Ameliorated effects of *Allium sativum* against bisphenol A-induced reproductive toxicity in male rats

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Abstract

There is growing evidence that bisphenol A (BPA) may adversely affect humans. BPA is an endocrine disruptor that has been shown to be harmful in laboratory animal studies. A comprehensive literature search found 91 studies linking BPA to human health; 53 published within the last year. This body of literature is showing associations between BPA exposure and adverse perinatal, childhood, and adult health outcomes, including reproductive and developmental effects, metabolic disease, and other health effects. These studies encompass both prenatal and postnatal exposures, and include several study designs and population types. But until recently, there were relatively few studies examining the effect of BPA on sperm quality and the protective effects of antioxidants against its reproductive toxicity. Thus, present examination tries to assess powerful antioxidant garlic against BPA. Rats were assigned to 1 of 4 groups: 0 mg BPA and 0 gm garlic/kg BW (control); 2 gm garlic/kg BW; 40 mg BPA/kg BW; BPA plus garlic. Rats were orally administered their respective doses daily for 70 days. BPA caused deterioration in semen characteristics and histological changes in testes. Body weight, plasma acid phosphatase, LH and FSH were increased, while total proteins, testosterone and sex organ weights (testes, epididymis, prostates and seminal vesicles) were significantly decreased. BPA increased thiobarbituric acid-reactive substances (TBARS) and decreased the activities of the antioxidant enzymes. Testicular 17-ketosteroid reductase, acid phosphatase and protein content were decreased, while 17β-hydroxysteroid dehydrogenase was increased. Garlic alone reduced TBARS, induced the activities of the antioxidant enzymes and improved semen characteristics. Administration of garlic with BPA intoxicated rats reduced the testicular toxic condition, morphological and biochemical changes were brought back to normal. In termination, antioxidant potential of garlic, ameliorates the changes that are induced by BPA.

Materials & Methods

Study the possible protective effect of garlic against the reproductive toxicity of bisphenol A.. In the experiment male rats were divided into 4 groups:

Group 1
Control (2ml corn oil/kg BW)

Group 2
2g /kg BW/day garlic dissolved in 10 ml water

Group 3
40 mg /kg BW/day BPA dissolved in 2ml corn oil

Group 4
Intoxicated with BPA as in group 3 and treated with garlic as in group 2

All groups given the doses by oral gavage daily for 70 days. The following investigations were done for all the studied groups:

- Body weight and testes, prostate, Epididymides and seminal vesicles weights .
- Plasma reproductive hormones (FSH, LH and Testosterone).
- Plasma & testes proteins & Acid phosphatase.
- Plasma & testes Enzyme activities of GPX, GST, SOD and CAT, and TBARS and GSH level.
- Semen characteristics (Sperm count, Sperm motility (%), Sperm abnormalities (%) & Live and dead sperm (%)).
- Testes Histopathological examination.
- Testes 17β-HSD & 17-KSR

Results

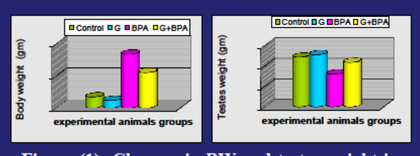

Figure (1): Changes in BW and testes weight in male rats treated with garlic (G), BPA and their combination(G+BPA)

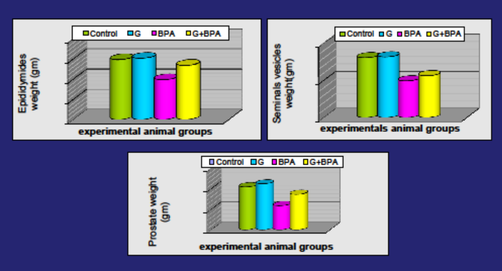

Figure (2): changes in Epididymides, Seminal Vesicles and Prostate weights in male rats treated with garlic (G), BPA and their combination (G+BPA)

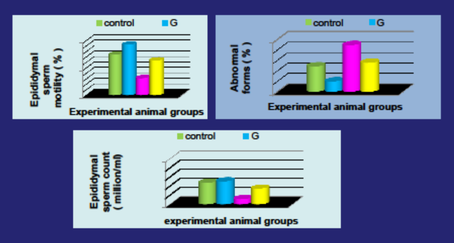

Figure (3): changes in epididymal sperm count (million/ml), epididymal sperm motility (%) and abnormal forms (%) in male rats treated with garlic (G), BPA and their combination(G+BPA)

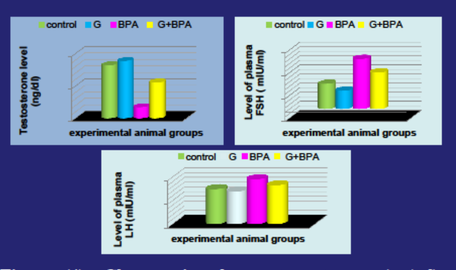

Figure (4): Changes in plasma testosterone (ng/ml), LH (mIU/ml) and FSH (mIU/ml) in male rats treated with garlic (G), BPA and their combination(G+BPA)

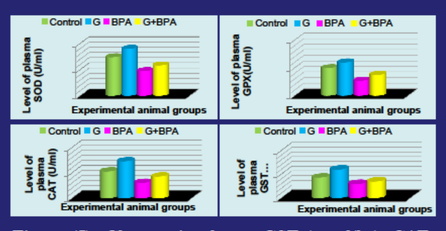

Figure (5): Changes in plasma GST (µmol/hr), CAT (U/ml), SOD (U/ml) and GPX (U/ml) in male rats treated with garlic (G), BPA and their combination (G+BPA)

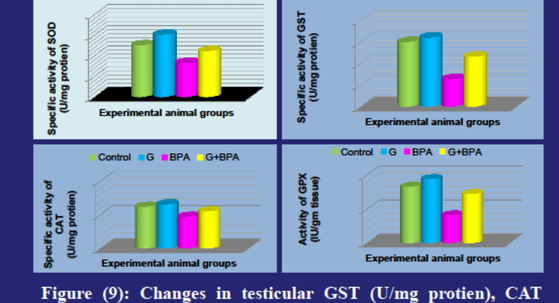

Figure (6): Changes in plasma reduced glutathione (GSH; U/ml) and TBARS (nmol/ml) in male rats treated with garlic (G), BPA and their combination(G+BPA)

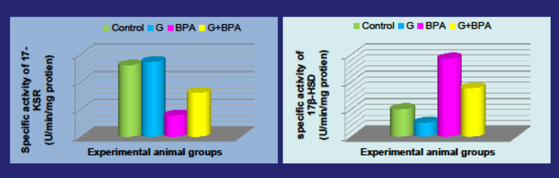

Figure (7): changes in 17β-HSD (U/min/mg protien) and 17-KSR (U/min/mg protien) in male rats treated with garlic (G), BPA and their combination(G+BPA)

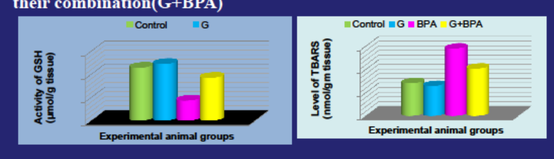

Figure (8): Changes in testicular TBARS (nmol/gm tissue) and GSH (µmol/g tissue) in male rats treated with garlic (G), BPA and their combination(G+BPA)

Figure (9): Changes in testicular GST (U/mg protien), CAT (U/mg protien), SOD (U/mg protien) and (GPX) (IU/gm tissue) in male rats treated with garlic (G), BPA and their combination (G+BPA)

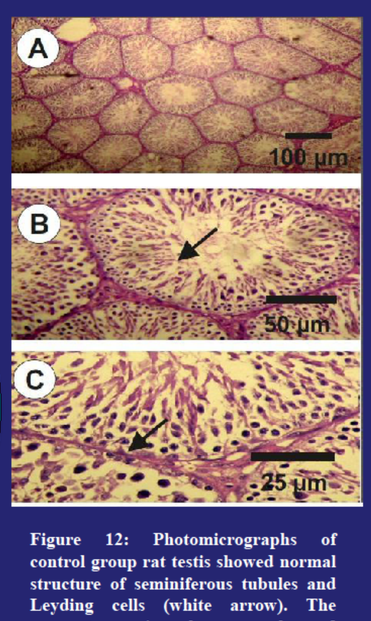

Figure 12: Photomicrographs of control group rat testis showed normal structure of seminiferous tubules and Leyding cells (white arrow). The spermatogenesis cycle was regular and the lumen of the seminiferous tubules was fully packed with sperms (dark arrows).

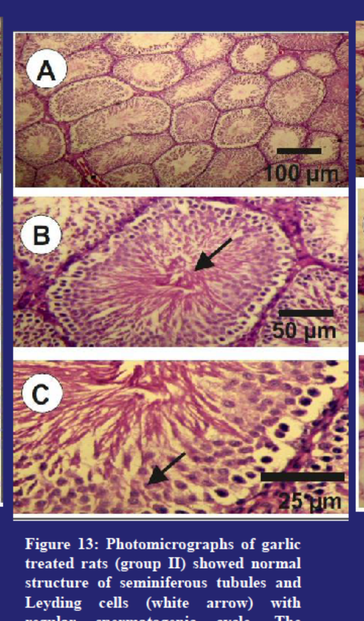

Figure 13: Photomicrographs of garlic treated rats (group II) showed normal structure of seminiferous tubules and Leyding cells (white arrow) with regular spermatogenic cycle. The seminiferous tubules lumen was full of sperms (dark arrows).Anormal number of Leyding cells (white arrow).

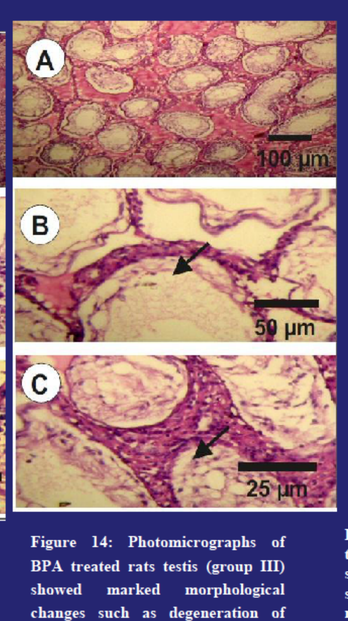

Figure 14: Photomicrographs of BPA treated rats testis (group III) showed marked morphological changes such as degeneration of germinal epithelium and sloughing of germ cells into the tubular lumen (dark arrow). The seminiferous tubules lumen was lack of sperms.

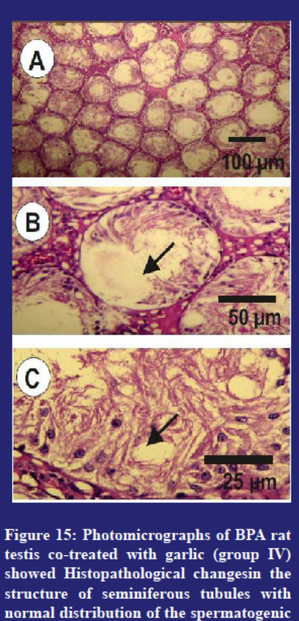

Figure 15: Photomicrographs of BPA rat testis co-treated with garlic (group IV) showed Histopathological changesin the structure of seminiferous tubules with normal distribution of the spermatogenic cells and an increase of sperms (dark arrows) . Regular distribution of the spermatogenic cells in the seminiferous tubules with an increased in the number of sperm cells (dark arrows).

Conclusion

Bisphenol A (BPA) caused reproductive toxicity in male rats. The presence of garlic with BPA minimized its reproductive toxicity by restoration of sperm characteristics, hormonal status, testicular function and antioxidant enzymes.

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