Karchesy J.J., Eds., Chemistry and Significance of Condensed Tannins, Plenum Press, New York. 1998, 553.
15. Bojase, G., Majinda, R.R.T., Gashe, B.A. and Wanjala, C.C.W., **Planta Medica,** 2002, 68, 615.
16. Ebi, G.C. and Ofoefule., **Phytother. Res**., 1997, 11, 149.

Accepted 24 February 2006
Revised 25 April 2005
Received 29 November 2004
Indian J. Pharm. Sci., 2006, 68 (1):115-116