



## Alterations in Female Reproductive Hormones of Wistar Rats Sequel to the Administration of *Xylopi aethiopic a* Fruit

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### Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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### ABSTRACT

**Aim:** This present study was designed to examine the impact of *Xylopi aethiopic a* fruit on the reproductive hormones of female Wistar rats.

**Methodology:** The fruits of *Xylopi aethiopic a* were air-dried and extracted by Soxhlet extractor using ethanol as solvent. The lethal dose of the plant extract was assessed by standard method. Thirty adult female Wistar rats were grouped into 5 of 6 rats each. Animals in groups A, B, C, and D were exposed to 130, 259, 389 and 518 mg/kg b. wt. of *X. aethiopic a* fruit extract respectively, while those in group E received normal animal feeds and water only. The administration was done once daily for 28 days via oral route. Reproductive hormones were assay using ELISA techniques.

**Results:** A non-significant increase was observed in the blood concentration of follicle stimulating hormone (FSH) when animals exposed to 130 mg/kg b. wt. of *Xylopi aethiopic a* fruit extract were compared with those in the control group. Increase in the dose of *Xylopi aethiopic a* fruit extract resulted in a decrease in serum FSH levels. Administration of the extract for 28 days led to a dose-

dependent decline in the blood level of luteinizing hormone (LH). The result of this study indicates the extract decreased serum level of progesterone in female rats at low doses of 130 mg/kg and 259 mg/kg when compared with those in the control group. However, increasing the dosage of the extract increases the serum progesterone concentrations. Administration of *Xylopi aethiopia* extract to animals for 28 days led to a dose-dependent decline in the serum concentration of estrogen. This decrease was significant ( $P < 0.05$ ) when the estrogen levels of animals exposed to 389 mg/kg and 518 mg/kg of *Xylopi aethiopia* extract were respectively compared with those in the control group. Conversely, *Xylopi aethiopia* extract increases serum levels of prolactin with respect to dosage.

**Conclusion:** The impact of *Xylopi aethiopia* extract on female reproductive hormones observed in this study showed that the extract might be a potent contraceptive. Contraceptives of plant origin should be generally acceptable because they are less expensive with minimum adverse effects than synthetic agents.

**Keywords:** Contraceptive; female reproductive hormones; infertility; *Xylopi aethiopia* fruit.

## 1. INTRODUCTION

*Xylopi aethiopia* has a great patronage in both nutrition and ethnomedicine. The plant which also known as African Negro pepper, is popular among traditional medicine practitioners and traditional birth attendants (TBA) who utilize the fruit preparations to cause the discharge of placental after a woman has giving birth [1]. A preparation of the stem bark or fruit is helpful in the management of bronchitis, stomach aches, asthma, and dysenteric conditions [2]. The seed extract is helpful as a vermifuge for roundworms [3]. Several postnatal women eat the aqueous preparation of the fruit for its perceived antiseptic properties. Some of the women have been reported to sometimes come to the hospitals with characteristics which suggest complications in organ [4]. Medicinal plant extracts with a therapeutic property has the tendency of wrong prescription and sometimes, overdosed. The fact that *Xylopi aethiopia* is a natural product does not automatically confers on it safety and might be risky to its consumers. Chemical ingredients of the plant are perceived to be useful in preventing and managing cancerous tumors [5]. *Xylopi aethiopia* fruit is known to have alkaloids, terpenoids, flavonoids, and organic oils [6,1].



**Fig. 1.** *Xylopi aethiopia* Fruit [7]

*Xylopi aethiopia* is characterized with numerous chemical components with various medicinal potentials [8]. The chemical components of this plant have been investigated to include saponins, sterols, carbohydrates, glycosides, mucilage, acidic compounds, tannins, balsams, cardiac glycosides, volatile aromatic oils, phenols [9,10], alkaloids, rutin and fixed oils [11,12]. The plant has also be known to contain vitamins such as vitamin A, vitamin B, vitamin C, vitamin D, and vitamin E, and proteins as well as several minerals such as copper, manganese and zinc [10,12]. The impact of the fruit on b. wt. and glucose concentration [13] and lipid profile [14] of animals has been reported. The fruit has also been reported to induce hepatotoxicity [15], renal toxicity [16] as well as oxidative stress [17]. Recently, Ogbuagu et al. [18] reported that the fruit extract of *Xylopi aethiopia* adversely perturbed sperm qualities in male Wistar rats. This study was therefore aimed at investigating its effect on the reproductive hormones of female Wistar rats.

## 2. MATERIALS AND METHODS

### 2.1 Collection and Authentication of Plant Materials

The *Xylopi aethiopia* fruits were purchased from a market in Aba, Abia State. They were authenticated by Prof. (Mrs.) Margaret Basseyy of Botany and Ecological Studies Department, University of Uyo. It was assigned a voucher number of UU/PH/4e and deposited in the Herbarium of the Department of Pharmacognosy and Natural Medicine, University of Uyo, Akwa-Ibom State, Nigeria.

### 2.2 Extraction of Plant Materials

Extraction of the plant was carried out based on the outlined method in Ogbuagu et al. [7]. The

fruits were rinsed under flowing tap water to eliminate contaminants and air-dried. The plant material was milled by laboratory blender. The pulverized plant material was macerated in 250 mL of 99.8% ethanol (Sigma Aldrich) contained in a flask attached to a Soxhlet extractor coupled with condenser and heating mantle (Isomantle). It was then poured into the sample holder (thimble) and inserted in the apparatus. The side arm is lagged with glass wool. The mixture was heated using the heating mantle (Isomantle) at 60 °C and as the temperature rises it starts to evaporate, going via the extractor to the condenser. The condensate dropped into the reservoir keeping the thimble. As soon as the solvent gets to the siphon it emptied itself into the flask and the process repeats itself. The procedure goes on until it is exhaustively extracted. The process runs for a total of 13 hours. As soon as it was set up, it was allowed to run without interruption as long as water and power supply were not interrupted. The apparatus was switched on and off and overnight running was not allowed, and the time for the complete process split over some days. The extract was poured into 1000 mL beaker and concentrated to dryness in water bath (A3672-Graffin Student Water Bath) at 35 °C. The total weight of the marc (residue) and the concentrated extract were noted. Several days was spent on the entire process. The evaporated extract was kept in the refrigerator until when the need for it arise.

### 2.3 Determination of Median Lethal Dose (LD<sub>50</sub>)

The lethal dose (LD<sub>50</sub>) of the fruit extract was determined using albino mice according to the method described by Airaodion et al. [19]. This method involves two phases:

In Phase one, five groups containing five mice each weighing between 20 g and 27g were fasted for 18 hours. They were respectively treated with 1000 mg/kg, 2000 mg/kg, 3000 mg/kg, 4000 mg/kg and 5000 mg/kg body weight via intraperitoneal (i.p) route and were monitored for visible signs of toxicity and mortality for 24 hours. A dosage of 1000 mg/kg recorded 0% mortality while 2000 mg/kg, 3000 mg/kg 4000 mg/kg and 5000 mg/kg recorded 100% mortality within 24 hours. Based on the value of phase one, phase two was conducted.

In Phase two, twenty-five albino mice weighing between 20 and 27g were grouped into 5 of 5

mice per group and were fasted for 18 hours. Each group was administered 1200 mg/kg, 1400 mg/kg 1600 mg/kg, 1800 mg/kg and 2000 mg/kg b. wt. intraperitoneally (i.p) and was observed for physical signs of toxicity and mortality within 24 hours. 1200 mg/kg recorded 0% mortality while 1400 mg/kg, 1600 mg/kg, 1800 mg/kg and 2000 mg/kg recorded 100% mortality within 24 hours. The LD<sub>50</sub> was computed as according to the formula below:

$$LD_{50} = \sqrt{ab}$$

Where a = highest dose giving 0% mortality  
b = lowest dose giving 100% death

### 2.4 Experimental Design

Thirty female Wistar rats used in this study were purchased from the University of Uyo, Nigeria. They were acclimatized for seven days prior to the start of the treatment. The weights were determined and were separated into five groups of six rats each. Groups A, B, C, D served as the experimental groups, while group E served as the control. Animals in group A were exposed to 130 mg/kg b. wt. (10% of LD<sub>50</sub>) of *X. aethiopica* fruit extract, those in group B were treated with 259 mg/kg b. wt. (20% of LD<sub>50</sub>) of *X. aethiopica* fruit extract, those in group C were exposed to 389 mg/kg b. wt. (30% of LD<sub>50</sub>) of *X. aethiopica* fruit extract, those in group D were treated with 518 mg/kg b. wt. (40% of LD<sub>50</sub>) of *X. aethiopica* fruit extract, while those in group E (control) received normal animals feeds and water only. The treatment was done once daily for 28 days via oral route. After the treatment period, the animals were sacrificed under ether anaesthesia in a desiccator after an overnight fast. Blood was taken from the rats through cardiac puncture.

### 2.5 Estimation of Female Reproductive Hormones

Blood levels of follicle stimulating hormone (FSH), luteinizing hormone (LH), progesterone, estrogen and prolactin were measured by enzyme-linked immunosorbent assay (ELISA) technique described by Tanv and Harkaran [20].

### 2.6 Statistical Analysis

Results were statistically analyzed using Graph Pad Prism software. Data were presented as Mean ± Standard Deviation (SD). The means were compared by one-way analysis of variance

(ANOVA), followed by Tukey's post hoc test. The results were considered to be significant at 95% confidence level ( $p \leq 0.05$ ).

### 3. RESULTS

#### 3.1 Median Lethal Dose (LD<sub>50</sub>) Result

The visible signs of toxicity of *X. aethiopica* fruit extract observed in this study are excitation, decreased motor activity, paw licking, increased respiratory rate, gasping and coma which could be followed up by death. In the first phase of the median lethal dose determination, no death was observed in the group administered 1000 mg/kg b. wt. of *X. aethiopica* fruit extract. However, all the animals died in the groups exposed to 2000, 3000, 4000, and 5000 mg/kg b. wt. of *X. aethiopica* fruit extract respectively (Table 1). In the same vein, in the second phase of medial lethal dose determination, no death was recorded in the group treated with 1200 mg/kg b. wt. of *X. aethiopica* fruit extract while 100% mortality was recorded in the groups treated with 1400, 1600, and 1800 mg/kg b. wt. of *X. aethiopica* fruit extract respectively as presented in Table 1.

The LD<sub>50</sub> was computed as according to the formula below:

$$LD_{50} = \sqrt{ab}$$

Where a = highest dose giving 0% mortality

b = lowest dose giving 100% death

Thus, a = 1200 mg/kg

b = 1400 mg/kg

LD<sub>50</sub> = 1296.15 mg/kg

#### 3.2 Impact of ethanolic extract of *Xylopi*a *aethiopica* fruit on Female Reproductive Hormones of Animals after 28 days of Treatment

A unnoticeable increase was seen in the blood concentration of FSH when animals exposed to 130 mg/kg b. wt. (low dose) of *Xylopi*a *aethiopica* fruit extract were compared with those in the control group ( $P = 0.05$ ), as presented in Table 2. Increase in the dose of *Xylopi*a *aethiopica* extract resulted in a decrease in serum FSH levels. This decrease was significant when the FSH levels of animals treated with 389 mg/kg and 518 mg/kg b. wt. of ethanol extract of *Xylopi*a *aethiopica* fruit were respectively compared with those in the control group ( $P < 0.05$ ). Administration of ethanol

extract of *Xylopi*a *aethiopica* fruit to animals for 28 days led to a dose-dependent decrease in the serum level of luteinizing hormone (LH). This decrease was only significant ( $P = 0.01$ ) when the LH levels of animals treated with 259, 389 and 518 mg/kg of *Xylopi*a *aethiopica* extract were respectively compared with those in the control group. The result of this study indicates that extract of *Xylopi*a *aethiopica* decreased serum level of progesterone in female rats at low doses of 130 mg/kg and 259 mg/kg. The decrease was only significant ( $P < 0.05$ ) at the lowest dose of 130 mg/kg when compared with those in the control group. However, increase in the dose of the extract increases the serum progesterone concentrations. The increase became significant ( $P = 0.02$ ) when the concentration of serum progesterone in animals treated with 518 mg/kg of *Xylopi*a *aethiopica* extract were compared with those in the control group. Administration of *Xylopi*a *aethiopica* extract to animals for 28 days led to a dose-dependent decrease in the serum level of estrogen. This decrease was only significant ( $P < 0.05$ ) when the estrogen levels of animals treated with 389 mg/kg and 518 mg/kg of *Xylopi*a *aethiopica* extract were respectively compared with those in the control group. Conversely, *Xylopi*a *aethiopica* extract increases serum levels of prolactin in a dose-dependent manner. The increase was however nonsignificant ( $P < 0.05$ ) when the prolactin levels of animals treated with 130 mg/kg (low dose) of *Xylopi*a *aethiopica* extract were compared with those in the control group.

### 4. DISCUSSION

The acute toxicity study of the plant extracts recorded 100% mortality at a dose of 1400 mg/kg bodyweight and above (Table 1). This shows that the fruit of *Xylopi*a *aethiopica* might be highly toxic. The visible signs of toxicity seen in the animals are excitation, paw licking, increased respiratory rate, decreased motor activity, gasping and coma which was followed by death.

The results of the impact of ethanolic fruit extract of *Xylopi*a *aethiopica* on female reproductive hormones of Wistar rats after twenty-eight days of exposure are shown in table 2. The ability of pre-ovulatory follicles to mature as well as for ovulation to occur is controlled by the effects of ovary as well as ovarian hormones. Perturbations in the levels of these hormones result in abnormality in ovarian functions as well as the period of estrous cycle [21].

**Table 1. The Median lethal dose (LD<sub>50</sub>) of *Xylopia aethiopica* fruit extract**

Study Phase/ (Animal)	Dosage of Extract (mg/kg) b.w	No of Mice per Group	No. of Death Recorded	% Mortality
<b>PHASE ONE</b>				
I	1000	5	0	0
II	2000	5	5	100
III	3000	5	5	100
IV	4000	5	5	100
V	5000	5	5	100
<b>PHASE TWO</b>				
I	1200	5	0	0
II	1400	5	5	100
III	1600	5	5	100
IV	1800	5	5	100
V	2000	5	5	100

*LD<sub>50</sub>*= 1296.15 mg/kg

**Table 2. Impact of ethanol extract of *Xylopia aethiopica* fruit on Female Reproductive Hormones of Animals after 28 days of Treatment**

Group	A	B	C	D	E	P Value
Dose of extract (mg/kg)	130	259	389	518	Control	
FSH (mg/dL)	20.52±2.15	16.84±3.08	11.47±2.26*	9.33±1.42*	18.77±2.26	0.05
LH (mg/dL)	31.89±7.08	29.03±3.82*	24.41±3.33*	20.72±3.06*	34.98±5.07	0.01
Pg (ng/dL)	11.03±2.62*	16.67±3.27	23.55±2.99	28.22±4.01*	19.71±2.13	0.02
Estrogen (mg/dL)	29.11±3.38	26.45±4.10	24.06±2.44*	20.98±3.04*	33.02±7.25	0.04
Prolactin (ng/dL)	25.09±2.35	30.27±4.05*	32.33±3.62*	38.02±3.84*	20.14±4.04	0.05

Results are presented as Mean±S.D, where n = 6. Values with \* are statistically significant at p value ≤ 0.05 when compared with the control group.

Legend: FSH = Follicle Stimulating Hormone, LH = Luteinizing Hormone, Pg = Progesteron

These perturbations in hormones could be a reflection of several components of plants [22]. Maintaining homeostasis in human reproductive hormones is vital [23]. To achieve a success in fertility during the first 14 days of the menstrual cycle, concentrations of estrogen increase and influence the growth and elevation of uterine cells. Sequel to the FSH, an ovum starts developing within one of the ovaries. On the 14<sup>th</sup> day of a 28-day cycle, an ovary is released in following the action of LH, and a rise in the concentration of progesterone happened during the 14 days (day 15 to 28) of the menstrual cycle, which leads to an elevation in the thickness of the lower limb [24]. In this present study, a nonsignificant elevation was seen in the blood concentration of follicle stimulating hormone (FSH) when animals exposed to 130 mg/kg b. wt. (low dose) of ethanol extract of *Xylopiya aethiopic*a fruit were compared with those in the control group. Increase in the dose of *Xylopiya aethiopic*a extract resulted in decrease in serum FSH levels. This decline was noticeable ( $P < 0.05$ ) when the FSH levels of animals exposed to 389 mg/kg and 518 mg/kg b. wt. of *Xylopiya aethiopic*a extracts were respectively compared with those in the control group. FSH is the main reproductive hormone in mammals, useful in the development of the gonad and maturation at puberty and the production of gamete in the fertile phase of life [25]. It enhances the growth and maturation of ovarian follicles by exerting its action directly on granulosa cell receptors [22]. The decline in the FSH concentration by fruit of *Xylopiya aethiopic*a at high doses might hinder production of follicles as well as its maturation in the pre-ovulatory phase [26]. The decline in the blood levels of FSH at these doses is similar to the study of Nnodim *et al.* [27] who observed a decrease in serum FSH when animals were treated with high doses of *Xylopiya aethiopic*a fruit extract. It could also mean that the extract at the administered doses could have exhibited its potential on the hypothalamus because the release of these hormones is controlled by the gonadotropic releasing hormone released by the hypothalamus [28]. The decline seen in the concentration of FSH could have a negative effect on conception in female animals and possibly humans. The major role of this hormone is to induce gametogenesis as well as the development of follicles in females [29]. In females, FSH facilitates the maturation of follicular cells of the ovary. Steroidogenic functions in females are dependent on other hormonal factors such as LH while FSH induces

the modification of androgens into estrogens [30]. The decrease in circulating FSH seen in this study could also be traced to the overall effect of metabolism. Since steroids reduce FSH synthesis and extracts of *Xylopiya aethiopic*a fruit contains steroids [7], it might be suggestive that steroids could also possibly be responsible for decrease in circulating FSH level seen in this present study.

Luteinizing hormone (LH) is known to induce the release of reproductive steroids from the gonads [31]. In females, ovulation of follicles that are matured is stimulated by a surge in the release of LH prior to the ovulation periods. Different scholars have proved that the release of LH surges at the pre-estrous stage were responsible for ovulation [22,26]. Anything capable of stopping this secretion could unhinged ovulation by reducing the volume of matured follicles or cause a disruption in the estrous cycle [32,33]. The significant decline seen in the concentration of blood LH in this study (especially at high doses) might indicate the extract inhibits the secretion of LH which could have resulted in the perturbation of ovulation. This could lead to impairment of estrous cycle, impedes conception as well as distort normal reproduction in females. Thus, it is likely that *X. aethiopic*a fruit contains anti-gonadotropic agents which might adversely impact the estrous cycle and distort reproduction in females [34]. The decline in the blood level of LH seen in this present study was dose-dependent.

Progesterone aids the regulation of the menstrual cycle which occurs monthly. It is involved in the preparation of the body in order to achieve conception and increase sexual desire [35]. Progesterone helps in the maturation of lactating glands during pregnancy. A surge in the concentration of progesterone was perceived to be behind the symptoms seen in premenstrual syndrome (PMS). The feedback inhibition of the release of Gonadotropin-releasing hormone (GnRH) by estrogens and progesterone forms the foundation for the development of most contraceptives. This inhibition of Gonadotropin-releasing hormone disallowed a rise in LH and ovulation during the cycle [36]. Observations from this present investigation revealed that the extract of *X. aethiopic*a decreased serum level of progesterone in female rats at low doses of 130 mg/kg and 259 mg/kg. The decrease was more noticeable ( $P < 0.05$ ) at the lowest dose of 130 mg/kg when compared with those in the control group. The decline observed in blood

progesterone concentration by *Xylopi aethiopic a* extract at these doses might have negative impact on ability to achieve conception in females; hamper ovulation which might lead to annovulation and sequelae [22]. Alkaloids had shown to hamper the production of progesterone in the cell [37]. Thus, the decreased progesterone concentration by *Xylopi aethiopic a* could be due to the present of alkaloidal in the fruit. This result is in line with the findings of Onuka *et al.*, [38] who observed an increase in the level of progesterone when animals were treated with low doses of *Xylopi aethiopic a* fruit extracts. However, increase in the dose (388.5 and 518 mg/kg) of the extract in this study increased the progesterone concentrations. The increase became significant ( $P < 0.05$ ) when the concentration of serum progesterone in animals exposed to 518 mg/kg of *Xylopi aethiopic a* extract were compared with those in the control group. The phytochemical evaluation of *Xylopi aethiopic a* fruit revealed that it contains alkaloids, saponin, tanins, Coumarin, phlobatannins, anthraquinones, steroids, flavonoids, cardiac glycosides and so on [7]. Yun *et al.*, [39] cited in Egba *et al.*, [26] had reported that high dose of extract of *Xylopi aethiopic a*, containing saponins lowered blood androgens as well as  $17\beta$ -estradiol, but elevated the concentrations of progesterone, indicating that presence of saponins might affect the synthesis of steroid in the ovary. High level of progesterone has shown antiestrogenic impact on the cells of myometrium, thereby reducing their excitability, their sensitivity to oxytocin, and their spontaneous electrical activity while elevating their membrane potential [40]. The rise observed in the blood level of progesterone in this research sequel to administration of high dose of *Xylopi aethiopic a* fruit extract was consistent with the findings of Nnodim *et al.*, [27] who investigated the effects of *Xylopi aethiopic a* fruits on reproductive hormonal level in rats. Decrease in blood concentrations of FSH and LH had been reported to increase progesterone concentration in Wistar rats [41]. Therefore, the increase observed in the progesterone level of experimental rats used in this study following the administration of high dose of *Xylopi aethiopic a* might be due to the reduction in the concentrations of FSH and LH observed in this study. Increase in serum progesterone concentrations had been speculated to indirectly predispose animals to teratogenicity and carcinogenesis [42]. Therefore, the elevation observed in the blood level of progesterone in this study at high doses suggested that extracts

of *Xylopi aethiopic a* might indirectly predispose its consumers to teratogenicity and carcinogenesis when consumed in high dosage.

Estrogen is known to facilitate the development of the linings of the uterus, leading to its thickness prior to ovulation. Estrogen is also involved in making reproductive organs mature. Estrogen and FSH increase the number of cells of the granules when follicles are developing. Herbal remedies possessing estrogenic agents are known to affect the action pituitary by lowering the release of LH and FSH thereby hindering ovulation. Hence, the decline in the blood levels of estrogen seen in this study might be linked to a reduction in the activity of aromatase or substrate supplementation during the production of estrogen [43]. Such a reduction in the concentration of estrogen could impair ovulation as well as the sustenance of pregnancy [43]. Kadohama *et al.* [44] had observed that various alkaloids from plant origin impair the activity of the enzyme, aromatase. It is therefore likely that the phytochemical content of extract of *Xylopi aethiopic a* fruit reported by Ogbuagu *et al.* [7] might inhibit the activity of the endocrine system and subsequently cause an imbalance in reproductive hormones. The results of this present study could be useful in the development of female contraceptive from herbal origin. The reduction in the serum concentration of estrogen seen in this study is consistent with the report of Adienbo *et al.*, [45] who observed a dose-dependent decline in the number of pregnant females in all their experimental groups when they reported the contraceptive efficacy of hydro-methanolic fruit extract of *Xylopi aethiopic a* in male albino rats.

Ovaries play crucial roles in estrogen synthesis and several things could perturb its functions. In the process of synthesizing follicles, thecal and granulosa cells take part in the estrogen synthesis. Theca cells can not directly synthesize estrogen, thus in developing follicles, androgens are secreted from the thecal cells and moved to the granulosa cells in which  $P_{450}$  aromatase modifies androgens to estrone and 17-beta estradiol [46]. Apart from saponin, flavonoids have also been reported to be one of the phytochemicals in *Xylopi aethiopic a* fruit extract [7]. Reports have revealed that both saponins and flavonoids impair the activity of aromatase in human preadipocyte [47] and the impairment of aromatase activity is known decrease the production of estrogen to zero level [48]. Furthermore, estrogen derived from the

modification of androgen forms a major portion of estrogen pool. In addition, the production of androgen from the thecal cells is predominantly regulated by LH from the pituitary [49]. Thus, the reduction in the levels of LH seen in this study might inhibit the production of androgen and impair the derivation of estrogens from androgens in the cell of the granule leading to a decline in the concentration of estrogen. This result is consistent with the reports of Onuka *et al.*, [38] who observed a decrease in estrogen concentration sequel to *Xylopiya aethiopicia* administration. FSH has also been reported to stimulate the conversion of androgens to estrogens [30]. The decrease in the level of estrogen might also be attributed to the observed decrease in serum FSH level in this study. The synthesis of estrogen by corpus luteum takes place due to a relationship between various endocrine glands and enzymes [50]. It is most probable that the extract of *Xylopiya aethiopicia* fruit used in this study had the propensity to decrease the level of estrogen by obstructing its synthesis.

A rise in prolactin level seen in this study might be due to the impact of the extract which is likely functioning as an antagonist of dopamine. The elevated level of prolactin observed in this study confirms the folklore utilization of the fruit to induce lactation. The result of this study is consistent with the reports of Onyebuagu *et al.*, [34], Anacletus *et al.*, [51] and Ehigiator and Adikwu [52] who respectively reported an increase in blood prolactin level when they administered different doses of *Xylopiya aethiopicia* extracts on female Wistar rats. The increased blood prolactin was due to a rise in the production and release of prolactin in the anterior pituitary sequel to hormonal factors [53]. The blood level of prolactin per time is affected by several factors regulating synthesis [54]. These hormonal imbalances observed in this study might be influenced by chemical component of the extract. Yakubu *et al.* [22] and Benie *et al.* [32] independently reported that phytochemical analysis has shown that plant extracts contained chemical components that may influence the control of estrous cycle, conception and reproduction. Alkaloids and flavonoids have been reported to decrease plasma levels of estrogen [54]. Therefore, the presence of these phytochemicals in *Xylopiya aethiopicia* fruit may be responsible for the perturbations in the concentrations of the circulating hormones seen in this study. Our previous study [18] showed that extracts of *Xylopiya aethiopicia* fruit reduced

sperm qualities in Wistar rats and might result in infertility in male rats. This is suggestive that the fruit has the propensity to induce infertility in both male and female rats.

## 5. CONCLUSION

The effect of *Xylopiya aethiopicia* extract on female reproductive hormones observed in this study showed that the extract might be a potent contraceptive. Plant products as contraceptive will be more acceptable for economic reasons and for the fact that they are associated with minimum side effects than synthetic agents.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

Animal Ethic committee approval has been taken to carry out this study.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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