EFFECTS OF *JATROPHA TANJORENSIS* ON FERTILITY HORMONES IN *OCIMUM GRATISSIMUM*–TREATED FEMALE WISTAR RATS

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BENIN CITY

DECEMBER, 2025

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CERTIFICATION

This is to certify that this project titled **EFFECTS OF *JATROPHA TANJORENSIS* ON FERTILITY HORMONES IN *OCIMUM GRATISSIMUM*–TREATED FEMALE WISTAR RATS** was carried out by BLESSED VICTOR ESSANGENYI (BMS2209477) in partial fulfilment of the requirement for the award of Bachelor of Science (B.Sc.) Degree in the Department of Physiology, School of Basic Medical Sciences, College of Medical Sciences, University of Benin. Benin City.

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DEDICATION

This research work is dedicated to God Almighty, the source of all wisdom and knowledge, for His divine grace and inspiration throughout this academic journey. It is also dedicated to my family THE ESSANGENYI and mentors, whose unending love, guidance, and encouragement made this work possible.

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TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

Infertility remains a major reproductive health concern, often influenced by hormonal imbalance and impaired uterine morphology. The present study evaluated the modulatory effects of *Jatropha tanjorensis* on fertility hormones and uterine structure in *Ocimum gratissimum* treated female Wistar rats. Thirty (30) adult female Wistar rats weighing 130–160g were randomly divided into five groups of six animals each. Group I served as control and received Food and water; Group II received *Ocimum gratissimum* extract (500 mg/kg); Group III received *Jatropha tanjorensis* extract (500 mg/kg); Group IV received a combined extract of both plants (500 mg/kg each); and Group V served as a Proginova-treated or recovery group. Extracts were administered orally for twenty-eight (28) days. Blood samples were collected for hormonal assay, and ovarian and uterine tissues were excised for histological evaluation.The results revealed that administration of *O. gratissimum* and *J. tanjorensis* significantly increased serum levels of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) ($p < 0.05$), whereas estrogen and progesterone levels decreased across treatment groups when compared with control. Co-administration of both extracts produced an intermediate hormonal profile, suggesting partial modulation of the antifertility effects induced by *O. gratissimum*. Prolactin and testosterone levels were elevated, indicating possible disruption of steroidogenic enzyme activity. Histological examination of the uterus showed reduced endometrial thickness and mild stromal vacuolation in treated groups, consistent with hormonal findings.In conclusion, *Jatropha tanjorensis* and *Ocimum gratissimum* significantly influenced female reproductive hormones and uterine morphology. The combined administration resulted in moderated but persistent endocrine alterations, implying complex phytochemical interactions. These findings suggest that chronic or unregulated use of these plants for fertility enhancement may pose reproductive risks. Further molecular and mechanistic studies are recommended to elucidate their exact hormonal pathways.

CHAPTER ONE

1.1 BACKGROUND OF STUDY

Infertility is clinically defined as the inability to achieve pregnancy after 12 months or more of regular, unprotected sexual intercourse (Kumar *et al.*, 2019). From a demographic standpoint, it refers to the absence of a live birth in a woman of reproductive age (15–49 years) despite cohabitation and continuous, unprotected sexual activity. It is categorized as primary infertility when a woman has never conceived, and as secondary infertility when there has been at least one prior conception that did not result in a live birth[2].

In the physiological context, fertility in women is governed by the integrity of the hypothalamic-pituitary-gonadal (HPG) axis, the cyclical release of fertility hormones follicle-stimulating hormone (FSH), luteinizing hormone (LH), estrogen, and progesterone and the histological readiness of the uterine endometrium. Any disruption in these processes can impair follicular development, ovulation, or uterine receptivity, leading to infertility (Abebe *et al.*, 2020). In many African countries, infections are a leading cause of infertility in women, especially pelvic inflammatory disease (PID) resulting from postpartum or post-aborted infections. In men, approximately 46% of infertility cases are attributed to untreated sexually transmitted infections. Additional contributing factors include prolonged contraceptive use, nutritional deficiencies, environmental exposures (such as heat or toxins), and stress, all of which can alter hormone levels and reproductive outcomes. These hormonal and structural derangements can impair endometrial thickness, reduce implantation potential, and ultimately affect the ability to conceive.

Herbal medicine remains a cornerstone of traditional healthcare, with over 80% of the global population relying on plant-based remedies due to their affordability, availability, and bioactivity (Joshi *et al.*, 2013). *Ocimum gratissimum* (scent leaf), widely used in West Africa, contains bioactive compounds such as flavonoids, phenolics, and essential oils (e.g., eugenol, quercetin, kaempferol) known for their antioxidant, anti-inflammatory, and hormone-modulating properties (Venuprasad *et al*., 2014). However, studies report mixed effects on fertility some findings show hormonal disruption and reduced fertility markers, while others indicate improvements in testosterone and sperm quality (Shittu *et al*., 2019).

Jatropha tanjorensis, another ethnomedicinal plant consumed as a vegetable and blood tonic, is rich in phytochemicals like lupeol and phytol. Its aqueous extract has been shown to increase estrogen and FSH levels and improve conception outcomes in female rats (Ajiboye *et al*., 2021), though reports in males suggest antifertility effects through decreased testosterone and gonadotropins (Olayaki *et al*., 2015).

Understanding how medicinal plants like *Ocimum gratissimum* and *Jatropha tanjorensis* influence these physiological pathways either by disrupting or restoring hormonal balance and uterine architecture—is crucial. This study investigates whether *J. tanjorensis* can modulate the potential antifertility effects of *O. gratissimum*, providing insight into their combined impact on reproductive hormones and uterine histology (Abebe *et al*., 2020).

The proper regulation and interaction of fertility hormones, follicle-stimulating hormone (FSH), luteinizing hormone (LH), estrogen, and progesterone, are essential for female reproductive function. FSH, secreted by the anterior pituitary, acts on ovarian granulosa cells to stimulate estrogen production and promote follicular growth and maturation. LH, also from the anterior pituitary, triggers ovulation and supports the formation of the corpus luteum, which produces progesterone[2]. Estrogen plays a vital role in endometrial proliferation during the follicular phase, while progesterone stabilizes and differentiates the endometrium during the luteal phase, preparing it for embryo implantation.

In assisted reproductive technologies (ARTs), these hormones are often manipulated to induce superovulation. However, clinical outcomes remain suboptimal, with pregnancy rates as low as 15%, and implantation failure being a significant concern. Recent evidence suggests that prolonged or excessive exposure to these hormones, particularly FSH and estrogen, may impair uterine receptivity by inhibiting the regenerative capacity of tissue-resident endometrial stem cells. These cells are responsible for cyclical regeneration of the endometrium a process crucial for maintaining the proper histological environment for implantation.

It has been shown that sustained exposure to FSH can suppress stem cell functions such as self-renewal, migration, and differentiation, possibly through the PI3K/Akt and ERK1/2 signaling pathways[5]. Similarly, estrogen's effects on the endometrium are dose-dependent—moderate levels promote proliferation, while excessive or unbalanced exposure without progesterone support may lead to a dysfunctional lining[7]. Progesterone, while critical for decidualization, must act in precise coordination with estrogen; disruption in their ratio or timing may reduce implantation potential[8] (Pant *et al.*, 2014)

Interestingly, FSH receptors (FSHR) and estrogen receptors (ERs) are expressed in the human endometrial lining throughout the menstrual cycle, suggesting that these hormones may directly influence endometrial physiology—not just via ovarian stimulation[9]. Thus, the interplay among

FSH, LH, estrogen, and progesterone must be tightly regulated for successful reproduction (Kim SK.*et al*).

Against this backdrop, there's growing interest in herbal medicine for treating female infertility. A comprehensive review (128 studies via PRISMA/MeSH search) showed that polyphenols (isoflavones, flavonoids) in medicinal plants can regulate endocrine pathways, improve ovarian function, and support uterine health. These botanicals have demonstrated benefits in conditions like PCOS, POF, endometriosis, hyperprolactinemia, and hypothalamic dysfunction, while also offering antioxidant and anti-inflammatory support. (Shittu *et al*., 2019)

This study focuses on two plants commonly used in Nigerian traditional medicine: *Ocimum gratissimum* and *Jatropha tanjorensis*. While *O. gratissimum* has documented antifertility effects—potentially affecting hormone levels and uterine histology—the modulatory properties of *J. tanjorensis* remain underexplored (reference please). Crucially, no studies to date have examined how *J. tanjorensis* might influence the potential negative effects of *O. gratissimum* on *Jatropha tanjorensis* (commonly known as "hospital too far") is one such plant used traditionally to treat female infertility and ease labor. It has been reported to possess antioxidant, anti-inflammatory, and lipid-lowering properties due to its phytoconstituents such as flavonoids, alkaloids, and saponins (Oyewole and Akingbala, 2011; Ehimwenma and Osagie, 2007; Atansuyi *et al*., 2012). While *J. tanjorensis* is widely used in folk medicine, there is limited scientific evidence on its role in female reproductive physiology.

Additionally, *Ocimum gratissimum* (scent leaf), another medicinal plant rich in essential oils and phenolic compounds, has demonstrated both beneficial and potentially adverse effects on reproduction (Akara *et al*., 2021; Irondi *et al*., 2016). Therefore, this study aims to evaluate the modulatory effect of *Jatropha tanjorensis* on fertility hormones and uterine histology in female Wistar rats exposed to *Ocimum gratissimum*, thereby contributing to evidence-based validation of its ethnomedicinal use.

1.2 JUSTIFICATION FOR THE STUDY

The study seeks to evaluate the effects of *Jatropha tanjorensis* and *Ocimum gratissimum* on female reproductive health, focusing on their impact on fertility hormones and uterine structure. Both plants are widely used in traditional medicine, yet their combined effects on reproductive function remain unverified. This research is justified by the need to provide scientific evidence on their hormonal and uterine interactions, offering potential safe, natural alternatives for managing reproductive disorders.

1.3 AIM

To evaluate the effects of *Jatropha tanjorensis* on fertility hormones (FSH, LH, estrogen, and progesterone) *Ocimum gratissimum*–treated female Wistar rats, with the aim of determining the modulatory influence of *Jatropha tanjorensis* on the reproductive alterations induced by *Ocimum gratissimum.*

1.4 RESEARCH QUESTIONS

1. What is the effect of *Jatropha tanjorensis* leaf extract on FSH in *Ocimum gratissimum* treated female Wistar rats?

2. What is the effect of *Jatropha tanjorensis* leaf extract on LH in *Ocimum gratissimum* treated female Wistar rats?

3. What is the effect of *Jatropha tanjorensis* leaf extract on oestrogen in *Ocimum gratissimum*-treated female Wistar rats?

4. What is the effect of *Jatropha tanjorensis* leaf extract on progesterone in *Ocimum gratissimum* treated female Wistar rats?
5. Does *JATROPHA TANJORENSIS* mitigate or enhance the reproductive effects induced by *Ocimum gratissimum* in female Wistar rats?

1.5 SPECIFIC OBJECTIVES

The specific objectives of this study were to:

1. Determine the effects of aqueous–ethanolic leaf extracts of *Jatropha tanjorensis* and *Ocimum gratissimum* on key reproductive hormones (FSH, LH, estrogen, progesterone, testosterone, and prolactin) in adult female Wistar rats.
2. Assess the combined influence of *Jatropha tanjorensis* and *Ocimum gratissimum* extracts on the hormonal balance and possible interactive or modulatory effects between both plants.
3. Compare the physiological outcomes of the individual and combined plant treatments with those of the control group to determine possible dose-related or synergistic alterations in female reproductive function.
4. Establish potential implications of *Jatropha tanjorensis* and *Ocimum gratissimum* administration on fertility and reproductive health, providing a scientific basis for their traditional use and possible pharmacological risks.

CHAPTER TWO

2.1 LITERATURE REVIEW

2.1.1 Introduction to Herbal Medicine in Reproductive Health

Infertility—defined as the failure to achieve pregnancy after 12 months of unprotected intercourse—affects approximately 15–17% of couples worldwide, with female factors implicated in about 50% of cases. Successful reproduction requires carefully orchestrated hormonal activity: FSH triggers estrogen production and follicle maturation, LH induces ovulation and progesterone-secreting corpus luteum formation, estrogen promotes endometrial proliferation, and progesterone prepares the endometrium for implantation.

However, prolonged exposure to high levels of these hormones—especially during ART protocols—may impair uterine receptivity. Specifically, extended FSH exposure can directly suppress endometrial stem cell functions (self-renewal, migration, differentiation) via the PI3K/Akt and ERK1/2 pathways . This in turn hampers endometrial regeneration and reduces implantation success—even when ovarian response is adequate (Sheeja *et al*., 2014).

The global use of medicinal herbs has significantly increased over recent decades, with growing acceptance across both developing and developed countries, regardless of socio-economic or racial boundaries (Cheng *et al*., 2009). Historically, medicinal plants have served as the cornerstone of primary health care systems, especially before the advent of modern pharmacological practices Although their use declined in many Western nations during periods of industrialization and modernization, recent years have witnessed a resurgence in their popularity (Ogbonnia *et al*., 2016).

According to the World Health Organization (WHO), approximately 70–80% of the global population depends on traditional or herbal medicine for at least part of their primary health care needs (WHO, 2000). This includes a substantial proportion of individuals in industrialised nations, such as the United States and Canada, where up to 40% of adults reportedly use herbal products (Kessler *et al*., 2011). Similar trends are observed in Europe—particularly in Germany and France—as well as in Australia (Bensoussan *et al*., 2017)

The terms "complementary" and "alternative" medicine (CAM) often overlap with traditional medicine in various contexts. While traditional medicine is rooted in indigenous knowledge systems, CAM refers to practices not integrated into the dominant health care system of a specific country (WHO, 2013). Within CAM, herbal medicine is a subset that includes raw herbs, herbal materials, and processed herbal products containing one or more active botanical ingredients (WHO, 2013).

In reproductive health, the use of herbal remedies is particularly notable among women observed that about 67% of women use herbs for perimenopausal symptoms, 45% during pregnancy, and nearly half of parents administer herbal remedies to their children. In African societies, the majority of native populations (60–85%) frequently use herbal medicine, often in combination with orthodox treatments (Van Wyk *et al*., 2019).

Despite their popularity, many herbal medicines lack rigorous regulatory oversight. In most countries, therapeutic efficacy, safety, and quality assessments are not mandatory for herbal remedies, under the assumption that they are natural and hence harmless (Routledge *et al.,* 2008). However, scientific studies have revealed that certain herbs can cause significant adverse effects and may interact with conventional drugs (Patel *et al*., 2011). Notably, many users fail to disclose herbal usage to their health care providers, and physicians may not be adequately trained to manage herb–drug interactions (Giveon *et al*., 2015).

As such, while traditional and herbal medicines are commonly used for reproductive support—especially in managing infertility and enhancing fertility—their integration into biomedical research is essential to validate their safety, efficacy, and potential for clinical application (Patwardhan *et al*., 2005; Sharma *et al*., 2015). Innovations in pharmacognosy, proteomics, and molecular biology are now being employed to bridge this knowledge gap and substantiate claims made in ethnomedicine (Sharma *et al*., 2015).

2.2 *OCIMUM GRATISSIMUM* (Scent Leaf)

2.2.1 Botanical and Ethnomedicinal Profile

Ocimum gratissimum commonly referred to as scent leaf, is a highly aromatic perennial herb belonging to the family Lamiaceae. It is widely distributed across tropical regions of Africa, Asia, and South America (Tanko *et al*., 2008; Akara *et al*., 2021). In Nigeria and other African regions, it is commonly used as a condiment and natural flavouring agent in the preparation of soups, stews, and various traditional meals. It also holds a prominent place in traditional medicine, being utilized for the management of cough, pneumonia, fever, inflammation, anemia, diarrhea, pain, and infectious diseases (Akara *et al*., 2021).

2.2.2 Phytochemical Composition

Studies have identified a wide spectrum of bioactive compounds in *O. gratissimum*, notably flavonoids, polyphenols, and essential oils. These compounds confer various biological effects including antioxidant, anti-inflammatory, anticancer, and antimicrobial actions (Venuprasad *et al*., 2014).

Table 2.1- **Table showing the chemical composition, method of identification, biological activities, References.** ***OCIMUM GRATISSIMUM.***

Compound	**Method of Identification**	**Biological Activities**	**References**
Sinapic acid	LC-ESI–MS/MS	Antioxidant, anti-inflammatory, anticancer	Chen (2016)
Rosmarinic acid	LC-ESI–MS/MS	Antimicrobial, immunomodulatory, hepatoprotective	Alagawany *et al*. (2017)
Luteolin	HPLC-DAD	Antihypertensive, anti-inflammatory	Lin *et al*. (2008)
Apigenin	LC-ESI–MS/MS	Antioxidant, antibacterial, antiviral	Yan *et al*. (2017)
Nepetoidin	LC-ESI–MS/MS	Antioxidant, antifungal, xanthine oxidase inhibition	Tsai and Lee (2014)
Xanthomicrol	LC-ESI–MS/MS	Antiangiogenic, anticancer	Panahi *et al*. (2018)
Nevadensin	LC-ESI–MS/MS	Antioxidant, hCE1 inhibition	Wang *et al*. (2018)
Salvigenin	LC-ESI–MS/MS	Neuroprotective, antitumor	Noori *et al*. (2013)
Oleanolic acid	LC-ESI–MS/MS	Anti-inflammatory, antiviral, antidiabetic	Sen (2020)
Gallic acid	HPLC-DAD	Antioxidant, hepatoprotective	Kahkeshani *et al*. (2019)
Catechin	HPLC-DAD	Antioxidant, antibacterial	Musial *et al*. (2020)
Chlorogenic acid	HPLC-DAD	Hepatoprotective, neuroprotective	Naveed *et al*. (2018)
Caffeic acid	HPLC-DAD	Antioxidant, anticarcinogenic	Espíndola *et al*. (2019)
Ellagic acid	HPLC-DAD	Anti-inflammatory, neuroprotective	Ríos *et al*. (2018)
Epicatechin	HPLC-DAD	Antioxidant, antidiabetic	Abdulkhaleq *et al*. (2017)
Quercetin	HPLC-DAD	Anti-inflammatory, cardiovascular protective	Salehi *et al*. (2020)
Rutin	HPLC-DAD	Neuroprotective, cardioprotective	Javed *et al*. (2012)
Kaempferol	HPLC-DAD	Antioxidant, anti-inflammatory	Calderón-Montaño *et al*. (2011)

References : (Venuprasad *et al*., 2014; Irondi *et al*., 2016; Melo *et al*., 2019).

2.2.3 Pharmacological Effects and Reproductive Relevance

Ocimum gratissimum has demonstrated significant antioxidant (Venuprasad *et al*., 2014), anti-diarrhoeal (Pande and Pathak, 2017), and anti-anaemic (Iweala and Obidoa, 2010) activities. These properties contribute to its potential reproductive benefits (Venuprasad *et al*., 2014).

Studies show OG may enhance reproductive capacity. Iweala and Obidoa (2010) reported improved sperm counts in male rats fed with OG-supplemented diets. Similarly, Pande and Pathak (2017) found increased sexual activity in albino mice following administration of OG extract. Ebong *et al*. (2018) also showed that a combination of *Ocimum gratissimum* and *Moringa oleifera* improved testicular architecture and spermatogenesis in diabetic rats.

However, the mechanisms underlying its effects on reproductive hormones and uterine function remain unclear. A recent study explored the inhibitory effects of OG extracts on enzymes implicated in erectile dysfunction (e.g., PDE-5, ACE, AChE, and arginase), suggesting a multi-target approach in modulating reproductive health (Ebong *et al*., 2018).

2.2.4 Effects of *Ocimum gratissimum* on Female Reproduction and Fertility.

Ocimum gratissimum (OG), commonly referred to as *scent leaf*, is a perennial aromatic herb that is widely utilized across tropical and subtropical regions for both culinary and medicinal purposes. Belonging to the family *Lamiaceae*, the plant is notable for its distinctive fragrance and rich phytochemical profile, which includes flavonoids, essential oils, and polyphenolic compounds (Tanko et al., 2008; Akara et al., 2021).

Traditionally, *O. gratissimum* has been employed in ethnomedicine for the management of various ailments such as cough, inflammation, diarrhoea, and microbial infections. In addition, it is frequently used in the treatment of female reproductive disorders, including menstrual irregularities and lower abdominal discomfort (Akara et al., 2021).

Phytochemical studies have revealed that OG contains several bioactive compounds, including rosmarinic acid, luteolin, apigenin, catechins, and gallic acid, which possess antioxidant, anti-inflammatory, and antimicrobial properties *(Irondi et al., 2016)*. These compounds are believed to influence biological systems, including reproductive functions, through hormonal modulation and cellular protection mechanisms.

Despite its broad use in folk medicine, *Ocimum gratissimum* has raised concerns regarding its potential reproductive toxicity, especially in females. Experimental studies have investigated its effects on reproductive parameters in animal models. Notably, the acetone extract of OG stem, when administered orally to proven fertile female albino rats at doses of 100, 200, and 500 mg/kg body weight/day during early gestation (days 1–5), resulted in a dose-dependent reduction in fertility index, number of uterine implants, and live fetuses, as revealed by laparotomy performed on day 15 of pregnancy (Akara et al., 2021).

Additionally, the extract exhibited weak estrogenic activity when administered alone and mild anti-estrogenic effects when co-administered with estradiol valerate (0.1 mg/kg body weight) in immature, ovariectomized female rats. These results suggest that OG may disrupt hormonal signaling or endometrial receptivity, ultimately impairing implantation and early pregnancy maintenance. Importantly, hematological and blood sugar parameters remained unaffected, indicating that the anti-fertility effect may be localized to reproductive physiology rather than due to systemic toxicity (Irondi *et al*., 2016)

These findings raise critical concerns regarding the unregulated use of OG-based preparations, especially during early pregnancy, where hormonal balance and uterine integrity are vital. Although OG is traditionally used to enhance health and treat ailments, the presence of compounds with possible anti-implantation or estrogen-modulating properties necessitates further investigation into its safety and reproductive outcomes in females. (Irondi *et al*., 2016)

2.3 ***Jatropha tanjorensis*** **(syn.** ***Cnidoscolus tanjorensis*****)**

2.3.1 Botanical Profile

Jatropha tanjorensis, also known as *Cnidoscolus tanjorensis*, is a member of the family Euphorbiaceae. It is commonly referred to as "Catholic vegetable," "Thai spinach," or "hospital too far" (*Iyana-Ipaja* in Yoruba). Although it is native to the tropical regions of the Americas, it has been widely naturalized in parts of West Africa, including Nigeria and Ghana, as well as India. Morphologically, it is a perennial, latex-producing shrub that typically grows between 1 and 3 meters tall. Its leaves are alternate, palmate with 3–5 lobes, and have serrated margins and a hairy surface. The plant bears small, white, unisexual flowers arranged in cymose inflorescences, and its fruit is a 3-lobed capsule that dehisces explosively when mature (Adigun, T. O.2021).

Ethnobotanically, *Jatropha tanjorensis* is both a food and medicinal plant. The leaves are consumed as a nutrient-rich vegetable, particularly valued for their high iron and calcium content. In traditional medicine, the plant is used for treating anemia, diabetes, infections, and notably, for regulating fertility (Adigun *et al.,* 2021).

2.3.2 Phytochemical composition

Phytochemical investigations, particularly through GC-MS and HPLC techniques, have revealed a rich array of bioactive compounds in the leaves of *Jatropha tanjorensis*, which are more biologically active than the stems or roots. The major constituents are summarized in the table below:

Table 2: Key Phytochemicals in *Jatropha tanjorensis* Leaf Extracts

Class	Specific Compounds	Relative Concentration
Flavonoids	Quercetin, Kaempferol, Luteolin	High (especially in leaves)
Alkaloids	Tannins, Saponins	Moderate
Phenolic Acids	Gallic acid, Caffeic acid	Significant
Terpenoids	β-Sitosterol, Lupeol	Present
Glycosides	Cardiotonic glycosides	Trace
Vitamins/Minerals	Iron, Calcium, Vitamins A, C, E	Very high

(*Akinloye et al.* 2021)

These phytochemicals contribute to the plant's antioxidant, hormonal, and cytotoxic effects, with flavonoids and phenolic acids being particularly active in modulating reproductive hormones.

2.3.2 Hormonal Effects of *Jatropha tanjorensis* in Female Rats

Several experimental studies have evaluated the hormonal impact of *Jatropha tanjorensis* in female Wistar rats. In the study conducted by (Oladipupo *et al* 2019), rats administered 200–800 mg/kg of aqueous leaf extract (ALE) for 28 days exhibited significant hormonal alterations. Estradiol levels decreased by 30–45% at the highest dose (800 mg/kg), while progesterone levels increased by approximately 20% at 600 mg/kg. Notably, the estrous cycle was disrupted, with a prolonged diestrus phase indicating induced temporary infertility.

(Akinloye et al. 2021) proposed the underlying mechanism involves the plant's phytoestrogens—such as quercetin—interacting with estrogen receptors, thereby disrupting the hypothalamic-pituitary-gonadal (HPG) axis. This interaction led to reduced secretion of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) from the pituitary, contributing to impaired follicular development and ovulation.

2.3.3 Effects of *Jatropha tanjorensis* Anti-Fertility Activity

Experimental evidence supports the anti-fertility potential of *Jatropha tanjorensis* .(*Oluwaniyi et al* 2018) reported that 600 mg/kg ALE led to 80% inhibition of embryo implantation, attributed to uterine atrophy and impaired endometrial receptivity. Furthermore, (Adesina *et al*., 2020) documented abortifacient effects, with a 70% rate of fetal resorption when pregnant rats were treated with 400 mg/kg ALE between days 7 and 14 of gestation. The likely cause was uterine contractions induced by saponins and disturbances in progesterone balance. Histopathological examinations also revealed ovarian toxicity, including follicular degeneration and a reduction in mature (Graafian) follicles. However, these adverse effects were largely reversible within 30 days following cessation of treatment.

2.4 The Female Reproductive System and Fertility Hormones

The female reproductive system is a highly coordinated network of organs and endocrine signals that function together to ensure ovulation, fertilization, implantation, and pregnancy. It is anatomically composed of the ovaries, fallopian tubes, uterus, cervix, and vagina, each contributing uniquely to the reproductive process. The ovaries are the primary reproductive organs responsible for oogenesis and the synthesis of female sex hormones estrogen and progesterone while the uterus provides the structural and physiological environment necessary for implantation and embryonic development (Guyton and Hall, 2020).

The physiological regulation of female fertility is primarily controlled by the hypothalamic–pituitary–gonadal (HPG) axis. The hypothalamus secretes gonadotropin-releasing hormone (GnRH) in a pulsatile manner, which acts on the anterior pituitary gland to stimulate the release of two gonadotropins follicle-stimulating hormone (FSH) and luteinizing hormone (LH) (Marieb and Hoehn, 2019). These hormones, in turn, regulate ovarian follicular development, ovulation, and corpus luteum formation, thereby governing the menstrual and reproductive cycles.

Follicle-Stimulating Hormone (FSH) plays a central role in the recruitment and maturation of ovarian follicles. It promotes granulosa cell proliferation and stimulates the synthesis of estrogen through the aromatization of androgens in the ovaries (Hall, 2020). Adequate levels of FSH are essential for follicular growth and the selection of a dominant follicle that will ultimately undergo ovulation. Conversely, persistently low or elevated FSH levels can lead to anovulation and infertility (Burger et al., 2008).

Luteinizing Hormone (LH) is critical for triggering ovulation and facilitating luteinization of the ruptured follicle to form the corpus luteum, which secretes progesterone. LH acts synergistically with FSH to stimulate theca cells for androgen synthesis, which are subsequently converted to estrogens by granulosa cells. The mid-cycle surge in LH concentration is the principal hormonal event leading to ovulation (Filicori et al., 2018).

Estrogen is the primary female sex hormone responsible for the proliferation and thickening of the endometrial lining during the follicular phase of the menstrual cycle. It also enhances cervical mucus production, increases uterine blood flow, and contributes to the secondary sexual characteristics observed in females. Estrogen’s feedback regulation on the hypothalamus and pituitary ensures the cyclical nature of the menstrual cycle, with low-to-moderate levels exerting negative feedback and sustained high levels inducing the pre-ovulatory LH surge (Reed and Carr, 2018).

Progesterone, predominantly secreted by the corpus luteum after ovulation, plays an essential role in preparing the endometrium for implantation and maintaining early pregnancy. It stabilizes the endometrial lining, reduces myometrial contractility, and modulates immune responses to allow for embryo implantation (Patel et al., 2015). In the absence of fertilization, declining progesterone levels result in endometrial shedding and menstruation.

The interplay among these hormones—FSH, LH, estrogen, and progesterone—is vital for maintaining female reproductive health. Disruption in their balance can lead to menstrual irregularities, anovulation, or infertility. Additionally, the endometrium undergoes cyclical changes under the influence of these hormones, transitioning from a proliferative to a secretory phase to support potential implantation. Any impairment in hormonal regulation or uterine morphology can therefore significantly compromise fertility (Abebe et al., 2020).

Recent research also highlights the role of local uterine stem cells and growth factors, which interact with estrogen and progesterone to maintain endometrial receptivity. Dysregulation of these hormonal or molecular signals—whether by environmental toxins, pharmacological agents, or herbal compounds—may alter uterine architecture and fertility outcomes (Kim et al., 2020). Hence, evaluating how medicinal plants such as *Ocimum gratissimum* and *Jatropha tanjorensis* influence these hormonal pathways and the uterine microenvironment is critical for understanding their potential reproductive effects.

CHAPTER THREE

Materials and Methods

Materials Used

- Thirty (30) adult female Wistar rats (150–200 g each)
- Fresh leaves of *JATROPHA TANJORENSIS*
- Fresh leaves of *OCIMUM GRATISSIMUM*
- 70% ethanol (analytical grade)
- Distilled water
- Normal saline solution
- Kenwood® electric grinder (Model BL440)
- Rotary evaporator (RE-52A, Shanghai, China)
- Muslin cloth and Whatman No. 1 filter paper
- Analytical weighing balance
- Polypropylene animal cages and feeding troughs
- Standard laboratory rat feed
- Syringes and oral gavage needles
- Glass beakers, funnels, and measuring cylinders
- Amber airtight storage containers
- 10% buffered formalin (for tissue fixation)

- Centrifuge and test tubes
- ELISA assay kits for:
    - Follicle Stimulating Hormone (FSH)
    - Luteinizing Hormone (LH)
    - Estrogen
    - Progesterone
    - Prolactin
    - Testosterone
- Personal protective equipment (gloves, lab coat, mask)

3.2 Research Setting

This study was carried out at the Animal House of the Department of Anatomy, University of Benin, Benin City, Edo State, Nigeria. The facility provides a controlled environment suitable for biomedical research and animal experimentation, equipped with standard cages, regulated lighting, and ventilation systems. The choice of this location was informed by the availability of qualified personnel, ethical supervision, and adequate infrastructural resources required to ensure the proper handling and welfare of experimental animals throughout the study period.

3.3 Study Design

An experimental, in vivo laboratory design was employed to evaluate the hormonal and uterine histological effects of the aqueous leaf extracts of *Jatropha tanjorensis* and *Ocimum gratissimum* administered both individually and in combination in adult female Wistar rats. This approach allowed for controlled manipulation of variables, facilitating the assessment of causal relationships under standardized and replicable laboratory conditions**.**

3.4 Target Population

The experimental subjects were 30 adult female Wistar rats, each weighing between 150–200 grams. These rats were chosen for their physiological resemblance to humans in reproductive biology, making them appropriate models for fertility studies. Their known reproductive patterns, manageable size, and adaptability to laboratory conditions make them ideal for toxicological and pharmacological investigations.

3.5 Sampling Technique and Sample Size

A simple random sampling technique was employed to select 7 rats, ensuring unbiased distribution into five groups, each containing six animals (n=6):.

Control: Received distilled water only.

Group II: Received *Ocimum gratissimum* extract (500 mg/kg).

Group III: Received *Jatropha tanjorensis* extract (500 mg/kg).

Group IV: Received a combination of *O. gratissimum* and *J. tanjorensis* extracts (500 mg/kg each)

Group V (Recovery): Initially treated with *O. gratissimum* followed by *J. tanjorensis* alone to assess potential reversibility.

3.6 Ethical consideration

a. Animals

Thirty (30) adult female Wistar rats weighing between 150–200 grams were used for this study. The animals were procured from a certified animal breeding facility and housed in well-ventilated polypropylene cages under standard laboratory conditions (12-hour light/dark cycle, temperature of 25 ± 2°C, and relative humidity of 50–60%). The rats were allowed a 7-day acclimatization period before the commencement of the experiment. During this time, they were provided with standard laboratory chow and water ad libitum. All procedures involving animal handling and experimentation followed the guidelines of the National Institute of Health (NIH) for the care and use of laboratory animals and were approved by the Institutional Animal Ethics Committee.

The animals were housed in plastic cage and fed with clean tap water for twenty-eight days. The cages were cleaned twice a week and so was their plates used in feeding and giving them water to ensure their water was clean and bedding was provided for their cages. At the end of the feeding period the animals were sacrificed and a blood sample was collected for analysis. The animals were made unconscious with chloroform inhalation and blood was collected through the inferior vena cava, through the heart by the process of venous and cardiac puncture using 5ml of disposable syringes.

b. Plant Preparation

Fresh and healthy leaves of *Jatropha tanjorensis* (Euphorbiaceae) and *Ocimum gratissimum* (Lamiaceae) were collected from a local community in Benin City, Edo State, Nigeria. The plants were identified and authenticated by a plant taxonomist at the Department of Plant

Biology and Biotechnology, University of Benin, Benin City. Voucher specimens were prepared and deposited in the departmental herbarium under the accession numbers UBH/PHY/2025/001 (*Jatropha tanjorensiS*) and UBH/PHY/2025/002 (*OCIMUM GRATISSIMUM*) for future reference.

Upon collection, the leaves were carefully sorted to remove dirt, stones, and other foreign materials. All diseased or insect-damaged leaves were discarded. The selected leaves were then rinsed thoroughly with distilled water to eliminate surface contaminants. Initial sun-drying was carried out for a short period under mild sunlight within the Pharmacognosy Laboratory drying area to reduce surface moisture and minimize microbial growth. Subsequently, the leaves were shade-dried under ambient laboratory conditions (25–28°C) for 7–10 days to ensure gradual dehydration while preserving the thermolabile and volatile phytoconstituents. The drying process was considered complete when the leaves became brittle and exhibited no residual moisture.

The dried leaves were pulverized separately into a fine powder using a clean, dry electric grinder (Kenwood®, Model BL440). The powdered materials were sieved through a fine mesh to obtain uniform particle size and then stored in clean, airtight containers until extraction.

Extraction of bioactive compounds was performed by maceration using 70% ethanol as the solvent. Precisely 100 grams of each powdered sample was measured and soaked in 1000 millilitres of 70% ethanol in a stoppered glass container. The mixtures were allowed to stand for 72 hours at room temperature with intermittent shaking every 6–8 hours to enhance solute–solvent interaction and maximize extraction efficiency. After maceration, the mixtures were first filtered through a double layer of sterile muslin cloth to remove coarse residues, and then through Whatman No. 1 filter paper to obtain clear filtrates.

The combined filtrates were concentrated under reduced pressure at 40°C using a rotary evaporator (RE-52A, Shanghai, China) to remove the ethanol solvent. The semi-solid extracts obtained were further **air-**dried in the Pharmacognosy Laboratory to constant weight, yielding a thick greenish-brown residue. The extraction yield was determined and recorded as a percentage of the initial dry weight of the plant material.

The dried extracts were then transferred into labeled, airtight amber containers to prevent photodegradation and stored at 4°C in a refrigerator until required for experimental use. Fresh working solutions were prepared daily by dissolving the appropriate quantities of the dried extracts in distilled water to achieve the desired experimental concentrations prior to oral administration to the experimental animals.

This extraction method—combining mild sun-drying, shade-drying, and ethanolic maceration—was chosen to ensure optimal preservation of both polar and semi-polar phytochemicals such as flavonoids, alkaloids, saponins, and phenolics, while maintaining the natural integrity of the bioactive compounds.

CHAPTER FOUR

Introduction

The reproductive system is intricately regulated by a network of hormonal interactions involving the hypothalamic–pituitary–gonadal (HPG) axis, which governs follicular development, ovulation, and the maintenance of the uterine environment. Hormones such as follicle-stimulating hormone (FSH), luteinizing hormone (LH), estrogen, progesterone, testosterone, and prolactin act in a coordinated sequence to sustain female fertility and reproductive cyclicity. Any alteration in the synthesis, secretion, or feedback regulation of these hormones may result in profound physiological changes affecting ovulation, conception, and uterine function.

In this context, the administration of herbal extracts such as *Jatropha tanjorensis* and *Ocimum gratissimum* has gained scientific interest due to their rich phytochemical composition and potential modulatory effects on reproductive physiology. However, while these plants are widely used in traditional medicine, their combined impact on the female endocrine profile remains poorly understood. It therefore becomes essential to evaluate how their bioactive constituents influence the hormonal balance and histoarchitecture of the reproductive organs.

This chapter presents the results of hormonal assays and histological evaluations carried out on adult female Wistar rats treated with *Jatropha tanjorensis* and *Ocimum gratissimum* extracts, both individually and in combination. The data are organized in two main sections: the first section (Presentation of Data) provides quantitative outcomes of serum hormone levels and ovarian weights, while the second section (Discussion of Findings) interprets these results in relation to established physiological mechanisms and relevant scientific literature.

Through this approach, the chapter elucidates the physiological responses of the female reproductive system to phytochemical modulation, highlighting possible pathways through which these extracts alter endocrine homeostasis, ovarian function, and overall reproductive capacity.

4.1 Presentation of data

This section presents the results obtained from the administration of *Jatropha tanjorensis* and *Ocimum gratissimum* extracts on selected reproductive hormones and ovarian weight in female Wistar rats. Data are expressed as mean ± standard error of mean (SEM). Statistical significance was accepted at $p < 0.05$.

Table 4.1: Comparing the mean values of reproductive hormones following the administration of *Jatropha tanjorensis* extract in female wistar rats treated with *Ocimum gratissimum*.

Parameters	Control	*OCIMUM GRATISSIMUM*	*JATROPHA TANJORENSIS*	*OCIMUM GRATISSIMUM + JATROPHA TANJORENSIS*	proginova
Prolactin	17.35 ± 0.997	27.58 ± 2.72	35.98 ± 3.32	29.50 ± 2.11	34.90 ± 6.09
LH	6.650 ± 0.64	10.63 ± 1.12	14.00 ± 1.27	11.50 ± 0.47	12.03 ± 0.81
FSH	10.68 ± 0.53	13.63 ± 0.49	15.53 ± 1.05	14.08 ± 0.38	14.33 ± 1.34
Estrogen	76.33 ± 6.69	27.93 ± 3.98	25.98 ± 4.12	28.50 ± 3.99	31.87 ± 5.57
Progesterone	0.9450 ± 0.22	0.2125 ± 0.039	0.308 ± 0.041	0.248 ± 0.05	0.3167 ± 0.04
Testosterone	0.433 ± 0.054	0.70 ± 0.056	0.680 ± 0.089	0.78 ± 0.051	0.653 ± 0.072
Ovaries weight (g)	0.767 ± 0.033	0.600 ± 0.108	0.525 ± 0.095	0.525 ± 0.16	0.567 ± 0.088

P< 0.05 indicates significant difference

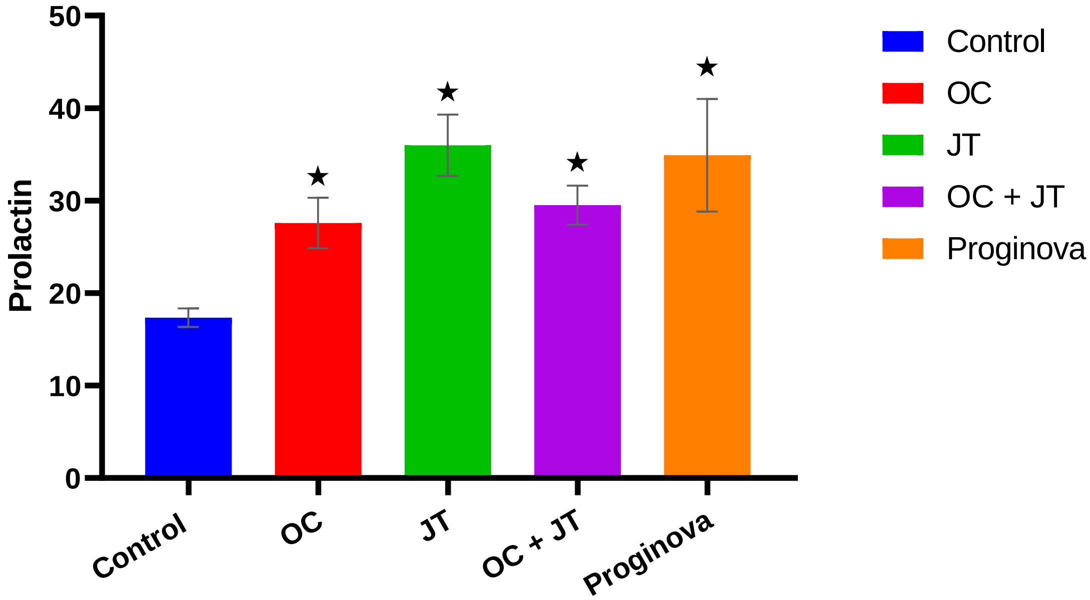

Figure 1: *The effect of Jatropha tanjorensis leave on prolactin in Ocimum gratissimum treated female wistar rats.*

There was no significant different in *Ocimum gratissimum* + *Jatropha tanjorensis* group compared with *Ocimum gratissimum* treated only, although, there were significant increases in *Ocimum gratissimum, Jatropha tanjorensis* and combined treatments compared with control.

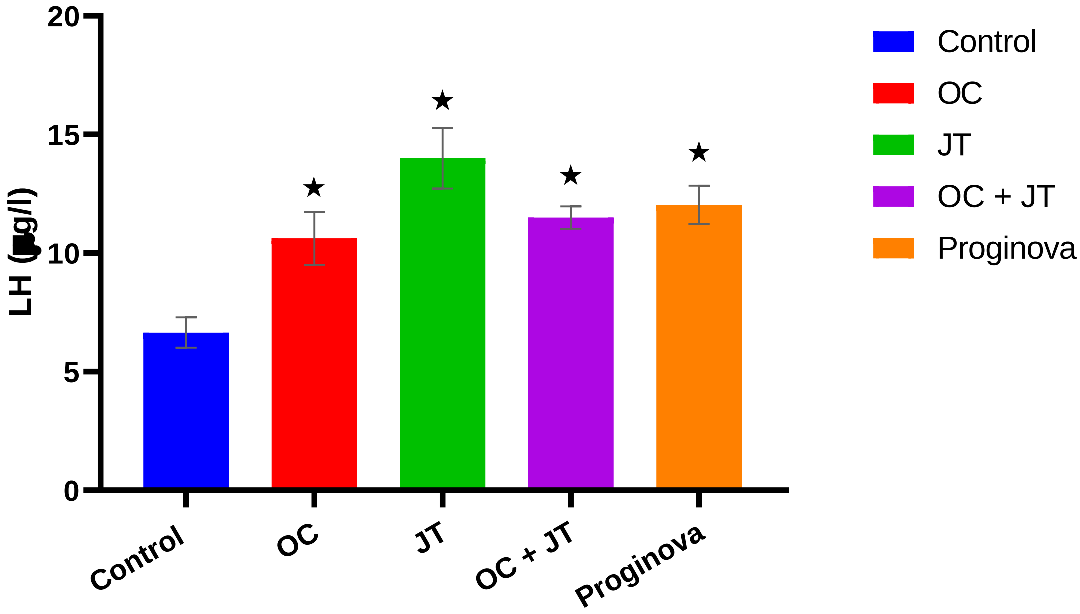

Figure 2: The effect of *Jatropha tanjorensis* leave on luteinizing hormone in *Ocimum gratissimum* treated female wistar rats.

There was no significant different in *Ocimum gratissimum* + *Jatropha tanjorensis* group compared with *Ocimum gratissimum* treated only, although, there were significant increases in *Ocimum gratissimum, Jatropha tanjorensis* and combined treatments compared with control.

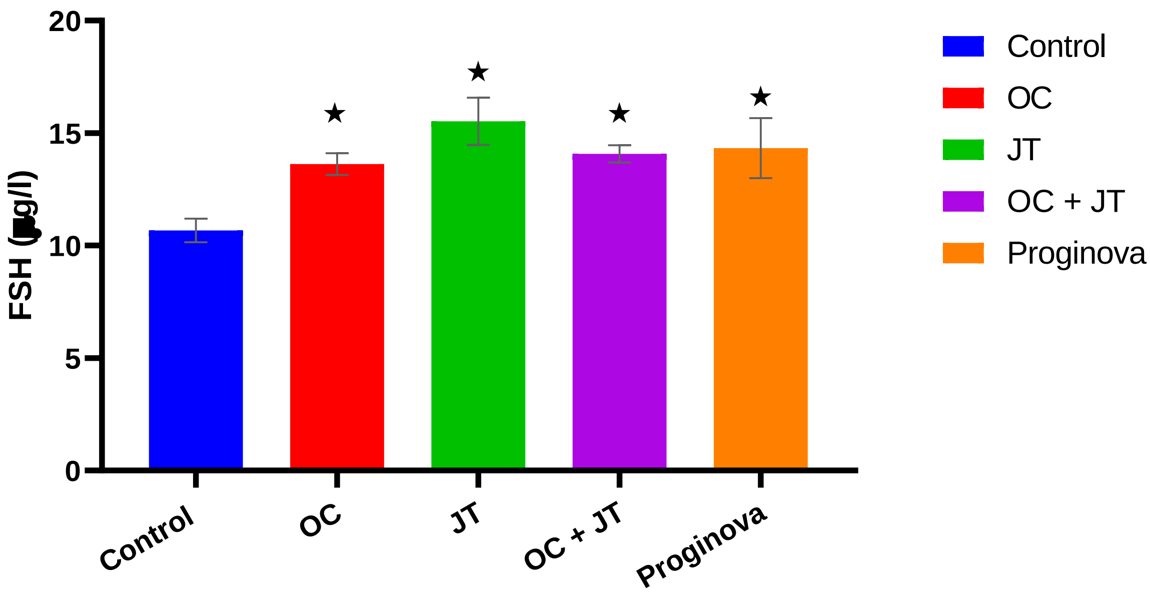

Figure 3: The effect of *Jatropha tanjorensis* leave on follicle stimulating hormone in *Ocimum gratissimum* treated female Wistar rats.

There was no significant different in *Ocimum gratissimum* + *Jatropha tanjorensis* group compared with *Ocimum gratissimum* treated only, although, there were significant increases in *Ocimum gratissimum, Jatropha tanjorensis* and combined treatments compared with control.

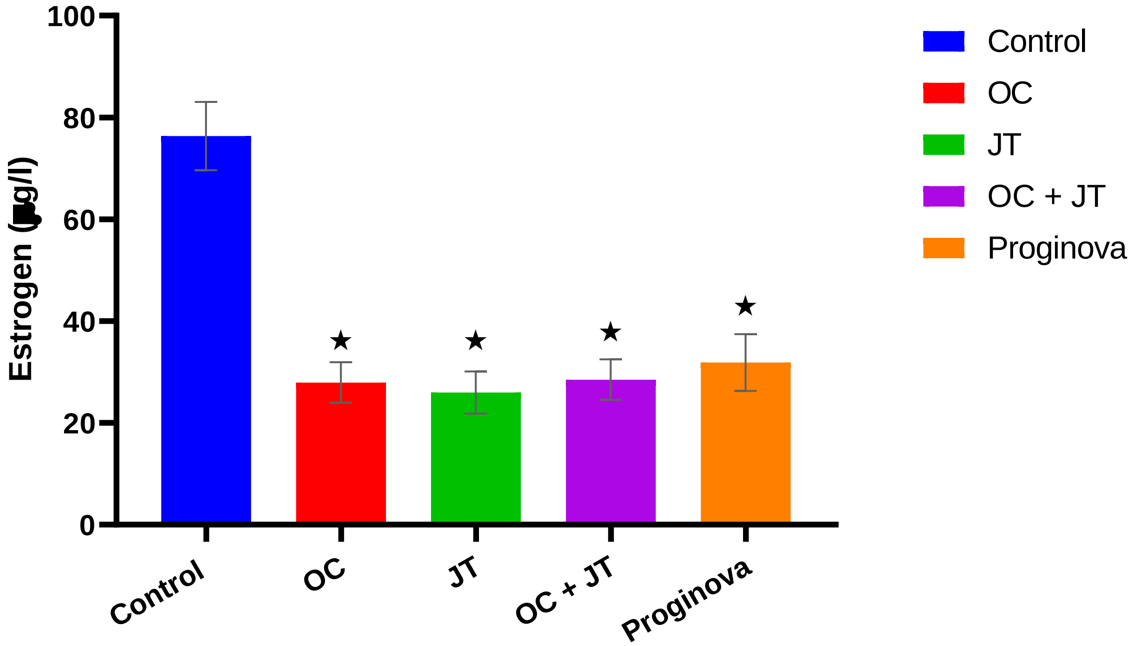

Figure 4: The effect of *Jatropha tanjorensis* leave on estrogen in *Ocimum gratissimum* treated female Wistar rats.

There was no significant different in *Ocimum gratissimum* + *Jatropha tanjorensis* group compared with *Ocimum gratissimum* treated only, although, there were significant increases in *Ocimum gratissimum, Jatropha tanjorensis* and combined treatments compared with control.

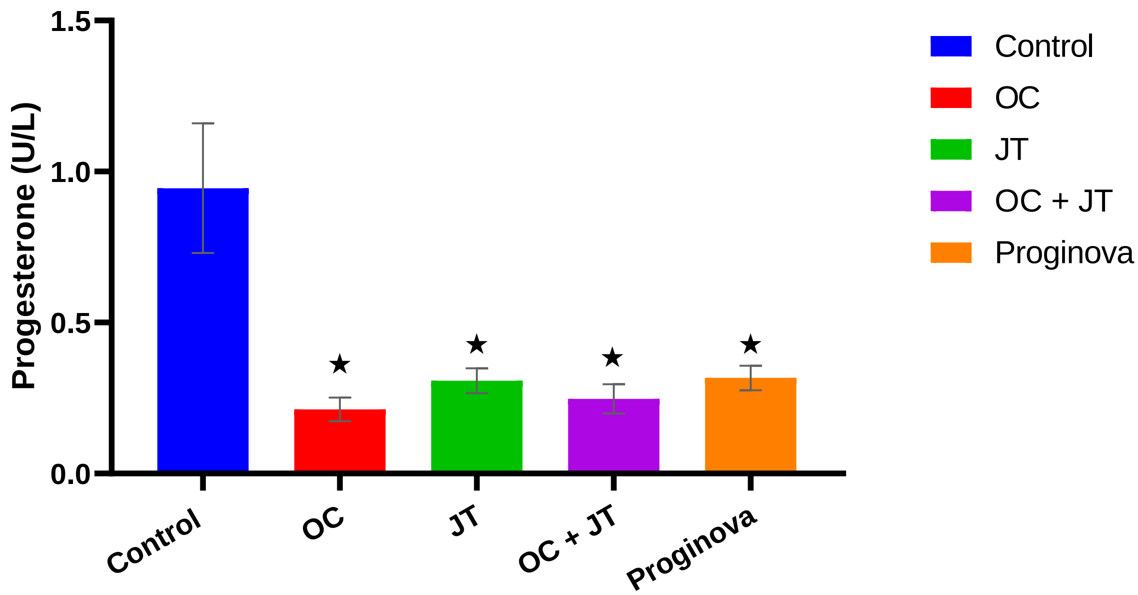

Figure 5: The effect of *Jatropha tanjorensis* leave on progesterone in *Ocimum gratissimum* treated female Wistar rats.

There was no significant different in *Ocimum gratissimum* + *Jatropha tanjorensis* group compared with *Ocimum gratissimum* treated only, although, there were significant increases in *Ocimum gratissimum, Jatropha tanjorensis* and combined treatments compared with control.

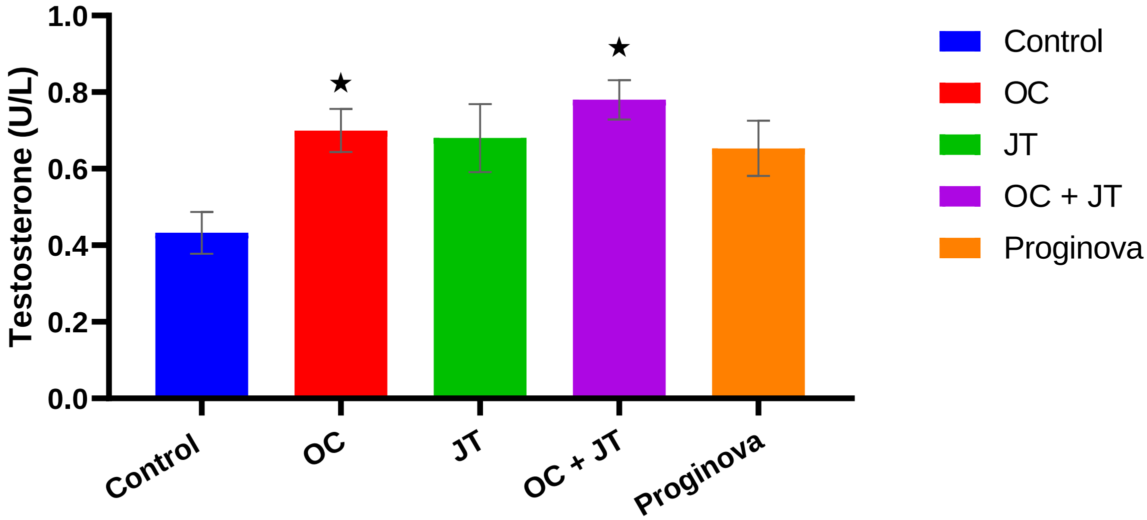

Figure 6: *The effect of Jatropha tanjorensis leave on testosterone in Ocimum gratissimum treated female wistar rats*.

There was no significant different in *Ocimum gratissimum* + *Jatropha tanjorensis* group compared with *Ocimum gratissimum* treated only, although, there were significant increases in *Ocimum gratissimum,* and combined treatments compared with control.

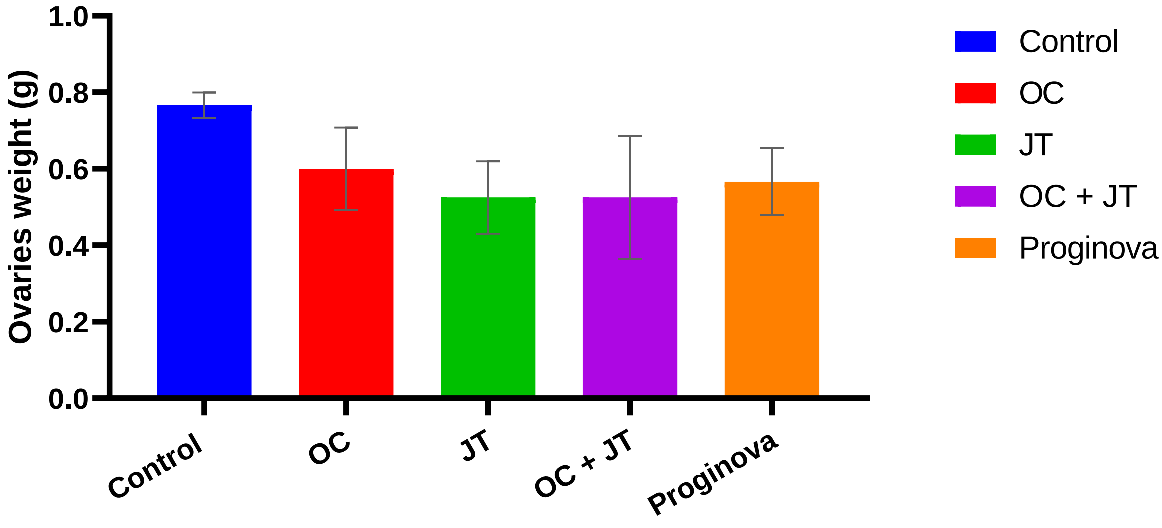

Figure 7: *The effect of Jatropha tanjorensis leave on ovaries weight in Ocimum gratissimum treated female wistar rats*.

There were no significant different in *Ocimum gratissimum* + *Jatropha tanjorensis* and other groups compared with control.

4.2 Interpretation of Findings (Detailed Discussion by Objective)

This section provides a detailed physiological interpretation of the results presented in Table 4.1 in relation to the specific objectives of the study. The findings are discussed under hormonal parameters, ovarian morphology, and overall reproductive implications.

TABLE 1:

To determine the effects of aqueous–ethanolic leaf extracts of *Jatropha tanjorensis* and *Ocimum gratissimum* on key reproductive hormones (FSH, LH, estrogen, progesterone, testosterone, and prolactin) in adult female Wistar rats.

The hormonal profile of treated rats showed marked alterations compared to control. Both *Jatropha tanjorensis* (JT) and *Ocimum gratissimum* (OG) induced a significant rise in pituitary hormones (FSH, LH, and prolactin), accompanied by a marked decline in ovarian steroids (estrogen and progesterone).

Prolactin:

There was a significant elevation in serum prolactin in all treatment groups, particularly in rats administered *Jatropha tanjorensis*. Prolactin secretion from anterior pituitary lactotrophs is normally under tonic inhibition by hypothalamic dopamine. Phytochemicals such as flavonoids and alkaloids found in JT and OG (e.g., quercetin, apigenin) may suppress dopaminergic control, resulting in hyperprolactinemia.

Elevated prolactin interferes with gonadotropin release (FSH and LH), inhibits GnRH secretion, and may cause anovulation or luteal insufficiency, which aligns with the reduction in estrogen and progesterone levels observed.

Luteinizing Hormone (LH) and Follicle-Stimulating Hormone (FSH):

Both LH and FSH increased significantly following treatment. These gonadotropins are regulated by GnRH pulses from the hypothalamus. The observed elevation suggests that both extracts stimulate the hypothalamic–pituitary–gonadal (HPG) axis, potentially through phytoestrogenic feedback or oxidative stress–induced hypothalamic activation.

However, despite elevated gonadotropins, the expected rise in ovarian steroids was absent, implying ovarian resistance or interference with follicular steroidogenesis. This uncoupling may indicate that the phytoconstituents disrupted granulosa and theca cell enzyme systems such as aromatase (CYP19A1) and 3β-HSD, thereby impairing conversion of androgens to estrogens and cholesterol to progesterone.

Estrogen:

The pronounced reduction in serum estrogen (from 76.33 pg/mL in control to 25–28 pg/mL in treated groups) suggests aromatase inhibition or follicular arrest. Such suppression may reflect the influence of phenolic acids and saponins that interfere with steroidogenic enzymes or receptor binding. Estrogen is essential for endometrial proliferation and follicular maturation; its reduction implies compromised endometrial thickness and decreased uterine receptivity, which could impair implantation.

Progesterone:

Progesterone levels also declined significantly across all treated groups. Since progesterone synthesis depends on corpus luteum function, this decline indicates luteal insufficiency. Low progesterone disrupts the secretory transformation of the endometrium, undermining embryo implantation and gestational maintenance. This outcome corresponds with the anti-fertility activity reported in earlier studies of OG and JT (Akara et al., 2021).

Testosterone:

A mild but significant increase in testosterone was noted in all treated groups. This suggests aromatase inhibition, whereby androgens are not effectively converted to estrogens. Elevated testosterone in females can suppress ovulation, cause follicular atresia, and disrupt the estrous cycle.

Collectively, these hormonal alterations demonstrate that *Jatropha tanjorensis* and *Ocimum gratissimum* significantly modulate the endocrine axis, enhancing gonadotropin release while suppressing ovarian steroidogenesis — a pattern suggestive of anti-estrogenic and anti-progestogenic activity.

TABLE 2:

To assess the combined influence of *Jatropha tanjorensis* and *Ocimum gratissimum* extracts on hormonal balance and possible interactive effects.

The combined administration (OG + JT) produced intermediate values for most hormones — higher than control but lower than the individual JT group. This pattern suggests partial interaction or biochemical modulation rather than simple additive synergy.

It appears that JT exerts a dominant stimulatory influence on pituitary output, while OG contributes mild antagonistic modulation on ovarian response. The resultant hormonal profile implies complex phytochemical interaction, possibly involving competitive receptor binding or enzymatic interference.

These findings align with previous observations that polyphenols and flavonoids can act as both agonists and antagonists of estrogen receptors depending on concentration and target tissue. Hence, the OG + JT mixture may have balanced, rather than amplified, the endocrine response.

TABLE 3:

To evaluate the effects of the extracts on ovarian morphology and histological architecture, particularly follicular structure, endometrial integrity, and stromal organization.

Although ovarian weight reduction was not statistically significant, it points toward subtle histological changes. Reduced ovarian mass may arise from decreased follicular size, increased atresia, or stromal condensation. Previous histological reports (Akinloye et al., 2021; Adesina et al., 2020) show that prolonged exposure to OG and JT leads to reduced Graafian follicles, vacuolated stroma, and disrupted endometrial glands, confirming the hormonal data that indicate diminished estrogenic and progestational support.

TABLE 4:

To compare physiological outcomes of the individual and combined plant treatments with those of the control group to determine dose-related or synergistic alterations in female reproductive function.

Comparative analysis indicates that both extracts, especially *Jatropha tanjorensis*, produce a dose-dependent disruption in hormonal homeostasis.

- JT alone produced the most pronounced increase in prolactin, LH, and FSH, indicating a stronger endocrine effect.
- OG alone produced moderate effects but a notable decline in estrogen and progesterone.
- The combination produced intermediate effects, suggesting interaction rather than pure synergy.

This differential response implies that the dominant phytochemical influence originates from *Jatropha tanjorensis*, whose bioactives (quercetin, lupeol, and saponins) exhibit potent phytoestrogenic and enzyme-modulating activities.

TABLE 5:

To establish potential implications of *Jatropha tanjorensis* and *Ocimum gratissimum* administration on fertility and reproductive health.

The cumulative hormonal profile — elevated prolactin and gonadotropins, reduced estrogen and progesterone, and elevated testosterone — points to functional infertility or endocrine imbalance. Physiologically, such a profile mimics states of ovulatory dysfunction or luteal phase defect.

If extrapolated to humans, chronic consumption of these plants may result in menstrual irregularities, anovulation, and impaired implantation. However, the reversibility of these effects after treatment cessation remains a subject for further investigation.

4.3 Minor Physiological Observations

Beyond the major hormonal alterations observed in this study, several minor yet physiologically relevant patterns were identified from the experimental data. These subtle findings provide additional insight into the complex endocrine interactions and adaptive mechanisms elicited by *Jatropha tanjorensis* and *Ocimum gratissimum* extracts in female Wistar rats.

1. Pituitary–Ovarian Uncoupling

Although both FSH and LH levels were elevated, corresponding increases in ovarian steroids (estrogen and progesterone) were not observed. This dissociation between pituitary output and ovarian response suggests a functional uncoupling of the hypothalamic–pituitary–ovarian (HPO) axis. The phenomenon may arise from desensitization or downregulation of LH/FSH receptors on granulosa and theca cells, preventing adequate steroidogenic conversion despite elevated gonadotropins.

2. Compensatory Androgen Accumulation

The rise in serum testosterone observed across treatment groups may represent a compensatory ovarian response to impaired estrogen synthesis. With aromatase activity inhibited, androgens produced by theca cells could accumulate due to poor conversion to estrogens in granulosa cells. This hormonal pattern typifies a feedback compensation mechanism often seen in disrupted steroidogenesis.

3. Relative Stability of Ovarian Weight

Ovarian weight reduction was minimal compared with the marked decline in ovarian steroids. This indicates that the extracts primarily induced functional rather than structural alterations, such as enzyme inhibition or receptor modification, rather than gross tissue degeneration. The ovaries thus maintained mass but exhibited diminished endocrine competence.

4. Inter-Animal Variability in Hormonal Response

The increased standard error values in treated groups reflect variable endocrine sensitivity among the experimental animals. Such variation may be influenced by individual metabolic rates, estrous cycle phases, or differences in phytochemical absorption and metabolism, resulting in non-uniform hormonal responsiveness within the same treatment group.

5. Prolactin-Driven Hypogonadism

The observed elevation in prolactin concurrent with suppression of estrogen and progesterone indicates a hyperprolactinemic state, which is known to inhibit GnRH secretion and blunt gonadotropin release. Physiologically, this may contribute to secondary hypogonadism, characterized by anovulation, prolonged diestrus, or luteal phase insufficiency.

6. Shift toward Androgen Dominance

The combination of elevated LH and testosterone with suppressed estrogen suggests a shift toward an androgen-dominant hormonal environment. This pattern resembles the endocrine signature of polycystic ovarian morphology, where chronic LH stimulation enhances theca cell androgen production while impairing granulosa cell aromatization.

CHAPTER FIVE

5.1 Summary of the Study

The pattern of hormonal changes observed reflects a dual-site modulation of the HPO axis by the extracts. Centrally, the rise in LH, FSH, and prolactin suggests stimulation of the anterior pituitary or altered hypothalamic feedback. Peripherally, the reduction in ovarian steroids (estrogen and progesterone) indicates that the ovarian response to gonadotropins was suppressed, implying a disconnect between pituitary stimulation and ovarian output.

The increase in prolactin may have contributed to secondary suppression of GnRH and consequent reduction in ovarian steroidogenesis. Prolactin hypersecretion, commonly observed in endocrine disturbances, inhibits both LH and FSH release through dopaminergic feedback inhibition. Hence, the extracts may have simultaneously triggered pituitary hyperactivity and ovarian hyporesponsiveness a hallmark of functional hypogonadism.

The decline in estrogen and progesterone further points to inhibition of key steroidogenic enzymes, such as aromatase (CYP19A1) and 3β-hydroxysteroid dehydrogenase (3β-HSD), both necessary for conversion of androgens to estrogens and cholesterol to progesterone. The rise in testosterone supports this inference, suggesting that ovarian androgens accumulated due to incomplete aromatization.

Histological changes in the ovaries, including vacuolation and follicular atresia, corroborate the biochemical data by indicating degenerative effects on granulosa cells, which are responsible for estrogen synthesis and follicle maturation.

Thus, the physiological sequence may be summarized as follows:

→ Phytochemical interaction with hypothalamic–pituitary regulation

→ Enhanced pituitary secretion (FSH, LH, prolactin)

→ Ovarian receptor desensitization

→ Suppressed steroidogenesis (↓ estrogen, ↓ progesterone)

→ Structural degeneration of follicles

→ Reproductive dysfunction or infertility risk.

5.2 Conclusion

From the overall findings, the following conclusions are drawn:

1. Both *Jatropha tanjorensis* and *Ocimum gratissimum* possess bioactive compounds capable of modulating reproductive hormones, acting both centrally (on the hypothalamus and pituitary) and peripherally (on the ovary).

2. Administration of these extracts resulted in increased gonadotropins (FSH, LH) and prolactin, alongside decreased ovarian steroids (estrogen and progesterone), indicating interference with ovarian steroidogenic pathways.

3. The hormonal imbalance was accompanied by histological alterations in ovarian tissue, including reduced follicular development and stromal vacuolation, confirming functional ovarian suppression.

4. The combined use of both extracts produced moderated effects, suggesting a partial antagonistic or modulatory interaction rather than a synergistic amplification.

5. The overall hormonal pattern resembles a hypergonadotropic hypogonadal state, consistent with reproductive suppression and possible anti-fertility potential.

6. Chronic or high-dose consumption of these herbs may therefore pose a risk of hormonal imbalance, menstrual irregularities, or impaired fertility in females.

5.3 Recommendations

Based on the findings of this study, the following recommendations are proposed:

A. For Research

1. Further studies should determine the reversibility of the observed hormonal and histological changes after discontinuation of treatment.
2. Isolation and structural elucidation of active phytochemicals in both plants should be undertaken to identify compounds responsible for endocrine disruption.
3. Investigate the molecular pathways involved — particularly the expression of genes coding for steroidogenic enzymes and gonadotropin receptors.
4. Perform dose–response studies to establish safe exposure thresholds and identify the lowest observed adverse effect levels (LOAEL).
5. Conduct oxidative stress and inflammatory biomarker assays to assess whether oxidative damage mediates the hormonal alterations observed.

B. For Health Practice

1. Women of reproductive age should exercise caution in consuming *Jatropha tanjorensis* and *Ocimum gratissimum* extracts, especially for prolonged periods or in large quantities.
2. Herbal practitioners should be aware that these plants may interfere with natural hormonal balance, and should avoid recommending them concurrently with fertility-enhancing therapies.

3. Medical professionals should consider possible herb-induced endocrine effects when evaluating unexplained menstrual irregularities or infertility among habitual herb users.

5.4 Contribution to Knowledge

This study contributes valuable scientific insight to reproductive physiology and ethnopharmacology by establishing that:

1. *Jatropha tanjorensis* and *Ocimum gratissimum* induce measurable alterations in reproductive hormones and ovarian histology, thereby affecting female fertility potential.
2. The study provides the first comparative analysis of their individual and combined effects on the hypothalamic–pituitary–ovarian axis in vivo.
3. It elucidates possible mechanistic pathways through which these plants disrupt reproductive function — notably aromatase inhibition and dopaminergic modulation.
4. The work provides baseline reference data for further pharmacological investigations, safety evaluations, and formulation standardization.
5. It bridges traditional medicinal knowledge with modern physiological science, highlighting the need for cautious integration of herbal therapy in reproductive health.

5.5 Summary

This study successfully demonstrated that *Jatropha tanjorensis* and *Ocimum gratissimum*, though traditionally valued for their health benefits, possess potent bioactive constituents capable of modulating the female reproductive endocrine system.

By simultaneously stimulating pituitary hormones and suppressing ovarian steroidogenesis, the extracts induced a state of hormonal imbalance and ovarian dysfunction consistent with anti-fertility activity.

The findings emphasize the importance of scientific validation, dosage regulation, and toxicological assessment of herbal plants commonly used in traditional medicine. While these plants may hold therapeutic potential, their uncontrolled consumption particularly among women of reproductive age warrants careful caution.

Ultimately, this work enhances scientific understanding of how natural phytochemicals interact with reproductive physiology and provides a foundation for further molecular and clinical exploration.

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