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Achillea millefolium alleviates testicular damage in paclitaxel-intoxicated rats via attenuation of testicular oxido-inflammatory stress and apoptotic responses

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Abstract

The aim of this study was to investigate the effects of *Achillea millefolium* extract in paclitaxel-induced testicular toxicity in rats. The groups were designed as (1) control, (2) paclitaxel (8 mg/kg, intraperitoneally), (3) paclitaxel (8 mg/kg, intraperitoneally) + *Achillea millefolium* (200 mg/kg, orally for 14 consecutive days) and (4) paclitaxel (8 mg/kg, intraperitoneally) + *Achillea millefolium* (400 mg/kg, orally for 14 consecutive days). Serum levels of testosterone, luteinising hormone and follicle-stimulating hormone, as well as total antioxidant capacity and total oxidant status were measured one day after receiving the last dose of *Achillea millefolium* extract. Testicular superoxide dismutase activity, malondialdehyde, tumour necrosis factor alpha and interleukin-1β levels, the expressions of nuclear factor kappa B and caspase-3 were evaluated. In addition, testicular sections were evaluated histopathologically and 8-hydroxy-2′-deoxyguanosine was detected immunohistochemically. *Achillea millefolium* improved the levels of luteinising hormone, follicle-stimulating hormone and testosterone, upregulated testicular antioxidant enzymes and downregulated inflammation. Furthermore, we observed that *Achillea millefolium* restored testicular histopathological structure and significantly suppressed oxidative DNA damage and apoptosis by reducing the expression of caspase-3. Taken together, our results suggest that *Achillea millefolium* has protective effects against paclitaxel-induced testicular toxicity and is a promising natural product with the potential to improve male fertility.

KEYWORDS

Achillea millefolium, apoptosis, oxidative stress, paclitaxel, testis toxicity

1 | INTRODUCTION

Chemotherapy is one of the common treatment options for cancer therapy. It improves the quality of life of cancer patients and gives hope of remission in cancer treatment. Despite being very effective, the most potent antineoplastic drugs have adverse effects. Most of them display their effects nonspecifically, destroying both malignant and normal cells, resulting in gonadotoxicity, hepatotoxicity, cardiotoxicity, nephrotoxicity, neurotoxicity and hematopoietic system injury (Borovskaya et al., 2009; Zhang et al., 2018).

