



Counteracting Hexavalent Chromium-Induced Testicular Damage: The Antioxidant Effect of Aronia melanocarpa

Jelena SAVICI, Simona MARC, Diana BREZOVAN, Oana-Maria BOLDURA
University of Life Sciences King Mihai I firm Timisoara, Faculty of Veterinary Medicine

Abstract: The chemistry of chromium is complex due to its existence in six major oxidation states. The most common and stable forms are trivalent (Cr III) and hexavalent (Cr VI). Hexavalent chromium is a strong oxidizing agent known for its toxicity and carcinogenic properties. In this state, it readily crosses cell membranes, exerting a toxic effect that is 1,000 times greater than that of trivalent chromium. Widely used in over 50 industries—including leather tanning, chrome electroplating, welding, stainless steel manufacturing, and wood processing—Cr VI has led to extensive contamination of air, water, soil, and food. Aronia melanocarpa exhibits powerful antioxidant properties due to its high content of polyphenols, including anthocyanins, proanthocyanidins, and phenolic acids. The antioxidant effect of Aronia melanocarpa is linked to its ability to inhibit reactive oxygen species (ROS) formation, restore antioxidant enzyme levels, and suppress prooxidant enzymes. This study aimed to evaluate the antioxidant capacity of Aronia melanocarpa in counteracting oxidative damage induced by the administration of hexavalent chromium (75 ppm) in the testis. After three months of hexavalent chromium administration in drinking water, histological changes were observed, including degenerative necrotic lesions of the basement membrane, interstitial edema, Sertoli cell necrosis, and epithelial atrophy. However, when hexavalent chromium was administered alongside an aqueous extract of Aronia melanocarpa, the lesions were significantly reduced and were associated with vascular dilations. Additionally, the diameter of the seminiferous tubules was measured, revealing an increase when chromium was co-administered with Aronia melanocarpa. These findings suggest that the antioxidant properties of Aronia melanocarpa may help mitigate the toxic effects of hexavalent chromium on the testis.

• Introduction

Hexavalent chromium (Cr(VI)) is a well-known environmental pollutant with significant toxicological effects on various organs, including the male reproductive system. Exposure to Cr(VI) has been associated with oxidative stress, DNA damage, and disruption of steroidogenesis in testicular tissue. Studies have shown that Cr(VI) can impair spermatogenesis, reduce sperm quality, and alter the structure and function of the testes, ultimately compromising male fertility.

• Material and method

Adult male Wistar rats were divided in three groups and treated as follows:

Cr group – potassium dichromate (75 ppm) in water for three months;

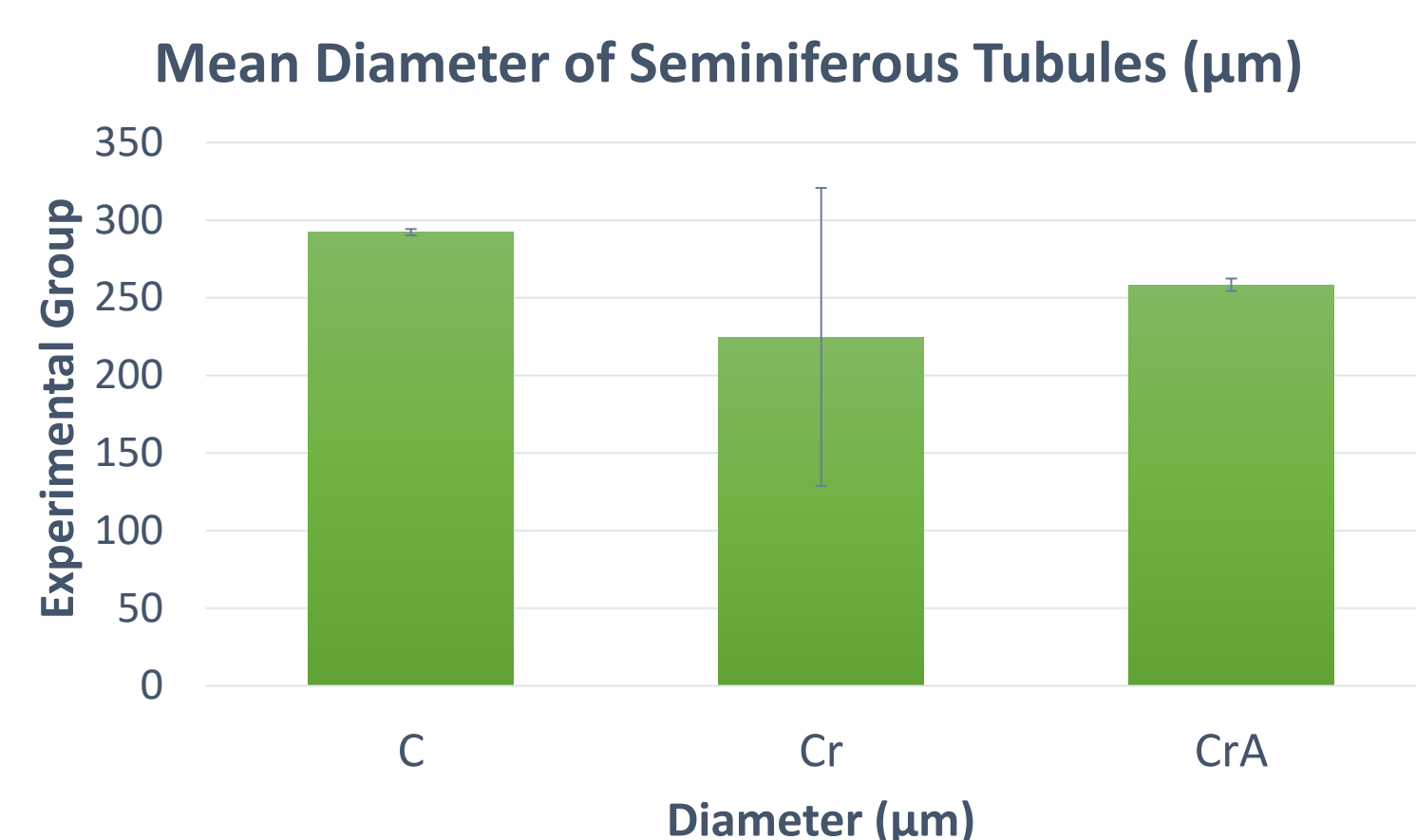
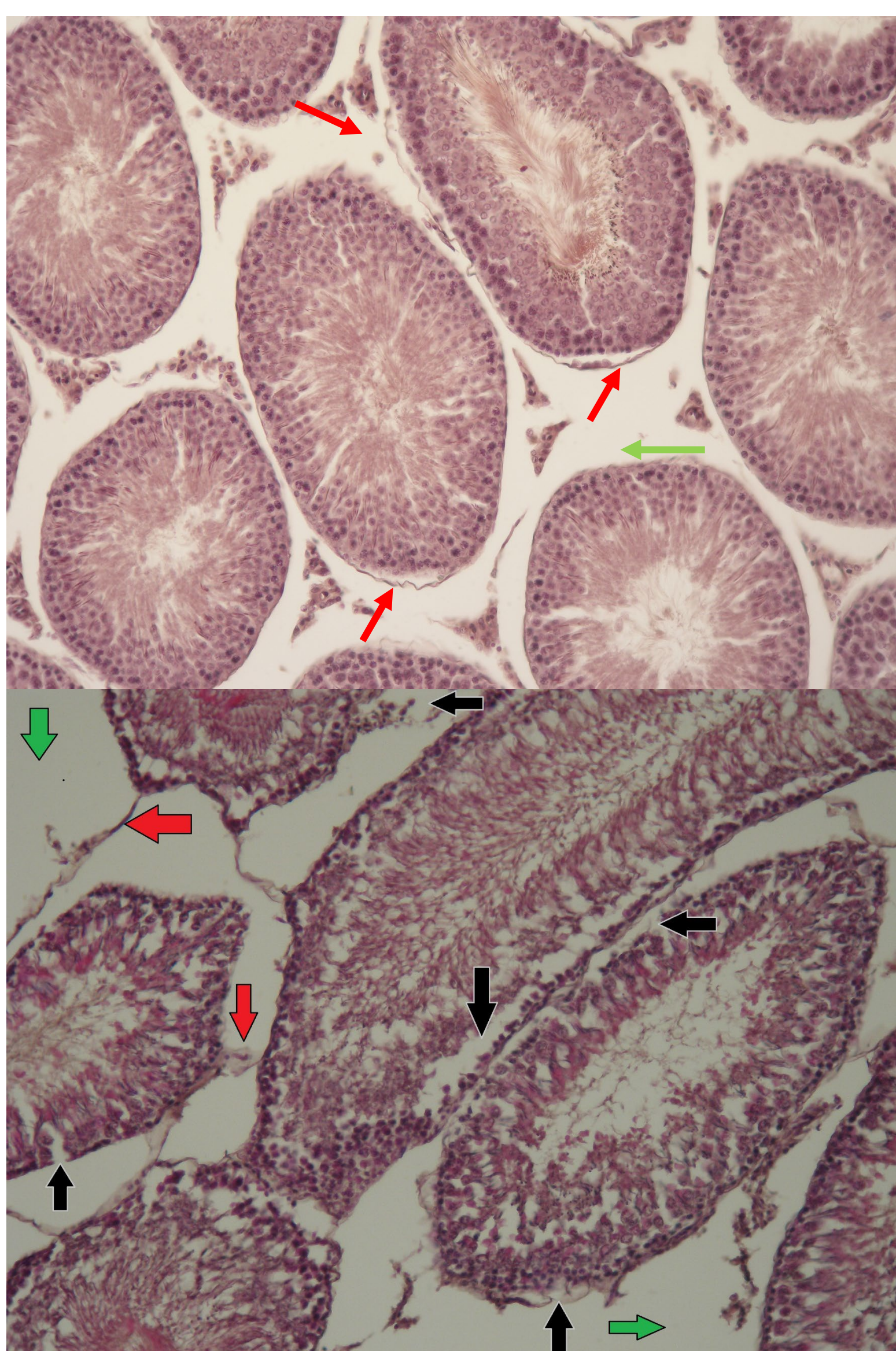
CrA group – hexavalent chromium (75 ppm) and Aronia melanocarpa in water for three months,

C – control group – distilled water.

Histological slide, made from testis fixed in Bouin's-Hollande solution and stained with Hematoxylin-Eosin, were examined using an Olympus CX41 microscope. The diameter of the seminiferous tubules was calculated using software for image analysis QuickPHOTO Micro 2.2.



• Results and discussions

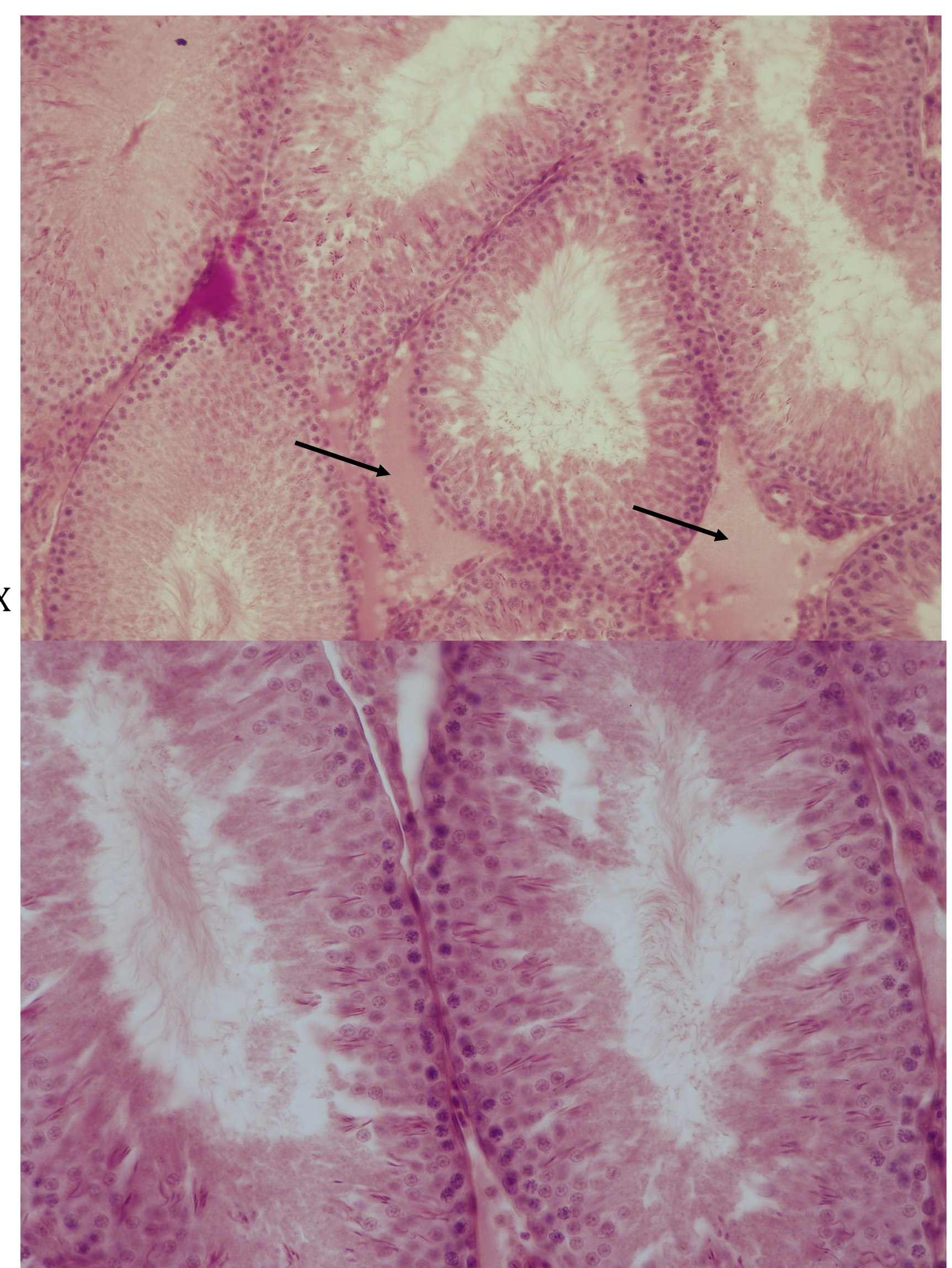


Testis section - Cr group, H.E., ob 20X
← interstitial edema, ← detachment or absence of basement membrane

Testis section - CrA group, H.E., ob 20X
← vasodilations

Testis section - Cr group, H.E., ob 20X
← interstitial edema, ← basement membrane and epithelial degenerative-necrotic lesions, ← detachment of basement membrane

Testis section - Cr group, H.E., ob 40X
Absence of interstitial edema, and degenerative-necrotic lesions



• Conclusions

The detrimental effects of hexavalent chromium on the testes were evident through the emergence of degenerative necrotic lesions in the basement membrane, interstitial edema, Sertoli cell necrosis, and epithelial atrophy. When chromium was administered alongside an aqueous extract of Aronia melanocarpa, a reduction in degenerative necrotic lesions and edema was noted, although there was a marked dilation of blood vessels. Additionally, the diameter of the seminiferous tubules was significantly reduced in the group exposed to chromium. However, the Aronia extract positively influenced these conditions, as it led to a decrease in interstitial edema, with some areas of the testis showing almost complete resolution.