Significant changes in ocean parameters after the Gujarat earthquake

The Gujarat earthquake[1] of magnitude 7.8 which occurred on 26 January 2001 at 8 h 46 min, rocked the whole of Gujarat and adjoining areas. This earthquake caused severe damage and killed tens of thousands and left many more homeless. In this note, we report the changes in chlorophyll and suspended sediment concentrations after the earthquake. The chlorophyll and suspended sediment concentrations have been estimated using IRS-P4 OCM digital data. IRS-P4 Oceansat is the first in the series of operational ocean remote satellites that was launched on 26 May 1999. The OCM sensor records in 8 bands at visible and near-infrared wavelengths[2]. The field of view of the optics is 43°, providing a swath of 1420 km from a 720-km altitude[3]. The digital data for IRS-P4 OCM of path 9 row 13 for 18 January 2001 prior to the earthquake and for the same path for 26 January 2001 about few hours after the earthquake have been analysed. The two data sets were corrected for atmospheric effects using an approach suggested by Doerffer[4]. From the atmospheric corrected images, chlorophyll and suspended concentrations were estimated for ocean water. The details of the algorithms used and the processing of data are discussed by Kundu *et al.*[2] The chlorophyll and suspended sediment distribution in the adjoining ocean of Gujarat prior to (Figures 1 *a* and 2 *a*) and after the (Figures 1 *b* and 2 *b*) Gujarat earthquake[1] are shown in Figures 1 and 2, respectively. A comparison of these images shows significant increase in chlorophyll and suspended sediment concentrations. The significant increase has also been found by comparing it with the 2 January 2000 image. The increase of the chlorophyll and suspended sediment concentrations is seen clearly in the creek regions of the Gujarat coast and also along the west coast. The significant increase in chlorophyll and suspended sediment concentrations after the earthquake can be attributed to the upwelling of subsurface water and vertical mixing[5]. The upwelling of subsurface water generally observed is due to increase in ocean surface temperature. The sudden upwelling of the ocean is also likely due to the intense ground shaking after the Gujarat earthquake, leading to the ocean waves and coastal surf. The increase of the productivity in the ocean is well known due to upwelling[5], and as a result the productivity increases from January to February as the temperature increases. The increase of suspended sediments may be due to the intense shaking. The high concentration of chlorophyll together with high ocean surface temperature is a favourable condition for fish catch. The ocean surface temperature prior to and after the earthquake was not available; however, the fish catch data were available through the Fisheries Department[6] of the Union Territory of Daman (Table 1). Due to the upwelling caused by the increase of the temperature from December to January and February, normally the fish catch increases by 20%. But the significant increase in fish catch (found to be double) in February after the earthquake supports our results of the increase of chlorophyll concentrations around Gujarat coast and also along the western coast of India after the earthquake of 26 January 2001. Due to technical problems, the OCM data about a week from IRS-P4 are not available to check the systematic increase in the chlorophyll and suspended sediment concentrations. However, the sudden increase in chlorophyll and suspended sediment concentrations soon after the earthquake is clearly observed (Figures 1 and 2).

The increase in chlorophyll and suspended sediment concentrations after the Gujarat earthquake gives a new insight

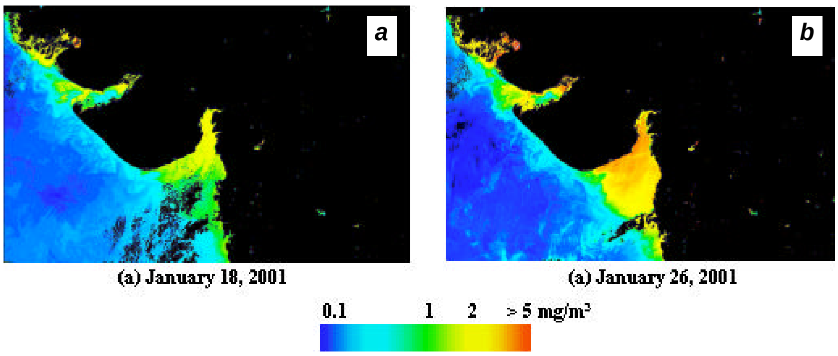

Figure 1. Chlorophyll distribution image (***a***) prior to and (***b***) after the Gujarat earthquake of 26 January 2001.

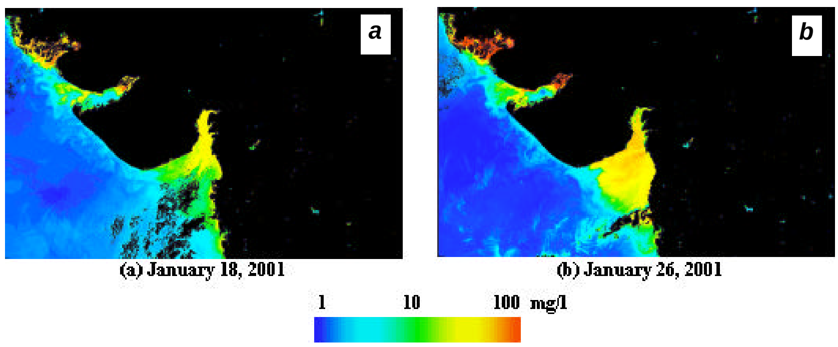

Figure 2. Suspended sediment concentration distribution (***a***) prior to and (***b***) after the Gujarat earthquake of 26 January 2001.

Table 1. Monthly fish catch near Daman coast (in kg)

	December	January	February
1998–1999	407×10^3	331×10^3	290×10^3
1999–2000	296×10^3	157×10^3	157×10^3
2000–2001	80×10^3	105×10^3	218×10^3

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.

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ACKNOWLEDGEMENTS. Financial support from Indian Space Research Organization throughout Oceansat Announcement of Opportunity is gratefully acknowledged. We are also grateful to DST, New Delhi for financial assistance. We appreciate the efforts of Ms Aparna, Data Centre, National Remote Sensing, Hyderabad for promptly supplying IRS-P4 OCM data. We are thankful to Mr Sandeep Kumar, Collector, Daman and Mrs Abhilasha Agarwal, Superintendent, Fisheries, Daman (Union Territory) for providing us fisheries data.

Received 21 February 2001; revised accepted 31 March 2001

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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

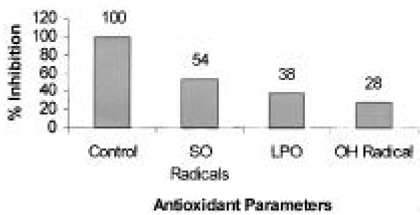

Figure 1. Protective effect of the alcohol extract of *M. pruriens* on different species of free radicals and $FeSO_4$-induced lipid peroxidation in *in vitro* conditions. (Conc. of extract 200 µg/ml).