Radioprotective Effect of Panax ginseng on the Phosphatases and Lipid Peroxidation Level in Testes of Swiss Albino Mice

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The Panax ginseng has been used as traditional medicine for past several years among oriental people. The present investigation has been made to assess the radioprotective efficacy of ginseng root extract in the testicular enzymes of Swiss albino mice. The Swiss albino mice were divided into different groups. (i) Ginseng treated group: The animals were administered 10 mg/kg body weight ginseng root extract i.p. (ii) Radiation treated group: The animals were exposed to 8 Gy gamma radiation at the dose rate of 1.69 Gy/min at the distance of 80 cm. (iii) Combination group: Animals were administered ginseng extract continuously for 4 d and on 4th day they were irradiated to 8 Gy gamma radiation after 30 min of extract administration. The animals from above groups were autopsied on day 1, 3, 7, 14 and 30. Biochemical estimations of acid and alkaline phosphatases and Lipid peroxidation (LPO) in testes were done. In ginseng treated group acid and alkaline phosphatases activity and LPO level did not show any significant alteration. In irradiated animals there was a significant increase in acid phosphatase activity and LPO level. However, significant decline in alkaline phosphatase activity was observed. The treatment of ginseng before irradiation causes significant decrease in acid phosphatase and LPO level and significant increase in alkaline phosphatase activity. One of the cause of radiation damage is lipid peroxidation. Due to lipid peroxidation, lysosomal membrane permeability alters and thus results in release of hydrolitic enzymes. So, an increase in acid phosphatase was noticed after radiation treatment. The alkaline phosphatase activity is associated with membrane permeability and different stages of spermatogenesis. Due to membrane damage and depletion of germ cells of testes after irradiation the enzyme activity was decreased. Ginseng markedly inhibits lipid peroxidation. It acts in indirect fashion to protect radical processes by inhibition of initiation of free radical processes and thus reduces the radiation damages in testes of Swiss albino mice.

Key words testis; phosphatase; lipid peroxidation; ginseng

MATERIAL AND METHODS

Animals Adult male Swiss albino mice (6—8 weeks old) weighing 22±2 g from an inbred colony were used for the present study. The animals were maintained on the standard mice feed (procured from Hindustan lever Ltd., India) and water ad libitum.

Irradiation Source Animals were irradiated by 60Co Source (ATC-C9) at the cancer treatment centre, Radiotherapy Department, S.M.S. Medical College and Hospital, Jaipur. The animals were exposed to 8 Gy whole body gamma radiation at a dose rate of 1.69 Gy/min at a distance of 80 cm from the source.

Ginseng Extract The Panax ginseng root extract was obtained from Amsar Pvt. Ltd., Indore (India) in powder form.

Experimental Design Mice selected from inbred colony were divided into three groups.

Group I: The animals were administered 10 mg/kg body weight Panax ginseng root extract (in D.D.W.) for 4 consecutive days intraperitonially.

Group II: Animals were exposed to 8 Gy gamma radiation.

Group III: Animals were administered ginseng extract for 4 d and on 4th day they were irradiated to 8 Gy gamma radiation after 30 min of extract administration.

The animals from the above groups were autopsied at 1, 3, 7, 15 and 30th day after the treatment and testes were removed for biochemical estimation of alkaline and acid phosphatase activity and Lipid peroxidation level.
RESULTS

Radiation Sickness and Mortality The animals exposed to 8 Gy of radiation showed anorexia, diarrhoea, weight loss, lethargy and epilation. 70% of the animals died within 30 d after exposure to 8 Gy radiation. However, radiation sickness was not observed in the irradiated animals, which were pretreated with ginseng intraperitonially for 4 d. Further there was only 20% mortality within 30 d in pretreated ginseng group.

Biochemical Observation The data are presented as per Figs. 1, 2 and 3.

Ginseng Treated Group In ginseng treated group the testicular acid and alkaline phosphatase activity and lipid peroxidation level did not show any significant alterations at all autopsy intervals. The values were found near normal.

Irradiated Group In irradiated animals the testes acid phosphatase activity and LPO level exhibited significant elevation ($p<0.001$) at all autopsy intervals. However the alkaline phosphatase activity showed a significant decline ($p<0.001$) at all autopsy intervals as compared to normal animals.

Ginseng Extract+Irradiated Group The pretreatment of ginseng extract before irradiation significantly altered the biochemical changes in testes as compared to irradiated group. A significant decline was observed in acid phosphatase activity and LPO level ($p<0.001$). Whereas alkaline phosphatase activity exhibited significant elevation.

DISCUSSION

Present study revealed a significant increase in acid phosphatase activity in the testes of Swiss albino mice after irradiation. Acid phosphatase is localized in cellular lysosomes and irradiation causes lipid peroxidation of lysosomal membrane. Increased acid phosphatase activity may be attributed due to breakdown of lysosomal membrane and liberation of the enzyme. Present studies are in agreement of the findings of Jacob and Maini$^{17}$ and Samarth et al.$^{10}$ Increased activity may also be due to synthesis of new lysosome as a consequence of radiation exposure.$^{18}$

In the present study decrease in alkaline phosphatase activity was observed in the testis after irradiation. The alkaline phosphatase activity is associated with the differentiation and growth processes of cells. Martin and Jacoby$^{19}$ suggested its importance in the process of spermatogenesis. Radiation depletes germ cell population.$^{11,20}$ So, decrease in alkaline phosphatase activity is correlated with the state of germ cells.
population. According to Cowler and Grodzinski\textsuperscript{21}) the acrosomic system of sperm head is composed of alkaline phosphatase. In our previous reports we have observed that radiation causes loss of sperms from the testes\textsuperscript{11,20}). So, loss of sperms by irradiation in the present study may be one of the causes of low alkaline phosphatase activity.

Alkaline phosphatase also plays an important role in maintaining the cell membrane permeability\textsuperscript{22}). The radiation damages the cell membrane thus decline the alkaline phosphatase activity. The decrease in alkaline phosphatase activity may be due to the changes in the amino acid residues and catalytic activity of alkaline phosphatase\textsuperscript{23}).

A significant elevation in testes LPO level in terms of TBARS (thiobarbituric acid reactive substances) or MDA (malondialdehyde) level was observed following radiation exposure. Lipid peroxidation is one of the measure to determine the cellular toxicity. Uma Devi and Ganasaundari\textsuperscript{12}) also observed that radiation exposure significantly increases the lipid peroxidation. Radiation induces the formation of reactive oxygen species such as superoxide radicals, which causes lipid peroxidation\textsuperscript{24,25}). Lipid peroxidation has been suggested as one of the main causes of radiation induced membrane damage\textsuperscript{26}). These findings supported our earlier findings on histopathological studies that suggest that radiation cause germ cell depletion\textsuperscript{11,20}).

In the present investigation, it has been observed that ginseng extract provides the protection by reflecting a significant decrease in testicular acid phosphatase activity LPO level and significant increase in alkaline phosphatase activity as compared to irradiated animals. It has been reported that ginseng extract contains active components Baicalcein ginsenosides Rf and Baicalin ginsenosides Rbl and Rg1. These active components are well known to suppress radiation induced lipid peroxidation and reduce the radiation induced cellular damage. Zhao\textsuperscript{27}) has also observed that in ginseng treated group anti lipid peroxidative activity was increased and thus lipid peroxidation was inhibited.

Kim et al.\textsuperscript{28}) also reported that water fraction and alkaloid
fraction of ginseng may reduce cell damage, especially the damage to DNA molecules, caused by gamma rays and thus playing a role in the repair of regeneration process of damaged cells. It is possible that ginseng reduces DNA damage by antiradical action. Thus the present study suggests that radiation damage may be reduced by inhibiting lipid peroxidation by ginseng extract, which in turn is reflected by a decline of testicular acid phosphatase and LPO level and elevated alkaline phosphatase activities as compared with the irradiated animals. These findings confirms our earlier findings which shows that administration of ginseng before radiation treatment significantly protected the germ cell population against the gamma radiation in mice.20)

CONCLUSION

From the present study it can be concluded that the ginseng extract could give effective protection against radiation induced testicular damages.

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