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Toxicity and Negative Effects of Selenium Nanoparticles on Male Nile Tilapia (Oreochromis Niloticus) Sperm at Supranutritional and Imbalance Levels

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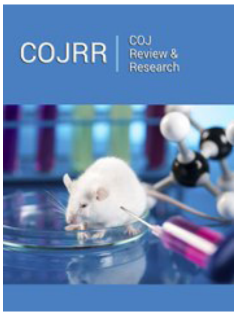

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Abstract

In male reproduction and antioxidative systems, selenium plays a significant role. Although a lack of this element can harm the body's organs, this metalloid can cause oxidative stress in other species, which has negative effects. Selenium nanoparticles (SeNPs) were evaluated for their spermatotoxicity in this study's Nile tilapia (Oreochromis niloticus) using genotoxicity, antioxidant status, sperm quality, and histopathology. For 30 and 60 days, fish weighing an average of 70g (n=288) were fed SeNPs three times daily at varying dosages of 0, 0.1, 0.5 and 1mgkg diet. The fish were separated into four experimental groups (three repetitions). After a feeding trial of 30 and 60 days, at 1mgkg SeNPs on day 30 and at 0.5 and 1mgkg on day 60, spermatocrit percentage significantly decreased in comparison to the control group (p 0.05). SeNPs caused a decrease in computer-assisted sperm analysis parameters, particularly VCL, VSL, and VAP (p 0.05). Following the feeding experiment, fish fed with 0.1mgkg of SeNPs had the largest percentage of fast speed progressive sperm cells, which significantly decreased in a SeNPs dose-dependent way (p 0.05). Additionally, all SeNPs-treated groups had significantly higher levels of malondialdehyde and glutathione peroxidase in their seminal plasma (p 0.05). At 1mgkg SeNPs on day 60, sperm DNA damage significantly increased (p 0.05). Furthermore, spermatocyte and spermatid counts were higher in the maximum concentration of spermatozoa was found at the highest SeNPs dose, while the lowest and moderate SeNPs doses recorded the highest percentage of spermatozoa. These results suggested that non-optimal dosages of SeNPs might impair testis growth, cause oxidative stress and DNA damage in sperm, and diminish sperm quality.

Keywords: Nanoparticles; Nile tilapia; Selenium; Sperm

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Selenium participates in enzyme structures known as selenoproteins, including glutathione peroxidase (GSHPx), and serves as a cofactor in biological systems [1,2]. As a result, selenium plays a crucial role in skeletal muscle, thyroid metabolism, anti-carcinogenesis, and male reproduction [3,4]. According to studies, a selenium deficit can harm the testes, heart, liver, kidneys, and skeletal muscle [5]. Additionally, studies have demonstrated that a deficiency in selenium or selenoproteins may result in the development of aberrant spermatozoa throughout the spermatogenesis process [6]. According to selenium's ameliorative effects, the improvement of reproduction in the male gonadal testis must be supported by adequate levels of this crucial element [7-9]. Additionally, it has been demonstrated that this metalloid can cause oxidative stress in organisms to have harmful effects [10]. Due to the small range between its non-toxic and toxic doses, selenium is a micronutrient that is essential for proper physiology at low concentrations and can have negative effects at larger quantities [11,12]. To prevent infertility and maintain reproductive health, selenium intake in meals should be adequate. Due to its numerous applications in the fields of materials, biology, the environment, and energy, nanotechnology is a frontier field of science that has been expanding quickly in recent years [13-20]. However, sword because of their ambiguous risks to land and aquatic creatures and potential negative impacts [21]. Few studies have been conducted to assess this technology's dangers to biological systems because of its novelty [22]. Compared to other forms of the metal, including sodium selenite, sodium selenosulfate, selenomethionine, and se-methyl selenocysteine, selenium nanoparticles (SeNPs) appear to be more physiologically beneficial [9,23]. In fact, the structure of selenium plays a crucial role in determining both its positive and harmful aspects [24]. Around 3,000-3,500 tonnes of selenium were produced industrially around the world in 2010, and this sizable amount would change more to be in nano form [25]. Due to their photoelectric and semi-conductor capabilities, SeNPs have recently been used as a red pigment and enhancer in the production of glass and ceramics [26]. Animal physiological indicators, including as growth performance, muscle composition, blood biochemical profiles, and antioxidant status, have all benefited from the use of SeNPs as a food supplement [27,28]. The toxicity of these nanoparticles in aquatic environments and across trophic levels in the food chain is therefore receiving more attention because of their expanding and widespread use [29]. SeNPs may cause toxicity in aquatic species like bacteria, crustaceans, and fish, according to a few publications [29-31]. Nevertheless, even though SeNPs are being used more and more, very little is known about the health concerns associated with these substances, and researchers should take SeNPs' negative effects into account.

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