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# Zinc loaded whey protein nanoparticles mitigate the oxidative stress and modulate antioxidative gene expression in testicular tissues in rats

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Abstract

This study aimed to utilize whey protein nanoparticles (WPNPs) and zinc (Zn) loaded WPNPs to protect against carbon tetrachloride ($CCl_4$)-induced testicular damage in rats . Zn was loaded on WPNPs at three levels and Zn release was determined at different time intervals. Seventy male Wistar rats were divided into 7 groups and

treated orally for 4 weeks as follows: the control group, $CCl_4$-treated group (0.5 ml/100 g b.w) twice a week, $CCl_4$ plus WPNPs-treated group (300 mg/kg b.w), $CCl_4$ plus Zn citrate-treated group (50 mg/kg b.w), and the groups treated with $CCl_4$ plus the three Zn-WPNPs formulations. Blood and testicular tissue samples were collected for different assays. Animals treated with $CCl_4$ showed a significant decrease in body weight and relative weight of the testis, testosterone level, antioxidant enzymes activity and mRNA expression of Nrf2, HO-1 and NQO1 and increased Malondialdehyde (MDA), nitric oxide (NO) and mRNA expression of Keep1 and induced histological changes in the testis. WPNPs alone, Zn alone or Zn loaded WPNPs at the three levels protect against $CCl_4$-induced testicular damage. These effects were more pronounced in the group received the fabrication with low Zn level. This study concluded that Zn-WPNPs could reduce the oxidative stress in the testicular tissue via different mechanisms mainly via the regulation of Nrf2-Keap1 antioxidative signaling pathway. © 2021 Elsevier B.V.

Author keywords

Drug delivery; Gene expression ; Oxidative stress ; Testicular injury; Whey protein nanoparticles ; Zinc citrate

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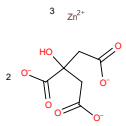

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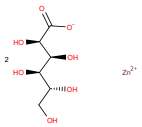

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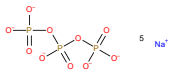

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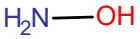

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**EMTREE drug terms**

carbon tetrachloride; heme oxygenase 1; malonaldehyde; messenger RNA; nanoparticle ; nitric oxide; oxidoreductase; quinone oxidoreductase 1; testosterone; transcription factor Nrf2; unclassified drug; whey protein ; zinc citrate

**EMTREE medical terms**

adult; animal experiment; animal model; animal tissue ; Article; blood sampling; body weight; controlled study; drug delivery system; enzyme activity; gene expression ; histopathology; male; mRNA expression level; nonhuman; oxidative stress ; rat ; testis injury; testis tissue ; testis weight

**Topic name**

Thymoquinone; Nigella Sativa; Caraway Oil

**Prominence percentile**

97.077

**carbon tetrachloride**

56-23-5

**malonaldehyde**

542-78-9

**nitric oxide**

10102-43-9

**oxidoreductase**

9035-73-8, 9035-82-9, 9037-80-3, 9055-15-6

**testosterone**

58-22-0

**zinc citrate**

25618-84-2, 546-46-3

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