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Contraceptive Potential of *Ipomoea asarifolia* Aqueous Leaf Extracts in Female Wistar Rats as an Alternative Approach to Rodent Pest Management in Agriculture

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Abstract

Combined pre- and post-harvest loss in agricultural production accounts for about 40% in Africa with rodent contributing significant damage causing severe economic impact to farmers. This study explores whether *Ipomoea asarifolia* has contraceptive effects in female Wistar rats as a method of control of rodent pest depredating agricultural produce, by reducing their fertility. The impact of the aqueous leaf extract was assessed on fertility hormones, ovarian structure, and overall physiology in the rat. Forty-five female rats were divided into three groups: a control group and two experimental groups fed with diets containing 200 g/kg and 400 g/kg of *I. asarifolia* extract for 21 days. Various parameters, including body weight, feed intake, blood composition, hormone levels, and ovarian tissue structure, were analyzed. The results showed no significant changes in body weight or food consumption across the groups ($p > 0.05$). While some minor variations were observed in haematological and biochemical markers, they were largely insignificant, except for a slight increase in creatinine levels and a decrease in aspartate aminotransferase, which may indicate mild renal and antioxidant effects. Hormonal analysis revealed no substantial changes in luteinizing hormone (LH), follicle-stimulating hormone (FSH), progesterone, or oestrogen levels ($p > 0.05$). Histological examination of the ovaries showed some degenerative changes in the group that received the lower dosage, but no abnormalities in the higher dosage group. These findings suggest that *I. asarifolia* does not have a significant contraceptive effect in female rats within the duration of the study. However, further research using higher doses and longer exposure periods is needed to fully understand its potential anti-reproductive effects.

Keywords: *Ipomoea asarifolia*, contraceptive potential, female Wistar rats, fertility hormones, ovarian histology, haematology, serum biochemistry, reproductive health

1. Introduction

Rodents are major vertebrate pests belonging to the order Rodentia and class Mammalia, characterized by upper and lower pairs of ever-growing, rootless incisor teeth. They are the largest group of mammals, constituting almost half of the class Mammalia's approximately 4,660 species. They are cosmopolitant and highly adapted to different lifestyles as some are terrestrial, aquatic, semi-aquatic, rock-dwelling, burrowing, arboreal, and fossorial. The availability of water, shelter, and food enhance their prolific tendency and are favoured by high reproductive potential (Badmus & Ala, 2024; Krubitzer et al., 2011; Morris et al., 2022). They are indigenous to every land area except Antarctica, New Zealand, and a few Arctic and other oceanic islands, although some species have been introduced even to these places through their association with humans. This vast order of animals encompasses 27 separate families, including not only the "true" rats and mice (family Muridae) but also diverse groups such as porcupines, beavers, squirrels, marmots, pocket gophers, and chinchillas (Musser et al., 2005).

Rodents are among the major pests that have accompanied human society and agriculture since ancient times shaping human history as vectors of fatal diseases. As ecological opportunists, they are frequently associated with fields, orchards, farms, livestock stables, grain stores, food industry facilities, and many other places in agricultural and anthropogenic environments (Buckle & Smith, 2015; Gorbunova et al., 2008). They consume diverse food and non-food items ranging from plant and animal matters to inorganic matters. Ala and Badmus (2023) reported

vegetable matters as the major diet items in the gut of the captured species indicating their preferences for plant matters in the study area. The dietary items that form the bulk of the stomach contents could be used as bait of delivery medium for botanicals of rodenticidal and/or abortifacient potential (Ala & Badmus, 2023).

Several methods are available in agricultural storage facilities for controlling or reducing rodent damage, but IPM programs remain insufficiently developed (Spragins, 2006). This highlights the need for intensified research to mitigate the impact of rodents on farms. Given the dangers associated with chemical rodenticides, there is a pressing need to adopt natural pest control methods. These methods are environmentally friendly, sustainable, and can be integrated into broader pest management strategies.

Chemical rodenticides have been linked to environmental pollution and human health risks (Elliott et al., 2016). In contrast, natural pest control methods, such as the use of predators or repellents, can be effective and humane (Shiels et al., 2013). Natural pest control relies on understanding rodent ecology and behavior to develop effective and humane control measures (Leirs et al., 1996). By adopting such methods, reliance on chemical rodenticides can be reduced, promoting a more sustainable approach to pest management.

Ipomoea asarifolia, commonly known as ginger leaf morning glory, is a plant species belonging to the family Convolvulaceae (Nacro & Millogo, 1993). It thrives in tropical and subtropical regions and is widely distributed in India, Thailand, Africa, and America. In West Africa, it is a common weed in hydromorphic soils, low-lying inland valleys, streams, and riverbanks. In Nigeria, it is traditionally called “Duman Kada” in Hausa and “Gboro Ayaba” in Yoruba (Jegede et al., 2009).

The water extract of *I. asarifolia* exhibits anti-inflammatory and analgesic properties (Lawal et al., 2010). In Nigeria, its leaves are used as compost material, mulch, and a common weed on farms. Ekenyem (2006) suggests that *I. asarifolia* leaf meal could also be used as a feed ingredient in pig production.

In Senegal, *I. asarifolia* is traditionally used to treat gynecological ailments, including urinary problems during pregnancy, hemorrhage, as an abortifacient, and as an ecbolic. It is also used to alleviate arthritis pain, neuralgia, headaches, wound dressing, and ophthalmia (Aliyu et al., 2011). Phytochemical research reveals that *I. asarifolia* contains active compounds such as saponins, tannins, alkaloids, phenols, and carbohydrates (Jegede et al., 2009). These compounds exhibit biological activities, including hormonal modulation and antifertility effects (Lawal et al., 2010)

In a study conducted by Akindele et al. (2015) the hydroethanolic leaf extract of *Ipomoea asarifolia* was shown to significantly reduce sperm motility and count in male rats. This indicates potential antifertility properties of the plant. Badmus and Ala (2025) evaluated the potential of castor seed powder formulated feed in the fertility control of wild-caught female african giant rats. It was reported that castor seed powder has the potential of reducing the reprouctive ability of the female african giant rats and therefore can be recommended to the farmers for use.

The goal of this work was to investigate the effects of aqueous leaf extracts of *Ipomoea asarifolia* on the fertility hormones of female Wistar rats in a bid to use it as an alternative and safer approach to controlling rodent populations.

2. Materials and Methodology

2.1 Plant Collection

The whole fresh plant of *I. asarifolia* was harvested along the Federal University of Ibadan, Ibadan, Oyo State Nigeria (Latitude: 7.3912 Longitude: 3.9167). The plant was authenticated at the herbarium section of University of Ibadan, Ibadan, Oyo State. A voucher specimen was also deposited at the herbarium with the voucher number UIH-23451.

2.2 Sample Preparation

The extraction process followed a solvent extraction technique described by Hidayat and Wulandari (2021) with slight modifications. The leaves were washed thoroughly with distilled water to remove dirt and surface contaminants. The washed leaves were cut into small pieces and blended with distilled water at a ratio of 1:10 (w/v) to facilitate extraction. The resulting mixture was transferred into a clean glass beaker and left to macerate at room temperature for 72 hours with occasional stirring to enhance the diffusion of bioactive compounds into the solvent.

After the maceration period, the mixture was first filtered using a muslin cloth to remove large plant residues. The filtrate was then passed through Whatman No. 1 filter paper to obtain a clearer extract. The final aqueous extract was stored in a refrigerator at 4 °C before being used to carry out the study.

2.3 Collection of Ethical Approval

Ethical approval for this study was collected from Animal Care and Use Research Ethics Committee (UI-ACUREC), University of Ibadan, Ibadan, Nigeria. The assigned number was UI-ACUREC/122-0824/26.

2.4 Feed Formulation

The feed was purchased and taken for formulation, incorporating *Ipomoea asarifolia* extracts before being pelletized. It was then divided into three portions:

- ✓ The first portion contained 200 grams of extract per kilogram of feed.
- ✓ The second portion contained 400 grams of extract per kilogram of feed.
- ✓ The third portion served as a control, consisting of pure rat feed without any extract.

2.5 Experimental Animals and Treatment

Forty-five (45) healthy Swiss albino female rats, weighing between 80 and 120 g, were obtained from the Animal House of the University of Ibadan, Ibadan, Oyo State. The animals were kept under controlled environmental conditions, including a temperature of 26±2 °C, relative humidity of 55-60%, and a 12-hour light-dark cycle. They were housed in sanitized standard iron cages, with each cage containing five rats. Before the commencement of the administration process, the animals were allowed a 10-day acclimatization period, during which they were provided with growers' mash feed and water *ad libitum*.

Following acclimatization, the rats were randomly assigned to three groups: one control group and two experimental groups. The formulated feed, incorporating *Ipomoea asarifolia* extract, was administered for 21 days as follows:

- ✓ Control Group: Rats in this group were fed 100 grams of standard rat feed daily, without any *Ipomoea asarifolia* extract.
- ✓ Treatment 1 Group (Low Dosage): Each rat received 100 grams of feed containing *Ipomoea asarifolia* extract at a concentration of 200 grams per kilogram of feed.
- ✓ Treatment 2 Group (High Dosage): Each rat was given 100 grams of feed containing *Ipomoea asarifolia* extract at a concentration of 400 grams per kilogram of feed.

2.6 Blood and Organs Collection

After 21 days of treatment, blood samples were collected from the retro-orbital sinus of the animals using capillary tubes. The samples were immediately transferred into EDTA (Ethylene Diamine Tetra-Acetic Acid) anticoagulant tubes, labeled, and transported promptly to the laboratory for analysis. The ovaries were also collected for histopathological analysis.

2.7 Statistical Analysis

Data were expressed as Mean + Standard Error of Mean (SEM). The data analysis was carried out using the Statistical Package for the Social Sciences (SPSS) software. Descriptive and inferential statistical methods were employed to summarize the data and test the hypotheses. Results were regarded as significant with $P < 0.05$.

3. Results

3.1 Effects of Ipomoea asarifolia Extract on Body Weight of Female Wistar Rats

The results of the present study show variations in the weekly average weight (g) of female Wistar rats across the groups:

Table 1. Mean body weight of experimental animals

Groups	Day 1	Day 4	Day 7	Day 10	Day 13	Day 16	Day 19	Day 21
Control	88.80±3.63 a	96.00±2.50 a	110.33±0.93 a	116.87±2.21 a	122.67±4.26 a	125.87±3.25 a	132.13±3.75 a	137.26±4.76 a
Treatment 1	87.87±6.78 a	100.46±3.28 a	107.97±5.34 a	114.13±2.67 a	126.13±5.13 a	125.73±4.05 a	134.00 ±2.73 a	140.00±1.50 a
Treatment 2	100.80±7.75 a	102.67±3.60 a	118.27±6.85 a	122.80±5.59 a	127.27±7.67 a	130.20±5.40 a	133.53±7.08 a	140.07±6.54 a

Note. Means with the same letters across the column are not significantly different from each other.

In the first week of the experimental period, the group that received the highest concentration of the experimental feed had the highest mean weight (100.80±7.75 g), while the group that received the lower concentration had the

lowest mean weight compared to the control group. However, there was no significant difference across the treatment groups ($F = 1.31$, $df = 8$, $p > 0.05$) (Table 1).

On day four, the group that received the highest concentration had the highest mean weight (102.67±3.60 g). However, there was no significant difference in the average weight across all groups, including the control ($F = 1.15$, $df = 8$, $p > 0.05$) (Table 1).

On day 7, the group that received the highest concentration had the highest mean weight (118.67±6.85 g). However, no statistically significant difference was observed across all groups ($F = 1.14$, $df = 8$, $p > 0.05$) (Table 1).

On day 10, the group that received the highest concentration had the highest mean weight (122.80±5.59 g). However, there was no statistically significant difference in the mean weight across all groups ($F = 1.37$, $df = 8$, $p > 0.05$) (Table 1).

On day 13, the group that received the highest concentration had the highest mean weight (127.27±7.67 g). However, there was no statistically significant difference in the mean weight across all groups ($F = 0.17$, $df = 8$, $p > 0.05$).

On day 19, the group that received the lowest concentration had the highest mean weight (134.00±2.73 g) (Table 1). However, the difference was not statistically significant ($F = 0.04$, $df = 8$, $p > 0.05$).

On day 21, the group that received the highest concentration had the highest mean weight (140.07±6.57 g) (Table 1). However, the difference was not statistically significant ($F = 0.13$, $df = 8$, $p > 0.05$).

3.2 Effects of Ipomoea asarifolia on Feed Intake

The results of the present study show variations in the daily feed intake (%) of female Wistar rats across the groups. There was no significant difference in the average feed intake across the groups, including the control ($F = 3.99$, $df = 8$, $p > 0.05$) (Table 2).

Table 2. Mean feed intake of experimental animals

Groups	Mean Feed Intake of Experimental Animals
Control	100.00±00.00 a
Treatment 1	97.57±1.21a
Treatment 2	100.00±00.00 a

Note. Means with the same letters across the column are not significantly different from each other.

3.3 Effects of Ipomoea asarifolia on Haematological Parameters in Female Wistar Rats

The results of the present study show that there were variations in the mean PCV (%) values across the experimental groups. The treatment that received the lower concentration had the highest mean PCV (33.31±1.99). The difference recorded across the treatment groups, in comparison with the control and Treatment 2, was statistically significant ($F = 18.76$, $df = 44$, $p < 0.05$) (Table 3).

Similarly, variations were observed in the mean Hb (g/dL) values across the experimental groups (Table 4.3). The treatment that received the lower concentration had the highest mean Hb (10.78±0.76). The difference recorded across the treatment groups, in comparison with the control and Treatment 2, was statistically significant ($F = 11.71$, $df = 44$, $p < 0.05$) (Table 3).

Variations were also observed in the mean values of WBC (cells/mL) across the treatment groups.. The experimental group that received the mid concentration of the experimental feed recorded the highest mean WBC (16,112.67±3,029.62), while the group that received the highest concentration of the feed had the lowest mean WBC (12,763.33±1,690.40). However, there was no significant difference across the treatment groups and the control ($F = 2.05$, $df = 44$, $p > 0.05$) (Table 3).

A similar trend was observed for mean RBC (cells/mL), MCV (fL), MCH (pg), and MCHC (g/dL) values.

The group that received the lower concentration of the experimental feed recorded the highest mean RBC (0.42±0.08) ($F = 2.00$, $df = 44$, $p > 0.05$) and MCH (460.78±87.68) ($F = 1.74$, $df = 44$, $p > 0.05$) (Table 3).

For MCV, the group that received the higher concentration had the highest mean (1,258.03±247.16) ($F = 1.47$, $df = 44$, $p > 0.05$), while the control group had the highest mean MCHC (33.52±0.12) ($F = 1.72$, $df = 44$, $p > 0.05$). However, there was no significant difference across the treatment groups and the control (Table 3).

Table 3. Effects of *Ipomoea asarifolia* on haematological parameters of female Wistar rats during the experimental period

Group	PCV (%)	Hb (g/dl)	WBC (cells/ml)	RBC count (10^6 cell/ml)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Control	19.50±1.73 a	6.71±0.65 a	9719.33±1692.13 a	0.24±0.04 a	833.33±43.67 a	278.54±14.18 a	33.52±0.12a
Treatment 1	33.31±1.99 b	10.78±0.76 b	16112.67±3029.62 a	0.42±0.08 a	1193.48±209.98 a	460.78±87.68 a	33.17±0.17 a
Treatment 2	24.46±0.93 a	8.06±0.31 a	12763.33±1690.40 a	0.33±0.06 a	1258.03±247.16 a	410.89±86.06 a	33.27±0.09 a

Note. Means with the same letters across the column are not significantly different from each other.

3.4 Effects of Ipomoea asarifolia on Hormones and Serum Biochemistry Parameters in Female Wistar Rats

The results show that there were variations in the mean Luteinizing Hormone (LH), Follicle-Stimulating Hormone (FSH), Progesterone, and Oestrogen values (Table 4).

For LH, the treatment that received the lowest concentration had the highest mean value (95.07±8.77), while the control had the lowest mean value (35.09±0.41). The difference recorded in Treatment 1, in comparison with the control and Treatment 2, was statistically significant ($F = 25.04$, $df = 44$, $p < 0.05$) (Table 4).

For FSH, the treatment that received the highest concentration had the highest mean value (11.33±1.30), while the control had the lowest mean value (4.33±0.21). The difference recorded in Treatment 2, in comparison with the control and Treatment 1, was statistically significant ($F = 13.46$, $df = 44$, $p < 0.05$) (Table 4).

For Progesterone, the treatment that received the highest concentration had the highest mean value (0.10±0.09), while the treatment that received the lower concentration had the lowest mean value (0.04±0.02) . The difference recorded across the treatment groups, in comparison with the control and Treatment 2, was not statistically significant ($F = 3.81$, $df = 44$, $p > 0.05$) (Table 4).

For Oestrogen, the treatment that received the highest concentration had the highest mean value (34.41±1.23), while the control had the lowest mean value (30.60±1.07). The difference recorded across the treatment groups, in comparison with the control, was not statistically significant ($F = 2.65$, $df = 44$, $p > 0.05$) (Table 4).

The study also shows that there were variations in the mean values of serum biochemistry parameters.

For Urea, the control group had the highest mean value (43.87±4.19), while the group fed with the highest concentration of the experimental feed had the lowest mean value (30.07±2.62). Statistically, there was a significant difference in the mean Urea value between the control group and the treatment groups ($F = 6.29$, $df = 44$, $p < 0.05$) (Table 4).

For AST, the group fed with the lower concentration had the highest mean AST value (115.28±2.66), while the control group had the lowest mean value (99.23±2.79). The difference recorded across the treatment groups, in comparison with the control, was statistically significant ($F = 9.25$, $df = 44$, $p < 0.05$) (Table 4).

For ALP, the group fed with the highest concentration had the highest mean ALP value (87.29±4.99), while the control group had the lowest mean value (37.09±1.37). The difference recorded across the treatment groups, including the control, was statistically significant ($F = 24.62$, $df = 44$, $p < 0.05$) (Table 4).

For ALT, the group fed with the lowest concentration had the highest mean ALT value (58.69±3.26), while the group that received the highest concentration had the lowest mean value (39.71±2.63). The difference recorded across the treatment groups, in comparison with the control and Treatment 2, was statistically significant ($F = 16.87$, $df = 44$, $p < 0.05$) (Table 4).

For Creatinine, the group fed with the lowest concentration had the highest mean Creatinine value (98.55±5.17), while the control group had the lowest mean value (52.94±9.84) (Table 4.4). The difference recorded across the treatment groups, in comparison with the control, was statistically significant ($F = 12.09$, $df = 44$, $p < 0.05$) (Table 4).

Table 4. Effects of *Ipomoea asarifolia* on hormones and serum biochemistry parameters in female Wistar rats during the experimental period

Group	LH (mIU/ml)	FSH (miU/ml	Progesterone (ng/ml)	Oestrogen (pg/ml)	Urea (mg/dl)	AST (IU/L)	ALP (IU/L)	ALT (IU/L)	Creatinine
Control	35.09±0.41 a	4.43±0.21 a	0.05±0.01 a	30.68±1.07 a	43.87±4.19 b	99.23±2.79 a	37.09±1.37 a	41.80±1.28 a	52.94±9.84 a
Treatment 1	95.07±8.77 b	7.49±0.95 a	0.04±0.02 ab	34.41±1.19 a	32.16±1.35 a	115.28±2.66 b	58.95±7.00 b	58.69±3.26 b	98.55±5.17 b
Treatment 2	50.36±0.26 a	11.33±1.3 b	0.10±0.09 a	34.41±1.23 a	30.07±2.62 a	106.78±0.44 ab	87.29±4.99 c	39.71±2.63 a	81.06±0.74 b

Note. Means with the same letters across the column are not significantly different from each other.

3.5 Histology of the Ovary

Photomicrographs of the ovary across experimental groups reveal the oocytes (black arrows), primary follicles (yellow arrows), and primordial follicles (red arrows) at various magnifications. Figure 1 at ×100 magnification shows a wide ovarian cortex with intact oocytes and multiple primary and primordial follicles, but at ×400 magnification, signs of follicular degeneration, including vacuolation and cystic changes, are evident. In contrast, Figure 2 at both ×100 and ×400 magnifications demonstrates normal histology, with well-preserved oocytes and uniformly distributed primary and primordial follicles, alongside an intact stromal arrangement, with no signs of degeneration, fibrosis, or cystic changes. Similarly, Figure 3 reveals a healthy ovarian structure with numerous follicles in various developmental stages; at ×100 magnification, primordial and primary follicles are well-organized, while at ×400 magnification, the cellular structures remain intact, with no evidence of pathological changes such as fibrosis, cystic degeneration, or atresia. In summary, normal physiological activity is observed in Figures 2 and 3, while Figure 1 indicates degenerative and pathological changes.

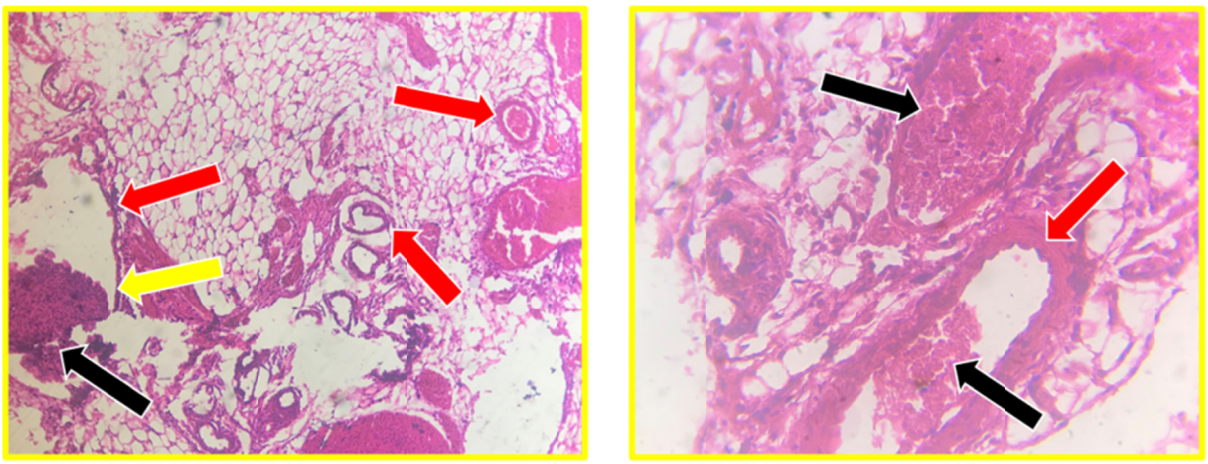


Figure 1. Ovary of experimental animals that received low dosage of experimental feed (Left = Magnification × 100, Right = Magnification × 400)

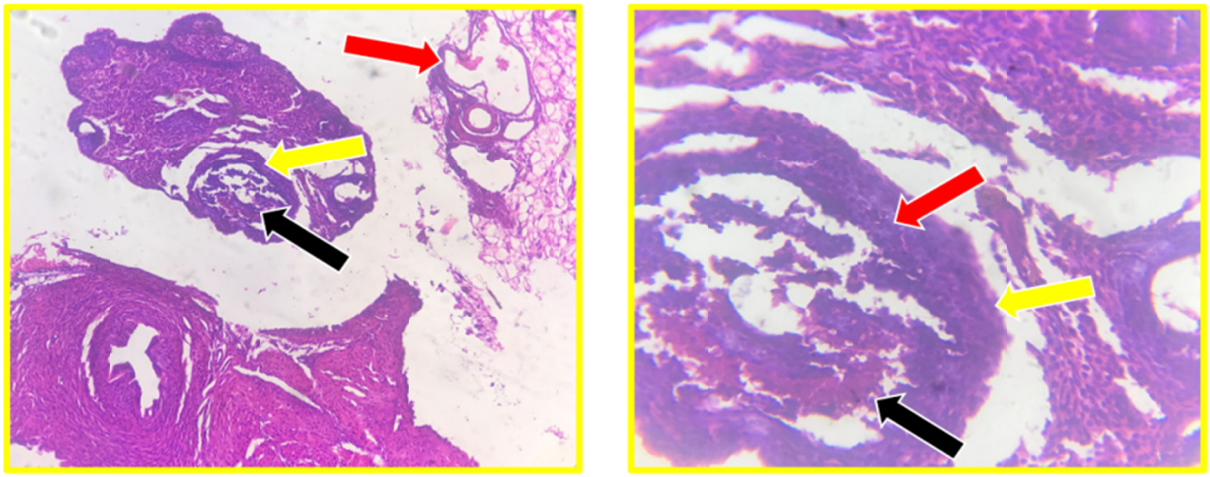


Figure 2. Ovary of control experimental animals (Left = Magnification × 100, Right = Magnification × 400)

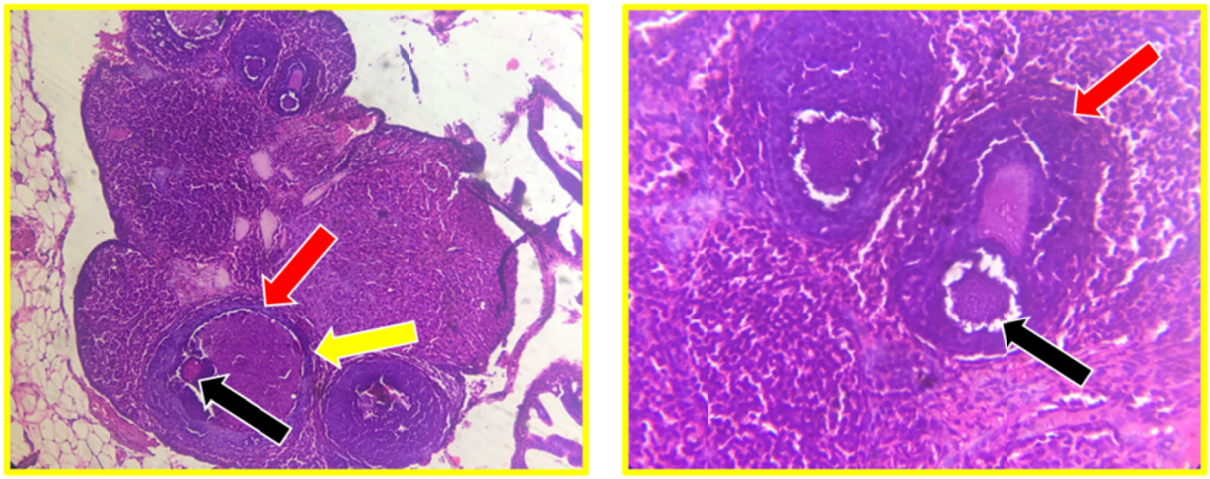


Figure 3. Ovary of experimental animals that received high dosage of experimental (Left = Magnification × 100, Right = Magnification × 400)

4. Discussion

The study found no significant changes in the feed intake of the rats administered with *I. asarifolia* compared to the control group, indicating that the extract does not affect the appetite or hydration levels of the rats. Similarly, there was no significant change in the body weight, indicating that *I. asarifolia* does not cause weight gain or weight loss in Wistar rats over the study period. This is in agreement with the previous findings by Akindele et al. (2015) who reported that hydroethanolic leaf extract of *Ipomoea asarifolia* does not significantly affect feed intake or body weight in Wistar rats.

The study assessing the toxicological profile of *Ipomoea asarifolia* leaf extract in rats found that while there were no significant changes in most haematological parameters, there was a reversible reduction in haemoglobin levels and red blood cell count at a dose of 400 mg/g.

This aligns with the findings of Akindele et al. (2015) who assessed the toxicological profile of *Ipomoea asarifolia* leaf extract in rats. The reduction suggests potential anaemic effect.The PCV level also decreased at 400 mg/g which aligns with the findings of Ojo et al. (2022). It is generally non-toxic to rats. However, Pinheiro et al. (2010) noted symptoms such as muscle tremors and loss of equilibrium, with progressive symptoms in goats leading to death in some cases. This indicates that the plant can be toxic to goats, affecting their haematological health.

It was revealed from the result of the present study that most of the serum biochemical parameters did not show significant changes both at lowest and highest level of concentration. However, there was a significant increase in

creatinine level in both lowest and highest concentration. There was also a reversible reduction in aspartate aminotransferase, which suggests potential antioxidant activity in the kidneys.

This discovery aligns with the findings of Akindele et al. (2015) in the 90-day toxicological assessment he carried out.

However, Shittu et al. (2019) noted that dietary inclusion of *Ipomoea asarifolia* significantly affected serum parameters such as mean cell hemoglobin, alkaline phosphatase, cholesterol, globulin, platelet count, white blood cell count, and total serum proteins. However, some parameters like aspartate amino acid and red blood cell count were not significantly affected

The study showed no significant difference in the fertility hormones of the rats. However, Akindele et al. (2015) suggest that the hydroethanolic extract of *Ipomoea asarifolia* significantly reduce sperm motility and count in male rats. This effect was noted to be reversible, indicating a potential temporary antifertility effect when the extract is administered at doses ranging from 40 to 1000 mg/kg.

The study revealed that the ovarian structure of the rats remained intact except for the rats administered with the lowest dosage where degenerative and pathological changes were observed.

Farida et al. (2012) suggest that *Ipomoea asarifolia* leaves exhibited hepatoprotective activity against chemically induced liver damage in rats, with histological improvements in liver tissue observed.

5. Conclusion

The results of the study show that *Ipomoea asarifolia* does not have contraceptive effects on female wistar rats when administered for a period of 21 days. No significant effects were observed on the mean weight and feed intake of the animals when fed with the experimental feed.

The difference in the Haematology and Serum biology was mostly non-significant, and no mortality or behavioural change was observed in all groups. This might be due to the quantity of leaves used.

6. Recommendation

Leaf dose dependent studies could be carried out to further investigate the contraceptive effects of the leaves. Even if contraceptive effects are not confirmed, *Ipomoea asarifolia* possesses other medicinal properties such as its anti-inflammatory properties, which merit further investigation

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Authors Contributions

H.A.B. was responsible for project administration, study design, statistical analysis, and editing the manuscript. B.O.A. was responsible for data collection and writing of the original manuscript. H.A.B. and M.O. revised the manuscript. All authors read and approved the final manuscript.

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