

EFFECT OF *CORNUS MAS* L. (CORNELIAN CHERRY) ADMINISTRATION ON THE MICROSCOPIC STRUCTURE OF REPRODUCTIVE ORGANS IN DIABETIC FATTY RATS

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ABSTRACT

Obesity and *diabetes mellitus* are chronic metabolic disorders with widespread effects on physiological functions, including reproduction. This study aimed to investigate the influence of *Cornus mas* L. (Cornelian cherry) administration on the microscopic structure of testes and epididymides in obese rats. Fifty male Zucker diabetic fatty (ZDF) rats were used in a three-month experiment. Experimental groups received varying doses and forms of *C. mas* (pulp, stone, or both) administered orally via gastric probe. Morphometric and histological analyses were performed on testicular and epididymal tissues, followed by statistical evaluation of structural parameters. Significant changes ($p < 0.05$) were observed in seminiferous epithelial and interstitial area proportions, while spermatogenic cell counts showed higher mean values in group receiving a dose of 500 + 250 mg/kg of pulp and stone combination without statistically significant differences. The epididymal lumen width increased and epithelial height decreased, although these changes were not statistically significant. The results indicate that *Cornus mas* induces dose-dependent structural changes in testicular histoarchitecture in obese rats. These findings suggest a modulatory effect on reproductive tissue under metabolic stress conditions.

Keywords: *Cornus mas*, ZDF rats, testes, epididymis, *diabetes mellitus*, morphometry

INTRODUCTION

Obesity is a complex metabolic disorder characterized by excessive fat accumulation and chronic oxidative stress that disrupts hormonal balance and reproductive function in males. It is associated with structural and functional alterations in the testes, including degeneration of the seminiferous epithelium, expansion of interstitial tissue, and decreased activity of Leydig and Sertoli cells. These microscopic changes contribute to reduced sperm count, impaired motility, and abnormal morphology, leading to a decline in overall fertility potential (Costa et al., 2025). The pathophysiological mechanisms involve lipid peroxidation, mitochondrial dysfunction, and oxidative damage to germ cells, resulting in progressive disorganization of testicular architecture (Jing et al., 2023; Meng et al., 2025; Wang et al., 2025). Given the increasing prevalence of obesity-related infertility, there is growing interest in identifying natural compounds capable of mitigating oxidative stress and preserving testicular structure.

Closely linked to obesity, type 2 diabetes mellitus (T2DM) represents one of the most prevalent metabolic disorders worldwide, accounting for more than 90 % of all diabetes cases. It arises from the combined effects of insulin resistance and impaired insulin secretion by pancreatic β -cells, ultimately leading to chronic hyperglycaemia. The progressive metabolic dysregulation associated with T2DM further exacerbates oxidative stress and tissue damage (Galicia-Garcia et al., 2020; Yokoi et al., 2013).

The Zucker diabetic fatty (ZDF) rat is a well-established animal model for studies of T2DM and obesity-related complications. These rats carry a mutation in the leptin receptor gene, which leads to impaired glucose tolerance, hyperinsulinemia, hyperlipidemia and hypertension. Diabetes in ZDF rats develops within 4 weeks, with a fully developed diabetes evident between 8 and 10 weeks (Srinivasan & Ramarao, 2007).

Cornus mas L. (Cornelian cherry) is a deciduous shrub of the family *Cornaceae*, traditionally used in European and Asian herbal medicine for the treatment of metabolic, inflammatory, and gastrointestinal disorders (Dinda et al., 2016). Its fruits are rich in biologically active constituents, including anthocyanins, flavonoids, phenolic acids, iridoids, and vitamin C, which are responsible for its strong antioxidant and anti-inflammatory properties (Czerwińska & Melzig, 2018). These compounds act synergistically to neutralize free radicals, modulate oxidative stress responses, and influence carbohydrate and lipid metabolism, making *Cornus mas* a promising candidate for alleviating metabolic and reproductive complications associated with obesity (Danielewski et al., 2021; Karğın et al., 2023; Moroz et al., 2024).

Experimental research has confirmed the potent antioxidant activity of *Cornus mas* extracts in various metabolic models. Supplementation enhances the activity of antioxidant enzymes such as superoxide dismutase, catalase, and glutathione peroxidase, while decreasing lipid peroxidation and oxidative damage to proteins (Dzydzan et al., 2020; Karğın et al., 2023). These biochemical effects contribute to improved redox homeostasis and reduced systemic oxidative load in diabetic and high-fat-diet models. The phytochemical profile of *Cornus mas* dominated by iridoid glycosides and anthocyanins has been shown to modulate lipid metabolism and adipokine regulation through activation of nuclear receptors such as PPAR- α and PPAR- γ , which play a central role in energy balance and cellular stress responses (Danielewski et al., 2021).

At the tissue level, *Cornus mas* exhibits cytoprotective and regenerative effects by maintaining the structural integrity of metabolically compromised organs. Its bioactive constituents help to stabilize cell membranes, prevent mitochondrial swelling, and preserve the organization of parenchymal tissues under oxidative or inflammatory stress (Moldovan et al., 2022; Shamsi et al., 2011). Histological studies have demonstrated that *Cornus mas* extract supports normal microarchitecture of tissues by preventing cellular disorganization and apoptosis within oxidative environments (Öztekin et al., 2023; Parlak Ak et al., 2022; Zhang et al., 2025). These findings suggest that the antioxidant mechanisms of *Cornus mas* may extend to the protection of reproductive organs affected by obesity and metabolic dysfunction.

Although the systemic effects of *Cornus mas* are well-documented, its direct influence on the microscopic structure of male reproductive organs has not been fully elucidated. The testes and epididymides are particularly susceptible to oxidative stress due to their high metabolic rate and lipid content, and any structural alteration may impair spermatogenesis and sperm maturation (Jing et al., 2023; Kohsaka et al., 2020; Liu et al., 2024). Investigating how *Cornus mas* affects the microarchitecture of these organs could therefore provide valuable insights into its role in reproductive protection under metabolic stress.

Although obesity-associated type 2 diabetes mellitus is known to adversely affect male reproductive function (Ding et al., 2015), detailed information on its impact on the microscopic and morphometric organization of the testes and epididymides remains limited. Therefore, the present study was designed to investigate the effects of oral *Cornus mas* administration, using different doses of pulp and stone, on the microscopic structure of the testes and epididymides in obese Zucker diabetic fatty (ZDF) rats.

MATERIAL AND METHODS

Plant material and preparation

Cornus mas (Cornelian cherry) was obtained from the Institute of Biodiversity Conservation and Biosafety of Slovak University of Agriculture in Nitra, Slovak Republic. The fresh ripe fruits were washed, separated from the stones, crushed, mixed and stored frozen at -20 °C. Stones were also crushed into small pieces and were ground into a fine powder. Aliquots were prepared in distilled water (Sigma Aldrich, Germany) and homogenised in order to be suitable for the administration by a gastric gavage.

Animals

Zucker diabetic fatty (ZDF) rats (a fatty *fa/fa* mutation (-/-); n = 44) in the age of 2.5 months (10 weeks of age) were involved in the study. Animals were obtained from the Breeding Department of the Institute of Experimental Pharmacology and Toxicology (Dobra Voda, Slovak Republic, SK CH 24016). Animals were housed in pairs in plastic cages (80 cm²) and in standard laboratory conditions under controlled temperature (22 ± 2 °C), humidity (55 ± 5 %), and a 12-hour light/dark cycle. Food and water were provided *ad libitum*.

The experimental protocol adhered to institutional and national ethical guidelines for animal research. The experiment was conducted at the Institute of Applied Biology, Slovak University of Agriculture in Nitra. The experiment was approved by the Ethical committee and the State Veterinary and Food Administration of the Slovak Republic under the number 2288/16–221.

Experimental design

The animals were divided into six groups. All animals were fed by KKZ-P/M (complete feed mixture for rats and mouse, reg. no 6147, Dobra Voda, Slovak Republic, 10 MJ/kg). The control group received only clean water, whereas the experimental groups received homogenized *Cornus mas* pulp, stone, or their combination at the indicated doses (Table 1). Water intake and body weight were monitored once per week.

The treatments were administered orally once a day for 90 days via gastric probe. The chosen doses were based on preliminary studies and literature data indicating safety and efficacy of *Cornus mas* supplementation in rodents (Zarei et al., 2014; Zarei & Shahrooz, 2019). Moreover, in our previous studies similar doses of sea buckthorn (Dupak et al., 2022), showed positive modulating effects on liver histology (Jaszcza et al., 2025).

Table 1 Experimental design and dosing of *Cornus mas* treatments.

Group	n	Mixed and homogenized stone [mg/kg body weight]	Mixed and homogenized pulp [mg/kg body weight]
C (control)	6	–	–
K	8	250	–
DK	8	250	500
DDK	8	250	1000
D	10	–	1500
DD	10	–	2000

Table 2 Morphometric parameters of ZDF rat testes

	C	K	DK	DDK	D	DD
^a Seminiferous epithelium [%]	51.04 ± 1.74	54.55 ± 2.40	50 ± 6.61	41.19 ± 3.43	52.44 ± 4.62	47.95 ± 5.31
Seminiferous tubule lumen [%]	12.41 ± 1.97	12.43 ± 1.94	10.16 ± 2.98	8.74 ± 1.65	9.64 ± 2.15	9.49 ± 3.46
^a Interstitium [%]	36.55 ± 3.67	33.02 ± 1.16	39.84 ± 6.63	50.07 ± 3.41	37.92 ± 6.11	42.56 ± 8.49
Seminiferous tubule diameter [µm]	49.27 ± 2.10	48.78 ± 9.27	46.44 ± 6.49	47.56 ± 8.96	45.04 ± 14.53	51.22 ± 13.75
Epithelial height of seminiferous tubule [µm]	8.39 ± 0.55	8.72 ± 1.12	8.75 ± 0.77	8.95 ± 0.80	8.66 ± 1.07	7.76 ± 1.26
Lumen diameter [µm]	10.77 ± 1.91	9.72 ± 2.15	9.68 ± 1.82	11.24 ± 1.11	10.45 ± 0.74	9.28 ± 1.94
Seminiferous tubule area [µm ²]	1041.42 ± 122.95	923.93 ± 292.55	903.99 ± 175.97	1010.55 ± 197.37	953.41 ± 397.58	929.83 ± 373.85
Seminiferous tubule perimeter [µm]	126.81 ± 5.50	127.99 ± 19.19	123.05 ± 14.25	126.99 ± 16.13	117.20 ± 29.90	127.70 ± 31.74
Number of spermatogenic elements per 10000 µm ²	41	42	69	52	45	49

^a indicates statistically significant differences among groups (p < 0.05).

Legend: C group (n=6, ZDF diabetic positive controls, receiving clean water), K group (n=8, ZDF diabetic group, dose of *C. mas* homogenized stone 250 mg/kg bw), DK group (n=8, ZDF diabetic group, dose of *C. mas* homogenized stone 250 mg/kg bw and homogenized pulp 500 mg/kg bw), DDK group (n=8, ZDF diabetic group, dose of *C. mas* homogenized stone 250 mg/kg bw and homogenized pulp 1000 mg/kg bw), D group (n=10, ZDF diabetic group, dose of *C. mas* homogenized pulp 1500 mg/kg bw), DD group (n=10, ZDF diabetic group, dose of *C. mas* homogenized pulp 2000 mg/kg bw).

Sample collection

At the end of the treatment period, all animals were euthanized using chloral hydrate anaesthesia (40 mg/100 g body weight). Testes and epididymides were carefully dissected and fixed in 10 % buffered formalin for histological evaluation. The tissues were processed using standard paraffin embedding, sectioned at 8 – 12 µm using rotating microtome, and stained with toluidine blue stain.

Morphometric and histological analysis

Histological sections were examined under a light microscope (Olympus CX-41, Japan) equipped with a digital camera (Olympus U-CMAD3, Japan). For each animal, three histological sections were analysed. From each section, 8 – 10 non-overlapping fields of view were evaluated. Within these fields, seminiferous tubules were selected randomly, considering only round or nearly round cross-sections. A total of approximately 10 – 15 seminiferous tubules per animal were evaluated. Morphometric parameters measured in testis included seminiferous tubule diameter, epithelial height, seminiferous tubule lumen diameter, seminiferous tubule area, seminiferous tubule perimeter, number of spermatogenic elements per area of 10000 µm² and percentage area of seminiferous epithelium, interstitium, and tubular lumen. Epididymal measurements included tubule diameter, epithelial height, lumen diameter, tubule area, tubule perimeter, percentage of epididymal epithelium, interstitial tissue and lumen. Morphometric measurements were performed manually in Euromex ImageFocusAlpha software (1.3.7.27993.20250313, Netherlands) for further analysis. The analysis was performed in a blinded manner, as samples were evaluated without prior knowledge of group allocation.

Statistical analysis

Quantitative data were analysed using Microsoft Excel and GraphPad Prism 8.0 software (GraphPad Software, San Diego, CA, U.S.A.). Results are expressed as mean ± standard deviation (SD). Data normality was assessed using the Shapiro–Wilk normality test. Differences among groups with normal distribution were analysed using one-way analysis of variance (ANOVA) followed by Tukey's post-hoc test. In cases where data did not meet the assumptions of normality, the non-parametric Kruskal–Wallis test followed by Dunn's post-hoc test was applied. Statistical significance was accepted at p < 0.05.

RESULTS

Testicular morphometry

For the parameter representing the relative percentage area of seminiferous epithelium (Table 2), the DDK group (41.19 ± 3.43 %) exhibited a significantly lower percentage compared with K group (p < 0.05; Figure 1). Conversely, the same group displayed a significant increase in the relative percentage area of the interstitium compared with the K group (50.07 ± 3.41 %; p < 0.05; Figure 2). The DK group exhibited higher mean values of spermatogenic elements (69 per 10000 µm²) compared with the control and other experimental groups; however, these differences were not statistically significant (Figure 3).

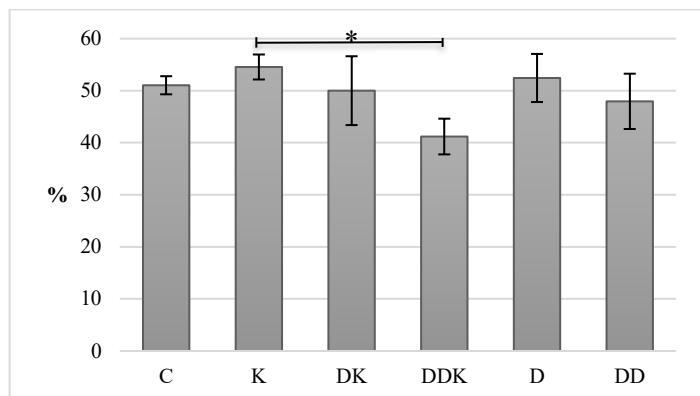


Figure 1 Percentage area of testis seminiferous epithelium. * indicates statistically significant difference ($p < 0.05$). Legend: Group abbreviations are defined in Table 1.

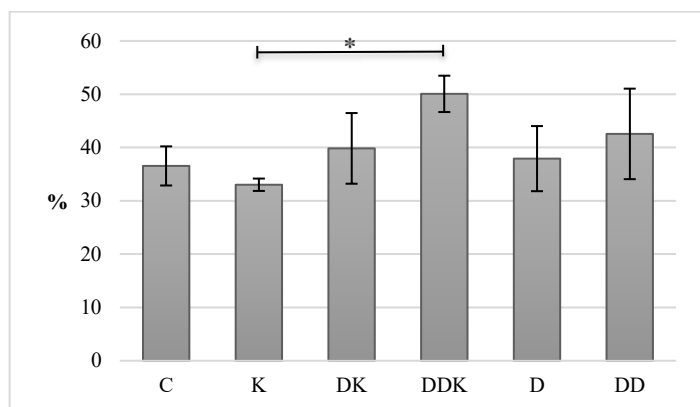


Figure 2 Percentage area of testis interstitium. * indicates statistically significant difference ($p < 0.05$). Legend: Group abbreviations are defined in Table 1.

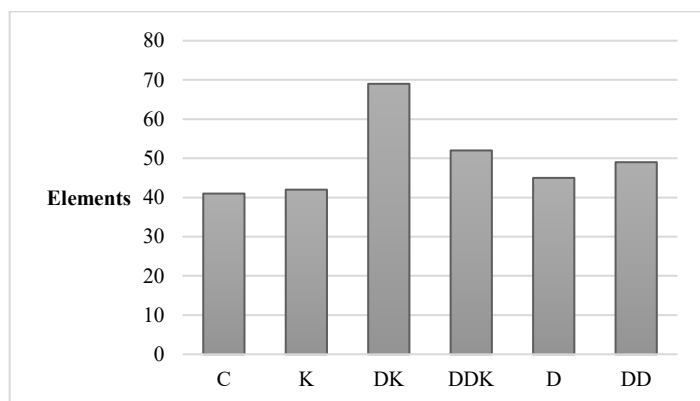


Figure 3 Number of spermatogenic elements per 10000 μm^2 in testis. Legend: Group abbreviations are defined in Table 1.

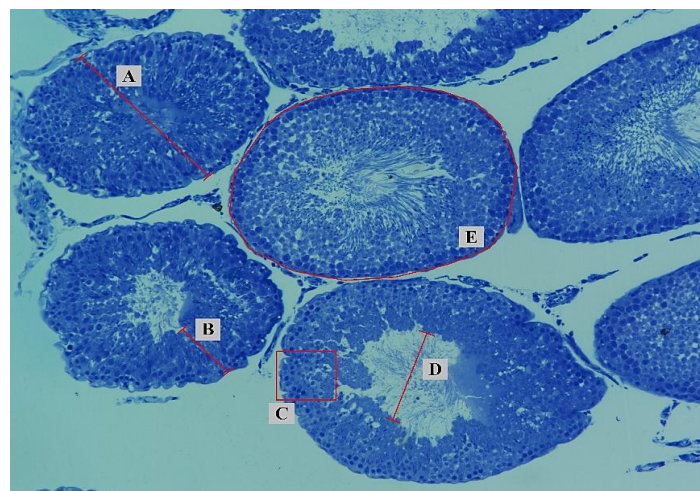


Figure 4 Histological micrograph of rat testis showing morphometric parameters, control group (C), 100 $\times$ magnification.

Legend: (A) seminiferous tubule diameter; (B) epithelial height; (C) number of spermatogenic elements; (D) lumen diameter; (E) seminiferous tubule perimeter.

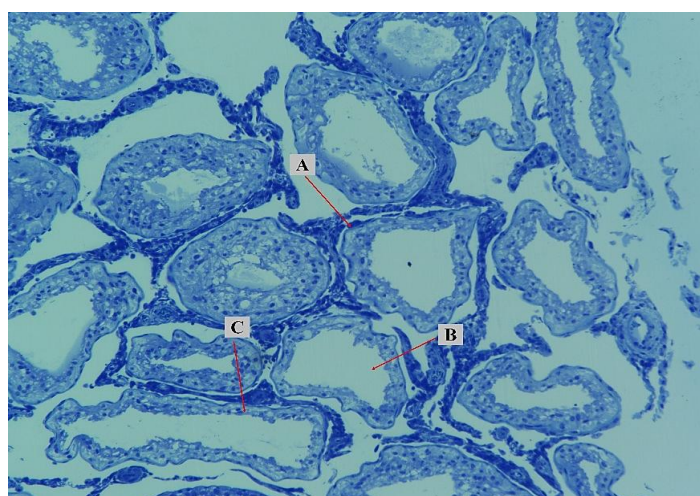


Figure 5 Histological micrograph of rat testis showing regression of seminiferous epithelium (group K) 100 $\times$ magnification.

Legend: Seminiferous epithelium (C), lack of spermatozoa in lumen (B) and tubule circular shape degeneration (A).

Overall, combined pulp and stone administration (DK and DDK groups) notably altered the testicular structure, with DDK showing reduced seminiferous epithelium and increased interstitium, whereas DK showed a tendency toward higher spermatogenic element density.

Epididymal morphology

The relative percentage area of epididymal epithelium showed no significant differences among the groups, although all experimental groups exhibited lower mean values compared with the control group (Table 3). A similar trend was observed for lumen diameter, where the control group presented the lowest mean value but with the highest variability ($18.70 \pm 7.59 \mu\text{m}$).

An inverse relationship was observed for the relative percentage area of the tubule lumen, with the control group showing the lowest mean value ($35.89 \pm 18.02 \%$) compared with all the treated groups. The epithelial height followed an opposite trend; the control group had the highest mean value ($11.51 \pm 11.23 \mu\text{m}$), but these differences did not reach statistical significance.

Table 3 Morphometric parameters of ZDF rat epididymis.

	C	K	DK	DDK	D	DD
Epididymal epithelium [%]	35.13 ± 15.56	24.01 ± 2.65	23.72 ± 1.59	20.34 ± 0.59	23.18 ± 4.02	23.47 ± 3.08
Tubule lumen [%]	35.89 ± 18.02	40.06 ± 5.44	44.10 ± 5.99	51.28 ± 2.82	50 ± 5.77	47.04 ± 6.29
Interstitial [%]	28.98 ± 15.78	35.94 ± 4.71	32.17 ± 5.59	28.41 ± 3.11	26.82 ± 1.87	29.49 ± 6.01
Tubule diameter [μm]	53.55 ± 21.83	55.82 ± 5.49	66.47 ± 5.23	63.88 ± 8.16	53.82 ± 3.60	65.77 ± 11.58
Epithelial height of tubule [μm]	11.51 ± 11.23	5.18 ± 0.90	5.26 ± 0.31	4.85 ± 0.45	4.03 ± 0.15	5.52 ± 1.37
Lumen diameter [μm]	18.70 ± 7.59	20.75 ± 1.97	23.86 ± 1.73	24.11 ± 3.39	23.71 ± 1.73	27.86 ± 2.76
Tubule area [μm^2]	1930.52 ± 1688.11	1527.66 ± 496.44	1813.72 ± 281.93	1918.55 ± 587.57	1353.63 ± 192.45	2010.66 ± 570.92
Tubule perimeter [μm]	147.15 ± 61.04	151.09 ± 19.50	177.75 ± 19.73	189.46 ± 33.14	145.94 ± 14.28	173.55 ± 30.15

Values are expressed as mean $\pm$ SD. No statistically significant differences among groups were detected.

Legend: C group (n=6, ZDF diabetic positive controls, receiving clean water), K group (n=8, ZDF diabetic group, dose of *C. mas* homogenized stone 250 mg/kg bw), DK group (n=8, ZDF diabetic group, dose of *C. mas* homogenized stone 250 mg/kg bw and homogenized pulp 500 mg/kg bw), DDK group (n=8, ZDF diabetic group, dose of *C. mas* homogenized stone 250 mg/kg bw and homogenized pulp 1000 mg/kg bw), D group (n=10, ZDF diabetic group, dose of *C. mas* homogenized pulp 1500 mg/kg bw), DD group (n=10, ZDF diabetic group, dose of *C. mas* homogenized pulp 2000 mg/kg bw).

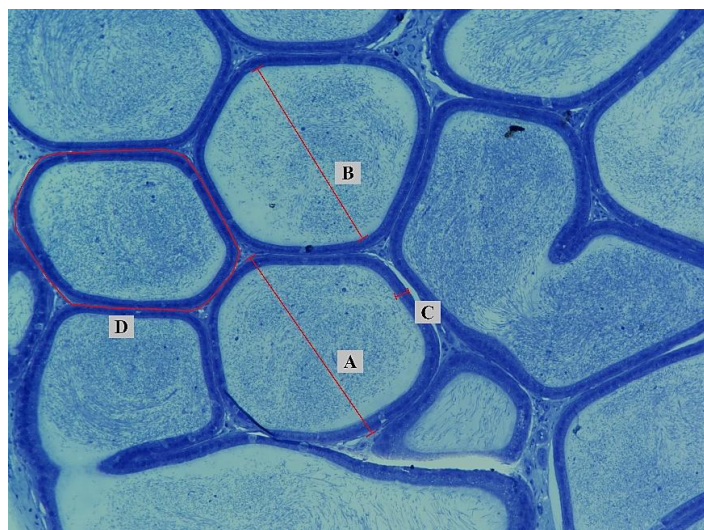


Figure 6 Histological micrograph of rat epididymis showing morphometric parameters, control group (C), 100× magnification. Legend: (A) tubule diameter; (B) lumen diameter; (C) epithelial height; (D) tubule perimeter.

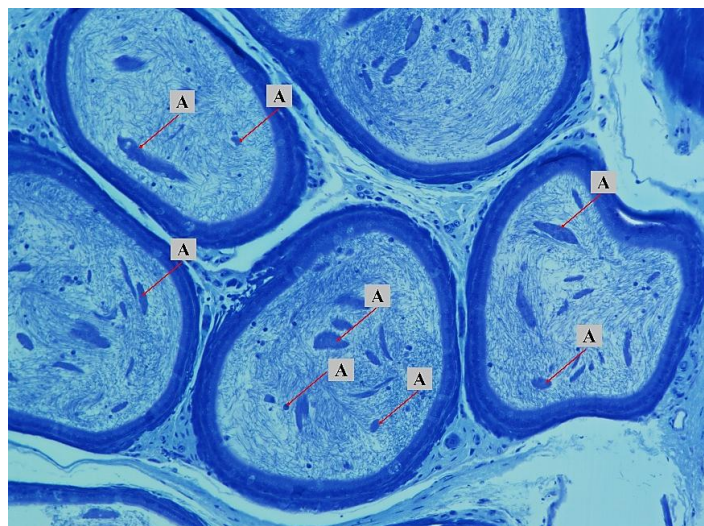


Figure 7 Histological micrograph of rat epididymis showing high presence of inclusions inside tubule lumen (A). DD group, 100× magnification.

In summary, epididymal morphology showed only minor alterations after *Cornus mas* administration, with non-significant differences across the parameters. Nonetheless, the treated groups displayed a consistent trend toward increased lumen diameter and reduced epithelial height compared with the control group.

DISCUSSION

The present study investigated the effects of *Cornus mas* L. (Cornelian cherry) administration on the microscopic structure of the testes and epididymides in obese Zucker diabetic fatty (ZDF) rats. Our morphometric results demonstrated that *Cornus mas* supplementation led to distinct, dose-dependent histological changes in the reproductive organs. Specifically, oral administration of the mixed stone and pulp extract at a dose of 1000 + 250 mg/kg resulted in a significant reduction ($p < 0.05$) in the percentage area of seminiferous epithelium, accompanied by a marked increase in the relative proportion of interstitial tissue. Conversely, the 500 + 250 mg/kg dose was associated with higher mean values of spermatogenic elements per 10000 μm^2 , although these differences were not statistically significant. These findings may suggest a dose-dependent influence of *Cornus mas* on spermatogenic parameters. These alterations indicate structural modulation of testicular compartments, with moderate doses showing a tendency toward increased spermatogenic cell density, whereas higher doses were characterized by a relative reduction of seminiferous epithelial area accompanied by expansion of interstitium. The observed reduction in seminiferous epithelial area should be interpreted with caution, as it may reflect either adaptive structural reorganization or a potential impairment of spermatogenic activity, which cannot be distinguished without functional or hormonal evaluation.

Our findings are consistent with several studies describing the protective and remodelling effects of *Cornus mas* on testicular and systemic tissue morphology. Öztekin et al. (2023) reported that *Cornus mas* extract (1000 mg/kg) significantly improved the histological organization of seminiferous tubules, reduced intratesticular apoptosis, and restored Johnsen scores in nicotine-treated rats, indicating enhanced spermatogenic activity and minimized parenchymal degeneration. Similarly, Moldovan et al. (2022) demonstrated that *Cornus mas* preserved the ultrastructural integrity of vascular tissues in rats subjected to a high-fat diet, showing reduced lipid peroxidation and cellular disorganization, thereby highlighting its cytoprotective and antioxidant capacity. These findings parallel the results observed in our diabetic obese rat model, in which *Cornus mas* may reflect structural alterations under metabolic stress conditions, while influencing the balance between interstitial and germinal components of the testes.

In our experiment, the observed increase in interstitial proportion and the concurrent decrease in seminiferous epithelial area at higher doses of *Cornus mas* may reflect a compensatory response to enhanced steroidogenic activity or a remodelling process within the testicular parenchyma. The interstitial expansion could be linked to increased Leydig cell volume and vascularization, often observed in metabolic stress conditions. Comparable findings have been reported in obese models treated with antioxidant-rich plant extracts, such as Goroho banana peel extract, where increased Leydig cell number and testosterone levels were detected alongside improved reproductive function (Sovian et al., 2023). Therefore, it is possible that *Cornus mas* modulates both spermatogenic and interstitial compartments, suggesting a potential involvement in the regulation of testicular microenvironment under metabolic stress in obesity-related metabolic dysregulation.

Moreover, the dose-dependent effects noted in our study are consistent with the hypothesis that different concentrations of *Cornus mas* bioactive constituents such as polyphenols, anthocyanins, flavonoids, and iridoids may exert distinct actions on the reproductive tissues. Lower to moderate doses showed a tendency toward increased spermatogenic cell density, whereas excessive concentrations may alter epithelial dynamics, potentially due to complex interactions between antioxidant and pro-oxidant mechanisms. Abdollahi et al. (2014) previously reported testicular degeneration and necrotic changes following administration of hydroalcoholic *Cornus mas* extract at doses of 100 – 400 mg/kg for 21 days, suggesting that extraction solvent and exposure duration play critical roles in determining tissue outcomes. The absence of degenerative findings in our study, where the extract was prepared in aqueous solution and administered over a longer period (90 days), supports the notion that both the vehicle and duration of treatment strongly influence histological effects.

Higher mean values of spermatogenic element density observed in our DK group (500 + 250 mg/kg) may be consistent with findings reported by Zarei et al. (2014), who demonstrated that higher *Cornus mas* doses (500 – 1000 mg/kg) reduced the percentage of morphologically abnormal sperm and preserved seminiferous architecture. Conversely, lower doses (250 mg/kg) were associated with a higher incidence of sperm abnormalities, emphasizing the biphasic nature of *Cornus mas* activity. This bidirectional response likely reflects the delicate balance between antioxidant protection and metabolic interference within the germinal epithelium. It is also important to consider the broader histological context of *Cornus mas* effects. Moroz et al. (2024) confirmed that *Cornus mas* extracts ameliorated oxidative stress and preserved erythrocyte ultrastructure in streptozotocin-induced diabetic rats, highlighting its systemic tissue-stabilizing properties. These cumulative findings reinforce the suggestions that the structural alterations observed in the current study may be related to the known antioxidant and anti-inflammatory properties of *Cornus mas* reported in previous studies, which alleviate structural disorganization caused by obesity-induced metabolic stress.

Our epididymal observations revealed no statistically significant differences among the treatment groups; however, a mild tendency toward decreased epithelial height and increased luminal diameter was noted. These subtle modifications could suggest adaptive epithelial remodelling, potentially reflecting alterations in androgenic stimulation or local antioxidant defence mechanisms. Such changes are consistent with those described by Flickinger (1977), who demonstrated that testicular and epididymal epithelial structure dynamically responds to hormonal and environmental modulation.

Taken together, the microscopic findings of this study indicate that *Cornus mas* exerts measurable, dose-dependent effects on testicular microarchitecture in obese rats. Moderate doses showed a tendency toward increased spermatogenic cell density, while higher concentrations induced changes in the relative proportions of seminiferous epithelium and interstitial tissue. These results highlight the intricate balance between the modulatory effects of *Cornus mas* bioactive compounds. Given the variability in plant phytochemical composition influenced by environmental and seasonal factors, further studies combining ultrastructural analysis and molecular markers of oxidative stress are warranted to elucidate the precise cellular mechanisms underlying these histological outcomes.

Nevertheless, the present study has several limitations. The absence of a non-diabetic control group represents a major limitation and restricts the ability to distinguish between diabetes-related alterations and treatment-induced effects. In addition, the lack of hormonal and oxidative stress markers limits the functional interpretation of the observed histological changes. Therefore, the findings should be interpreted primarily at the structural level.

Experimental studies focusing on the microscopic and morphometric evaluation of male reproductive organs in obese and diabetic animal models treated with *Cornus mas* remain limited. Most existing research emphasizes systemic metabolic effects or sperm quality, while detailed histological analyses are scarce. Therefore, the present study provides novel tissue-level insights into the effects of *Cornus mas* under metabolic stress. Given the dose-dependent nature of the observed responses, further studies incorporating ultrastructural and molecular approaches are needed to clarify the mechanisms underlying its reproductive effects in obesity-associated infertility.

CONCLUSION

The present study demonstrates that *Cornus mas* administration induces dose-dependent structural changes in the microscopic organization of testes and epididymides in obese rats. Combined pulp and stone supplementation at doses of 500 + 250 mg/kg and 1000 + 250 mg/kg was associated with structural alterations in spermatogenic cell density and seminiferous tubule morphology. These findings indicate a modulatory effect of *Cornus mas* on reproductive tissue microarchitecture under metabolic stress conditions.

However, further studies incorporating hormonal, molecular, and oxidative stress markers are required to clarify the mechanisms underlying these structural changes and to determine their functional relevance.

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