Radioprotective Effect of *Panax ginseng* against Giant Cell Formation in The Testis of Irradiated Mice

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Abstract

Panax ginseng (family- Araliaceae) is a native plant of Korea and has been used for past several years among oriental people. To evaluate the radioprotective potential of *P. ginseng* on the formation of giant cells in the testis of Swiss albino mice, the animals were divided into four groups: -(I)-Only vehicle was administered. (II) *P. ginseng* treated group: -The animals received 10 mg/kg body weight *P. ginseng* root extract (in DDW) i.p. continuously for 30 days. (III) Irradiated group: -The animals were exposed to 8 Gy gamma radiation at the dose rate of 1.69 Gy/min at the distance of 80 cms. (IV) Combined treatment group: -Animals were given *P. ginseng* extract for four days and on fourth day they were irradiated to 8 Gy gamma radiation after 30 minute of extract administration. The animals of these three groups were autopsied on day 1, 3, 7, 14 and 30 days. In *ginseng* treated group, active spermatogenesis was observed without any toxic effect. Histopathological studies of irradiated group (II) revealed reduction in germ cell count, loss of sperms and formation of multinucleated giant cells on day 7th. These giant cells were formed by round nuclei of early or late spermatids. In combination group (III), although germinal epithelium was still disorganized with loss of cells in few tubules, but no giant cell formation was observed. In order to know the mechanism of radioprotection of *ginseng*, LPO and GSH were estimated. It was observed that pretreated irradiated animals showed inhibition of LPO and increase in GSH. Thus the present study suggests *ginseng* protects male gonads. This may be attributed to the inhibition of LPO and increase synthesis of GSH by *ginseng*.

Introduction

Today ionizing radiation and radioisotopes have become powerful tool in hospitals to diagnose and to treat diseases including cancer. The setting-up to large number of nuclear reactor all over the world for powerful generation has resulted in additional sources of radiation exposure in the

form of radioactive effluents and nuclear waste.

In recent years, extensive research work has been carried out on chemical protection against radiation. Chemical like cysteine, cysteamine, 2-MPG, WR-2721, AET and superoxide dismutase have been tested for their radioprotective role, but application of these compounds is limited in radiation therapy owing to their high toxicity at optimum dose level.

A hunt is on to find a suitable detoxifying agent against environmental toxicants. In addition to synthetic drugs, some plant extracts such as Spirulina (Kumar *et al.*, 1998), garlic (Gupta, 1988), Ocimum (Uma Devi and Ganasoundari, 1999) and *ginseng* (Pande *et al.*, 1998) have been found to have a radioprotective effect. Plant products appear to have an advantage over the currently studied synthetic compounds in terms of low/no toxicity at effective dose.

Panax ginseng is a native plant of Korea. Its roots are used for the extraction purpose. It belongs to family Araliaceae. *Ginseng* acts on the CNS, cardiovascular system, endocrine secretion and promotes the functioning of immune system and metabolism. It also have antistress and antiageing activities (Liu-Cx *et al.*, 1992).

In the present study, an attempt has been made to assess the modification of radioresponse in the testes of Swiss albino mice in the terms of giant cell formation in the presence of *ginseng* extract.

Materials and Methods

Animals

Adult male Swiss albino mice (6-8 weeks old) weighing 22 ± 2 gm 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

The cobalt teletherapy unit (ATC-C9) at Cancer Treatment Centre, Radiotherapy Department, SMS Medical College and Hospital, Jaipur was used for irradiation. Unanaesthetized mice restrained in well ventilated perspex boxes and the whole body of these animals was exposed to gamma radiation (8 Gy) at the dose rate of 1.69 Gy/min at a distance of 80 cms. from the source.

Ginseng Extracts

Ginseng root extract (Powdered form) was obtained from Amsar Pvt. Ltd., Indore (India). Prior

to injection extract was dissolved in double distilled water.

Experimental design

Animal Swiss albino mice were divided into different groups.

Group-I : The animals were administered distilled water intraperitoneally (ip)

Group-II : These animals received *P. ginseng* root extract (10 mg/kg b.wt.)i.p.

Group-III : The animals were irradiated with 8 Gy gamma radiation at once.

Group-IV : Animals were administed *ginseng* root extract for four days at the dose of 10 mg/kg b.wt. i.p. and on fourth day these animals were irradiated with 8 Gy gamma radiation after 30 minutes of extract administration.

Animals from above groups were autopsied on 1, 3, 7, 14 and 30th days. The testes was removed and processed for LPO (Okhawa *et al.*, 1979) and histological alteration. The hepatic GSH level was also measurd by Moron *et al.* (1979) (Pande *et al.*, 1998).

Results & Discussion

It has been observed that irradiation caused toxic injuries to seminiferous tubules in the form of pyknosis, karyolysis & cytoplasmic vacuolization in germ cells. Few multinucleated giant cells were observed.

The occurrence of giant cells in the testes is considered to be an expression of germ cells degeneration. The present result showed that giant cells were formed by round nuclei of early spermatids or sometimes by flattened nuclei of late spermatids.

Main factor behind the formation of giant cells is a disturbance in maturation division in spermatocytes where karyokinesis could not be followed by cytokinesis (Saxena & Mathur, 1976).

Nakai & Hess (1984) observed in rats that giant cells are formed by failure of cytokinesis of secondary spermatocytes following nuclear division.

Singh & Abe (1987), Russel *et al.* (1987) and Ren & Russel (1991) suggested that giant cells are formed as a result of fusion of spermatids due to alteration in the intracellular bridges.

Bloom and Fawcett (1975) and Dym and Fawcett (1971) reported that giant cells formation could be a consequence of particular mode of cytokinesis of dividing germ cell. During germ cell division syntia of daughter cells remains connected by cytoplasmic bridges which eventually

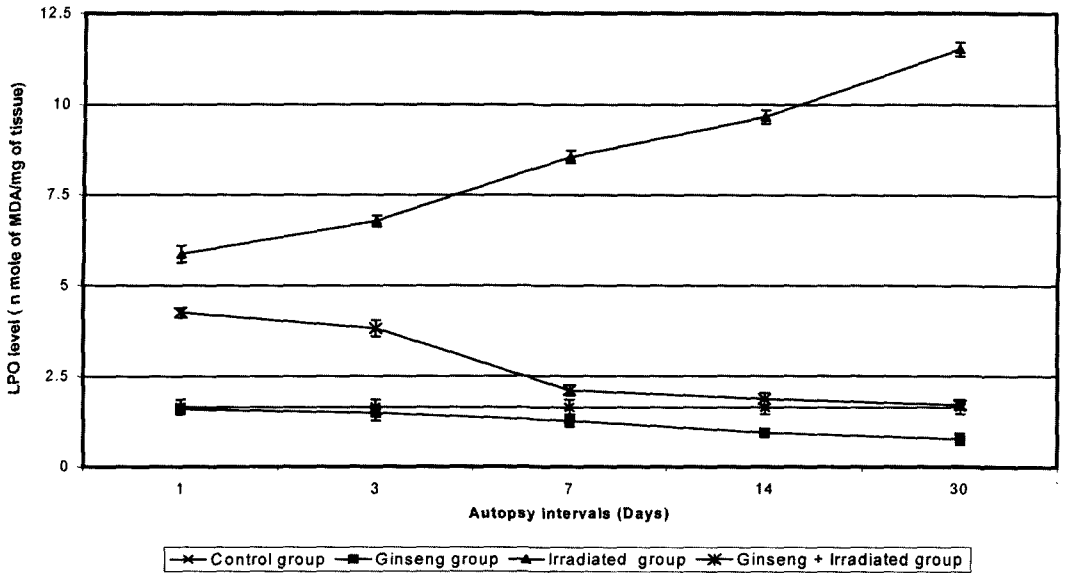

Fig. 1. Variation in testicular lipid peroxidation (LPO) content in different experimental groups.

constrict during maturation and release of spermatozoa. An insult results in the failure of the intracellular bridges to constrict and results in the formation of multinucleated syntia of spermatocytes. The breaking down or opening of intercellular connection can probably be the cause of multinucleated giant cell formation.

It is reported that intercellular bridges are maintained due to actin microfilaments (Nakai *et al.*, 1992).

From the present study it can be suggested that radiation causes formation of reactive oxygen species which causes lipid peroxidation and react with different kinds of bio-molecules such as proteins and DNA; resulting in testicular damage, inhibition of cell differentiation and act as microfilament disrupting agent which results in the formation of giant cells.

Ginseng has antioxidant property (Okada S, 1996) and act as free radical scavenger and protect the testicular damage (Pande *et al.*, 1998) following irradiation and enhances recovery process and rate of DNA synthesis.

Zhang *et al* (1987) reported that root exhact of Panax *ginseng* had the ability to protect against the lethal effets of Co-60 gamma irradiation in mice.

Thus it can be concluded that *ginseng* maintains the cytoplasmic bridges and avoids its damage and thus inhibit giant cell formation.

To know the exact mechanism of radioprotective effect of *ginseng*, LPO in testis and glutatione

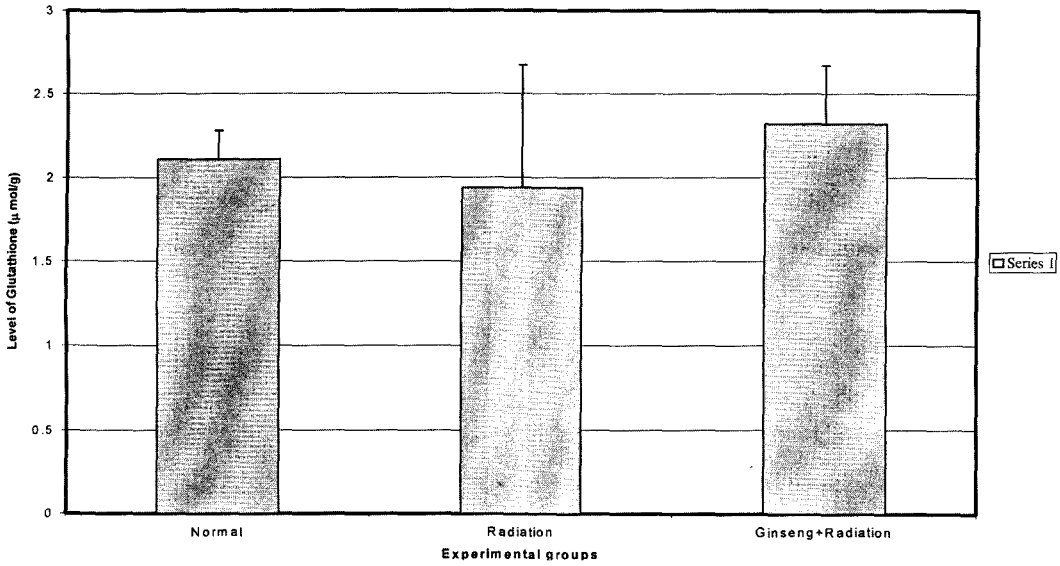

Fig. 2. Variation in hepatic GSH content in different experimental groups.

in liver has been measured. In the present study, ginserg extract is found to reduce the LPO content in testis (Fig. 1). Decrase in LPO content has also been reported by Zhao (1990) who, observed that when ginsenosides (ie Rb and Ro) was given intravenously, increases the creatine phospho-kinase and super-oxide dismutase (SOD) activities and thus reduced the lipid peroxidation.

In the present study hepatic GSH content was also increased after *ginseng* treatment. Pande *et al.*, (1998) and Bump and Broun, (1990) also reported radioprotective function of *ginseng* through free radical scavenging, maintenance of protein thiols in the reduced state and restoration of damaged molecules.

Acknowledgement

Authors are thankful to Amsar Pvt. Ltd., Indore (India) for providing *ginseng* root extract. Financial assistance provided by University of Rajasthan, Jaipur (India) to PSS is also highly acknowledged.

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