into the effect of large earthquakes in the nearby coastal waters. The routine evaluation of the chlorophyll concentrations is possible because numerous satellites are presently capable of monitoring ocean parameters.

1. Gaur, V. K., *Curr. Sci.*, 2001, **80**, 338–340.
2. Kundu, S. N. *et al.*, *Int. J. Remote Sensing*, 2001 (in press).
3. Chauhan, P. *et al.*, *NNRMS Bull.*, 2000, **24**, 7–13.
4. Doerffer, R., in *Imaging Spectrometry: Fundamentals and Prospective Applications* (eds Toselli, F. and Bodechtel, F.), Brussels and Luxemburg: ECSC, EEC, EAEC, 1992, pp. 215–257.
5. Uz, B. M. *et al.*, *Nature*, 2001, **409**, 597–600.
6. Agarwal, Abhilasha (pers. commun.).

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Antioxidant property of *Mucuna pruriens* Linn.

Mucuna pruriens Linn. (Fabaceae), commonly known as cowhage plant or kapikacho or kevach in Hindi, is the most popular drug in the Ayurvedic system of medicine[1]. Its different preparations (from the seeds) are used for the management of several free radical-mediated diseases such as ageing, rheumatoid arthritis, diabetes, atherosclerosis, male infertility and nervous disorders. It is also used as an aphrodisiac and in the management of Parkinsonism, as it is good source of L-dopa[2]. The seeds of *M. pruriens* show hypoglycemic, hypocholesterolemic activity in experimental rats[3]. Other parts of this plant are also in medicinal use, e.g. trichomes of pods are used for de-worming, decoction of root in delirium, root powder as a diuretic and anti-inflammatory agent. Similarly, the paste of fresh root is used in the treatment of lymphoedema.

The alcoholic extract of *M. pruriens* seeds gave four alkaloids, viz. mucunine, mucunadine, prurienine, and prunieninine[4]. The major portion of the alcoholic extract of seeds showed the presence of 5-indolic compounds, two of which were identified as tryptamine and 5-hydroxy tryptamine. It is a natural source of L-dopa (L-3,4-dihydroxy phenyl alanine). Interestingly, even after the wide clinical application of this herb, not much experimental work has been done to support the mechanism of action of the seeds of *M. pruriens* for its different clinical applications[5]. In this paper we have investigated the response of the alcoholic extract of the seeds of *M. pruriens* on two *in vivo* models of lipid peroxidation, i.e. stress-induced and alloxan-induced.

Normal albino rats (100–150 g body wt.) of Charles Foster strain, were randomly divided into two groups, one normal control and the other, extract treated. The optimum dose of alloxan and time of stress for optimum induction of lipid peroxidation were arrived at by dose and time response curve (data not reported)[6]. Alcoholic extract of the seeds of *M. pruriens* (yield 40.2%) was given orally to rats in the dose of 60 mg/100 g body wt. up to 30 days. Further, they were divided into 2 sets, each having 2 sub-groups, viz. control and experimental. One set was used for the stress-induced model, whereas the other set was used for the alloxan-induced model. In each set, one group was subjected to stress and the other group was left as experimental control to see the effect of only the extract, if any.

In the stress-induced model, immobilized stress was given for 6 h at 37°C. In another set of animals, alloxan was injected intraperitoneally in the dose of 20 mg/100 g body wt. After 48 h, animals were sacrificed to estimate the level of lipid peroxidation in liver. In similar conditions, normal rats (without extract administration) were also used for stress control and normal control. In each group, there were 6 animals. Degree of lipid peroxidation was assayed in terms of thiobarbituric acid reactive substance (TBARS) by using PTA method[7] as described earlier. In a separate *in vitro* study the effect of the extract was studied on $FeSO_4$-induced lipid peroxidation with slight modification[8] of the standard method of Ohkawa *et al.*[9]. Superoxide anion (O_2) scavenging property was assayed by observing the degree of reduction of nitro blue tetrazolium to blue farmazan[10]. The hydroxyl radical-scavenging property of the extract was determined by monitoring the degree of hydroxylation of salicylate by Fe^{+3} ascorbate H_2O_2 system[11].

In vitro study shows that *M. pruriens* possesses dose-dependent protection against superoxide generation, hydroxyl radical production and $FeSO_4$-induced lipid peroxidation. (Figure 1). *In vivo* study showed significant inhibition in lipid peroxidation induced by alloxan and immobilized stress. The extract by itself has no toxic effect on this dose, as it does not induce any peroxidation (Table 1).

Biological and chemical pro-oxidants are considered to be important for the provocation of free radical-mediated diseases in an individual. Although free

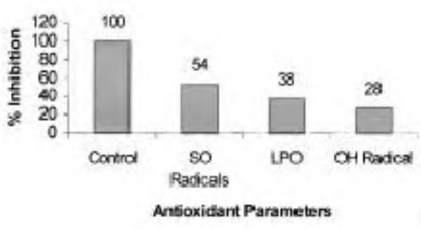

Figure 1. Protective effect of the alcohol extract of *M. pruriens* on different species of free radicals and $FeSO_4$-induced lipid peroxidation in *in vitro* conditions. (Conc. of extract 200 µg/ml).

Table 1. Effect of alcoholic extract of *M. pruriens* on stress-induced (6 h, 37°C) and alloxan-induced (20 mg/100 g body wt.) lipid peroxidation ($n = 6$)

	Lipid peroxidation inducing agent	
Group	Stress	Alloxan
Normal	433.73 ± 26.60	433.73 ± 26.60
Only extract	313.33 ± 20.14	313.33 ± 20.14
Only inducer	822.92 ± 12.67	779.78 ± 46.22
Extract + inducer	447.81 ± 33.81	346.51 ± 23.13

Extract was given orally at the dose of 60 mg/100 g body wt. to the animals for 30 days.

radicals are considered to be important for normal physiology when produced in excess, they cause cellular damage. The radicals initiate a chain reaction of lipid and protein peroxidation by attacking on the double bonds of these molecules. About 40 diseases are now being considered as free radical-mediated. Most of them are metabolic, nervous or other old age diseases. Radical-induced oxidation of peptides generates reactive carbonyl derivatives (RCD), which are involved in rheumatoid arthritis, Alzheimer's disease, smoking-related pathologies, muscle dystrophy, re-perfusion injuries, etc.[12]. In our previous communication, we have reported the dose- and time-dependent response of *M. pruriens* on lipid peroxidation[8]. Its clinical use for several free radical diseases, especially the age-related male infertility and Parkinson's disease is well documented[2]. Its protective response on these *in vivo* models suggests two possibilities. Either it is acting on the nervous system or else it is removing the free radicals generated due to catecholamine and iron interaction[13]. Stress is another factor which induces lipid peroxidation, both directly at the tissue level and also through the high release of catecholamines[13]. Stress causes 50% increase in protein oxidation as measured by its carbonyl content and about 40% decrease in the glutathione content of the fundic stomach, suggesting oxidative damage by stress. It also causes time-dependent increase in the superoxide dismutase activity in mitochondria and a decrease in the glutathione peroxidase activity[14]. Since this extract is inhibiting the lipid peroxidation induced by alloxan and also by $FeSO_4$, it could be concluded that its action is through the removal of free radicals. The mechanism could be through the removal of hydroxyl radicals, which are produced by the interaction of catecholamines with iron or by direct chelation of free iron. *In vitro* studies have already shown its role in the removal of $^{\bullet}OH$ radicals. Effects on alloxan-induced model could be due to its property of trapping the superoxides, because it is reported that alloxan initiates the process of lipid peroxidation through the production of superoxides.

1. Chopra, R. N., Nayar, S. L. and Chopra, I. C., *Indian Medicinal Plants*, CSIR, New Delhi, 1956.
2. Vaidya, R. A., Allorkar, S. D., Seth, A. R. and Panday, S. K., *Neurology*, 1978, **26**, 179–186.
3. Pant, M. C., Uddin, I., Bhardwaj, U. R. and Tewari, R. D., *Indian J. Med. Res.*, 1968, **56**, 1808.
4. Santra, D. K. and Majumdar, D. N., *Indian J. Pharmacol.*, 1953, **15**, 60.
5. Upadhyay, A. K., Ph D thesis submitted to Banaras Hindu University, Varanasi, 1998.
6. Tripathi, Y. B. and Upadhyay, A. K., *J. Ethnopharmacol.*, 2001 (in press).
7. Tero, *J. Free Radials Biol. Med.*, 1988, **4**, 155–161.
8. Tripathi, Y. B. and Upadhyay, A. K., *Phytother. Res.*, 2001, **15**, 1–5.
9. Ohkawa, M., Ohishi, N. and Yagi, K., *Anal. Biochem.*, 1979, **95**, 351–358.
10. Flohe, L. and Otting, F., *Methods Enzymol.*, 1984, **105**, 93–104.
11. Rowley, D. A. and Halliwell, B., *Clin. Sci.*, 1983, **64**, 649–653.
12. Parks, D. A. and Gragner, D. N., *Am. J. Physiol.*, 1983, **245**, 285.
13. Guliaeva, N. V., Luzina, N. L., Levshina, I. P. and Kryzhanovski, G. N., *Bull. Eksp. Biol. Med.*, 1988, **106**, 660–663.
14. Sutkovoi, D. A. and Barabari, V. A., *Ukr. Biokhim. Zh.*, 1985, **57**, 79–81.

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Bats of the Indian subcontinent – An update

Uncertainty on the exact number of taxa of chiropterans occurring in the Indian subcontinent has been a matter of debate[1–4]. One of the 26 mammalian orders, Chiroptera includes about 925 to 950 species of bats the world over in two rather unequal sub-orders – the Megachiroptera and the Microchiroptera[5,6]. The former is represented by only one family (Pteropodidae) which is restricted to the Old World tropics of Africa and Asia, while the latter includes 17 families (Rhinopomatidae, Emballonuridae, Craseonycteridae, Nycteridae, Megadermatidae, Rhinolophidae, Hipposideridae, Noctilionidae, Mormoopidae, Phyllostomidae, Natalidae, Furipteridae, Thyropteridae, Myzopodidae, Vespertilionidae, Mystacinidae and Molossidae)[7].

About a quarter of known mammals in India are bats. A recent checklist of Indian mammals[8] lists 105 species of bats belonging to 35 genera and 7 families. Agrawal[9] puts on record a total of 110 species of bats belonging to 36 genera and 6 families based on an earlier publication[5]. The most comprehensive and up-to-date revision of the Chiroptera of