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Protective effects of *Aloe vera* against radiation induced antioxidant activity in liver of mice

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ABSTRACT

The radioprotective effect of *Aloe vera* was studied in liver of Swiss albino mice. Animals were divided into three groups. Animals of group I administered double distilled water only, group-II *Aloe vera* (drug). Group III again divided into two sets, control set of group III were given radiation only where as animals experimental set of group III were administered by *Aloe vera* + Radiation. Animals were given *Aloe vera* leaf extract orally 1000 mg/kg body weight/day for 15 consecutive days before radiation exposure (0.5, 3 and 5.5Gy). Biochemical parameters such as Catalase and Vitamin C, were assessed at the interval of 6 hrs, day 1, 3, 5, 10 and 20. These results show a dose dependent decrease and time dependent increase in catalase and Vitamin C contents both in control and experimental sets. Results suggest that *Aloe vera* modulate the radiation induced biochemical alterations in Swiss albino mice.

KEYWORDS: Radiation, *Aloe vera*, Catalase, Liver, Vitamin C.

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1. INTRODUCTION

Free radicals are produced by radiations and these radicals are toxic for normal tissues. Radiation therapy for cancer patients could be improved by the use of radio protectors to protect normal tissues. Such free radicals combine with each other and dissolved oxygen to give a variety of potent oxidizing agents such as hydrogen peroxide, molecular oxygen and perhydroxy radicals. The potential application of radio protective chemicals in the event of planned exposures or radiation accidents/incidents has been investigated¹.

Anyhow, whatever is the mode of exposure, protection should be provided against the harmful effect of ionizing radiation and the integrity of vital tissues must be maintained. For this purpose, in favor of radioprotection different herbal plants are used².

Aloe is one of the most-known herbs and has been widely used for centuries and commonly known for its tropical use to treat wounds and burns. For the prophylaxis of radiation-induced dermatitis, a clinical trial has demonstrated the usefulness of *Aloe vera*³. Many investigators have shown that *Aloe vera* extract induces hepatoprotective effects⁴, protects against heavy metals induce oxidative stress⁵, as well as enhances anti-inflammatory properties⁶. In the market, across the globe *Aloe vera* enjoying a great demand due to its extensive medicinal and other uses⁷.

Liver plays a key role digestive system as in removing excess calcium, magnesium and iron internally and also important in food digestion. Therefore, this study was undertaken to evaluate the value of nutritional supplementation of *Aloe vera* against the radiation induced damage on the liver of Swiss albino mice.

2. MATERIALS AND METHOD

2.1 Animals

Male Swiss albino mice 6-8 weeks old 26±2g were used, they were given standard mice feed and water. The maintenance and handling of the animals were done according to the guidelines of the Committee for the Purpose of Control and Supervision of experimental animals, Ministry of Environment and Forests, Government of India. All the experimental work was approved by the institutional animal ethics committee.

2.2 Source of Radiation

Animals were treated with cobalt-60 source of radiation in radiotherapy Dept. SMS hospital, Jaipur. On exposure to radiation, animals were kept in a ventilated box and the radiation dose given to these animals were 0.5, 3 and 5.5Gy.

2.3 Experimental Design

Animals were divided into three groups:

Group I: Animals were administrated with double distilled water only (i.e. normal).

Group II: Animals was orally given *Aloe vera* drug (i.e. drug alone).

Group III: This was further divided into 2 sets i.e. control and experimental. Animals of the control set were treated with radiation and animal of experimental set were treated with both drugs and radiation. The radiation doses given to animals were 0.5, 3 and 5.5 Gy and the animals were autopsied at the interval of 6 hrs, day 1, 3, 5, 10 and 20.

2.4 Biochemical Studies

1. **Catalase activity:** Catalase activity was measured⁸.
2. **Vitamin C:** Vitamin C was measured⁹.

3. RESULT

Catalase activity in sham irradiated (normal) mice (group I) was considered as 100 per cent, which increased to 102.80 per cent in mice treated with *Aloe* alone (group II) (Fig.1).

Catalase activity were found to be 79.64, 68.19 and 63.05 percent at 6 h after irradiation with 0.5, 3 and 5.5 Gy respectively which was followed by a gradual increase at all subsequent autopsy intervals. Increase was found to be 83.84, 86.35, 89.12, 91.27 and 94.73 per cent at day 1, 3, 5, 10 and 20 respectively in 0.5 Gy. In both 3 and 5.5 Gy irradiated animals catalase activity was followed by continuous increase from day 1 to day 20 but did not reach the normal level and remained 89.37 and 83.27 percent respectively.

In *Aloe* pretreated 0.5, 3 and 5.5 Gy irradiated animals, activity of catalase were found significantly higher at 6 hrs than irradiated alone animals. Later, a gradual increase was noticed in its activity from day 1 to 20 (last autopsy interval) and found 98.79, 89.37 and 86.43 per cent at day 20 in *Aloe* pretreated 0.5, 3 and 5.5 Gy irradiated animals. The activity of catalase was higher at all autopsy intervals in animals of experimental set than that of their respective intervals of control set represented in Fig.1.

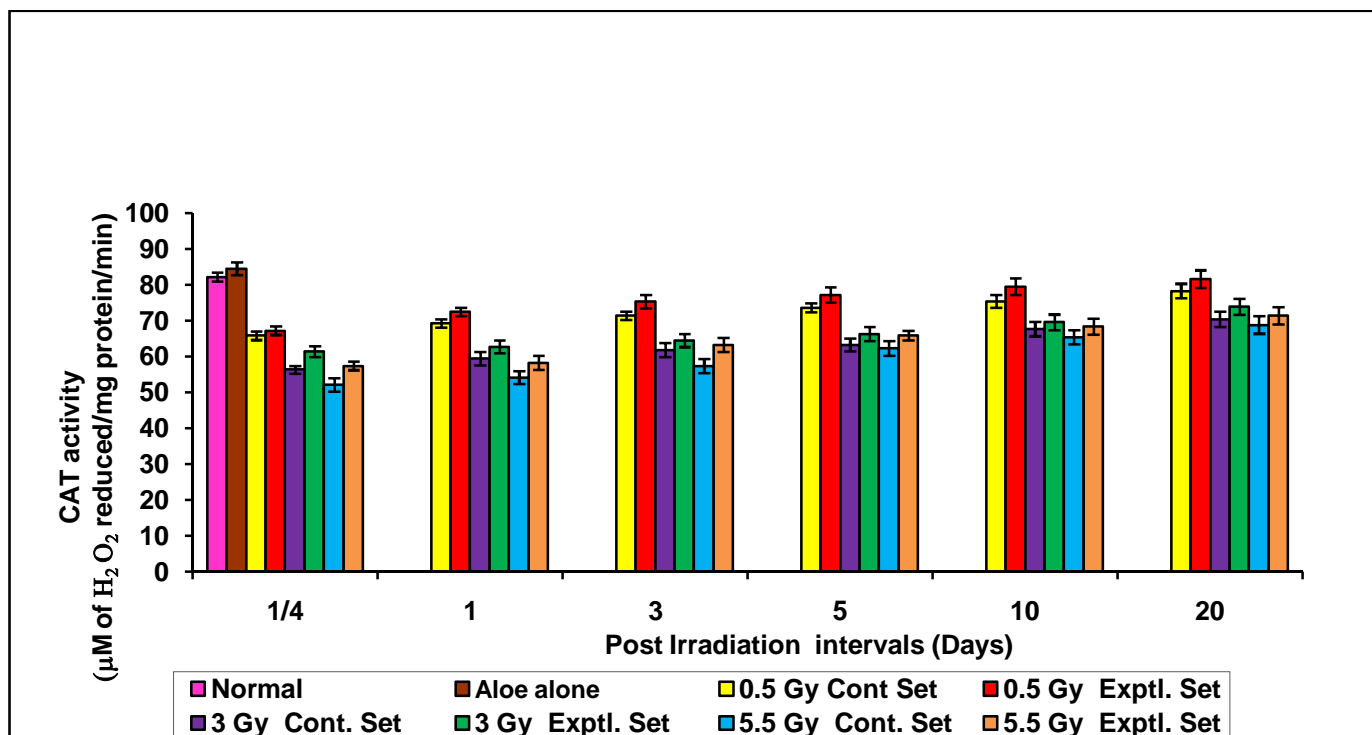


Fig. 1: Catalase activity ($\mu\text{H}_2\text{O}_2$ reducing/mg protein/min) in liver of Swiss albino mice exposed to different doses of gamma radiation with and without treatment of *Aloe*

Vitamin C level in mice of group I was considered as 100 per cent, which increased to 110.63 per cent in mice treated with *Aloe* alone (group II) (Fig.2).

In control set of 0.5, 3 and 5.5Gy irradiated animals level of vitamin C were found 65.66, 61.15 and 47.49 at 6 hours post irradiation, which increased at subsequent autopsy intervals and found 93.80, 89.11 and 79.82 per cent at day 20.

Vitamin C level was noticed 71.90 per cent in *Aloe* pretreated 0.5 Gy irradiated animals at first autopsy interval. Thereafter, Vitamin C increased continuously at later intervals, crossed normal level (100%) and recorded as 103.38, 107.87 and 113.49 per cent at day 5, 10 and 20 respectively. In *Aloe* pretreated 3 and 5.5 Gy irradiated animals level of Vitamin C decreased and estimated 66.22 & 56.51 per cent at 6 hours. Thereafter, vitamin C increased gradually from second autopsy interval to last autopsy interval but did not return to normal level and noticed 94.93 and 87.46 per cent at day 20. Thus, levels of Vitamin C were higher in experimental animals at all autopsy intervals than that of their respective intervals of control (Fig.2).

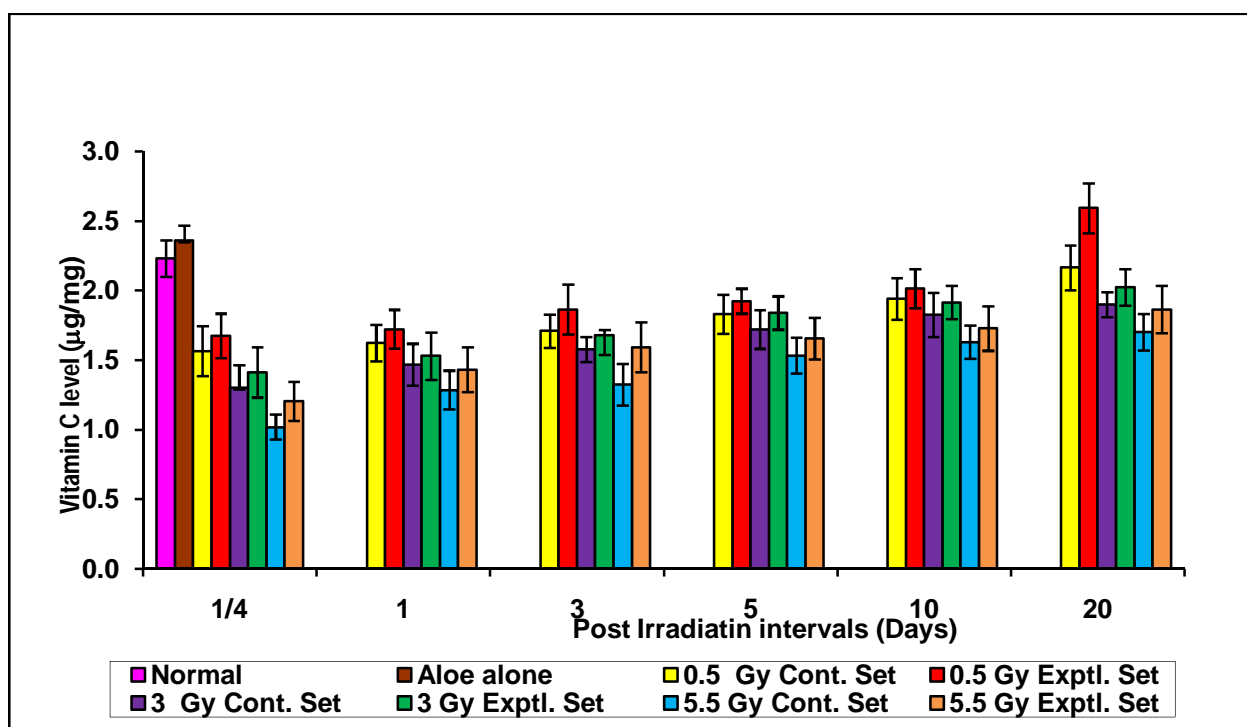


Fig. 2: Vitamin C ($\mu\text{g}/\text{mg}$) in liver of Swiss albino Mice exposed to different doses of Gamma radiation with and without treatment of *Aloe*

4. DISCUSSION

Catalase activity and Vitamin C contents decreased significantly and were found to be minimum at 6 hours post irradiation in liver of mice exposed to 0.5, 3 and 5.5 Gy gamma radiations in comparison to normal animals in the present study. Later, a significant increase was noticed in activity of catalase between day 1-10 in 0.5 and day 1-5 in 3 Gy exposed mice, while at remaining intervals increase was insignificant. But in 5.5 Gy exposed mice a significant increase was noticed at all autopsy intervals. Hydrogen peroxide (H_2O_2) is a strong and substantially harmful oxidizing entity, and its conversion to water (H_2O) and molecular oxygen (O_2) is catalyzed by catalase. H_2O_2 is also used by catalase for oxidizing potential toxins that include alcohols, formaldehyde and formic acid. Contents of vitamin C also increased significantly between day 1-3 in 0.5 Gy exposed mice, while at remaining autopsy intervals in 0.5 Gy and at all autopsy intervals in 3 and 5.5 Gy exposed mice, vitamin C contents were significantly higher than normal value. These results revealed that both activity of catalase and contents of vitamin C did not return to normal level (Fig.1, 2).

Results also indicate that Vitamin C was more affected (remained far below to normal level) than catalase. Probably catalase and vitamin C were utilized by a cell in scavenging radiation induced free radicals and therefore, at early autopsy intervals their levels decreased linearly with radiation dose in this investigation. *Azadirachtaindica*, *Adhatodavascia* Neesextracts have also been studied to access their radio protective potential by^{10,11,12} respectively and they reported that

treatment with these extracts before radiation exposure elevated the level of both enzymatic and non-enzymatic antioxidants in experimental animals. The efficacy of persimmon leaf extract (PL, as a rich plant source) in modulation of radiation-induced liver injury and some metabolic variations in gamma-irradiated rats were studied¹³. Irradiated rats showed significant decreases in catalase (CAT) activities. PL treatment has significantly attenuated radiation-induced oxidative stress in hepatic tissues concomitant with significant amelioration of liver function and metabolic disturbances. *Persea americana* leaf extract restored the levels of reduced glutathione, catalase, in liver homogenates of pre-treated (8 Gy) group¹⁴. A drop in the level of catalase by $10\% \pm 4\%$ in comparison to control was noticed when mice were exposed to whole body irradiation (3 Gy). But when cells were pretreated with acemannan for 7 days, there was an enhancement in the level of catalase by $33\% \pm 6\%$ in comparison to radiation control. It was also observed that acemannan alone also improves the level of catalase in the liver tissue and radio-protection was found maximum at the dose of 100 mg/kg and body weight¹⁵. *Aloe vera* extract could ameliorate X-ray-induced damage due to its free radical scavenging properties and its potential to boost cellular antioxidant defence machinery elevation in the levels of reactive oxygen species and catalase after radiation¹⁶.

5. CONCLUSION

In this study, contents of *Aloe* such as vitamins (A, C and E), glutathione peroxidase (GPx), several isozymes of superoxide dismutase and minerals like zinc and selenium played important role in scavenging radiation induced free radicals and prevented suppression of catalase and vitamin C, which is evidenced by their higher contents in liver of *Aloe* treated irradiated mice as compared to irradiated alone mice.

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