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Research Article

Cadmium Toxicity in the Seminal Vesicles and Lipid Profile of Wistar Rats: Can Uvaria chamae Ameliorate the Effect?

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Abstract

This research investigated the capacity of Uvaria chamae in alleviating cadmium-induced toxicity in the seminal vesicles and lipid profile of Wistar rats, addressing a critical gap in current knowledge. Cadmium, a hazardous heavy metal, poses substantial risks to male reproductive health. Conducted with 25 Wistar rats under controlled conditions, the study involved local sourcing of Uvaria chamae, extracting its bioative ingredients through alcohol maceration. Dosages for cadmium and the extract were meticulously determined for five experimental groups including the control group, with rats acclimatized for two weeks before a 28-day experiment. Seminal vesicle underwent detailed processing, and histological analysis, including dehydration, clearing, infiltration, embedding, sectioning, staining using hematoxylin/eosin and microscopic examination. Statistical analysis employed one-way ANOVA through GraphPad Prism (version 8.0.2), ensuring a concise and accurate data interpretation approach. Histological examinations revealed cadmium-induced damage, including epithelial degeneration and altered luminal structures etc. These structural changes were mitigated by Uvaria chamae in a dose-dependent manner. The study also assessed the impact of cadmium on lipid profiles, showing adverse changes, but counteracted by Uvaria chamae, signifying its role in preserving lipid homoeostasis. The findings underscore reproductive health risks from cadmium exposure and highlight Uvaria chamae's therapeutic potential, which is attributed to its antioxidant and anti-inflammatory properties. This research offers valuable scientific insights on the plant and thereby urging further investigations into molecular mechanisms, clinical trials, public awareness, environmental regulations, and nutritional guidance for enhanced reproductive health amid cadmium exposure.

Key words: cadmium; seminal vesicle; uvaria chamae; lipid profile

1.Introduction

Cadmium (Cd) is a highly toxic heavy metal present in various environmental sources, such as industrial processes, tobacco smoke, as well as contaminated food and water [1]. Its release into the environment occurs through activities like mining, smelting, and manufacturing processes. Exposure to cadmium has been linked to a range of adverse health effects, including cancer, kidney damage, cardiovascular diseases, and reproductive toxicity [1]. Of particular concern is its impact on reproductive health, as it has been demonstrated to have detrimental effects on the male reproductive system [2]. The male reproductive system, encompassing organs like the testes, epididymis, prostate, and seminal vesicles, play crucial roles in sperm production, maturation, and transportation [3]. Accumulation of cadmium in the testes and seminal vesicles has been shown to result to structural and functional abnormalities [4]. Seminal vesicles are paired accessory glands of the male reproductive system. They produce a significant portion of seminal fluid, essential for nourishing and supporting sperm during ejaculation [5]. The health and proper functioning of the seminal vesicles are critical for male fertility. Cadmium toxicity can damage the seminal vesicles, leading to decreased sperm production and quality [6]. Any disruption in seminal vesicle structure or function can profoundly impact reproduction processes, potentially causing fertility issues and reproductive disorders [7]. *Uvaria chamae*, also known as bush banana or finger root, is a plant native to various parts of Africa, traditionally used due to its medicinal properties [8]. Recognized for its antioxidant and anti-inflammatory properties, some studies have suggested its potential to mitigate the toxic effects of heavy metals [9]. However, its effectiveness in ameliorating cadmium toxicity in the seminal vesicles and lipid profile in experimental animal models remain largely unexplored. Despite the known risks of cadmium exposure on male reproductive health and the potential therapeutic properties of *Uvaria chamae*, there is a significant research gap in understanding whether *Uvaria chamae* can ameliorate the adverse effects of cadmium on the seminal vesicles and lipid profile of experimental animals. Addressing this gap is crucial not only for advancing the understanding of cadmium toxicity but also for potentially identifying a natural remedy to protect the male reproductive function in the face of cadmium exposure. This background provides a comprehensive knowledge of cadmium toxicity and its impact on

the seminal vesicles cum lipid profile, and the potential of *Uvaria chamae* as an ameliorating agent.

2. Materials and methods

2.1. Materials used

The materials used in this study comprised 25 adult Wistar rats, well-maintained wooden cages, water bowls, standard feeds, an electric weighing balance, temporary and permanent markers, iodine, sawdust, insulin syringe, masking tapes, dissecting set, small and large plain sample bottles, distilled water, cadmium, *Uvaria chamae* root extract, and buffered formalin.

2.2. Extract and Extract Acquisition

Uvaria chamae was sourced from a local farm in Ikot Efre Itak, Ikono Local Government Area, Akwa Ibom State, Nigeria.

2.3. Plant Extraction

The roots of *Uvaria chamae* were carefully cleaned, air-dried for few days, and subsequently ground using an electric blender. The powdered material was macerated in 70% alcohol and left to stand for 72 hours. Afterwhich, the mixture was filtered using a filter paper and the resulting filtrate was subjected to evaporation in a water bath. The dry residue was weighed and stored in a refrigerator for later use in the experiment.

2.4. Animal Care and Protocol

25 male adult albino Wistar rats weighing between 150g to 350g were obtained from the Animal House of the Department of Pharmacology and Toxicology, Faculty of Pharmacy, University of Uyo. The rats were carefully housed in wooden cages with sawdust bedding to provide warmth and protection. They were provided with standard food and water as per their routine requirements and acclimatized for a period of two weeks before the commencement of the experiment. The 25 rats were divided into five groups, each consisting of five animals per group. Group one served as the control and received feed and water. Group two to four were designated for the actual experiment. The animals were handled in strict accordance with the "Guide for the Care and Use of Laboratory Animals" published by the National Institute of Health, following established ethical guidelines.

2.5. Acclimatization of Animals

According to the university's animal handling guidelines, the rats were housed in cages and acclimatized for a period of two weeks (14 days) at the Animal House of the Faculty of Basic Medical Sciences, University of Uyo. During this acclimatization period, the rats had unrestricted access to drinking water and feed to adapt to their new environment.

2.6. Administration of Extract and Cadmium

Prior to administration, the body weight of the rats was measured to determine the appropriate dosage of cadmium and *Uvaria chamae* root extract. Cadmium was administered intraperitoneally and once weekly for 4 weeks while the extract was administered orally and daily for 28 days. The animals were divided into five distinct groups as follows:

Group 1 (Control) received standard feed and water for 28 days.

Group 2 received 3mg/kg of cadmium once weekly for 4 weeks.

Group 3 received 3mg/kg of cadmium once weekly for 4 weeks + 500mg/kg of extract daily for 28 days.

Group 4 received 3mg/kg of cadmium once weekly for 4 weeks + 1000mg/kg of extract daily for 28 days.

Group 5 received 3mg/kg of cadmium once weekly for 4 weeks + 1500mg/kg of extract daily for 28 days.

2.7. Sacrifice and Organ Extraction

At the conclusion of the four weeks study period, all rats underwent dissection to extract the seminal vesicles. To maintain organ integrity, the extracted seminal vesicles were preserved in plain sample bottles containing buffered formalin in order to prevent decay. Blood sample was taken to the laboratory for the evaluation of lipid profile.

2.8. Tissue Processing

The seminal vesicles from both the experimental and control groups were carefully collected and thoroughly cleansed using a solution of normal saline. Following this, the organs were meticulously preserved in a solution of 10% buffered formalin. This preservation method was employed not only to inhibit autolysis, but also to mitigate post-mortem alterations and prevent bacterial decay. This meticulous approach ensures the integrity of the seminal vesicles, allowing for accurate and reliable analysis in subsequent stages of the experiment. Subsequently the tissues were histologically processed and stained using hematoxylin and eosin stain.

2.9. Statistical Analysis

Data obtained from the study was expressed as mean ± standard error of mean and were analyzed using one-way analysis of variance (ANOVA) to determine the difference between the experimental groups and control groups with the use of GraphPad prism (version 8.0.2)

3. Results

3.1. Effect of *Uvaria chamae* on Lipid Profile in Cadmium-Induced Wistar Rats.

Results obtained from lipid profile analysis showed that cadmium increased serum levels of total cholesterol (TC), triglycerides (TG) and low-density lipoproteins (LDL) but significantly reduced high density lipoproteins (HDL). The extract dose-dependently reduced the serum levels of these parameters, but increased HDL (Table 1). The control group exhibited normal levels of TC, TG, HDL, and LDL (33.98 ± 0.23, 66.79 ± 0.45, 31.57 ± 0.12, and 24.36 ± 0.12 mg/dl, respectively). Cadmium exposure significantly increased serum levels of TC, TG, and LDL, while reducing HDL (54.98 ± 0.22, 87.11 ± 0.27, 15.46 ± 0.28, and 40.71 ± 0.16 mg/dl, respectively). Groups treated with *Uvaria chamae* extract showed dose-dependent improvements in the lipid profile components. The higher doses (1000mg/kg and 1500mg/kg) significantly reduced TC, TG, and LDL levels, while increasing HDL levels compared to the cadmium-exposed group.

Groups	TC (mg/dl)	TG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
Control	33.98 ± 0.23	66.79 ± 0.45	31.57 ± 0.12	24.36±0.12
3mg/kg Cd	54.98 ± 0.22#	87.11 ± 0.27#	15.46 ± 0.28#	40.71±0.16#
500mg/kg UC	43.71 ± 0.58	73.91 ± 0.31	28.55 ± 0.07	27.04±0.73
1000mg/kg UC	34.72 ± 0.06*	67.81 ± 0.49*	30.55 ± 0.06*	25.45±0.17*
1500mg/kg UC	33.33 ± 0.53*	65.85 ± 0.31*	31.85 ± 0.09*	24.91±0.05*

Values are expressed as mean ± standard error of mean, Cd- cadmium, UC- *Uvaria chamae,* TG-triglycerides, TC-total cholesterol, HDL-high density lipoprotein, LDL-low density lipoprotein

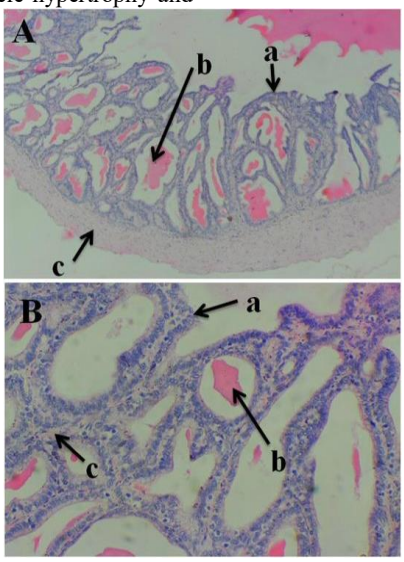
* Indicates significance fro m group 2 and other treated groups @p<0.05.

# indicates significance difference from control and other treated groups @p<0.05

Table 1: Effect of *Uvaria chamae* on Lipid Profile in Cadmium-Induced Wistar Rats

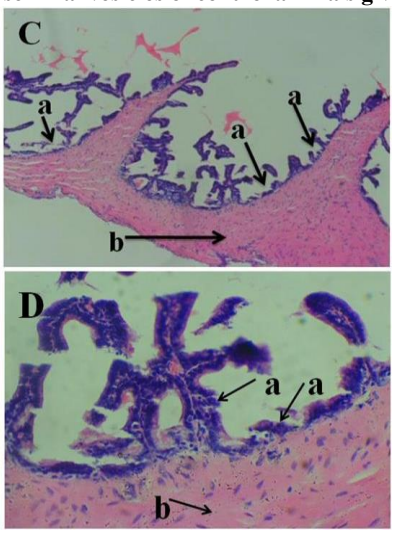
3.2. Effect of *Uvaria chamae* on the Histostructure of the Seminal vesicles in Cadmium-Induced Wistar Rats

Photomicrographs of the seminal vesicles obtained the control group revealed normal epithelium, a central lumen filled with pale staining homogeneous secretions, and non-hypertrophied smooth muscle. The structural integrity of the seminal vesicles was maintained, indicating a healthy state (Plate I, A and B). In contrast, the group exposed to 3mg/kg of cadmium for 4 weeks exhibited focal degeneration of the epithelium, leading to the absence of a central lumen in some areas. Muscle hypertrophy and infiltration of inflammatory cells were observed, indicating significant damage to the seminal vesicle structure (Plate II, C and D). Groups treated with *Uvaria chamae* extract (500mg/kg, 1000mg/kg, and 1500mg/kg) after cadmium induced toxicity showed varying degrees of amelioration. The higher doses of *Uvaria chamae* (1000mg/kg and 1500mg/kg) exhibited a well-defined epithelial lining, the presence of a regular lumen, and non-hypertrophied smooth muscle. Inflammatory cell infiltration was minimal, suggesting an ameliorating effect of *Uvaria chamae* against cadmium-induced damage (Plate III, E and F; Plate IV, G and H; Plate V, I and J).



A: Showing, **a**- normal epithelium, **b**- central lumen filled with pale staining homogenous secretion and **c**- smooth muscle (x100 magnification).
B: Showing, **a**- normal epithelium with pseudostratified columnar cells, **b**- central lumen filled with pale staining homogenous secretion and **c**- smooth muscle (x400 magnification).

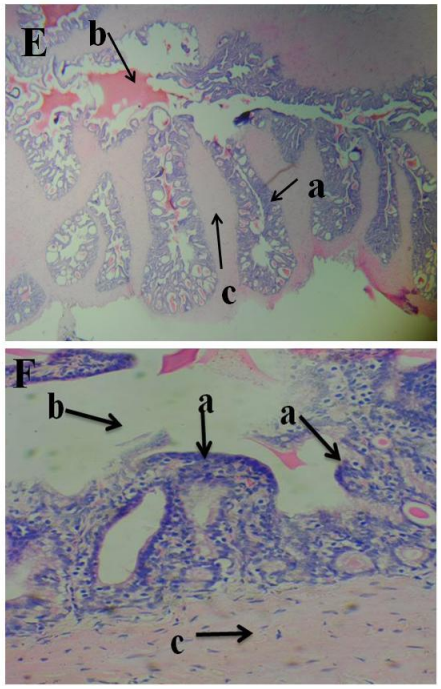
Plate 1: Photomicrograph of the seminal vesicles of control animals given water and feed alone (H&E).



C: Showing**, a**- focal degeneration of the folded epithelium leading to absence of central lumen with few deposition of homogenous secretion at the region of the atrophied lumen and **b**- muscle hypertrophy with numerous inflammatory cells (x100 magnification).

D: Showing, **a**- focal degeneration of the epithelium with large irregular hyperchromatic nuclei and **b**- muscle hypertrophy with inflammatory cells (x400 magnification).

Plate 2: Photomicrograph of the seminal vesicles of group 2 animals given 3mg/kg of cadmium once weekly for 4 weeks (H&E).



E: Showing, **a**- mild erosion of the lining epithelium, **b**- irregular lumen and **c**- reduced muscle hypertrophy (x100 magnification).

F: showing, **a**- mild erosion of the lining epithelium with cellular hyperplasia, **b**- irregular lumen and **c**-reduced muscle hypertrophy (x400 magnification).

Plate 3: Photomicrograph of the seminal vesicles of group 3 animals given 3mg/kg of cadmium once weekly for 4 weeks and 500mg/kg of *Uvaria chamae* root extract daily for 28 days (H&E).

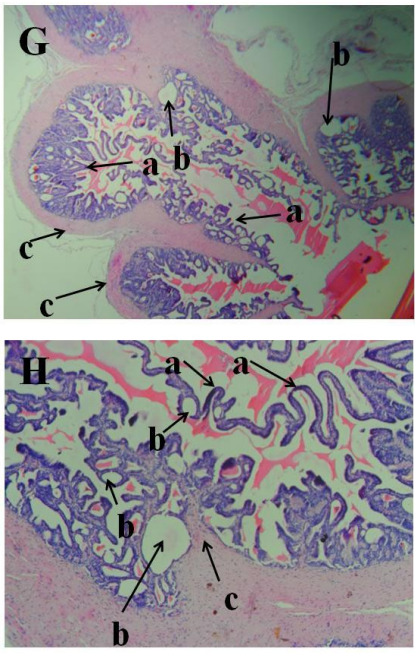
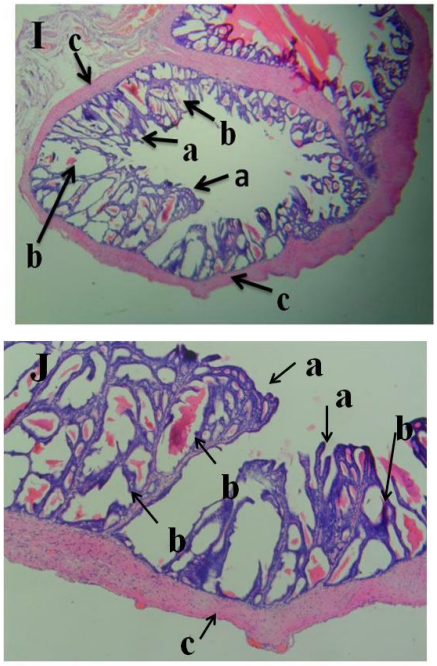


Plate 4: Photomicrograph of the seminal vesicles of group 4 animals given 3mg/kg of cadmium once weekly for 4 weeks and 1000mg/kg of *Uvaria chamae* root extract daily for 28 days (H&E).

G: Showing, **a**- well-defined epithelial lining, **b**- appearance of regular lumen though fewly formed by the folded nature of the epithelium and **c**-non-hypertrophied smooth muscle in most parts with very little or no infiltration of inflammatory cells (x100 magnification).

H: Showing, **a**- well-defined epithelial lining, **b**- presence of regular lumen though fewly formed by the folded nature of the epithelium and **c**-non-hypertrophied smooth muscle with little or no infiltration of inflammatory cells (x400 magnification).



I: Showing, **a**- normal epithelium, **b**- central lumen filled with pale staining homogenous secretions and **c**- non-hypertrophied smooth muscle (x100 magnification).

J: Showing, **a**- normal epithelium with pseudostratified columnar cells, **b**- central lumen filled with pale staining homogenous secretions and **c**- non-hypertrophied smooth muscle (x400 magnification).

Plate 5: Photomicrograph of the seminal vesicles of group 5 animals given 3mg/kg of cadmium once weekly for 4 weeks and 1500mg/kg of *Uvaria chamae* root extract daily for 28 days (H&E).

4. Discussion

The meticulous histological examination of seminal vesicles serves as a microscopic window into the intricate repercussions of cadmium exposure and the commendable ameliorative effects exerted by *Uvaria chamae*. In the control group, the observed histological features of the seminal vesicles depict a picture of a fully functional male reproductive system. The epithelial lining presented as normal, exhibiting a seamless structure, and the central lumen, filled with homogeneous secretions, attributed to the health of the system. Moreover, the absence of smooth muscle hypertrophy indicated a finely tuned equilibrium within the control group, emphasizing the baseline state of reproductive well-being. In stark contrast, the group subjected to cadmium exposure alone exhibited a panorama of structural aberrations under the microscopic lens. Focal degeneration of the epithelium, atrophy of the lumen, and pronounced muscle hypertrophy were distinctive hallmarks of cadmium-induced damage. These microscopic alterations align seamlessly with established related studies, corroborating the notion that the accumulation of cadmium induces a cascade of structural abnormalities in reproductive organs, inevitably culminating in compromised functionality [4, 6]. The introduction of *Uvaria chamae* into the experiments produced fascinating dose-dependent improvements in the seminal vesicle morphology. In Group 3, administered with 500mg/kg of *Uvaria chamae*, the microscopic examination revealed mild erosion of the lining epithelium, an irregular lumen, and a noticeable reduction in muscle hypertrophy. As *Uvaria chamae* dosage increased in Group 4 and 5, the microscopic analysis or interpretation showed further results, presenting a well-defined epithelial lining, the emergence of a regular lumen, and the absence of smooth muscle hypertrophy. These observations support *Uvaria chamae* emerging as a potent ameliorating agent against the microscopic damage brought about by cadmium in the seminal vesicles. Our findings gain enhanced significance when juxtaposed against related research. Labib and Galal (2020) [7] explored the realm of natural compounds and their potential to mitigate cadmium-induced reproductive toxicity. Their study demonstrated that compounds with antioxidant and anti-inflammatory properties could effectively counteract the deleterious effects of cadmium. *Uvaria chamae*, with its well-documented antioxidant and anti-inflammatory effects [8, 10], harmoniously aligns with the findings of Labib and Galal (2020) [7], positioning itself as a promising therapeutic agent at the microscopic level. Furthermore, the microscopic improvements witnessed in the seminal vesicles in the current study supports the outcomes of research conducted by Pamok (2018) [11]. Pamok delved into the ameliorating effects of herbal extracts against heavy metal-induced reproductive damage, providing additional layers to the growing body of evidence supporting the ameliorating potential of natural compounds. The microscopic nuances observed in the current study, coupled with these comparative analyses, fortify the understanding that *Uvaria chamae*, at the microscopic level, emerges as a robust guardian against cadmium-induced seminal vesicle damage. The investigation into lipid profile alterations provides a nuanced understanding of the systemic impact of cadmium exposure on reproductive health and highlights the intriguing potential of *Uvaria chamae* in mitigating dyslipidemia. Cadmium, a heavy metal known for its pervasive environmental presence, has been shown to exert a profound influence on lipid metabolism. The results of this study illuminate a dysregulated lipid profile induced by cadmium, with a marked increase in serum levels of total cholesterol (TC), triglycerides (TG), and low-density lipoproteins (LDL), coupled with a concomitant reduction in high-density lipoproteins (HDL). These alterations collectively point towards a scenario of disrupted lipid homeostasis, a condition with well-established links to cardiovascular risks and broader implications for overall health [12]. Also, a study by Zhou *et al*. (2016) [13] directly addresses the association between cadmium exposure and dyslipidemia, providing insights into the impact of cadmium on lipid metabolism. Furthermore, a study by Kim *et al*. (2022) [14] which is in line with our research work explores the association between heavy metal exposure, including cadmium, and dyslipidemia, providing insights into the impact of cadmium on lipid profiles in the general population. In addition, another study discusses the impact of cadmium exposure on lipid toxicity

and the potential therapeutic effects of *Cocos nucifera* water, providing insights into mitigating dyslipidemia induced by cadmium exposure [15]. The intriguing aspect of our study lies in the dose-dependent ameliorative effects observed upon administration of *Uvaria chamae*. The groups treated with *Uvaria chamae* exhibited a consistent reduction in TC, TG, and LDL levels, accompanied by a significant elevation in HDL. Particularly significant is the effectiveness of the highest administered dose (1500mg/kg) of *Uvaria chamae*, which not only reversed the cadmium-induced alterations but also restored lipid levels to values comparable to the control group. This suggests a potent ameliorating role for *Uvaria chamae* against cadmium-induced dyslipidemia, and this finding is in lieu with other related studies on medicinal plants and cadmium. Comparisons with studies conducted by Saar *et al*. (2008) [16] and Pamok (2018) [11] contribute to the broader contextualization of these findings. Saar *et al*.'s study, although primarily focused on cadmium-induced liver damage, fortuitously aligns with the outcomes of the current investigation by revealing similar dyslipidemic patterns in a comparable Wistar rat model. This congruence underscores the systemic consequences of cadmium exposure on lipid homeostasis, reinforcing the relevance of the present study. Furthermore, the observed lipid-modulating effects of *Uvaria chamae* find resonance in studies exploring the potential of other plant extracts in mitigating heavy metal-induced dyslipidemia. Pamok's (2018) [11] investigation into the ameliorating effects of a herbal extract echoes the current study's outcomes, demonstrating improvements in lipid profiles. This consistency across studies suggests a broader potential for various natural compounds, including *Uvaria chamae*, in countering the adverse effects of heavy metal exposure on lipid metabolism. In essence, the lipid profile alterations uncovered in this study not only emphasize the systemic effects of cadmium on reproductive health but also shed light on the promising role of *Uvaria chamae* as a natural remedy against cadmium-induced dyslipidemia. The multifaceted nature of these findings, coupled with their alignment with related research, adds depth to our understanding of the intricate interplay between environmental toxins, lipid metabolism, and the potential ameliorating effects of natural compounds. Elucidating the intricate mechanisms orchestrating cadmium-induced toxicity and the ameliorative potential of *Uvaria chamae* unveils a molecular ground that underscores the therapeutic efficacy of this natural compound. Cadmium, recognized for its proclivity to induce oxidative stress and inflammation, constitutes a multifaceted assailant on cellular integrity, as substantiated by the work of Bauer *et al*. (1980) [2]. At the forefront of cadmium-induced toxicity is oxidative stress. Bauer *et al*. (1980) [2] have meticulously delineated the molecular pathways through which cadmium inflicts damage on reproductive organs, emphasizing the pivotal role of oxidative stress. The generated reactive oxygen species (ROS) become potent instigators of cellular damage, disrupting the delicate balance of redox homeostasis. In response to this oxidative stress, *Uvaria chamae* emerges as an ameliorative factor. With recorded anti-oxidant properties [8, 10], *Uvaria chamae* acts as a molecular scavenger, neutralizing ROS and averting oxidative damage. This antioxidative effect becomes a cornerstone in the preservation of cellular integrity within the seminal vesicles. By mitigating oxidative stress, *Uvaria chamae* contributes substantially to the observed histological improvements, maintaining the structural and functional aspects of reproductive organs. In tandem with oxidative stress, the inflammatory effect triggered by cadmium exposure constitutes a critical threat to reproductive health. The infiltration of inflammatory mediators and the ensuing inflammatory responses can exacerbate cellular damage and compromise organ function. The anti-inflammatory properties attributed to *Uvaria chamae* [9, 10, 17, 18] positions it as a crucial sentinel in this molecular battleground. *Uvaria chamae*, through its anti-inflammatory effects, orchestrates a defence against the inflammatory onslaught induced by cadmium. By modulating the release of inflammatory mediators and curtailing the inflammatory cascade, *Uvaria chamae* contributes to the maintenance of a conducive microenvironment for reproductive function. The observed reductions in inflammatory infiltrates within the seminal vesicles of *Uvaria chamae*-treated groups align with the mitigating influence of this natural compound on cadmium-induced inflammation. Studies have shown that *Uvaria chamae* exhibits potent anti-inflammatory effects by inhibiting the NF-κB pathway and increasing NRF2 levels, thereby attenuating inflammatory responses induced by lipopolysaccharide [19]. Additionally, the plant has been identified as having Nrf2-inducing, antioxidant, and anti-inflammatory effects, further validating its potential therapeutic use [20]. Drawing parallels with studies on other natural compounds fortifies the understanding of *Uvaria chamae*'s mechanisms of action. Labib and Galal (2020) [7] and Pamok (2018) [11] have illuminated the centrality of antioxidant and anti-inflammatory mechanisms in countering heavy metal-induced damage. The congruence of findings across these studies underscores the collective importance of these molecular pathways in the ameliorating arsenal of natural compounds against environmental toxicants. *Uvaria chamae*, situated within this broader context, emerges as an ameliorative factor. Its multifaceted approach, simultaneously combating oxidative stress and inflammation, aligns with the strategies employed by other natural compounds. The orchestrated interplay of antioxidant and anti-inflammatory mechanisms, as evidenced in our study, amplifies the potential of *Uvaria chamae* as a therapeutic intervention against cadmium-induced reproductive toxicity. While this study provides crucial insights into the molecular mechanisms of *Uvaria chamae*-mediated amelioration, avenues for further exploration beckon. Future research endeavors could delve deeper into the specific molecular interactions between *Uvaria chamae* and key players in oxidative stress and inflammation pathways. Unraveling the intricacies of *Uvaria chamae*'s interactions with cellular components and signaling molecules would enhance our understanding of its precise mode of action. Additionally, the exploration of *Uvaria chamae* in combination with other natural compounds may unravel synergistic effects, potentially enhancing its therapeutic efficacy. Collaborative studies investigating the synergies between *Uvaria chamae* and known antioxidants or anti-inflammatory agents could pave the way for innovative therapeutic interventions against heavy metal-induced reproductive toxicity. The molecular insights gained from this study elucidate the nuanced mechanisms through which *Uvaria chamae* orchestrates its ameliorating effects against cadmium-induced reproductive toxicity. Positioned as an antioxidant and anti-inflammatory ally, *Uvaria chamae* navigates the molecular environment, safeguarding seminal vesicles' health and interrelating with the broader landscape of natural compounds in countering environmental toxicants. The far-reaching implications of this study extend beyond the confines of the laboratory, offering critical insights into the broader landscape of male reproductive health and the formulation of environmental health policies. The documented ameliorating effects of *Uvaria chamae* on seminal vesicles' health and lipid profiles illuminate a promising avenue for addressing the consequences of cadmium-induced reproductive harm. Given the pervasive presence of cadmium in the environment, especially in regions marked by intensive industrial activities, the identification of effective ameliorating agents assumes paramount importance. The observed ameliorative effects of *Uvaria chamae* on seminal vesicles' morphology hold significant implications for male reproductive health. Seminal vesicles play a pivotal role in sperm nourishment and transportation, and any compromise in their structural integrity could lead to diminished sperm quality and production [6]. By demonstrating the potential of *Uvaria chamae* to counteract cadmium-induced damage, this research opens avenues for developing targeted interventions to protect male reproductive function. The findings of this study align with the broader discourse on the impact of environmental pollutants on male reproductive health. The detrimental effects of cadmium on reproductive organs, as evidenced by histological alterations, emphasize the urgency of addressing environmental factors contributing to male infertility. *Uvaria chamae*, with its demonstrated ameliorating effects, emerges as a prospective therapeutic agent that warrants further exploration in the context of male reproductive health. The environmental health

perspective of this research assumes significance in the context of regulatory frameworks and risk management strategies. Cadmium contamination, a prevalent consequence of industrial activities, raises concerns about its potential impact on human health, especially the reproductive system [5]. This study contributes valuable data that can inform risk assessments and influencing the development of evidence-based environmental health policies. Understanding the intricate relationship between cadmium exposure and reproductive organ damage is foundational for devising strategies to safeguard public health. The potential ameliorative effects of *Uvaria chamae* introduce an element to the path of mitigating the health risks associated with heavy metal exposure. Incorporating such natural remedies into regulatory considerations could pave the way for comprehensive policies aimed at protecting vulnerable populations from the adverse effects of environmental pollutants. The comprehensive understanding provided by this research offers a stepping stone for developing targeted strategies to mitigate the health risks associated with cadmium exposure. Environmental health policies can be enriched by incorporating insights into the potential ameliorating effects of *Uvaria chamae*. Strategies may involve the promotion of sustainable practices in industrial settings to minimize cadmium release, as well as the exploration of natural compounds like *Uvaria chamae* for preventive and therapeutic purposes. Furthermore, the data from this study can guide the establishment of exposure limits and regulatory standards for cadmium in occupational and environmental settings. By integrating scientific evidence on the ameliorating potential of *Uvaria chamae*, regulatory agencies can develop nuanced guidelines that balance industrial practices with the preservation of reproductive health. This study not only contributes to scientific knowledge about the impact of cadmium on male reproductive health but also provides practical insights for shaping environmental health policies. By acknowledging the potential of *Uvaria chamae* as a natural remedy against cadmium-induced harm, this research lays the groundwork for a multidimensional approach to safeguarding male reproductive function and addressing the broader challenges posed by environmental pollutants. Exploring the synergistic effects of various plant compounds or combinations may unveil more robust ameliorating strategies. Unraveling the specific pathways through which *Uvaria chamae* mitigates cadmium-induced damage would enhance our understanding of its therapeutic potential. Furthermore, clinical studies involving human subjects could validate the extrapolation of these findings to real-world scenarios. This study provides compelling evidence for the potential of *Uvaria chamae* in mitigating cadmium-induced damage to the seminal vesicles and dyslipidemia in Wistar rats. The observed histological improvements and lipid profile alterations, coupled with mechanistic insights into oxidative stress and inflammation, position *Uvaria chamae* as a promising and ameliorating natural remedy against cadmium toxicity. Comparative analyses with related studies underscore the consistency of these findings within the broader context of research on heavy metal-induced reproductive toxicity. The implications of this research extend to environmental health policies, offering valuable data for mitigating the health risks associated with cadmium exposure.

Conclusion

The findings of this study underscore the detrimental impact of cadmium on the histological structure of the seminal vesicles and lipid metabolism, implicating it as a potential reproductive health risk. The observed ameliorative effects of *Uvaria chamae* extract suggest its therapeutic potential in counteracting cadmium-induced damage. The ameliorating properties of *Uvaria chamae*, attributed to its antioxidant and anti-inflammatory components, highlight its significance in mitigating oxidative stress and inflammation associated with cadmium exposure.

The study provides valuable insights into the intricate relationship between cadmium toxicity, seminal vesicles' health, and lipid profile, emphasizing the potential of natural compounds like *Uvaria chamae* as ameliorating agents. This contributes to the expanding knowledge in toxicology, reproductive biology, and pharmacology.

Competing Interest

Authors declare that, no competing interests exist.

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