

Original Research Article

Histomorphological Observations In Reproductive Organs Of Wistar Rats Administered With Aqueous Leaf Extract Of *Momordica Charantia*

ABSTRACT

Effort to explore the adverse effect of the plant, *Momordica charantia* on mammals has remained inadequate despite previous attempt by earlier investigators. More glaring is the paucity of information on the histomorphological effect of the plant's aqueous leaf extract hence the need to determine possible alteration of tissue structures in reproductive organs of adult Wistar rats which may affect their functions.

This study aimed at determining the effect of *Momordica charantia* aqueous leaf extract (MCE) on the reproductive organs of experimental adult Wistar rats.

Materials and Methods: Twenty five male and female rats weighing 180-200g were randomly divided into five (5) groups. The experimental groups, A to D were fed on standard diet and administered with 100, 200, 400 and 800 mg/kg body weight /day of MCE orally using gavage for 30 days. Rats in the control groups were fed on standard diet and physiological saline orally. Organs were harvested for histomorphological investigations.

Results

Sections of ovaries administered 200 mg/kg of MCE revealed follicular cyst and mild vacuolation of zona granulosa. Sections of the ovaries administered 400 mg/kg of MCE revealed degenerative changes, follicular cyst, mild vacuolation and reduction of zona granulosa layer while those treated with 800mg/kg showed severe vacuolation of the zona granulosa layer.

Conclusion: *Momordica charantia* caused histomorphological changes in ovaries of Wistar rats which could cause infertility in females. No histomorphological changes observed in male testes.

Keywords: Histopathology, *Momordica charantia*, ovaries, Wistar rats

1. INTRODUCTION

Demand for local herbs as alternative to orthodox medicine by consumers in both developed and developing countries have been on the increase in recent times. Pharmaceutical companies too have heightened their interest in prospecting for medicinal plants (1). Historically, the healthcare industry globally has benefited from medical plants as 25 percent of modern medicines are reported to be directly or indirectly derived from plants. Close to 80 percent of inhabitants in third world countries are claimed to depend on medicinal plants for treatment of diseases (3). Due to the increasing frustration in multi resistance to conventional drugs, interest in herbal alternatives have been upbeat especially in third world countries in Africa and Asia (4,5). The demand for herbal condiments have therefore been on the increase in these countries and some developed ones following the entrance of pharmaceutical companies prospecting for medicinal plants (6). Bitter melon,

Momordica charantia has gained popularity in alternative medicine in countries like India, Malaysia, China, Bangladesh, Nigeria and it is widely distributed in tropical Africa (7,8). The plant is climbing, monoecious, and botanically classified as family Cucurbitaceae (4, 9). The plant has been variously named as karela, wild cucumber, balsam pear and bitter cucumber. Locally in Nigeria, famous names are ejirin in Yoruba, daddasu in Hausa, okwunuolo in Igbo and Ugbebhe in Esa, Edo State (9, 10).

Common ailments parts of the plant was traditionally used for are, It is traditionally known and used as antidiabetic, antitumor, anticancer, anti-inflammatory, antiviral, and cholesterol lowering agent (11).

Cultural differences has been noticed in the use of *Momordica charantia*. While it is used as sub-continental diet in Asian countries like China, Indonesia and India, it is mostly used as herbal condiment in Nigeria by alternative medicine practitioners (5, 12). The leaves in particular are used in folk medicine as antimalaria, antihelminthics, anti-diabetic, anti-inflammatory, anti-digestion and anti-rheumatism (13).

Phytochemically, saponins, glycosides, proteins, alkaloids, fixed oils, triterpenes, steroids, carotenoids, monoterpenes, carbohydrates benzanoids, alkene C3, sterol, alkanol C5 and sesquiterpenes has been reported to be present in the plant. Others are ascorbigens, carotene, anthocyanins, flavonoids, luteolin, and quercetin. Flavonoids and triterpenoids in particular has been described as powerful antioxidants which could be useful in alleviating nutritional risk factors like obesity associated with atherosclerosis, hypertension and cardiovascular complications (2, 7, 8,14).

Previous studies emphasized the effect of seed and fruit extract of the plant (15, 16). The few who investigated on effect of aqueous leaf extract only considered biochemical parameters (17, 18). This study investigated the possible histomorphological changes in ovaries and testes of adult Wistar rats treated with aqueous leaf extract of *Momordica charantia* so as to enrich literature on the cellular and tissue toxicity effect of the plant when consumed for a long time.

2. MATERIAL AND METHODS

2.1 PLANT COLLECTION

Fresh leaves of *M. charantia* were harvested in a local garden at Eyenkorin area in Ilorin, Kwara State and sent to the Department of Biological Science, University of Ilorin for identification with reference number, UILH/001/963/2020 and dried in open air away from sunlight for one week for phytochemical content preservation.

2.1.1 PLANT EXTRACTION

Two hundred and fifty grams (250g) of the dried leaves of *M. charantia* were soaked in 500 ml of distilled water in a corked flask for 48 hrs at room temperature with intermittent shaking. The mixture was filtered, evaporated over water bath and kept inside hot air oven until a semi solid substance was obtained.

2.2 EXPERIMENTAL ANIMALS

A total of 25 male and female Wistar rats weighing between 180-200g were used in this study. The rats were allowed to acclimatize for 2 weeks where feed and water were administered without restrictions. The protocol for this study was approved by

the Ministry of Agriculture and Natural Resources, Benin City, Edo State with reference number V.1041/55

2.2.1 PREPARATION AND ADMINISTRATION OF EXTRACT

The extract of *Momordica charantia* was weighed by using a digital balance which measured in grams. The weighed extract was transferred to well labeled, small sized plastic bottles. The bottles were labeled according to the predetermined dosage of *Momordica charantia*. The corresponding weights were placed in each bottle with matching labels and reconstituted in 1ml of distilled water. The rats were subsequently administered with the extract of *M. charantia* through oral gavage while giving them their normal feed and drinking water ad libitum.

2.2.2 EXPERIMENTAL DESIGN

Control group rats were fed with 1 ml of normal saline daily through oral gavage for 30 days.

Group A were given 100 mg/kg body weight of aqueous extract of *Momordica charantia* for 30 days. **Group B** rats were given 200 mg/kg body weight of aqueous extract of *Momordica charantia* for 30 days. **Group C** rats were given 400 mg/kg body weight of aqueous extract of *Momordica charantia* for 30 days. **Group D rats** were given 800 mg/kg body weight of aqueous extract of *Momordica charantia* for 30 days. All the rats were sacrificed at the end of 30 days.

The animals were anaesthetized with chloroform and subsequently sacrificed. The ovaries and testes were harvested and immediately fixed in 10% Neutral Buffered Formalin (NBF) and Bouin's fluid respectively for 24 hrs.

2.3 TISSUE PROCESSING

Fixed tissues were processed in an automatic tissue processor machine (Leica, 2000), Frankfurt, Germany) and dehydrated in ascending grades of alcohol, cleared in xylene and impregnated in molten paraffin wax. Processed tissues were

embedded in fresh molten paraffin wax and allowed to set. Trimmed tissue blocks were sectioned at 5 μ and dried on a hotplate for 30min. Dried sections were taken to water and stained in Harris' haematoxylin and 1% aqueous eosin to demonstrate general tissue structure. Stained slides were dehydrated in ascending grades of alcohol, cleared in xylene and mounted in DPX. Sections were examined microscopically using x10 and x40 objective lenses.

2.3.1 HAEMATOXYLIN AND EOSIN STAINING TECHNIQUE

Sections of testes and ovaries were taken to water, hydrated in descending grades of alcohol and water. Hydrated sections were stained in Mayer's haematoxylin for 10 min, rinsed in water and differentiated in 1% acid alcohol. Sections were rinsed in water, allowed to blue for 10 min and counterstained in 1% aqueous eosin for 2 min. Stained sections were rinsed in water, dehydrated in ascending grades of alcohol, cleared in xylene and mounted in Dibutylphthalate Polystyrene Xylene (DPX). Stained sections were examined for histopathological changes using Olympus Microscope.

3. RESULTS

3.1 OVARIES

Sections of the ovary from Control group showed numerous follicles at various stages of maturation and corpus luteum dispersed in the peripheral cortical areas. The ovarian stroma is composed of spindle-shaped, fibroblast-like cells and delicate collagen fibres admixed with ground substance. The ovarian bursa is distinct with a wide space separating it from the cortical section. Blood vessels are seen anastomosing the luteal cells. The luteal cells are eosinophilic with large nuclei and moderate cytoplasm (Figure 1).

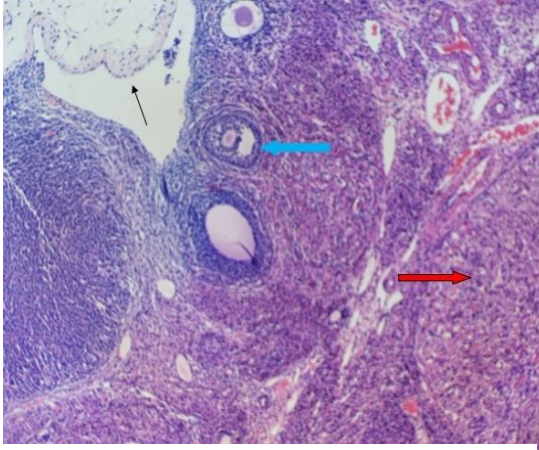
Sections of ovary of rats given 100 mg/kg body weight of *Momordica charantia* extract showed secondary follicles suspended in a dense connective tissue stroma, composed mainly of collagen connective tissues. The ovarian stroma surrounding a

mature Graafian follicle is composed of spindle –shaped, fibroblast-like cells and delicate collagen fibres admixed with ground substance. The oocyte of the Graafian follicle was seen detached from the zona granulosa by a thick layer of cumulus oophorus but closely knitted by the corona radiata. The zona pellucida was clear and distinct while the follicular antrum was extensive and amorphous. The ovarian corpus luteum seems mature with eosinophilic cytoplasm and large nuclei with numerous vesicular spaces between the luteal cells. A wide inter-lutea oedematous blood vessel with few red blood cells was also visible (Figure 1).

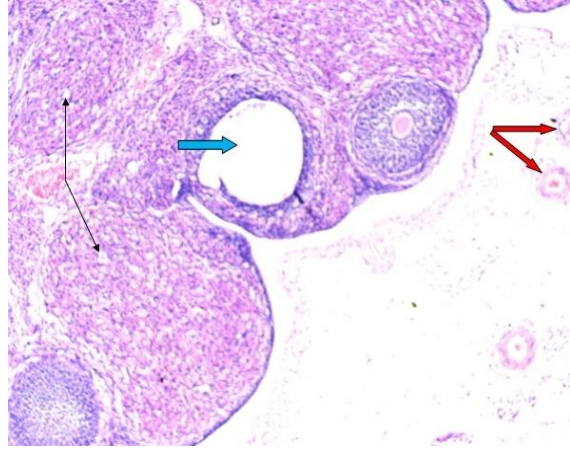
Sections of ovary of rats administered 200 mg/kg body weight of *Momordica charantia* extract revealed many corpus luteum with vesicular foci. One of the follicles seen presented with a large cystic space. Arteries with thick tunica intima and few red blood cells were identified in the inter-lutea borders (Figure 1).

Sections of ovary of rats given 400 mg/kg body weight of *Momordica charantia* extract revealed corpus luteum with some degenerative changes. Follicles presented with cystic spaces and a occlusive zona granulosa with mild vacuolation (Figure 1).

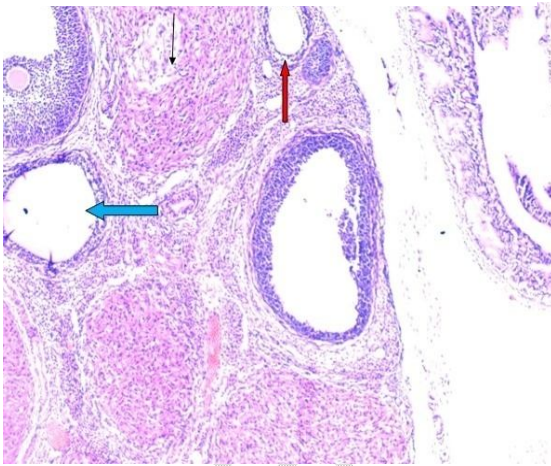
Sections of ovary of rats administered 800 mg/kg body weight of *Momordica charantia* extract revealed corpus luteum with some degenerative changes. Secondary follicles with oocyte and zona granulosa layer with extensive vacuolation were seen (Figure 1).



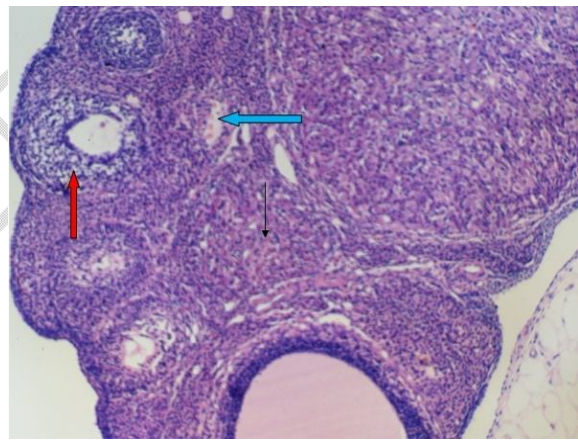
Control: Section of rat ovary showing normal Graafian follicle (blue arrow), Corpus luteum (red arrow) and ovarian bursa (black arrow). H&E . Mag x400



Section of rat ovary administered 200mg/kg bw of MCE showing corpus luteum with vesicular spaces (black arrow), follicular cyst (blue arrow) and severe thickened blood vessels (red arrow). H&E. Mag x400 e



Section of rat ovary administered 400mg/kg bw of MCE showing degenerated corpus luteum (black arrow), follicular cyst (blue arrow) and mild vacuolization of zona granulosa (red arrow). H&E. Mag x400



Section of rat ovary administered 800mg/kg bw of MCE showing degenerating corpus luteum (black arrow), few rbc (blue arrow) and severe vacuolization of zona granulosa (red arrow). H&E. Mag x400

Figure 1 : Sections of rat ovaries for control group, and treatment at 200mg/kg, 400mg/kg, and 800mg/kg body weight/day of the aqueous MCE respectively for 30 days.

3.3 TESTES

Sections of testes from control rats showed testicular parenchyma with numerous seminiferous tubules bound by thin layer of basement membrane. Transverse

sections of seminiferous tubules from control rats showed different phases of spermatogenesis. Sertoli cells tucked between primary spermatocytes were seen supporting germinal cells. Secondary spermatocytes were seen congregating at the center and forming majority of the stromal cells. The cells were lying in discrete layers and had large nuclei with coarse chromatin, peripheral nucleoli, some nuclear vacuoles and poorly stained cytoplasm. Also seen were elongated spermatids and small, mature spermatozoa.

Sections of testis of rats administered 100 mg/kg body weight of *Momordica charantia* extract exhibited germ cells in various phases of spermatogenesis. The seminiferous tubules are well preserved in a clean stroma background. Primary spermatocytes were seen arising from the basal layer with some sertoli cells. Also seen were several secondary spermatocytes in various phases of development. Elongated spermatids and mature spermatozoa were visible. Sections of testes appeared normal when compared with the control (Fig. 2).

Sections of testes of rats administered 200 mg/kg body weight of *Momordica charantia* extract revealed germ cells in various phases of spermatogenesis. The testicular capsule was intact and the seminiferous tubules well preserved. There was evidence of progressive development of germinal cells from the basal layer to primary and secondary spermatocytes with prominent nuclei and eosinophilic cytoplasm. The numerous secondary spermatocytes in various stages of development, spindle shaped spermatids and mature spermatozoa were visible. The morphological presentation observed to be consistent with normal histomorphology of the testis when compared with the control (Fig. 2).

Sections of testes of rats administered 400 mg/kg body weight of *Momordica charantia* extract showed germ cells in various phases of spermatogenesis. The cells were seen lying in discrete layers with large, round, oval nuclei with condensed chromatin, peripheral nucleoli, nuclear vacuoles and poorly stained cytoplasm. Features of testes appeared normal (Fig. 2).

Sections of testes of rats administered 800 mg/kg body weight of *Momordica charantia* extract showed spermatogonia in various stages of spermatogenesis. The seminiferous tubules were intact and well separated with thin, inter-seminiferous tubule basement membrane. The cells were observed to be well preserved with

clear nuclear and cytoplasm differentiation. The nuclei stained purplish-blue and round to oval with condensed chromatin. Spindle shaped spermatids and dot-like spermatozoa were also seen. Features of testes appeared normal when compared with control (Fig. 2).

3.3. DISCUSSION

Observations noticed in this study showed that the oral administration of *Momordica charantia* leaf extract triggered alterations in the histomorphology of the female reproductive organ. Such changes has been attributed to hormonal imbalance especially levels of follicle stimulating hormone, FSH (9, 17, 19).

The activities of this hormone have been reported to depend on the hypothalamic-pituitary-ovarian axis integrity and that of the hypothalamus-pituitary-gonadal axis through the positive and negative feedback loops and products (20, 21).

Hormonal imbalance could be due to elevated estradiol value which could be caused by stress, low fiber, nutrients deficiencies, high toxic burden, gut dysbiosis, elevated beta-glucuronidase, constipation, and methylation gene variants (22). It could also be due to high level of progesterone and prolactin (23, 24). High levels of progesterone have been implicated in pregnancy, ovarian cyst, molar pregnancy, ovarian cancer or adrenal glands disorder (23) while high level of prolactin has been attributed to pituitary tumour, hypothyroidism, and disease of the hypothalamus (24). Sections of ovaries of Wistar rats at the dose of 200 mg/kg body weight of MCE revealed follicular cyst and arteries with thick tunica media. Such changes may be due to the high plasma levels of follicle stimulating hormone (FSH) and progesterone (22). Follicle stimulating hormone (FSH) is produced by the gonadotropin releasing hormone (GnRH) from the hypothalamus-pituitary axis which in turn stimulates the granulosa cells of the ovaries to secret progesterone (8, 21).

The follicular cyst observed histologically in this study could have been induced by the phytochemical constituents in *Momordica charantia* especially, steroids. Activities of steroids have been implicated in the developmental status of the ovarian follicles (6, 25).

Ovarian sections of Wistar rats administered with 400 and 800 mg/kg body weight of MCE showed follicular cyst, mild vacuolation and severe vacuolation of granulosa cells layer, disorientation of interstitial cells, obliteration of theca cells and disorganization of the follicular morphology respectively. This is a more severe effect that could have resulted from high levels of FSH and progesterone (8, 21, 22). Dosage of 100, 200, 400 and 800 mg/kg body weight of *M. charantia* leaf extract showed no negative histomorphological effect on the testes of the Wistar rats. This is an opposite effect on what was observed for female animals. An estimation of testosterone levels in the male animals could be a complementing investigation to reinforce this observation of ours as phytochemical substances in plants has been credited with aphrodisiac capability hence encouraging consumption in males (26, 27, 28). The testis is the male reproductive organ responsible for sperm cell production and the secretion of testosterone (29). Testosterone is secreted by Leydig cells of the testis and the stimulus for its production depends on the blood level of luteinizing hormone (LH) from the pituitary (30). The testis is also where spermatogenesis occurs and this function depends on endocrine control by the pituitary-testicular axis in concert with complex autocrine and paracrine interactions with Sertoli cells, germ cells, leydig cells, endothelial cells and testicular macrophages (31). Both the hypothalamus and pituitary controls the endocrine functions of the testis by the release of FSH and LH. Luteinizing hormone when

released acts on Leydig cells to stimulate testosterone synthesis while FSH acts on Sertoli cells to regulate spermatogenesis (32).

4. CONCLUSION

Momordica charantia extract altered the histomorphological architecture of the ovaries in female Wistar rats which could lead to infertility and malfunctions while there was no alteration in the histomorphological architecture of the testes of the animals.

CONSENT

NOT APPLICABLE

ETHICAL APPROVAL

All authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropriate ethics committee.

REFERENCES

1. Ajani EO, Sabiu S, Bamisaye FA, Ibrahim S. and Salau BA. Evaluation of the Acute and Sub-acute Toxicity Effects of Ethanolic Leaves Extract of *Lagenariabrevitolia* (Bitter gourd) of Hepatic and Renal Function of Rats. *European Journal of Medicinal Plants*. 2015;5(2):210-219.
2. Adekunle FA, and Akinbo FO. Effect of Aqueous *Garcinia Kola* Seed Extract on The Histopathology of The Reproductive Organs of Wistar Rats. *Journal of Basic and Applied Medical Sciences*. 2020;1(2):61-69.

3. Linus SC. Nigerian folklore medicinal plants with potential antifertility activity in males: A scientific appraisal. *Research Journal of Medicinal Plants*. 2016;10:201-227.
4. Grace IO, Olusola O, Adegboyega OA, Obasola EF, Neena V, Isaac O, et al. In vitro studies on the sensitivity pattern of Plasmodium falciparum to anti-malarial drugs and local herbal extracts. *Malaria Journal*. 2014;13:63
<https://www.malariajournal.com/content/13/1/63>
5. Chikezie PC, Ojiako OA, Nwufo KC. Overview of Anti-Diabetic Medicinal Plants: The Nigerian Research Experience. *Journal of Diabetes Metabolism*. 2015;6:546.
6. Shuo J, Mingyue S, Fan Z, Jianhua X. Recent Advances in Momordicacharantia: Functional Components and Biological Activities. *International Journal of Molecular Sciences*. 2017;18:2555.
7. Ahadina R, Shishir AS, Sabrina HS, Hosne J S, Pritesh RD. A comprehensive review of Momordica charantia L. (Karela). *International Journal of Botany Studies*. 2018;3(1):95-102.
8. Benard SA. Histopathological Effects of Consumption of Aqueous Extract of The Leaf of Momordica charantia ON The Reproductive Organs Of Wistar Rats. An MSc Thesis presented to the department of Medical Laboratory Science, Faculty of Basic Medical Sciences, University of Bening, Benin. 2021.
9. Ihesie GC. The medicinal values of Balsam pear.
<https://guardian.ng/features/health/the-medicinal-values-of-balsam-pear/>
10. Ataman JE & Idu M. Histopathologic Effects of Methanolic Extract of *Momordica charantia* L. Leaves on the Liver of Wistar Rats. *Trends in Medical Research*. 2007;2(4):176-184.

11. Nguyen PM. Extraction of polyphenol in bitter melon (*Momordica charantia*). *International Journal of multidisciplinary research*. 2014;1(4):115-125
12. Javed A, Saima A, Showkat RM. *Momordica charantia* Linn. (Cucurbitaceae): Review on Phytochemistry and Pharmacology. *Research Journal of Phytochemistry*. 2017;11(2):53-65.
13. Rafaela DS, Marilia BC, Rafael JR, Luiz CA, Karina PR. Anatomical Study and Characterization of Metabolites in Leaves of *Momordica charantia* L. *Pharmacognosy Journal*. 2018;10(5):823-826.
14. Deepti K, and Vijendar SM. Phytochemical and Pharmacological Profile of *Momordica Charantia*: A Review Biochemistry and Therapeutic Uses of Medicinal Plants. *Biochemistry and Therapeutic Uses of Medicinal Plants*. Discovery Publishing House Ltd. 2017; ISBN:979-93-5056-866-8
15. Panas T, Ravicha, P, Urai P, Wachiryah T. Reroductive toxicity of *Momordica charantia* ethanol seed extracts in male rats. *Iran Journal of Reproductive Medicine*. 2014;12(10):695-704.
16. Narendra SD. Safety assessment of McB-E60(extract of a *Momordica* sp.): Subchronictoxicity study in rats. *Toxicology Reports*. 2016;3:481-489.
17. Osonuga OA, Osonuga IO, Osonuga A. Oral administration of leaf extracts of *Momordica charantia* affects reproductive hormones of adult female Wistar rats. *Asian Pacific Journal of Tropical Biomedicine*. 2014a; 4(1):5521-5524.
18. Osonuga OA, Osonuga OI, Osonuga A. Evaluation of Oral Administration of Aqueous Leaf Extract of *Momordica charantia* on Fertility Hormones of Adult Male Wistar Rats. *Global Journal of Pharmacology*. 2014b;8(2):150-153.
19. Umar IM. Effects of oral administration of *Momordica charantia* on

haematological parameters of adult albino rats. *Bayero Journal of Pure and Applied Sciences*. 2017;10(2):52-56.

20. Catteau A, Bach-Ngohou K, Blin J, Barriere P, Freour T, Masson D. Abnormally elevated Follicle –Stimulating Hormone (FSH) Level in an Infertile Woman. *Case Report in Endocrinology*. 2019; <https://doi.org/10.1155/2019/3071649>. PMID

20. Emokpae MA, Ogboru E, Abubakrae RO. Relationship between Luteinizing hormone/follicle stimulating hormone and body mass index in women with polycystic ovarian syndrome. *Journal of Medical Laboratory Science*. 2020; 30(4):1-10.

21. Oke JA, Onyeaghala AA, Dada RA. Thesis and Antithesis of Infertility in Nigeria: A Review and Implications on Medical Laboratory Practice. *Journal of Medical Laboratory Science*. 2020;30(2):18-37.

22. Composed nutrition. 12 possible causes of high estrogen. 2020
<https://www.composednutrition-com.cdn.ampproject.org>

23. Medlineplus. Lab tests. Progesterone-test. 2021a
<https://medlineplus.gov/lab-tests/progesterone-test>

24. Medlineplus. Lab tests. Prolactin levels. 2021b
<https://medlineplus.gov/lab-tests/prolactin-levels>

25. Ann ED. The role of steroids in follicular growth. *Reproductive biology and endocrinology*. 2006;4(16):3-11.

26. Husna NR, Nuriham HN, Azizah AH, Aman FO. Acute Oral Toxicity Effects of Momordica Charantia In Sprague Dawley Rats. *International Journal of Bioscience, Biochemistry and Bioinformatics*. 2013;3(4):408-410

27. Sampath KP & Bhowmik D. Traditional medicinal uses and therapeutic benefits of *Momordica charantia* Linn. *International Journal of Pharmaceutical Sciences Review and Research*. 2010;4(3):23-28.
28. Msiska T, Mwakikunga A, Tembo D, Lampiao FA. A phytochemical analysis and in vivo effects of an herbal aphrodisiac, *Nwotonia hildebrandtii* on male wistar rat reproductive system. *Pharmacological research*.2020;12(3):243-249.
29. Gordon JB, Peter D, Eddie J, Jody EJ, Oksana K, Kruse D, Brandon P, James AW, Womble M, Kelly AY. *Anatomy and Physiology*. OpenStax College, Rice University; 6100 Main Street, MS-300; Houston Texas. 2013;345.
30. Pauline C, Matan G, Ombeline H, Tatiana F, Patrice M. Pituitary Cell and Molecular. *Encyclopedia of Reproduction (Second Edition)*. 2018;1:184-187
31. lipo H. Endocrine and local testicular regulation. *Oxford Textbook of Endocrinology and Diabetes*. Second edition.2011; <https://doi:10.1093/med/9780199235292.003.9018>
32. Jenny O. Male reproductive system. *Guidelines to histopathological evaluation*. 2008. https://oecd.org/male_reproductive_system