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Anatomy

Effect of Ethanolic Extract of *Xylopia aethiopica* on Cadmium Chloride Induced Toxicity on Serum Luteinizing, Follicle Stimulating Hormone and Testosterone in Adult Male Wistar Rats

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Abstract **Original Research Article**

FOLLICLE stimulating hormone and testosterone both aid in the spermatozoa's ultimate development and guard the germ cell line from apoptosis. flat epididymis are characteristics of men who have azoospermia as a result of secondary testicular failure. Primary testicular failure reduces testosterone production, diminishes negative feedback inhibition, and increases gonadotropin production (hypergonadotropic hypogonadism). This study was carried out to assess the effect of ethanol of seed extract of Xylopia aethiopica on cadmium chloride induced toxicity on luteinizing and follicle stimulating hormones and testosterone in adult male wistar rats. Twenty (20) male albino wistar rats were used for this study. The animals were randomly divided into four groups with each containing four adult male wistar rats. Group 1 received distilled water and feed per day for 14 days, group 2 was treated with 2mg/body weight of Cadmium for 14 days, group 3 was treated with 2mg/body weight of Cadmium plus 50mg body weight of ethanol of seed extract of *Xylopia aethiopica,* group 4 was treated with 2mg/body weight of Cadmium plus 100mg/body weight of ethanol of seed extract of *Xylopia aethiopica*, group 5 was treated with 100mg/ body weight of of ethanol of seed extract of *Xylopia aethiopica*. The experiment lasted for 14 days. The rats were weighed before the experiment and after each week of administration. After 14 days of administration, the rats were sacrificed via chloroform inhalation and the testes harvested and fixed immediately in 10% buffered formalin, processed and stained with hematoxylin and eosin (H&E) staining method. Blood samples were collected were collected by cardiac puncture in EDTA bottle and plain bottles for analysis of serum follicle stimulating hormone, luteinizing hormone and testosterone. Data were expressed as Mean + standard error of the Mean (mean + SEM) and subjected to one-way analysis of variance (ANOVA). Significant difference between mean was assessed by Duncan post hoc test. 95% level of significance ($p< 0.05$) was used for statistical analysis. The result of this experiment revealed an elevation in the serum testosterone, FSH and LH in group 4 and 5 when compared to the control (group 1). Group 2 and 3 showed reduction in testosterone. These results revealed that consumption of high dose of *Xylopia aethiopica* has ameliorative effect on cadmium chloride toxicity.

Keywords: follicle stimulating hormone, luteinizing hormone and testosterone, serum, *Xylopia aethiopica,* Cadmium.

INTRODUCTION

Xylopia aethiopica Dunal (Annonaceae) is an aromatic plant commonly known as “African pepper”, “Ethiopia or Negro pepper”. It has been used in Europe, Asia, and Africa as a pepper substitute and spice in local cooking. In Nigeria, the common local names used in different languages to refer to this plant are: “Kimba” in Hausa, “Eeru” in Yoruba, and “Uda” in Igbo (Abolaji *et al.,* 2007).

The anterior pituitary gland then starts to release follicle stimulating hormone (FSH) and, luteinizing hormone (LH) after the hypothalamus releases gonadotropin releasing hormone (GnRH), at pulsatile intervals of 60 to 120 minutes. Sertoli cell-expressed receptors bind FSH, which acts to enhance spermatogenesis, and LH, which stimulates the production of testosterone by Leydig cells (Wistuba *et al.,* 2007; Sharpe, 2010). In the testis, LH stimulates the Leydig cells to produce and release the hormone testosterone; the amount of testosterone is roughly directly proportional to LH levels (Achard *et al.,* 2009). According to Wistuba (2007), LH's primary purpose is to regulate secondary sexual traits by increasing

testosterone. Leydig cells secrete testosterone when the hormone LH stimulates the endocrine system. Then, alongside FSH, testosterone diffuses into the seminiferous tubule and promotes spermatogenesis (Ge *et al.,* 2009). As a result, Leydig cell is important for the process of spermatogenesis (Hall and Guyton, 2011). Production of testosterone, which is affected by the activation of luteinizing hormone (LH) on Leydig cells, is a key factor in the onset of puberty

Cadmium is a shiny, silver-white and very flexible heavy metal. It has a bluish tinge on the surface and it tarnishes in air. Cadmium is a natural element that can be found in tiny amounts in water, air, soil, and food. Cadmium has a whole-body half-life between 15-30 years and therefore can accumulate in organs of the body including the testis. (Satarug *et al.,* 2017). Smoking and many industrial processes release cadmium into the atmosphere (Faroon *et al.,* 2012). Cadmium is primarily utilized in batteries, pigments, coatings, electroplating, plastic stabilizers, and other applications. It is a byproduct of the manufacturing of other metals like zinc, lead, or copper (Faroon *et al.,* 2012). Infertile couples (501 cases) in Rockville, Maryland, have higher blood levels of cadmium, proving that cadmium is hazardous to reproduction at environmentally relevant levels (Buck Louis *et al.,* 2012). The active hormones stimulating the production of sperm cells may be estradiol and dihydrotestosterone (Guyton and Hall, 2011). Low LH, low testosterone, and low FSH are additional effects of hypogonadotropic hypogonadism (HH), which is brought on by the pituitary's insufficient production of the gonadotropins necessary for the normal generation of enough testosterone. HH can be inherited or acquired. In addition to chromosomal abnormalities and, less frequently, cleft palate and unilateral renal agenesis, Kallmann's syndrome, a hypothalamic congenital condition caused by loss of GnRH secretion, is HH. Congenital HH may be associated with cryptorchidism and micro penis (Kim *et al.,* 2010).

MATERIALS AND METHOD

Animals:

Twenty-five (25) male wistar rats were used in this study. They were purchased from the Rivers State University, Port Harcourt, Nigeria and were allowed to acclimatize for fourteen days prior to the start of the treatment at the laboratory environment with 12 hours light and dark cycles. All animals were handled according to the International Guidelines for handling experimental animals (APS, 2022)

Cadmium:

Cadmium chloride was obtained from the chemistry department of Rivers State University, Port Harcourt, Nigeria. Before administration, cadmium was first dissolved in distilled water at a dose of 2mg/kg body weight and administered once daily. LD50 of the cadmium was predetermined as 2330mg/kg body weight.

Plant material:

Xylopia aethiopica seeds were purchased at Mile 3 market, Port Harcourt. They were dried under the sun and later grinded into a coarse powder form. 600g from the coarse form were weighed out and extracted with 1000ml of ethanol using extraction maceration for 24 hours in air tight container. All measurements were done using automated weighing machine. The LD50 of the extract was predetermined as 300mg/kg body weight.

Method

Experimental location

The investigation was carried out in the animal house of the department of human anatomy in Rivers state university, Port Harcourt.

Experimental Design

Group 1- control animals received only distilled water orally.
Group 2- Animals given oral doses of 2 mg/kg body weight of cadmium chloride.
Group 3- Animals treated with 2 mg/kg body weight of cadmium chloride plus 50mg/kg body weight of *Xylopia aethiopica* extract orally.
Group 4- Animals treated with 2 mg/kg body weight of cadmium chloride plus 100mg/kg body weight of *Xylopia aethiopica* extract orally.
Group 5- Animals treated with 100 mg/kg body weight of *Xylopia aethiopica* extract only.
The treatment was done once daily for 14 days. The rats were housed in a metal basket cage at room temperature and had access to commercial standard rodent pellets and cool clean water ad libitum. The cages and the animal house were constantly cleaned, feces and water changed about three times daily so as to maintain proper hygiene. The experiments were conducted according to the institutional animal care protocols at the Rivers State University Nigeria and followed approved guidelines and ethics for the treatment of Laboratory animals. The route of administration of the extract was via oral route with the aid of oral intubation tube. The body weight of the rats was measured just before administration, after 7 days of administration and after 14 days of administration.

Termination/Sacrifice/Organ Collection

Twenty-four (24) hours after the last administration, the rats were sacrificed using the chloroform inhalation method. The rats were starved for 24 hours to empty their bowels and stabilize the levels of biomarkers before sacrifice. Two from each group were sacrificed. They were each anasthesized in a desiccator which contained cotton wool that was soaked in chloroform. The rats were each taken out of the desiccator when they appeared to be weakened by the chloroform and not completely dead in order to enable blood collection. Blood samples from each rat were taken via cardiac puncture into lithium heparin sample bottles. The testes were harvested and preserved using 10% formal saline and formalin solutions with the

containers well labelled. The tissues were grossed and placed in tissue cassettes for further analysis.

Estimation of Serum Luteinizing Hormone, Follicle Stimulating Hormone and Testosterone

The serum samples obtained were analyzed to determine the concentrations of LH, FSH and testosterone.

Method

Enzyme Linked Immunosorbent Assay (ELISA) method was used, according to the standard protocol given by the National Institute of Health and Family Welfare (Srivastava,2001).

Principle

This uses "sandwich" principle. To measure testosterone levels in serums, plastic wells coated with monoclonal antibody of testosterone are supplied in a kit. The patient specimen and another monoclonal antibody labelled HRP (horseradish peroxidase) is added, testosterone, if present is fixed to the solid phase antibody and creating an HRP-antibody "sandwich" after the substrate is added. The rest is obtained by EIA plate reader.

Procedures for TESTOSTERONE

1. 50 microliters of controls and samples were dispensed into respective wells
2. 50 microliters of testosterone-HRP conjugate were dispensed into each well.
3. It was mixed thoroughly for 30 seconds and incubated at 37 degrees for 90 minutes.
4. The well was washed 5 times with distilled water, 10 seconds each.
5. 50 microliters of chromogen A were dispensed into each well
6. 50 microliters of chromogen B was dispensed into each well
7. It was mixed gently by swirling for 10 seconds and incubated at 20 degrees for 20 minutes.
8. 50 microliters of stop solution was dispensed into each well and mixed gently for 30 seconds.
9. Absorbance was read with EIA plate reader within 15 minutes (Marshall,1975; Rebar *et al.,* 1982).

Procedures for Follicle Stimulating Hormone

1. 50 microliters of controls and samples were dispensed into respective wells
2. 50 microliters of FSH-HRP conjugate were dispensed into each well.
3. It was mixed thoroughly for 30 seconds and incubated at 37 degrees for 90 minutes.
4. The well was washed 5 times with distilled water, 10 seconds each.
5. 50 microliters of chromogen A were dispensed into each well
6. 50 microliters of chromogen B was dispensed into each well
7. It was mixed gently by swirling for 10 seconds and incubated at 20 degrees for 20 minutes.
8. 50 microliters of stop solution was dispensed into each well and mixed gently for 30 seconds.
9. Absorbance was read with EIA plate reader within 15 minutes (Marshall,1975; Rebar *et al.,* 1982).

Procedures for Luteinizing Hormone (LH)

1. 50 microliters of controls and samples were dispensed into respective wells
2. 50 microliters of LH-HRP conjugate were dispensed into each well.
3. It was mixed thoroughly for 30 seconds and incubated at 37 degrees for 90 minutes.
4. The well was washed 5 times with distilled water, 10 seconds each.
5. 50 microliters of chromogen A were dispensed into each well
6. 50 microliters of chromogen B was dispensed into each well
7. It was mixed gently by swirling for 10 seconds and incubated at 20 degrees for 20 minutes.
8. 50 microliters of stop solution was dispensed into each well and mixed gently for 30 seconds.
9. Absorbance was read with EIA plate reader within 15 minutes (Marshall,1975; Rebar *et al.,* 1982).

Statistical Analysis

The data generated from this study were analyzed using SPSS version 22.0 statistical package. The first value indicates the mean while the second values indicate the standard error of mean of the body weight of the rats. The p-value was calculated to be less than 0.05 indication a significant value and non-significant for values higher than 0.05.

RESULT AND ANALYSIS

Results on Body weight

In the present study, *Xylopia aethiopica* and cadmium chloride was administered to 20 adults male wistar rats for a period of 14 days. The rats were weighed just before administration, after 7 days of administration and after 14 days of administration. The results obtained showed that body *Xylopia aethiopica* and cadmium chloride have an effect on the body weight of the animals. Table 1 shows the effect of treatment of ethanolic seed extracts of *Xylopia aethiopica* on body weight (g) in cadmium chloride induced toxicity in wistar rats.

From table 1, Group 1 which is the control group showed a progressive increase in the weight with the initial mean body weight of 85.0 ± 1.00g to 100.0 ± 1.00g after 7 days and 135.5 ±3.50g after 14 days. The control group was given distilled water and standard rodents pellets feed.

Group 2 which was treated with 2mg/kg body weight of cadmium chloride showed a decrease in the body weight of the rats when compared to the control group. They had an initial mean body weight of 82.5 ±

4.50g. The mean body weight increased after 7 days of administration to 86.5 ± 9.50g but decreased after 14 days of administration to 76.0 ± 13.00g.

Group 3 treated with 2mg/kg body weight of cadmium chloride plus 50mg/kg body weight of *Xylopia aethiopica* showed a decrease in the mean body weight when compared to the control group. The initial mean body weight was seen as 99.5 ± 0.50g. There was however an increase in the mean body weight after 7 days of administration to 153.5 ± 3.50g. this could be as a result of extract treatment. However, there was a decrease after 14 days to 111.5 ± 0.50g.

Group 4 rats which were administered 2mg/kg body weight of cadmium chloride plus 100mg/kg body weight of *Xylopia aethiopica* showed an increase in the mean body weight when compared to the control. The initial mean body weight was seen as 100.0 ± 22.00g. after 7 days of administration, the mean body weight of rats decreased to 99.5 ± 15.50g. The final mean body weight of rats was seen as 137.5 ± 40.50g.

Group 5 rats treated with 100mg/kg body weight of *Xylopia aethiopica* showed an overall decrease in the mean body weight of animals. The rats were seen to have an initial mean body weight of 176.5 ± 3.50g, 142.0 ± 5.00g after 7 days of administration and 138.5 ± 8.50g after 14 days of administration.

Table 1: Mean body weight (g)/SEM

GROUPS	INITIAL	WEEK 1	WEEK 2
GROUP 1	85.0 ± 1.00	100.0 ± 1.00	135.5 ±3.50
GROUP 2	82.5 ± 4.50	86.5 ± 9.50	76.0 ± 13.00
GROUP 3	99.5 ± 0.50	153.5 ± 3.50	111.5 ± 0.50
GROUP 4	100.0 ± 22.00	99.5 ± 15.50	137.5 ± 40.50
GROUP 5	176.5 ± 3.50	142.0 ± 5.00	138.5 ± 8.50

n = 2; mean ± SEM.

Group 1 = Normal Control (NC), Group 2 = 2mg/kg of Cadmium chloride, Group 3 = 2mg/kg of Cadmium chloride plus (+) 50mg/kg of *Xylopia aethiopica*, Group 4 = 2mg/kg of Cadmium chloride plus (+) 100mg/kg of Xylopia aethiopica, Group 5 = 100mg/kg of *Xylopia aethiopica*.

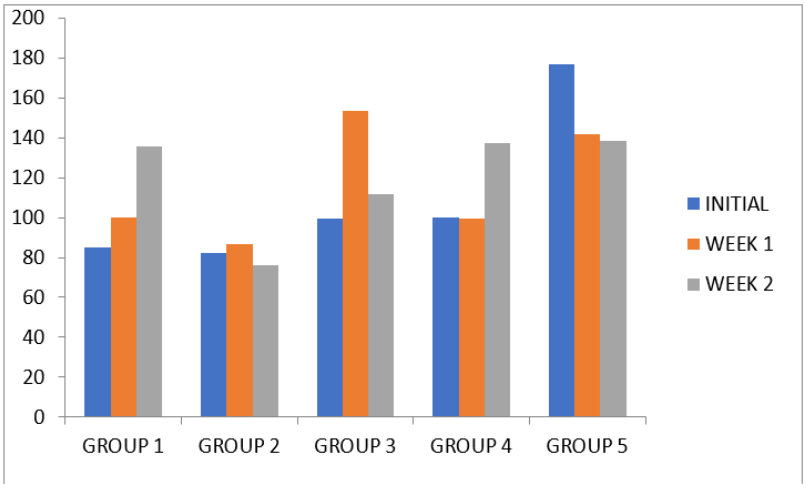

Figure 1: **Showing Mean body weight (g)/SEM**

Results on the effect of treatment with seed extracts of Xylopia aethiopica on hormonal activity in Cadmium chloride induced toxicity in male wistar rats

From table 2, After 14 days of administration, the serum FSH levels in group 1(control) was seen as 0.15 ± 0.01ng/ml. Group 2 rats treated with 2mg/kg body weight of cadmium chloride showed serum FSH level of 0.11 ± 0.01ng/ml. A significant increase in seen in the FSH level of Group 3 treated with 2mg/kg body weight of cadmium chloride plus 50mg/kg body weight of *Xylopia aethiopica* with serum FSH level of 0.34 ± 0.02ng/ml. Group 4 treated with 2mg/kg body weight of cadmium chloride plus 100mg/kg body weight of *Xylopia aethiopica* showed a serum FSH level of 0.21 ± 0.01ng/ml. 0.19 ± 0.01ng/ml of serum FSH was seen in Group 5 treated with 100mg/kg body weight of *Xylopia aethiopica* only.

Table 2 also shows the levels of serum LH after 14 days of administration. Group 1(control) showed a serum LH level of 0.29 ± 0.03ng/ml. Group 2 treated with 2mg/kg body weight of cadmium chloride showed serum LH level of 0.25 ± 0.02ng/ml. There was a

significant increase in the LH level of Group 3 which was treated with 2mg/kg body weight of cadmium chloride plus 50mg/kg body weight of *Xylopia aethiopica.* Serum level of LH was seen as 0.76 ± 0.01ng/ml. Group 4 treated with 2mg/kg body weight of cadmium chloride plus 100mg/kg body weight of *Xylopia aethiopica* showed a serum LH level of 0.42 ± 0.02ng/ml. 0.34 ± 0.02ng/ml of serum LH was seen in Group 5 treated with 100mg/kg body weight of *Xylopia aethiopica* only.

The results obtained from table 2 also show serum testosterone levels after 14days of administration. Group 1(control) show testosterone level of 0.87 ± 0.02ng/ml. Low testosterone levels can be seen in Group 2 and 3 which were treated with 2mg/kg body weight of cadmium chloride and with 2mg/kg body weight of cadmium chloride plus 50mg/kg body weight of *Xylopia aethiopica* respectively. Group 2 showed serum testosterone level of 0.74± 0.02ng/ml while Group 3 showed serum testosterone level of 0.57 ± 0.02ng/ml. Serum testosterone level of Group 4 treated with 2mg/kg body weight of cadmium chloride plus 100mg/kg body weight of *Xylopia aethiopica* was seen as 1.91 ± 0.26ng/ml while Group 5 treated with 100mg/kg body weight of *Xylopia aethiopica* only showed serum testosterone level of 3.07 ± 0.29ng/ml.

Table 2: **Mean hormone profile/SEM**

GROUPS	FSH	LH	TET
GROUP 1	0.15 ± 0.01*	0.29 ± 0.03 *	0.87 ± 0.02*
GROUP 2	0.11 ± 0.01*	0.25 ± 0.02*	0.74± 0.02*
GROUP 3	0.34 ± 0.02*	0.76 ± 0.01*	0.57 ± 0.02*
GROUP 4	0.21 ± 0.01*	0.42 ± 0.02*	1.91 ± 0.26*
GROUP 5	0.19 ± 0.01*	0.34 ± 0.02*	3.07 ± 0.29*

n = 2; mean ± SEM. One way ANOVA *test. p<0.05 when compared with the control.*

Group 1 = Normal Control (NC), Group 2 = 2mg/kg of Cadmium chloride, Group 3 = 2mg/kg of Cadmium chloride plus (+) 50mg/kg of *Xylopia aethiopica*, Group 4 = 2mg/kg of Cadmium chloride plus (+) 100mg/kg of Xylopia aethiopica, Group 5 = 100mg/kg of *Xylopia aethiopica*.

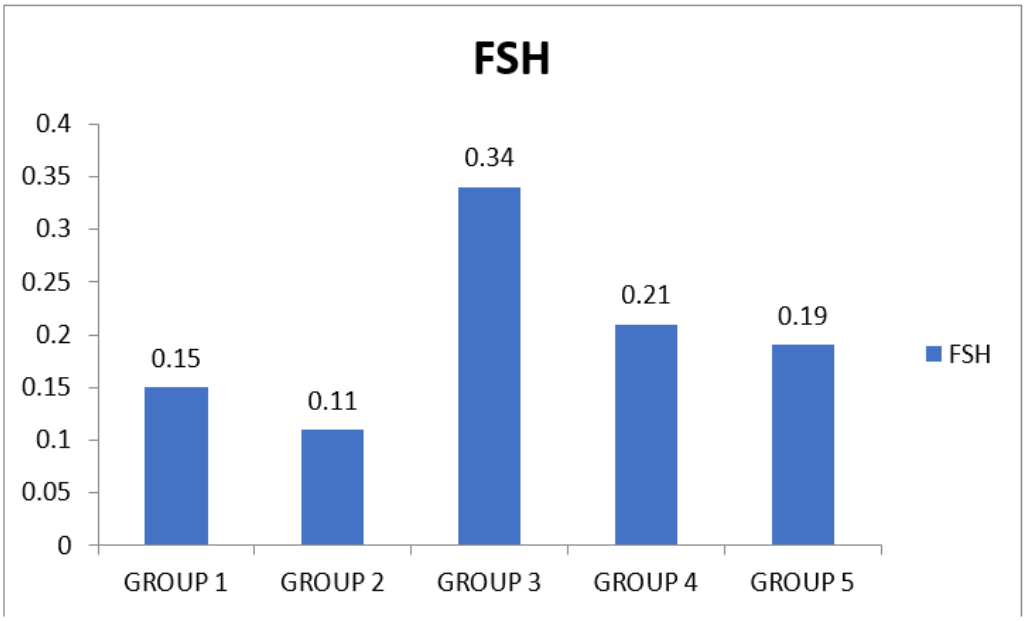

Figure 1: showing effect of treatment with seed extracts of *Xylopia aethiopica* on FSH activity in Cadmium chloride induced toxicity in male wistar rats

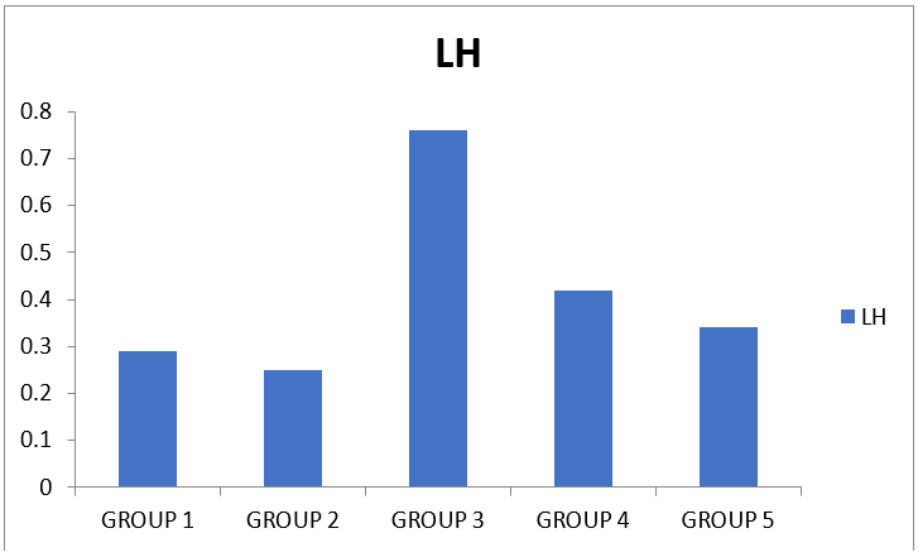

Figure 2: showing effect of treatment with seed extracts of Xylopia aethiopica on LH activity in Cadmium chloride induced toxicity in male wistar rats

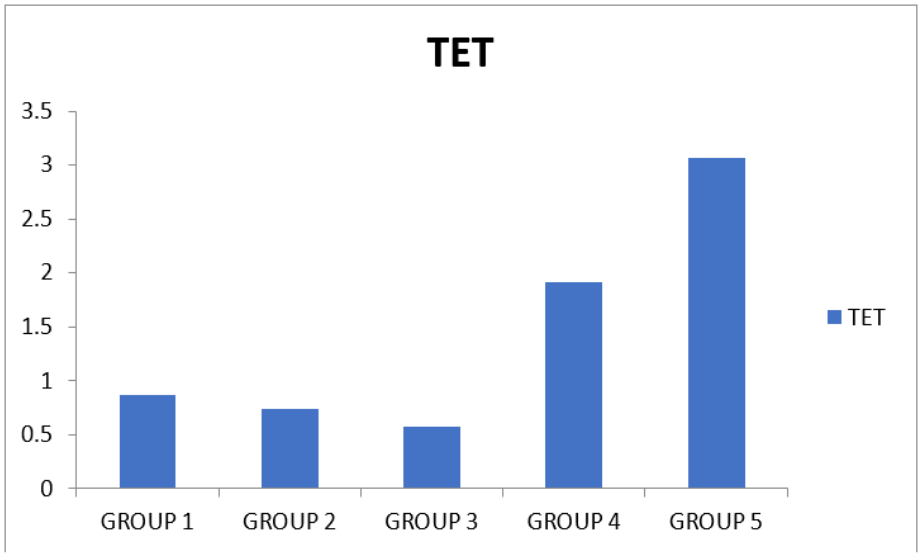

Figure 3: showing effect of treatment with seed extracts of Xylopia aethiopica on Testosterone activity in Cadmium chloride induced toxicity in male wistar rats

DISCUSSION

Wide use of Xylopia aethiopica warrants research to establish its effects on male fertility and potential use in the treatment of male fertility. Evidence to provide a biological mechanism of "Xylopia aethiopica" extract on the reproductive functions is needed, by governments, researchers, health professionals, and communities so as to make informed choices between legalizing it for economic reasons, banning it or regulating its consumption due to health concerns. There is need for greater awareness by health professionals on the use of Xylopia aethiopica and the related health problems. This requires health promotion activities which targets communities with high levels of Xylopia aethiopica use in order to help in promoting reduction of harm strategies, increasing the understanding of the potential risks of regular Xylopia aethiopica use and increasing awareness of services available for those experiencing harm. The present research study aimed at filling the information gap existing on the effects of aqueous extract of Xylopia aethiopica on male reproductive functions. The findings from this study should be considered in addressing the positive/negative reproductive effects of Xylopia aethiopica use on consumers.

Effect on Body weight

From table 1, it can be seen that both *Xylopia aethiopica* and cadmium affects the body weight. Group 1 rats which were the control animals showed a progressive increase in body weight from 85 ± 1.00g at the start of the experiment to 100.0 ± 1.00g after one week and 135.5 ±3.50g after two weeks.

From table 1, group 2 animals treated with 2mg/kg body weight of cadmium showed a decrease in the total body weight when compared to the control. This could be as a result of oxidative stress induced by cadmium, which is in line with the findings of Singh *et al.,* 2011, that oxidative stress is a mechanism of cadmium toxicity (Singh *et al.,* 2011). Cadmium chloride toxicity affects brain function, nutritional uptake in the gastrointestinal tract and metabolic activities.

From table 1, Group 3 animals treated with 2mg/kg body weight of cadmium plus 50mg/kg body weight of *Xylopia aethiopica* showed a significant decrease in the body weight of the animals. This could also be as a result of oxidative stress induced by cadmium chloride toxicity.

Table 1 also showed that Group 4 treated with 100mg/kg of *Xylopia aethiopica* plus 2mg/kg of cadmium showed an increase in body weight when compared to the control which can be attributed to the anti-oxidant properties of *Xylopia aethiopica* against free radicals from the cadmium. This is in accordance with a study carried out by Tijani *et al.,* 2022.

Also, from table 1 Group 5 treated with only 100mg showed a reduction in body weight compared to the initial body weight, which is an indication that *Xylopia aethiopica* plays a role in lipid metabolism, which is in agreement with the report of Chris *et al.,* 2015. However, when compared to the control group, there was an increase in the body weight. This could be as a result of the differences in the initial body weights of animals.

Serum Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH) and Testosterone

Table 2 shows the serum levels of FSH, LH and Testosterone the animals used for the study.

FSH is produced in the anterior lobe of the pituitary gland and stimulates Sertoli cells to release Androgen Binding Protein (ABP) and Inhibin. LH is also produced within the anterior lobe of the hypophysis gland and increases intratesticular testosterone hormone levels by acting on Leydig cells. In a paracrine manner, intratesticular hormone stimulates the Sertoli cells which in turn increases spermatogenesis (Mehmet *et al.,* 2015).

Testosterone is the main male gonadal hormone produced by the interstitial cells of the Leydig in the testis. It is also the major index of androgenicity. A certain concentration of androgens is also required for the initiation and maintenance of spermatogenesis and for the stimulation of growth and function of the prostate and seminal vesicles. Testosterone also helps in maintaining body shape, and increasing muscle mass and strength. Testosterone is produced by Leydig cells of the testes in response to LH, under the control of the hypothalamic–pituitary–testis axis.

In Group 2, when compared to the control group, the FSH, LH and testosterone levels were lower. Low levels of these hormones could be as a result of a disorder of the pituitary gland or the hypothalamus. According to Hachfi and Sakly (2010), the hypothalamic-pituitary axis could be the principal target of cadmium toxicity. This is also in line with a study carried out by Lafuente *et al.,* 2013 who studied that cadmium affects the regulatory mechanisms of the hypothalamic-pituitary axis, by altering neuro-transmitters involved in the regulation at the hypothalamic level, thereby disrupting gonadotropin hormone secretion and by affecting testicular and ovarian structure and activity.

From table 2, Group 3 animals treated with 2mg/kg body weight of cadmium plus 50mg/kg body weight of *Xylopia aethiopica* showed a significant increase in the levels of serum FSH and LH with low level of serum testosterone. This finding could be as a result of the accumulation of cadmium in the testis. Cadmium affects Sertoli cells activity by reducing the synthesis and release of inhibin. Therefore, the increased plasma levels of FSH could be explained as inhibin is the main inhibitory signal for FSH secretion (Ultee-Van Gessel *et al.,* 1985). The increase in LH could be as a result of the brain's response to low level of testosterone as testosterone serves as inhibitory signal for LH secretion. The low testosterone levels could also be as a result of the inability of the Leydig cells to produce testosterone caused by direct effect of the metal on the testis as the metal accumulates in this tissue (Marquez *et al.,* 1998). Low testosterone levels are linked to infertility and may lead to low sperm count (Sizar, 2021; Grinspon, 2020).

From table 2, it is observed that Group 4 animals which were treated with 100mg/kg of *Xylopia aethiopica* plus 2mg/kg of cadmium showed an increase in serum FSH, LH and testosterone levels when compared to the control. This could be as result of antioxidant properties of the seed extract on cadmium chloride toxicity.

Table 2 also shows that group 5 animals treated with 100mg/kg of *Xylopia aethiopica* only showed an increase in serum FSH, LH and Testosterone levels when compared with the control group. This is in line with the findings of Woode *et al.,* 2011 that ethanolic extract *of Xylopia aethiopica* improves the fertility indices in male rats.

CONCLUSION

The results obtained from this study show that cadmium chloride and *Xylopia aethiopica* affects body weight as it causes a decrease in the body weight.. Cadmium chloride also causes a reduction on the serum testosterone levels thereby leading to reduction in sperm

parameters such as sperm morphology, sperm vitality and sperm count.

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