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Evaluate protective role of Foeniculum Vulgare (SAUNF) against the reproductive toxicity induced by Zinc Oxide (ZnO) in Male Rats

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Abstract: This study investigates the reproductive toxicity induced by ZnO nanoparticles and the protective role of Foeniculum vulgare (fennel)) through their potent against reproductive boxicity induced by zinc oxide (zno) nanoparticles in male rats. the significant protective role of Foeniculum vulgare and Pimpinella anisum. Herbalists really use fennel, whose scientific name is Foeniculum vulgare. Apiaceae is the family to which this plant belongs, which is often known as the Umbelliferae family. Organic formulations derived from Foeniculum vulgare offer a safer alternative to synthetic medications.

Keywords: Foeniculum, Vulgare, Male Rats, Oxide , medicinal

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INTRODUCTION

Foeniculum vulgare (L.), generally referred to as fennel, is a prominent medicinal plant widely used in traditional medicine for its many therapeutic attributes. It has a wealth of bioactive elements, including as flavonoids, phenolic compounds, essential oils, and vitamins. These phytochemicals have significant antioxidant and anti-inflammatory properties, which may alleviate the detrimental effects of ZnO nanoparticles on reproductive health.

Foeniculum vulgare phytochemicals against reproductive toxicity produced by ZnO nanoparticles in male rats. It offers an extensive examination of the processes of toxicity, the phytochemical characteristics of Foeniculum vulgare, experimental results, and possible therapeutic uses.

Herbalists really use fennel, whose scientific name is Foeniculum vulgare. Apiaceae is the family to which this plant belongs, which is often known as the Umbelliferae family. Plants of this kind are grown all over the globe. Microbial potential in plants has been the subject of many studies as a possible treatment for infections caused by a wide range of microorganisms. The anti-oxidant properties of plants are only one of several that have been identified by experts. The hepato-protective activity of isolated essential oil from the F. valgare plant has been documented.

Research on the consequences must be prioritized, on reproductive health, particularly in workers exposed to Al2 O3 NPs and ZnONPs on the job. To do this, we examined the histology of male rats' testes and collected data on a variety of factors, including semen characteristics, DNA fragmentation, p53, cytokines, oxidative stress, sex hormones, and mitochondrial transcription factor A and uncoupling protein 2 genes.

Male rats treated intraperitoneally with ZnO NPs had a decreased sperm count, slower motility, and more abnormalities, according to research by Abbasalipourkabir et al. Talebi et al. found that spermatogenic parameters such as sperm count, motility, abnormality percentage, seminiferous tubule diameter, seminiferous epithelium height, and maturation arrest were significantly altered when administered 50 and 300 mg/kg of ZnO NPs. This suggested that ZnO NPs had a negative effect on spermatogenesis and testicular toxicity.

In male rats, ZnO nanoparticles have been demonstrated to disturb hormonal equilibrium by influencing testosterone and luteinizing hormone concentrations, cause testicular tissue damage resulting in compromised spermatogenesis, and elevate lipid peroxidation while diminishing antioxidant enzyme activity.

LITERATURE REVIEW

Sfar, Manel et.al. (2023) There are several culinary and medicinal uses for the seeds of the well-known herbal spice Foeniculum vulgare (F. vulgare). In this study, polysaccharides tested utilizing FT-IR, UV-vis, NMR, GC-MS, and SEC/MALS/DRI technology; the seeds of F. vulgare were used for the analysis. The polysaccharides contained in F. vulgare seeds (FPS) had a molecular mass of about 101,000 g/mol on average. These polysaccharides were composed of the following sugars in the following proportions: 20.4% galactose, 55.8% glucose, 5.3% arabinose, 13.6% mannose, 2.1% fructose, 1.5% rhamnose, and 1.3% arabinose. The isolated FPS demonstrated a remarkable antioxidant action. Additionally, FPS prevented cadmium intoxication in the liver by lowering malondialdehyde (MDA) production and raising levels of the antioxidant enzymes catalase and superoxide dismutase (SOD).

Debnath, Shilpa et.al. (2023). A member of in the family Apiaceae, you'll find Foeniculum vulgare Mill. is used for both medicinal and traditional purposes. Its use in South Asian medicine goes back many centuries, and it is a fundamental ayurvedic therapy. Many different phytochemicals, some of which are bioactivities, are found in this F. vulgare plant's seeds, leaves, aerial parts, and fruits. Anthocyanins, limonene, estragole, anethole, and p-coumaric acid are all phytochemicals. Fenchone and anethole, the principal bioactive components extracted from F. vulgare, have shown remarkable antioxidant, anticancer, carminative, diuretic, and galactagogue characteristics. Additionally, these chemicals have shown potential in alleviating symptoms of irritable bowel syndrome, tooth decay, and amenorrhoeic.

Barakat, Hassan et.al. (2023). Those who have contributed to this work include Hassan Barakat, Ibrahim Alka beer, Sami A. Althwab, Hani Alfheeaid, Raghad Alhomaid, Mona Almujaydil, Raya Almuziree, Taqwa Bushnaq, and Ahmed Mohamed. (2023). Toxic Effects of CCl4 on the Rat Kidneys and Oxidative Stress as Induced by Fennel (Foeniculum vulgare) Seeds and Sprouts: A Neuroprotective Study. Protective substances. 10.3390/antiox12020325. 12. 325.

Khammassi, Marwa et.al. (2023). Purpose for many different types of crops, weeds and fungus pose a significant threat. Furthermore, these pests are acquiring significant resistance to chemical pesticides as a result of the detrimental effects of these chemicals on the ecosystem. Hence, an increasing number of people are considering using active molecules produced from plants, such essential oils and phenolic compounds, on crops instead of harmful chemical pesticides. These molecules have the potential to be both

safe and environmentally helpful. This study used gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-mass spectrometry (LC-MS) to evaluate the chemical composition of the methanol extract (ME) and essential oil (Eos) of Foeniculum vulgare, respectively. Furthermore, we investigated their phytotoxic effects on Sinapis arvensis, Trifolium campestre, Lolium rigidum, and Lepidium sativum, as well as their antifungal characteristics in vitro against five phytopathogenic fusarium oxysporum species most prevalent monoterpenes in Eos were limonene (8.6%), α-thujone (9.6%), and estragole (76.2%).

Rafieian, Fatemeh et.al. (2023) The Foeniculum vulgare Mill., more often known as the fennel plant, is a tough perennial herb with yellow umbrella-shaped blooms that are usually bisexual. It has grooved stems and encased, intermittent leaves. Although the aromatic fennel plant is often linked to the Mediterranean, its widespread use as a spice and medicine has caused it to spread all over the world. This research aims to compile current details gleaned from published works about fennel's toxicology, chemical make-up, and functional characteristics. Multiple in vitro and in vivo pharmacological investigations have shown the antibacterial, antiviral, anti-inflammatory, anti-hepatoprotective, anti-bronchodilatory, and anti-memory-loss characteristics of this plant.

RESEARCH METHODOLOGY

Preparation of plant extracts:

The seeds were identified by the Department of Botany at the Faculty of Science, Alexandria University, Egypt. Using an electronic grinder F. vulgare and P. anisum seeds were ground into a powdery form. To prepare the aqueous extract of F. vulgare, 200 g of the powdered material was dissolved in 800 mL of distilled water and subsequently stored in a refrigerator for 24 hours.

Experimental design:

Group 1 (F. vulgare and P anisum): Rats were administered 150 mg/kg body weight and 125 mg/kg body weight, respectively, via gastric tube daily.

Group 2 (ZnO nanoparticles, F. vulgare and P anisum): Dosage rates of 30, 150, and 125 mg/kg b.wt. were administered to the rats, accordingly.

Collection of serum and tissue samples:

Half of the blood was placed in a centrifuge tube and centrifuged for 15 minutes at 1500 rpm to extract serum, and the other half was placed in heparinized tubes and centrifuged to extract plasma.

DATA ANALYSIS

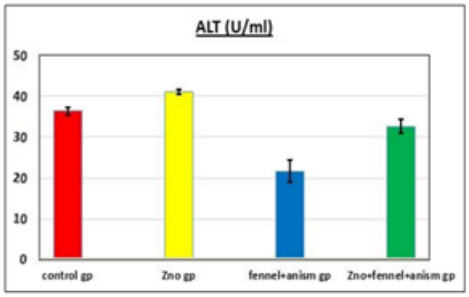
nanoparticles group's liver tissue displayed numerous changes indicative of severe hepatic injury, such as Kupffer cell activation, the presence of vacuoles, the dilation and congestion of hepatic sinusoids, and the formation of degenerated areas of destroyed hepatocytes that lost their normal characteristics and fused together. (C, D) show that the liver tissue in the ZnO nanoparticles group that was treated with Pimpinella anisum and Foeniculum vulgare looked normal histologically.

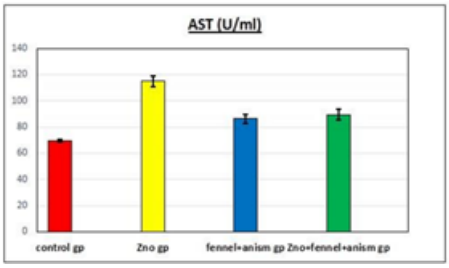
Table 1: The relationship between the serum activities of ALT, AST, ALP, MDA, CAT, and

interlukin-6 and the effects of Pimpinella anisum and Foeniculum vulgare (X ± E.).

Parameters	Control Gp	Zno gp	fennel+anism gp	Zno+fennel+anism gp
ALT (U/ml)	36.33 ± 0.8b	41 ± 0.5c	21.6 ± 2.7a	32.6 ± 1.7b
AST (U/ml)	69.3 ± 1.2a	115 ± 4.0c	86.3 ± 3.4b	89.3 ± 4.0b
ALP (U/L)	152.6 ± 1.7a	362.6±50.5b	130 ± 2.8a	211.6 ± 5.4a
MDA (nmolml)	5.6 ± 0.18a	28.0 ± 2.6c	5.6 ± 0.40a	14.2 ± 1.50b
CAT (UlL)	9.03 ± 0.3b	7.2 ± 0.3a	11.9 ± 0.7b	13.2 ± 0.5b
Interleukin-6 (pg/ml)	85 ± 1.1a	135.6 ± 3.1c	88 ± 1.7a	112 ± 6.2b

The enzymes ALT, AST, ALP, MDA, CAT, and interliukin-6 are involved. The means of the four rows that did not have a common superscript letter (a, b, c, and d) were substantially different, with a p-value of less than or equal to zero.





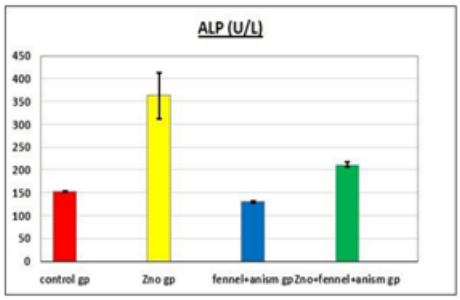


Figure 1: The impact of Pimpinella anisum and Foeniculum vulgare on ALT, AST, and ALP activities

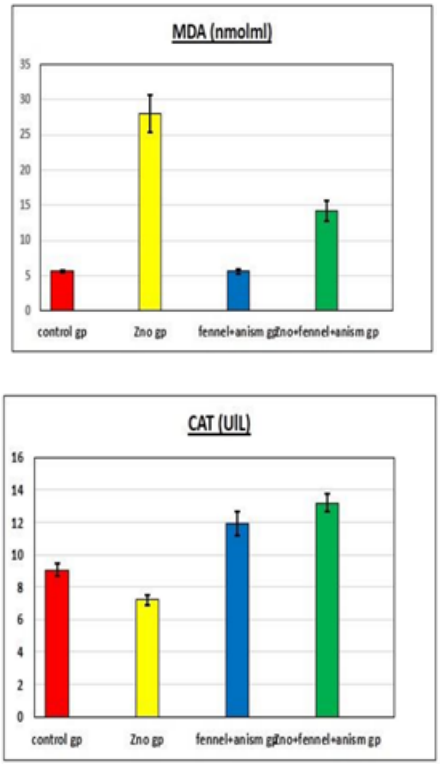


Figure 2: The impact of Pimpinella anisum and Foeniculum vulgare on MDA and CAT activities

The statistical analysis indicated that the decrease at doses of 140 and 280 mg/kg was substantial ($P < 0.05$) (Fig. 3). The count of Sertoli cells exhibited a substantial decrease in the experimental groups compared to the control group at a dose of 140 mg/kg ($P < 0.05$). Figure 3.

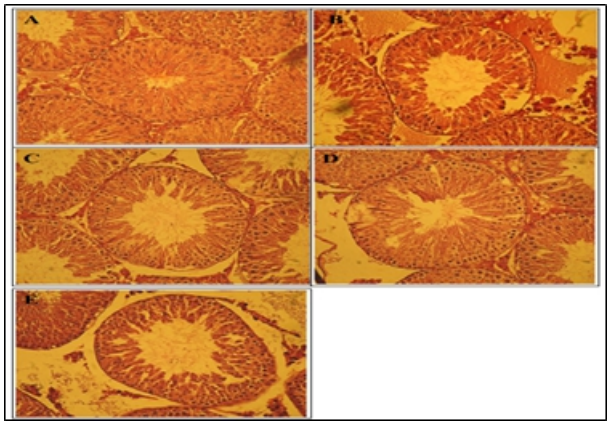


Figure 3: Photomicrograph of seminiferous tubules in rats

Table 2. Variations in epithelial thickness and seminiferous tubule diameter in experimental and control groups

Group	Diameter of seminiferous tubules	Thickness of epithelium
Control	128 ± 2.6	40 ± 1.8
Experimental 1 35 (mg/kg)	136 ± 2.2	38 ± 2.5
Experimental 2 70 (mg/kg)	135 ± 3.2	36 ± 1.3
Experimental 3 140 (mg/kg)	131 ± 3.1	37 ± 1.3
Experimental 4 280 (mg/kg)	136 ± 3	35 ± 1.3

Oral administration of F. uulgare at dosages of 100 and 250 mg/kg led to the appearance of spindle-shaped primary spermatocytes in the seminiferous tubules. The nuclei of several cells were at the metaphase stage (Fig. 4). Our findings indicated that fennel may extend germ cell division, enhance spermatozoid maturation, and increase the quantity of fusiform spermatogenic lineage, leading to a reduction in the number of spermatozoids inside the seminiferous tubules.

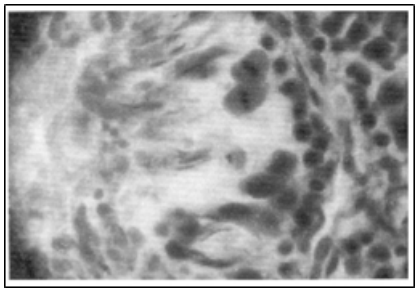


Figure 4: Spindle-shaped primary spermatocytes in seminiferous tubules at 100 and 250 mgkg F. vulgare extract.

Figure 5: Seminiferous tubule hyalinization with a 500 mgkg dosage of the medicine.

Our research showed that organic herb seed extract (at 250 and 500 mg levels) might augment blood estradiole levels (Fig. 5) while lowering testosterone levels. Research has shown that plants rich in phytoestrogen lower testosterone levels in the blood. Results for male sex hormones were similar.

CONCLUSION

Organic formulations derived from *Foeniculum vulgare* offer a safer alternative to synthetic medications. Further studies comparing the efficacy of *Foeniculum vulgare* with other medicinal plants, could identify synergistic or superior alternatives for mitigating reproductive toxicity Herbalists really use fennel, whose scientific name is Foeniculum vulgare. Apiaceae is the family to which this plant belongs, which is often known as the Umbelliferae family. nanoparticles group's liver tissue displayed numerous changes indicative of severe hepatic injury, such as Kupffer cell activation, the presence of vacuoles.

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