

Abstract

There is a rising use of Aluminium oxide nanoparticles (Al₂O₃NPs) in many branches of industry and personal care products. Because of these uses, their impact on the environment must be considered and investigated. Almost nothing is known about the effects of Al₂O₃NPs on semen quality and reproductive hormones. Possible mechanisms for the cytotoxicity of Al₂O₃NPs are still being discussed, but oxidative stress may be responsible for their effect. Therefore, the objective of this study was thus to know the capability of glutathione as antioxidant agent against the effects of Al₂O₃NPs on sperm parameters, testosterone, FSH, LH, steroid enzymes, histological changes, lipid peroxidation and antioxidant enzymes in male rats. Animals were divided into four groups, group 1 was used as control, group 2 was treated orally with glutathione (100 mg/kg BW), group 3 was treated intraperitoneally (IP) with aluminum oxide nanoparticles (70 mg/kg BW; <50 nm), group 4 was treated with aluminum oxide nanoparticles plus glutathione. Rats were administered their respective doses every day for 77 day. Results showed that Al₂O₃NPs decreased final body weight, body weight gain, relative testes and epididymis weights, sperm count, sperm motility, testosterone levels, 17-ketosteroid reductase, while increased abnormal sperm, follicle stimulating hormone, luteinizing hormone, 17β-hydroxysteroid dehydrogenase and weight of prostate gland. In addition, Al₂O₃NPs decreased the activities of antioxidant enzymes (GST, CAT, SOD, GPx) and reduced glutathione, while increased the levels of thiobarbituric acid reactive substances (TBARS) in both plasma and testes. Histological examination of testes showed that Al₂O₃NPs caused decrease in the number of spermatogenic cells in the seminiferous tubules, degeneration of germinal epithelium, disappearance in primary spermatogonia and round spermatid. The presence of glutathione with Al₂O₃NPs minimized its effect which improved the structural components of the testes and spermatogenic cells. The present data concluded that glutathione could be used as protective agents against the reproductive toxicity induced by Al₂O₃NPs.

Materials & Methods

Animals groups:

Group 1: Control

Group 2: Treated with glutathione alone (100 mg/kg BW)

Group 3: Treated with aluminum oxide nanoparticles alone (70 mg/kg BW)

Group 4 : Treated with aluminum oxide nanoparticles plus glutathione

Forty Wistar male rats were used in the present study

Measured parameters

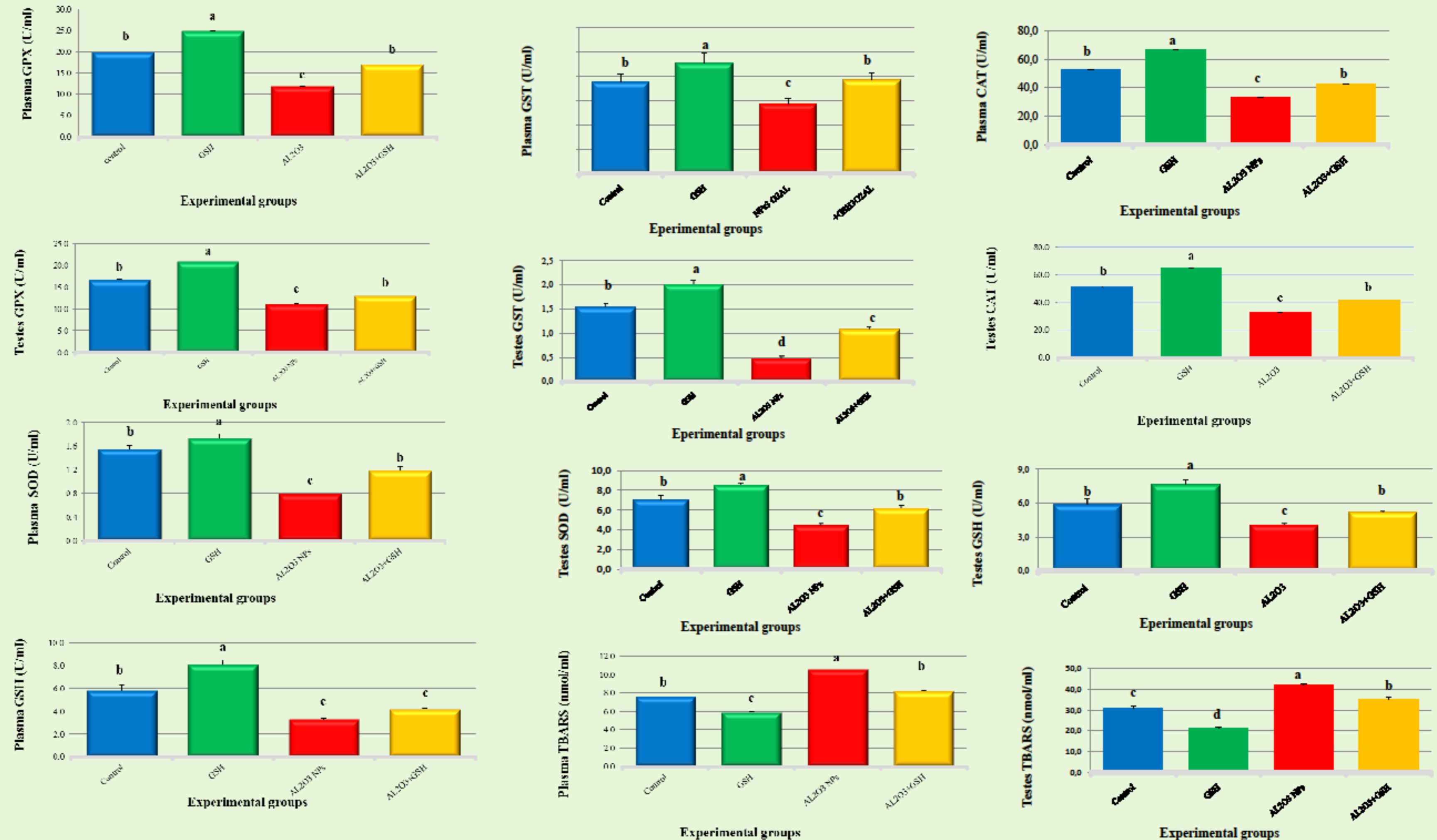
- 1- Body, testes and reproductive organs weights.
- 2- Semen characteristics (Sperm count, Sperm motility, Abnormal sperm).
- 3- Plasma and testes lipid peroxidation (TBARS, Thiobarbituric acid reactive substances).
- 4- Plasma and testes antioxidant enzymes (Superoxide Dismutase, SOD; Glutathione S-transferase, GST; Glutathione peroxidase, GPx and Catalase, CAT).
- 5- Plasma and testes reduced glutathione (GSH).
- 6- 17β-hydroxysteroid dehydrogenase (17β-HSD) and 17-ketosteroid reductase (17- KSR).
- 7- Plasma reproductive hormones profile (Testosterone, luteinizing hormone, LH; follicle stimulating hormone; FSH).
- 8- Histological changes in testes.

Conclusion

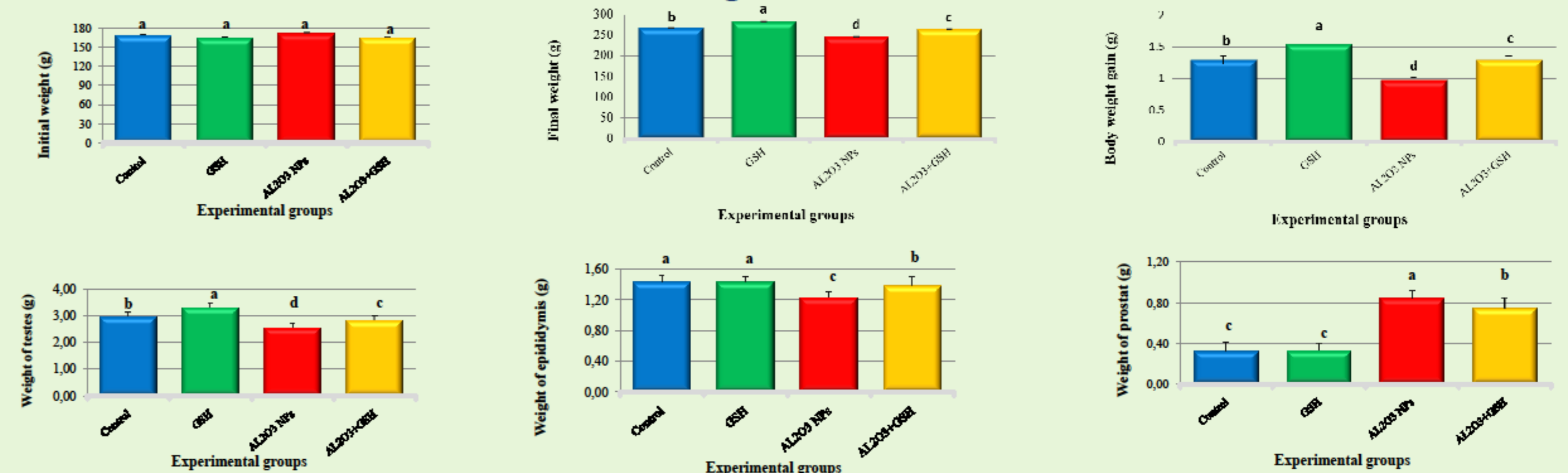
The present study showed that Al₂O₃NPs caused deterioration in semen characteristics, decreased testosterone, body and sex organ weights, and the antioxidant enzymes and reduced glutathione. While, Al₂O₃NPs caused increase in FSH and LH, induced oxidative stress and histological changes in testes. Glutathione caused improvement in reproductive performance of rats and decreased the levels of free radicals and increased the antioxidant enzymes and reduced glutathione. The presence of glutathione with Al₂O₃NPs elicited significant protective and ameliorative effects against its reproductive toxicity and this may be due to the antioxidant abilities of GSH to combat oxidative damage induced by Al₂O₃NPs. Therefore, the present study recommend to use GSH as potential agent in protecting against Al₂O₃NPs-induced reproductive toxicity.

Results

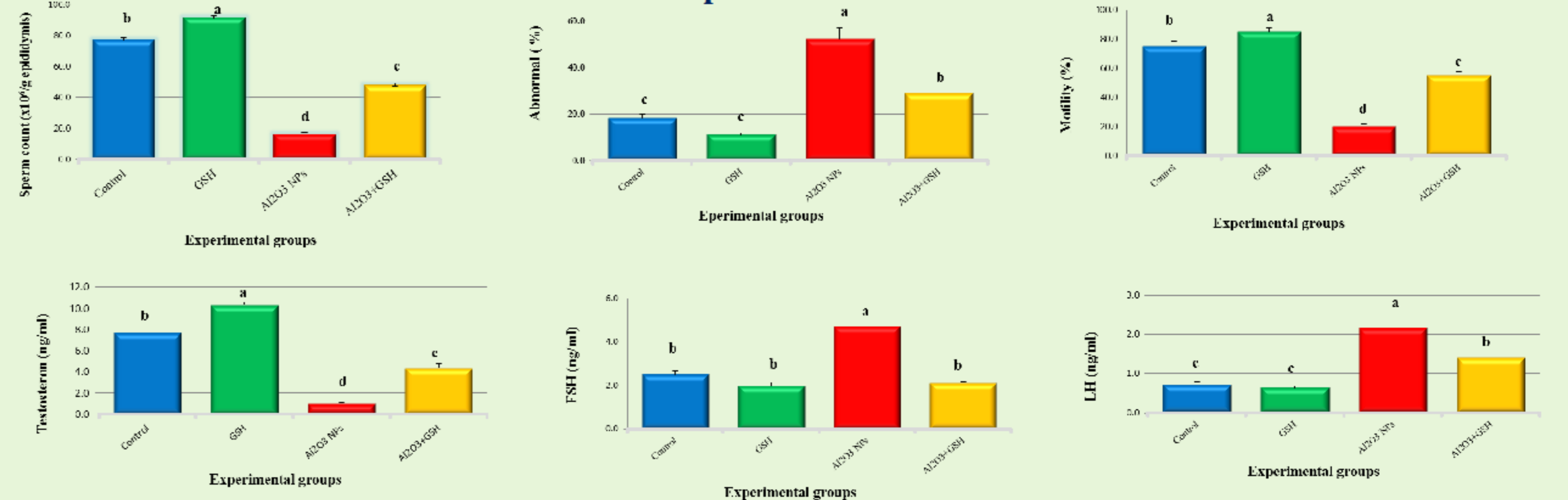
Effect of aluminum oxide nanoparticles, glutathione and their combination on plasma and testes antioxidant enzymes, oxidative stress and reduced glutathione



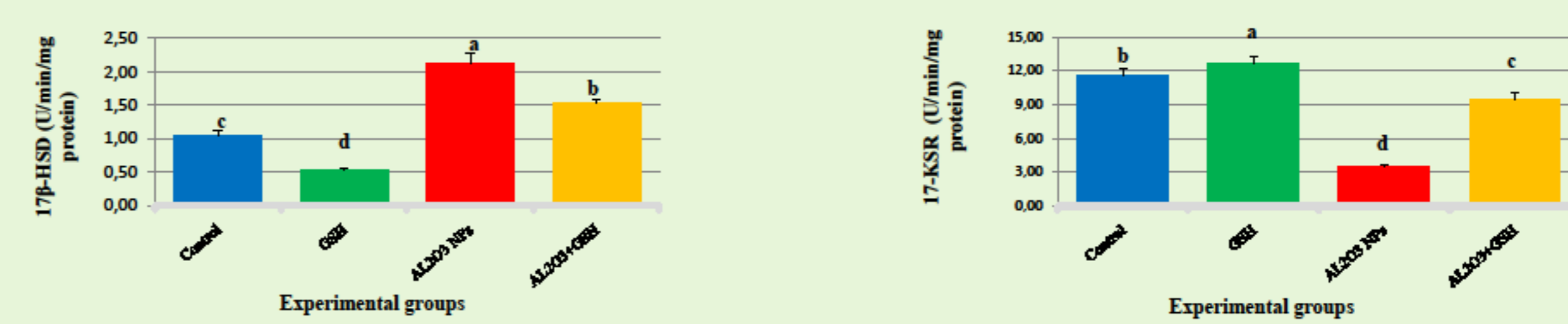
Effect of aluminum oxide nanoparticles, glutathione and their combination on body and sex organ weights



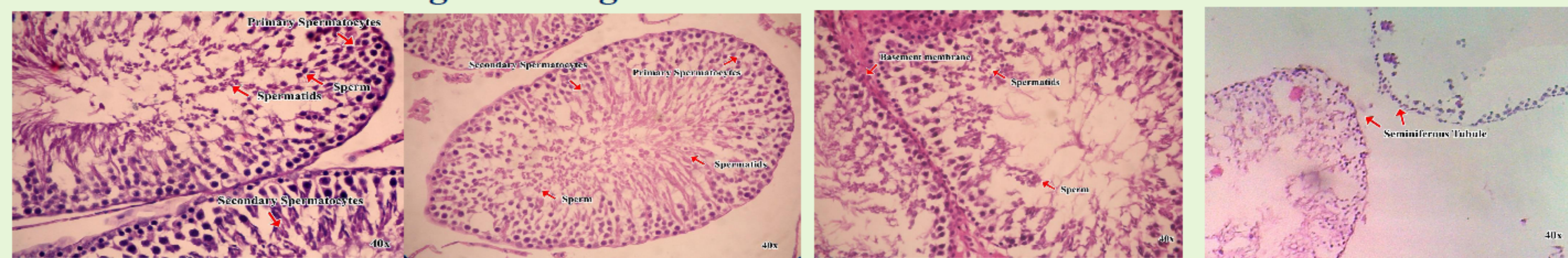
Effect of aluminum oxide nanoparticles, glutathione and their combination on semen characteristics and reproductive hormones



Effect of aluminum oxide nanoparticles, glutathione and their combination on the activity of testicular 17β-hydroxysteroid dehydrogenase and 17-ketosteroid reductase



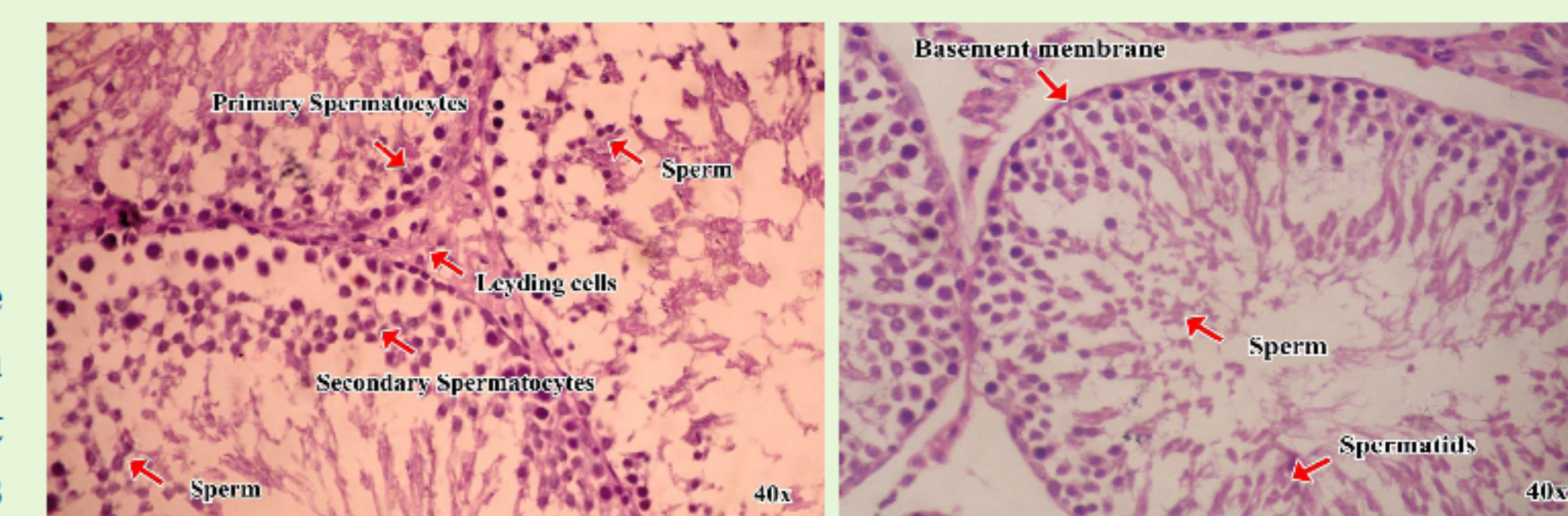
Histological changes in testes



Control group

Glutathione group

Aluminum oxide nanoparticles group



Aluminum oxide nanoparticles (Al₂O₃NPs) plus glutathione (GSH)