

## Histoarchitecture and Biochemical Effects of Coconut Oil Extract on the Ovary of Adult Wistar Rats

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### Abstract

**Background:** Coconut oil (CO) is a byproduct of coconut which can be extracted through heat or cold press method. Infertility in women is a problem in the society and some locals believe that coconut oil could be a solution to it. The ovary is the main female reproductive organ which functions by housing ovules and releasing them at regular cycle.

**Methods:** This study investigated the effects of coconut oil on the female reproductive organ (ovary) and the change in weight of the animals as obesity can also reduce the chances of a female's fertility. Eighteen (18) female rats were grouped into three groups A1-A6. Control, Low CO (0.6ml/200g body weight), High CO (1.2ml/200g body weight) doses.

**Results:** This study showed no significant change in LH, FSH, GnRH, progesterone level at the administration of low and high dose of coconut oil in Wistar rat. There was also found to be a significant decrease ( $p < 0.05$ ) in the estradiol level after the administration of low and high dose of coconut oil when compared with the control group. There was a slight increase in the body weight of animals given low dose coconut oil while those that were administered with high dose showed significant increase in their body weight.

**Conclusion:** from the results, there is very little effect of coconut oil on the hormonal levels of the female rats but excessive use of coconut oil could lead to obesity and that might be implicated as a risk factor for female infertility.

**Keywords:** Coconut Oil; Ovary; Wistar Rats

### Introduction

Coconut Oil is a pale yellow, semisolid, edible oil that is stable in air at room temperatures. It is miscible in carbon disulfide, chloroform, ether, and petroleum benzin and insoluble in water. Unlike other oils, Coconut Oil undergoes little change in melting point and consistency following hydrogenation because of its high degree of saturation. The narrow range of plasticity of Coconut Oil and the inability of the processor to modify greatly the properties of the oil restrict the use of Coconut Oil in edible products [5].

The ovary is a reproductive organ. Ovaries are paired pelvic organs that lie on either side of the uterus close to the lateral pelvic wall, behind the broad ligament and anterior to the rectum [2].

The ovary plays a pivotal role in the production of steroid hormones necessary for follicular development and oocyte maturation. It contains a finite number of oocytes that a female rat will have for the span of her reproductive life and influences the hormonal environment required for oocyte maturation and fertilization [6]. This complex regulation can be negatively impacted when pathologies occur within any juncture of the hypothalamic pituitary ovarian axis [6].

Vaginal smear cytology is used for the determination of the estrous cycle phases. The phases are described as follows: A proestrus smear consists of a predominance of nucleated epithelial cells an estrous smear primarily consists of a nucleated cornified cells. metestrus smear consists of the same proportion among leukocytes, cornified, and nucleated epithelial cells and a diestrus smear primarily consists of a predominance of leukocytes. The mean cycle length of a female rat is four days [4].

Estrous cycle is controlled by a cascade of neuroendocrine events, involving the activation of the hypothalamic-pituitary-gonadal axis [3].

## Materials and Methodology

### Procurement of animals

Eighteen (18) adult female Wistar rats with average weight of 200g were obtained from the University of Ilorin Biological garden, Ilorin. They were housed in cages and fed with standard laboratory diet and water ad libitum in the animal holding unit of the Faculty of Basic Medical Sciences, College of Health Sciences, University of Ilorin, Ilorin. The rats were exposed to a 12 hours' light/dark cycle at room temperature for 14 days before the commencement of the experiments. All rats were handled in accordance with the standard guide for the care and use of laboratory animals.

### Extraction of coconut oil

Coconut (*cocos nucifera*) was purchased in Oja Oba market in Ilorin, Kwara State, Nigeria and a voucher number (UILH/001/508/2021) was gotten from the Department of Plant Biology, University of Ilorin. The coconut was dishelmed and washed, grated by a manual grating to get fine particles which was air dried at room temperature for seven days. The initial weight before air drying was 6.12 kg and the weight after air drying was 3.261 kg. The Coconut Oil was extracted through the Soxhlet Extraction process, the solvent used was Petroleum Ether (boiling point 60-80°C). The solvent was heated and the vapor travelled up the distillation arm and flowed into the chamber housing the air dried coconut meat, the chamber containing the coconut meat slowly fills with the warm solvent thereby dissolving some of the air dried coconut and the cycle continues until the coconut meat was finished.

### Animal grouping

The rats were assigned according to their sex and dose administered into six groups A1-A6, each consisting of six animals. The control group was given 10 ml/kg of distilled water, the low dose group was given 500 mg/kg of coconut oil and the high dose group was given 1000 mg/kg of coconut Oil. All administration was given orally and for a period of 21 days.

### Vaginal smear

Vaginal fluid was taken every day for a period of 21 days before 10am from the female Wistar rats. The rats were held between the index and third fingers on the dominant hand while the other hand is used to insert a tiny pipette filled with sodium chloride (NaCl). The pipette is pressed to flush the fluid into the vagina and then released to suck it back after it must have mixed with the vaginal fluid, this is repeated one more time and then the vaginal fluid is placed on a glass slide for viewing and detecting the day of estrus cycle.

### Animal sacrifice

Animals were sacrificed under anesthesia ketamine (20 mg/kg) intramuscularly (IM), and a blunt thoracoabdominal incision was done, transcardial blood was collected in plain bottles and allowed to stand for 15-20 minutes for clotting to get the serum and was centrifuged at 4000 revolutions per minute for 30 minutes. The liver was then collected from each group into sample bottles and fixed in 10% formosaline for histology.

### Biochemical analysis

At the end of the treatment period, the animals were anaesthetized, sacrificed, and the ovaries were quickly removed and weighed. The serum was frozen at -20°C for biochemical measurements. The serum levels of the activity of ALT, AST, ALP, TP and ALB were measured using automated biochemical analyser (Simoa HD-1 biochemical analyser).

### Statistical analysis

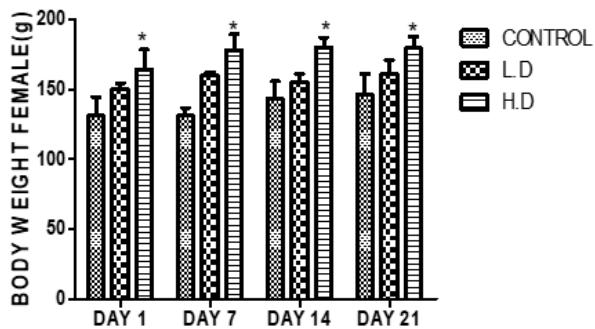
Data from the morphometric, behavioral and biochemicals were analyzed using One-way analysis of variance (ANOVA) and subjected to post hoc Bonferroni's multiple comparison test. The results are expressed as mean±SEM. Statistical analyses were performed using Graph Pad Prism software (version 5.0, La Jolla, CA). Values of  $p < 0.05$  were considered statistically significant.

## Results

### Body weight

The body weight of male and female Wistar rats was taken before, during and after the experiment across experimental groups.

Administration of coconut oil extract in female Wistar rats produced significant increase ( $p < 0.05$ ) in weight of the animals as illustrated in figure 1.

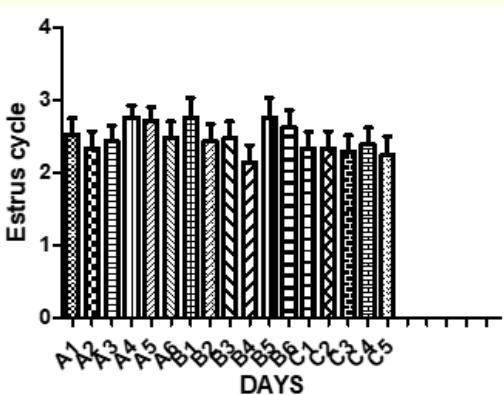


**Figure 1:** Body weight changes of experimental animals.

CONTROL; L.D = Administration of coconut oil extract in low dose; H.D = Administration of coconut oil in high dose.

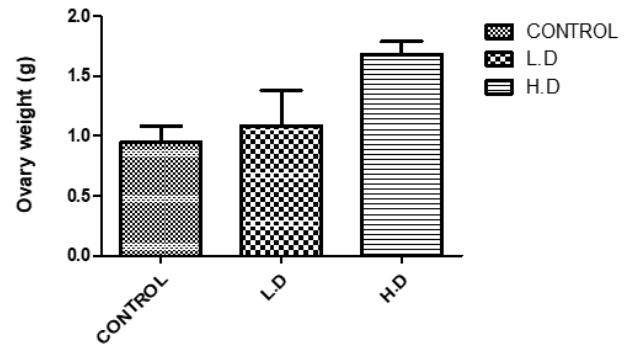
### Vaginal smear

There was no significance in the estrus cycle of the Wistar rats after being administered with coconut oil extract. The graph showing the estrus cycle is shown below in figure 2.



**Figure 2:** Graphical representation of the estrus cycle of the Wistar rats.

### Ovary weight changes

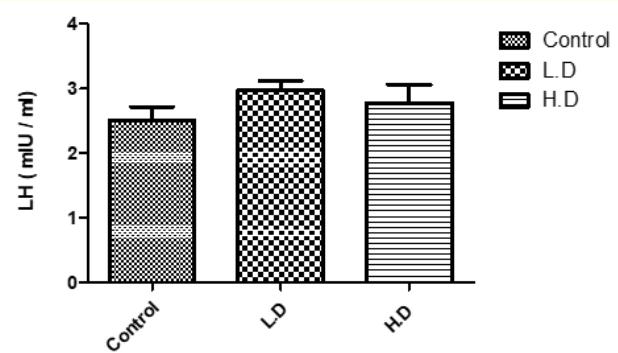


**Figure 3:** Ovary weight changes of the experimental animals. CONTROL; L.D = Administration of coconut oil extract in low dose; H.D = Administration of virgin coconut oil in high dose.

### Biochemical analysis

#### Effects of coconut oil on luteinizing hormone (LH) level

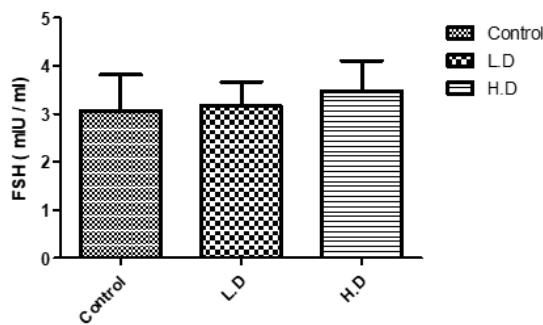
There was no significance in the serum level Luteinizing hormone (LH) in the adult female Wistar rats when they were exposed to both high doses and low doses of coconut oil, but a slight increase ( $p > 0.05$ ) was noted in the low dose and high dose group when compared with the control group as shown in figure 4 below.



**Figure 4:** A graphical showing the effects of coconut oil on luteinizing hormone (LH).

### Effects of coconut oil on follicle stimulating hormone (FSH) level

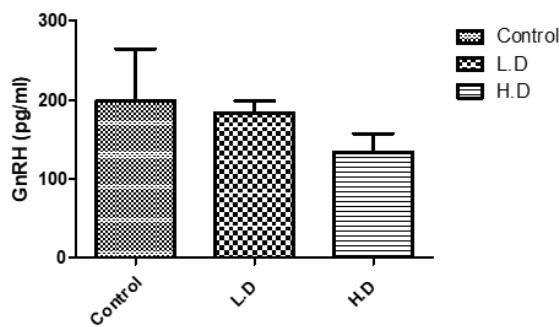
There was no significant difference in the level of Follicle stimulating hormone (FSH) after the Wistar rats were induced with different doses of coconut oil, but there was a slight increase ( $p > 0.05$ ) noted in the low and high dose group when compared with the control group as shown in figure 5 below.



**Figure 5:** A graph showing the effects of coconut oil on Follicle stimulating hormone (FSH) level.

### Effects of coconut oil on gonadotrophin releasing hormone (GnRH) level

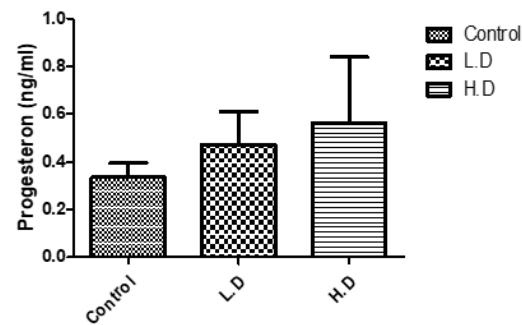
There was no significance in the serum level of GnRH in the female Wistar rat after they have been administered with both high dose and low dose coconut oil, but a slight decrease ( $p > 0.05$ ) was noted in the low and high dose group when compared to the control group as shown below.



**Figure 6:** A graph showing the effects of coconut oil on Gonadotropin releasing hormone (GnRH) Level.

### Effects of coconut oil on progesterone level

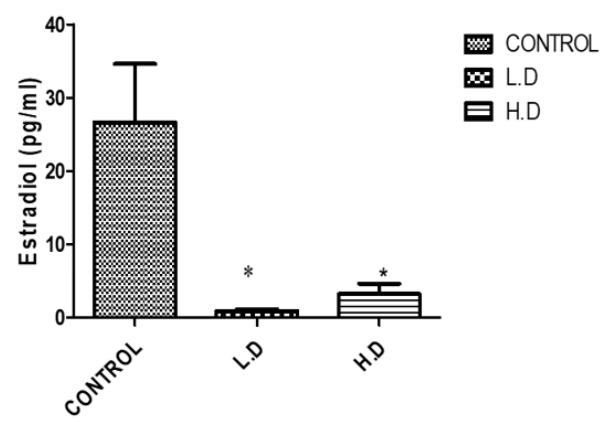
There is no significant change in the serum level of progesterone of the female Wistar rats in comparison with the control group after others were administered low dose and high dose coconut oil. There was an increase observed in both the low dose and high dose in comparison with the control.



**Figure 7:** A graph showing effects of coconut oil on progesterone.

### Effects of coconut oil on estradiol level

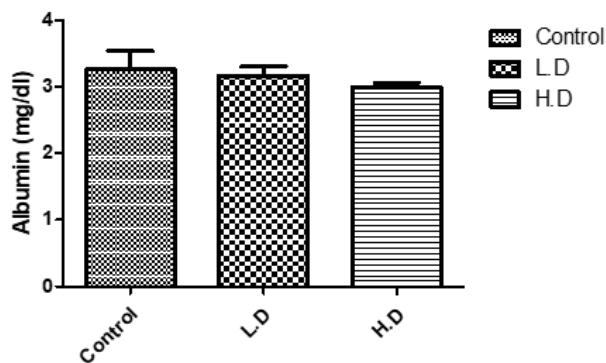
A significant decrease ( $p < 0.05$ ) was noted in the level of estradiol in the low dose and high dose group when compared with the control group as shown in the figure 8 below.



**Figure 8:** A graph showing effects of coconut oil on estradiol level.

### Effects of coconut oil on albumin level

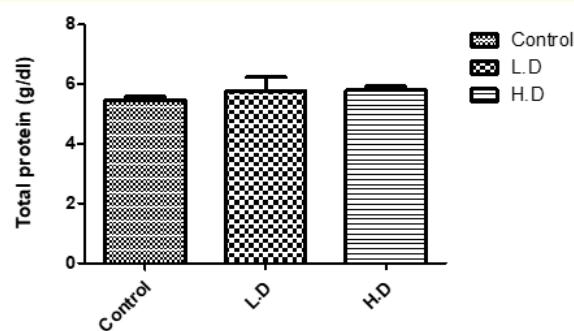
There is no significant change in the serum level of Albumin of the female Wistar rats, but there was a slight decrease ( $p > 0.05$ ) in comparison with the control group after the administration of low dose and high dose of coconut oil as shown in figure below.



**Figure 9:** A graph showing effects of coconut oil on albumin.

### Effects of coconut oil on total protein level

There is no significant change in the serum level of Total protein level of the female Wistar rats, but there was a slight increase ( $p > 0.05$ ) in comparison with the control group after the administration of low dose and high dose of coconut oil.



**Figure 10:** A graph showing effects of coconut oil on total protein.

### Photomicrographs

The ovary sections were stained using H&E stains and the images were captured using an Amscope at different magnifications.

**Figure 11**

**Figure 12**

### Discussion

Coconut oil is very commonly used as a tropical edible oil in many Asian cultures and is composed of almost 90-95% saturated fatty acids. The health and nutritional benefits derived from coconut oil are both compelling and contradictory, mainly due to its high saturated fat content as relates to chronic diseases [7].

In this study, we sought to identify the effect of Coconut Oil on the fertility and weight of the female Wistar rat (*Rattus norvegicus*). It was noted in this study that coconut oil does not have a significant effect on the level of the female reproductive hormones except for the level of estradiol that significantly decreased when compared with the control group after the administration of low and high dose of coconut oil. The insignificant effect of the coconut oil on other hormonal levels could be as a result of the little quantity of

doses administered. Although, researches have not been carried out on the effect of coconut oil on the hormonal levels of the female reproductive system of Wistar rat, coconut oil is generally believed to have a positive effect on the body. According to Carandang, 2008(1) the substances which are present in minute quantities in coconut oil provide nutritional and health benefits, especially in preventing or minimizing chronic diseases, apart from the protection already derived from MCFAs.

This study showed slight changes ( $p > 0.05$ ) in LH, FSH, GnRH, progesterone level at the administration of low and high dose of coconut oil in Wistar rat. There was also found to be a significant decrease ( $p < 0.05$ ) in the estradiol level after the administration of low and high dose of coconut oil when compared with the control group.

The animals were grouped into three groups control, low dose (500 mg), high dose (1000 mg), the low and high dose of coconut oil administered were compared with the control group that was given 10 ml/kg of distilled water that is, 2 ml/200g of Wistar rat.

## Conclusion

The result shows that coconut oil has no significant effect on the hormonal level and the estrus cycle of the female reproductive system of Wistar rats.

## Acknowledgement

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## Conflicting Interest

No conflict of interest.

## Contribution of Authors

Abioye, A.I.'R conceived and designed the research, Sulyman, O.R was involved in data acquisition, data analysis, statistical analysis, manuscript preparation. Literature search and manuscript review were done by Sulyman, O.R, Abioye, A.I.'R. Final approval of the version to be published was approved by Abioye, A.I.'R.

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