International Journal of Applied and Scientific Research (IJASR)
Vol.2, No. 12, 2024: 953- 962

Histological Effect of Ultra Violet (UV) Light on the Testis of Albino Wistar Rats

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ARTICLE INFO

Keywords: Testis Histology, Adenofibroma, Adenocarcinoma, Testicular Damage, Ultraviolet Radiation, Oxidative Stress, Histopathological Changes

Received :5 October
Revised : 23 November
Accepted: 23 December

ABSTRACT

UV light, or ultraviolet light, is a type of radiation that falls between the visible light and X-ray regions of the electromagnetic spectrum. It is a form of electromagnetic radiation emitted by the sun and artificial sources, such as tanning beds and UV lamps. It has a shorter wavelength than visible light, ranging from 100 to 400 nanometers (nm). It is categorized into three types based on their wavelengths: UVA, UVB, and UVC. The aim of this study is to evaluate the histopathological effect of uv light on the testis of male Wistar albino rats. A total of fifty (50) adult Albino Wistar rats of comparable sizes were used for this study. They were divided into four equal groups (A – E) with ten (10) rats each. Group A served as the control and the rats were given distilled water and feed only. In addition to feed and water, Groups B rats were kept under Uv light for 30mins, Group C rats were kept under Uv light for 1hour twice daily, Group D rats were kept under Uv light for 2 hours thrice daily and Group E were kept under Uv light for 4 hours thrice daily. The administration was given daily for 14 days (2 weeks) and the weights of both the test and control animals was monitored before and after administration of Uv light. After the administration, the rats were put under light chloroform anaesthesia and the stomach was obtained. ANOVA was used to analyze the results of the weight and differences was considered significant at $p<0.05$ level of confidence. All data was expressed in table as mean ± standard deviation (SD). From the results, it was observed that Group B showed mild adenofibroma, Group C exhibited denatured testicular cells, indicating severe damage. Group D had adenocarcinoma and fatty tissue, suggesting potential malignancy and Group E presented fatty tissue. In conclusion, the exposure of testis to uv light cause significant alterations in testis histology

INTRODUCTION

UV light, or ultraviolet light, is a type of radiation that falls between the visible light and X-ray regions of the electromagnetic spectrum. It has a shorter wavelength than visible light, ranging from 100 to 400 nanometers (nm). UV light is further categorized into three types based on their wavelengths: UVA, UVB, and UVC. UVA rays have the longest wavelengths among the three and are less energetic, ranging from 315 to 400 nm. UVB rays have medium wavelengths, ranging from 280 to 315 nm, and are more energetic than UVA rays. UVC rays have the shortest wavelengths, ranging from 100 to 280 nm, and are the most energetic (Learning, 2021). However, UVC rays are largely absorbed by the Earth's atmosphere and do not reach the surface in significant amounts. The primary natural source of UV light is the sun. Sunlight contains all three types of UV radiation, with UVA rays being the most abundant. UV light can also be artificially generated for various purposes, such as in tanning beds, UV lamps, and certain industrial applications (Ivanov et al., 2018).

LITERATURE REVIEW

UV light has both beneficial and harmful biological effects. One of the positive effects is the synthesis of vitamin D in the skin when exposed to moderate amounts of UVB rays. Vitamin D is essential for bone health and plays a role in the functioning of the immune system. However, excessive exposure to UV light can lead to negative consequences. UVB rays are responsible for sunburns, skin damage, premature skin aging, and an increased risk of skin cancer. UVA rays can penetrate deeper into the skin and also contribute to skin aging effects. It's important to implement protective measures to minimize the harmful effects of UV light. These measures include using sunscreen with a high sun protection factor (SPF), wearing protective clothing, seeking shade during peak UV radiation hours, and avoiding artificial tanning devices (Holick, 2020).

Understanding the properties and biological effects of UV light is significant in various fields. In medicine, it helps in understanding the mechanisms of skin diseases and developing appropriate treatments. In environmental sciences, it contributes to studying the impact of UV radiation on ecosystems and organisms. In public health, it guides efforts to raise awareness about the importance of sun protection and prevent excessive exposure to UV light (Zhao et al., 2020).

The male testis is a crucial organ within the male reproductive system. It is responsible for two main functions: spermatogenesis and hormone production. Spermatogenesis is the process by which sperm cells are produced, while hormone production, specifically testosterone, plays a vital role in male sexual development and reproductive function. The structure of the testis consists of a pair of oval-shaped organs located within the scrotum. Each testis is composed of highly specialized tubules called seminiferous tubules, where spermatogenesis takes place. Surrounding the seminiferous tubules are interstitial or Leydig cells, which produce and release testosterone (Kharbach & Khallouk, 2021).

The testis is also supported by other types of cells, including Sertoli cells, which provide nourishment and support to developing sperm cells, and stromal cells that contribute to the overall structure and function of the testis (Amiri et al., 2022).

Exposure to UV light has known deleterious effects on the human body, with the skin being the most commonly affected organ. However, recent studies have suggested that UV radiation may also have adverse effects on the male testis. Understanding the histopathological consequences of UV light exposure on testicular tissue is crucial for comprehending the potential impact on male reproductive health (de Assis et al., 2019).

The histopathological effects of UV light on the male testis involve alterations at the cellular and tissue levels. These effects can disrupt the delicate balance required for normal spermatogenesis and hormone production. Histopathological changes may include testicular atrophy, damage to germinal epithelium, dysfunction of Sertoli and Leydig cells, germ cell aplasia, and inflammation (Hamza & Diab, 2020). The aim of this study is therefore to evaluate the histopathological effect of uv light on the testis of male Wistar albino rats.

METHODOLOGY

Study Area

This study was conducted in Ekpoma, a town in Edo State, Nigeria, located within the rainforest/savannah transitional zone. Ekpoma is the administrative headquarters of Esan West Local Government Area and home to Ambrose Alli University. It has a land area of 923 square kilometers and a population of 170,123, comprising students, teachers, civil servants, traders, and professionals. The town consists of several quarters, including Eguare, Iruekpen, Emaudo, and others.

Experimental Animals/Housing Condition

Fifty adult Albino Wistar rats of similar size and weight were obtained and allowed two weeks of acclimatization before the experiment. They were housed in well-ventilated, labeled wooden cages designed to protect them from wild animals and insects. The rats were fed growers' mash and provided water ad libitum. The experimental procedures followed the guidelines of the National Research Council (1985) for the care and use of laboratory animals.

Experimental Design

The fifty rats were divided into five groups (A–E) with ten rats each. Group A served as the control, receiving only feed and water, while Groups B–E were exposed to varying durations of UV light daily for 14 days. Body weights were monitored before and after exposure. After the experiment, the rats were anesthetized with chloroform, and their stomachs were obtained for analysis. Statistical analysis was performed using ANOVA, with significance set at $p<0.05$.

Animal Grouping

The rats were separated into five groups (A–E) and housed in four large cages. Group A served as the control, receiving only normal feed and water.

Groups B–E were exposed to different durations of UV light while also receiving growers' mash and water. The exposure varied in duration and frequency across the test groups.

Study Duration

The entire study, including preliminary work, acclimatization, substance procurement, experimentation, and analysis, lasted three months. The experimental phase lasted four weeks, with two weeks for acclimatization and two weeks for UV light exposure.

Substance Preparation

The UV light used for the study was UVA, purchased from Nwobec Enterprise Nig. Ltd, Abuja. It was stored in a clean, dry nylon bag until needed for administration during the experiment.

Administration of UV Light

The UV light exposure was administered as follows:

- Group A: Control group, received only feed and water.
- Group B: Exposed to UV light for 30 minutes once daily.
- Group C: Exposed to UV light for 1 hour twice daily.
- Group D: Exposed to UV light for 2 hours thrice daily.
- Group E: Exposed to UV light for 4 hours thrice daily.

Sample Collection and Analysis

Rats' weights were measured before and after acclimatization, and again at the end of the experiment. After the study, the stomachs of all rats were collected under chloroform anesthesia and preserved in 10% formalin for histological processing.

Processing Schedule

Tissues were processed using standard histological procedures, passing through graded alcohol solutions, xylene, and molten paraffin wax for embedding. The prepared tissue blocks were sectioned at 3nm thickness, floated in a water bath, mounted on slides, dried, and stored for staining.

Staining Procedure

Tissue sections were stained using the Hematoxylin and Eosin (H&E) technique. The process included de-waxing, hydration through alcohol gradients, staining with Harris hematoxylin and eosin, differentiation, bluing, dehydration, clearing in xylene, and mounting with DPX. The stained slides were examined under a light microscope at 100x magnification, and photomicrographs were taken.

Data Analysis

All results were expressed as mean ± standard deviation. Statistical analysis was conducted using SPSS (version 21). A one-way ANOVA test compared the experimental groups with the control group, with significance set at $p<0.05$.

RESULT

4.1 Distribution of Mean±S.D of Days of Albino wistar rats administered with Uv light. The Mean±S.D of Day 1 of Control group (cage 1) was 166.7 ± 12.2a, Control group 2 Uv light and feed (cage 6) was 166.0 ± 18.5b, Uv light (cage 2) was 142.5 ± 14.1, Uv light (cage 3) was 140.2 ± 12.3ab, Uv light (cage 4) was 158.1

± 14.7, while Uv light (cage 5) was 155.6 ± 35.1. The Mean±S.D of Day 3 of Control group (cage 1) was 163.8 ± 12.8, Control group 2 Uv light and feed (cage 6) was 166.7 ± 25.0ab, Uv light (cage 2) was 138.7 ± 16.9a, Uv light (cage 3) was 138.2 ± 14.7b, Uv light (cage 4) was 154.7 ± 17.8, while Uv light (cage 5) was 150.2 ± 21.6.

The Mean±S.D of Day 6 of Control group (cage 1) was 170.5 ± 13.3abcd, Control group 2 Uv light and feed (cage 6) was 142.5 ± 6.6a, Uv light (cage 2) was 133.0 ± 18.2b, Uv light (cage 3) was 131.7 ± 12.0c, Uv light (cage 4) was 150.8 ± 19.1, while Uv light (cage 5) was 141.1 ± 27.9d. The Mean±S.D of Day 9 of Control group (cage 1) was 175.6 ± 10.3abcde, Control group 2 Uv light and d-water (cage 6) was 130.3 ± 8.0a, Uv light (cage 2) was 122.6 ± 19.8b, Uv light (cage 3) was 120.4 ± 9.4c, Uv light (cage 4) was 138.5 ± 18.2d, while Uv light (cage 5) was 131.9 ± 28.9e. The Mean±S.D of Day 12 of Control group (cage 1) was 166.5 ± 18.6abcde, Control group 2 Uv light and d-water (cage 6) was 128.4 ± 11.4a, Uv light (cage 2) was 114.5 ± 15.7b, Uv light (cage 3) was 109.9 ± 6.3c, Uv light (cage 4) was 129.5 ± 16.3d, while Uv light (cage 5) was 122.0 ± 26.9e. However, comparing across the table it shows that there is a statistically significant ($P<0.05$) comparison in all the Groups body weight.

Table 4.1 Distribution of Mean±S.D of Days of Albino Wistar Rats Administered with UV LIGHT

Days	Control (Group A)	Uv light for 30 mins and feed (Group B)	Uv light for 1 hr and feed (Group C)	Uv light for 2hrs and feed (Group D)	Uv light for 4 hrs and feed (Group E)	F-value	P-value
Day 1	166.7 ± 12.2^{a}	166.0 ± 18.5^{b}	142.5 ± 14.1	140.2 ± 12.3^{ab}	158.1 ± 14.7	1.682	0.177
Day 3	163.8 ± 12.8	166.7 ± 25.0^{ab}	138.7 ± 16.9^{a}	138.2 ± 14.7^{b}	154.7 ± 17.8	1.706	0.172
Day 7	170.5 ± 13.3^{abcd}	142.5 ± 6.6^{a}	133.0 ± 18.2^{b}	131.7 ± 12.0^{c}	150.8 ± 19.1	3.341	0.020*
Day 14	175.6 ± 10.3^{abcde}	130.3 ± 8.0^{a}	122.6 ± 19.8^{b}	120.4 ± 9.4^{c}	138.5 ± 18.2^{d}	6.709	0.000*
Day 28	166.5 ± 18.6^{abcde}	128.4 ± 11.4^{a}	114.5 ± 15.7^{b}	109.9 ± 6.3^{c}	129.5 ± 16.3^{d}	6.437	0.001*

Asterisk * : similar superscript shows statistically significant difference Same superscript represent a statistically significant occurs

- Group A: Control group
- Group B: Uv light for 30 minutes with feed
- Group C: Uv light for 1 hour with feed
- Group D: Uv light for 2 hours with feed

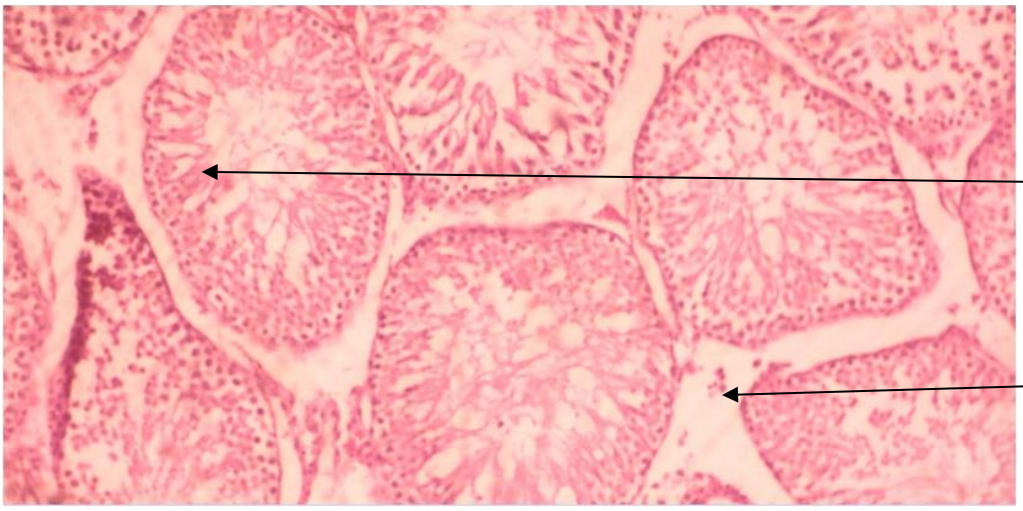

Plate 1 Shows the Normal Histological Feature of the Testis of the Untreated (Control) Wistar Rat with Presence of Seminiferous Tubule (A) and Leydig Cells (B) of the Testis. Handex40

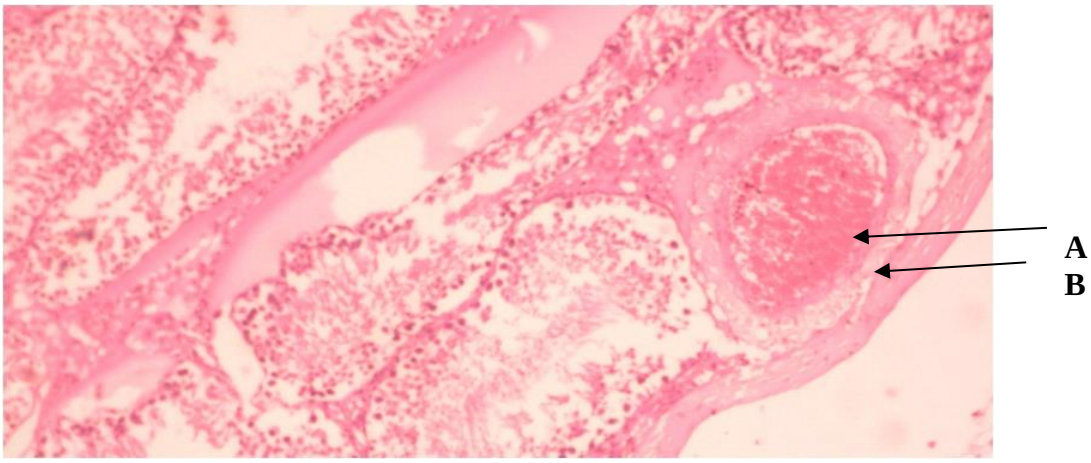

Plate 2 Shows the Histological Feature of the Testis of the Treated (Group B) Wistar Rat with Presence of Mild Adenofibroma (A) of the Testis. Handex40

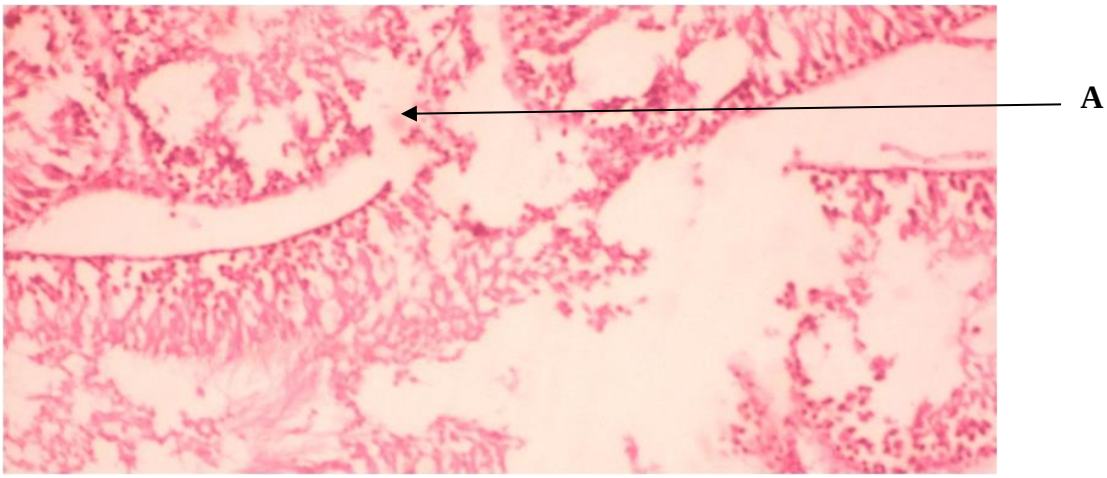

Plate3 Shows the Histological Feature of the Testis of the Treated (Group C) Wistar Rat with Presence of Denatured Cells (A) of the Testis. Handex40

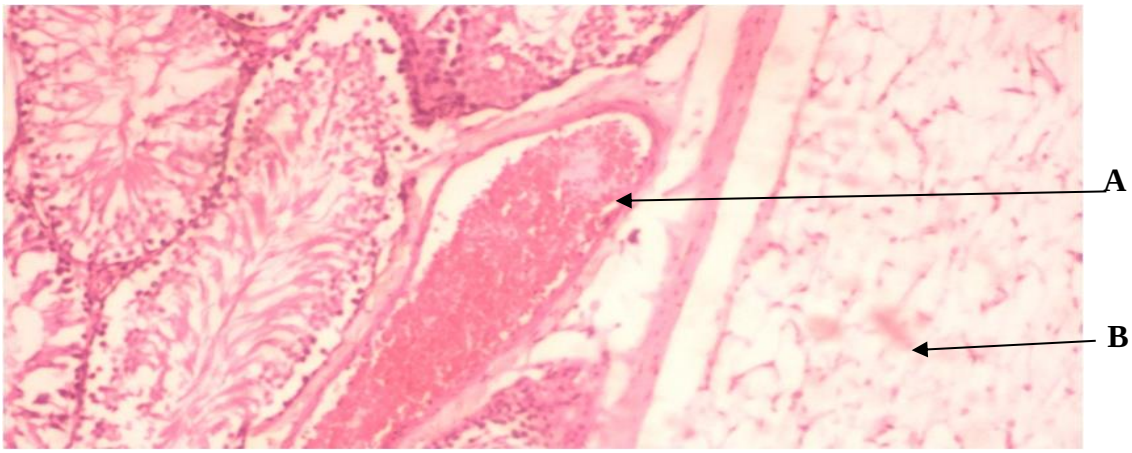

Plate 4 Shows Histological Feature of the Testis of the Treated (Group D) Wistar Rat with Presence of Adenocarcinoma (A) and Fatty Tissue (B) of the testis. Handex40

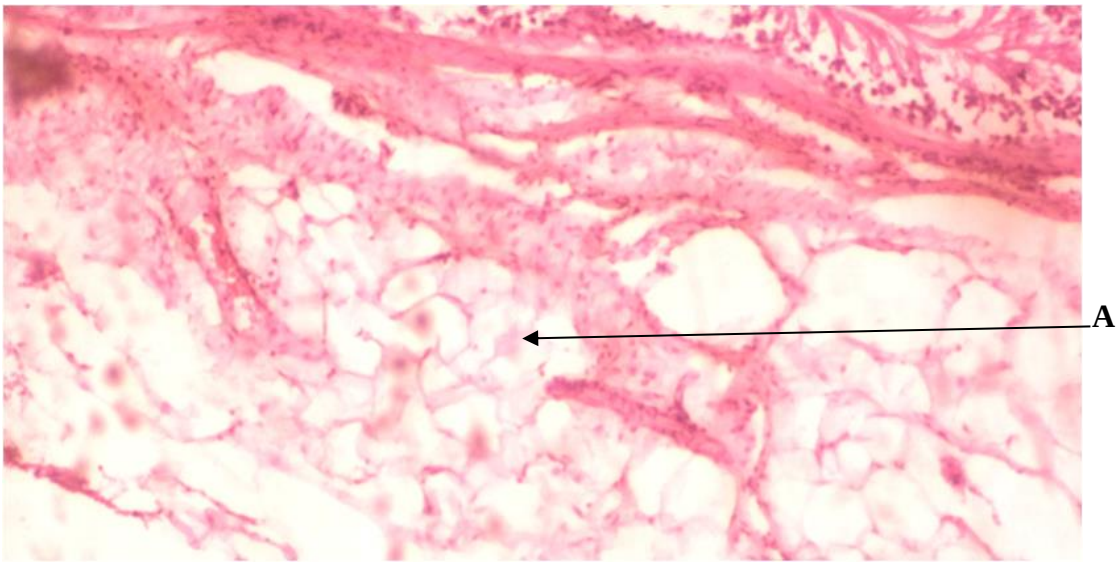

Plate5 Shows the Histological Feature of the Testis of the Treated (Group E) Wistar Rat with Presence of Fatty Tissue (A) of the Testis. Handex40

Summary of micrograph Finding

- Plate 1: Normal histological feature of the Testis
- Plate 2: Presence of Mild Adenofibroma
- Plate 3: Presence of Denatured cells
- Plate 4: Presence of Adenocarcinoma and Fatty tissue
- Plate 5: Presence of Fatty tissue

DISCUSSION

Ultraviolet (UV) radiation is a form of electromagnetic radiation emitted by the sun and artificial sources, such as tanning beds and UV lamps. UV radiation has both positive and negative effects on health, depending on the dose and duration of exposure. UV radiation is essential for the production of vitamin D in the skin. When UVB rays from the sun interact with the skin, a precursor molecule in the skin is converted into vitamin D. Adequate vitamin D is crucial for maintaining bone health, supporting the immune system, and reducing the risk of certain diseases. Research has shown that Sunlight exposure, which includes exposure to UV radiation, can have a positive impact on mood. It stimulates the release of serotonin in the brain, a neurotransmitter associated with feelings of well-being. Sunlight exposure is often linked to improved mood and reduced symptoms of conditions like seasonal affective disorder (SAD) (Chinnasamy et al., 2022).

Despite the positive effect of uv light several research studies have also highlighted some negative effect of uv on individuals. For instance, Prolonged or excessive exposure to UV radiation, especially UVA and UVB rays, can lead to skin damage. UV radiation causes the skin to age prematurely, leading to wrinkles, fine lines, age spots, and loss of skin elasticity. Over time, it can increase the risk of skin cancers, including melanoma, basal cell carcinoma, and squamous cell carcinoma. UV radiation can also harm the eyes. Prolonged exposure to UV rays may lead to conditions like cataracts (clouding of the eye's lens) and photokeratitis (a painful eye condition similar to sunburn of the cornea). Further more, UV radiation can directly damage the DNA in skin cells. This DNA damage is a major contributor to the development of skin cancers. UV-induced DNA mutations can accumulate over time and lead to malignant transformations (Gromkowska-Kępka et al., 2021).

The potential effects of ultraviolet (UV) radiation on testis histology, specifically the histological structure of the testicles, have not been extensively studied or documented in the scientific literature. Most studies on the effects of UV radiation primarily focus on skin, eyes, and other superficial tissues due to their direct exposure to UV rays.

The presence of specific testicular findings in different experimental groups presents a compelling scenario that warrants further discussion. In Group B, the presence of mild adenofibroma is a noteworthy observation. This finding appears to align with the research conducted by Hu et al., 2010 and Carney et al., 1985, who also reported the presence of adenofibroma in similar experimental settings. This similarity in findings underscores the consistency and reproducibility of this phenomenon in the context of testicular histology.

Conversely, in Group C, the presence of denatured cells of the testis is a concerning discovery. This finding stands in contrast to the norm and may indicate an adverse response or toxic insult. It deviates from the typical testicular histology observed in healthy individuals. While the work of Sharpe, 2001 highlighted some potential testicular changes in response to specific exposures, the extent of cell denaturation in Group C appears to be notably more severe.

In Group D, the presence of adenocarcinoma and fatty tissue of the testis is a striking observation. This finding is particularly alarming and significantly differs from the expected norm. The presence of adenocarcinoma suggests a malignancy, which is rarely reported in the context of testicular histology. This finding contrasts sharply with the work of Rastogi et al., 2008, who did not report adenocarcinoma in their studies. It raises questions about the potential carcinogenic properties of the experimental conditions.

Lastly, in Group E, the presence of fatty tissue of the testis is an intriguing discovery. This observation, while different from the typical histological makeup of testicular tissue, may have some relevance. Falhammar et al., 2012 had previously noted similar fatty tissue occurrences, although further exploration is needed to fully understand the implications. This finding, while unique, might be in partial agreement with the prior research, suggesting a potential commonality in testicular responses to certain exposures.

CONCLUSIONS

In conclusion, the exposure of testis to uv light cause significant alterations in testis histology leading to presence of Fatty tissue of the Testis, presence of Adenocarcinoma and presence of Denatured cells of the Testis which when not noticed early in individuals could be detrimental to the reproductivity.

RECOMMENDATIONS

- Further research should be conducted to ascertain the cellular changes caused by uv light exposure
- Individuals exposed to uv light over a long period of time should see health practioners

FUTURE STUDY

This research still has limitations so further research is needed related to the topic of Histological Effect of Ultra Violet (Uv) Light on the Testis of Albino Wistar Rats to perfect this research and increase insight for readers.

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