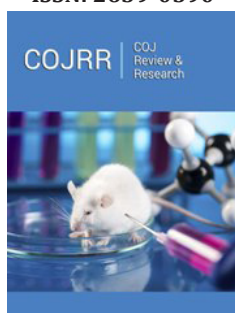


Toxicity and Negative Effects of Selenium Nanoparticles on Male Nile Tilapia (*Oreochromis Niloticus*) Sperm at Supranutritional and Imbalance Levels

ISSN: 2639-0590



***Corresponding author:** Sanjay Singh Rathore, Department of Aquaculture, College of Fisheries, Karnataka Veterinary, Animal and Fisheries Sciences University, India

Submission:  July 30, 2022

Published:  September 19, 2022

Volume 4 - Issue 3

How to cite this article: Sanjay Singh Rathore*, Shivananda MH, Jayashri MS. Toxicity and Negative Effects of Selenium Nanoparticles on Male Nile Tilapia (*Oreochromis Niloticus*) Sperm at Supranutritional and Imbalance Levels. COJ Rev & Res. 4(3). COJRR. 000586. 2022. DOI: [10.31031/COJRR.2022.04.000586](https://doi.org/10.31031/COJRR.2022.04.000586)

Copyright@ Sanjay Singh Rathore, This article is distributed under the terms of the Creative Commons Attribution 4.0 International License, which permits unrestricted use and redistribution provided that the original author and source are credited.

Sanjay Singh Rathore*, Shivananda MH and Jayashri MS

Department of Aquaculture, College of Fisheries, Karnataka Veterinary, Animal and Fisheries Sciences University, India

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 1mg/kg diet. The fish were separated into four experimental groups (three repetitions). After a feeding trial of 30 and 60 days, at 1mg/kg SeNPs on day 30 and at 0.5 and 1mg/kg 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 0.1mg/kg 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 1mg/kg 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

Mini Review

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 s-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.

References

- Sarkar B, Surajit B, Daware A, Tribedi P, Krishnani KK, et al. (2015) Selenium nanoparticles for stress-resilient fish and livestock. *Nanoscale Res Lett* 10 (1): 371.
- Lin J, Shen T (2020) Association of dietary and serum selenium concentrations with glucose level and risk of diabetes mellitus: a cross sectional study of national health and nutrition examination survey, 1999-2006. *J Trace Elem Med Biol* 63: 126660.
- Brown KM, Arthur J (2001) Selenium, selenoproteins and human health: a review. *Public Health Nutr* 4 (2b): 593-599.
- Rayman MP (2005) Selenium in cancer prevention: a review of the evidence and mechanism of action. *Proc Nutr Soc* 64 (4): 527-542.
- Wang K, Peng CZ, Huang JL, Jin MC, Geng Y (2013) The pathology of selenium deficiency in *Cyprinus carpio* L. *J Fish Dis* 36(7): 609-615.
- Qazi IH, Angel C, Yang H, Zoidis E, Pan B, et al. (2019) Role of selenium and selenoproteins in male reproductive function: a review of past and present evidence. *Antioxidants* 8(8): 268.
- Ahsan U, Kamran Z, Raza I, Ahmad S, Babar W, et al. (2014) Role of selenium in male reproduction-A review. *Anim Reprod Sci* 146(1-2): 55-62.
- Sarhan NR (2018) The ameliorating effect of sodium selenite on the histological changes and expression of caspase-3 in the testis of monosodium glutamate-treated rats: light and electron microscopic study. *J Microsc Ultrastruct* 6(2): 105-115.
- Zhou JC, Zheng S, Mo J, Liang X, Xu Y, et al. (2017) Dietary selenium deficiency or excess reduces sperm quality and testicular mRNA abundance of nuclear glutathione peroxidase 4 in rats. *J Nutr* 147(10): 1947-1953.
- Mahboob S (2013) Environmental pollution of heavy metals as a cause of oxidative stress in fish: a review. *Life Sci J* 10: 336-347.
- Wang H, Zhang J, Yu H (2007) Elemental selenium at nano size possesses lower toxicity without compromising the fundamental effect on selenoenzymes: comparison with selenomethionine in mice. *Free Radic Biol Med* 42(10): 1524-1533.
- Zhou X, Wang Y, Gu Q, Li W (2009) Effects of different dietary selenium sources (selenium nanoparticle and selenomethionine) on growth performance, muscle composition and glutathione peroxidase enzyme activity of crucian carp (*Carassius auratus gibelio*). *Aquaculture* 291(1-2): 78-81.
- An HJ, Sarkheil M, Park HS, Yu IJ, Johari SA (2019) Comparative toxicity of silver nanoparticles (AgNPs) and silver nanowires (AgNWs) on saltwater microcrustacean, *Artemia salina*. *Comp Biochem Physiol Part C Toxicol Pharmacol* 218: 62-69.
- Joo HS, Kalbassi MR, Johari SA (2018) Hematological and histopathological effects of silver nanoparticles in rainbow trout (*Oncorhynchus mykiss*)-how about increase of salinity? *Environ Sci Pollut Res Int* 25(16): 15449-15461.
- Santos CS, Gabriel B, Blanchy M, Menes O, Garcia D, et al. (2015) Industrial applications of nanoparticles-a prospective overview. *Mater Today Proc* 2(1): 456-465.
- Singh NA (2017) Nanotechnology innovations, industrial applications and patents. *Environ Chem Lett* 15(2): 185-191.
- Tayemeh MB, Kalbassi MR, Paknejad H, Joo HS (2020) Dietary nano encapsulated quercetin homeostated transcription of redox-status orchestrating genes in zebrafish (*Danio rerio*) exposed to silver nanoparticles. *Environ Res* 185: 109477.
- Xu L, Wang H (2020) Temperature-responsive multilayer films of micelle-based composites for controlled release of a third-generation EGFR inhibitor. *ACS Appl Polym Mater* 2(2): 741-750.
- Lu Y, Zhuk A, Xu L, Liang X, Eugenia K, et al. (2013) Tunable pH and temperature response of weak polyelectrolyte brushes: role of hydrogen bonding and monomer hydrophobicity. *Soft Matter* 9(22): 5464-5472.
- Xu L, Selin V, Zhuk A, Ankner JF, Sukhishvili (2013) Molecular weight dependence of polymer chain mobility within multilayer films. *ACS Macro Lett* 2(10): 865-868.
- Huang S, Wang L, Liu L, Hou Y, Li L (2015) Nanotechnology in agriculture, livestock and aquaculture in China A review. *Agron Sustain Dev* 35(2): 369-400.
- Moore M (2006) Do nanoparticles present ecotoxicological risks for the health of the aquatic environment? *Environ Int* 32 (8): 967-976.
- Sevcikova L, Pechova A, Pavlata L, Antos D, Mala E, et al. (2011) The effect of various forms of selenium supplied to pregnant goats on the levels of selenium in the body of their kids at the time of weaning. *Biol Trace Elem Res* 143(2): 882-892.
- Ebeid T (2009) Organic selenium enhances the antioxidative status and quality of cockerel semen under high ambient temperature. *Br Poult Sci* 50(5): 641-647.
- Naumov A (2010) Selenium and tellurium: state of the markets, the crisis, and its consequences. *Metallurgist* 54(3-4): 197-200.
- Fordyce FM (2013) Selenium deficiency and toxicity in the environment. *Essentials of Medical Geology* pp. 375-416.
- Hosnedlova B, Kepinska N, Skalickova S, Carlos F, Nedecky BR, et al. (2018) Nano-selenium and its nanomedicine applications: a critical review. *Int J Nanomedicine* 13: 2107.
- Jampilek J, Kos J, Kralova K (2019) Potential of nanomaterial applications in dietary supplements and foods for special medical purposes. *Nanomaterials* 9(2): 296.

29. Mal J (2017) A comparison of fate and toxicity of selenite, biogenically, and chemically synthesized selenium nanoparticles to zebrafish (*Danio rerio*) embryogenesis. *Nanotoxicology* 11(1): 87-97.
30. Kumar N, Krishnani KK, Singh NP (2018) Comparative study of selenium and selenium nanoparticles with reference to acute toxicity, biochemical attributes, and histopathological response in fish. *Environ Sci Pollut Res* 25(9): 8914-8927.
31. Selmani A (2020) Stability and toxicity of differently coated selenium nanoparticles under model environmental exposure settings. *Chemosphere* 250: 126265.

For possible submissions Click below:

[Submit Article](#)