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Effect of Ginger and Moringa Extract on Growth Parameters and Reproductive Hormones in Rabbit Bucks

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Abstract

This study investigated the effect of Ginger (Zingiber officinale) and Moringa (Moringa oleifera) extracts on growth parameters and reproductive hormones in rabbit bucks. Twenty-four rabbits of mixed breeds (New Zealand x Dutch) were randomly assigned to four treatment groups in a Completely Randomized Design, for a period of 8 weeks. The treatments consisted of: T1 (Control, no extracts), T2 (5ml of ginger extract/L of water), T3 (5ml of moringa extract/L of water) and T4 (5ml of ginger extract + 5ml of moringa extract/L of water). Growth parameters measured included feed intake, body weight gain, and feed conversion ratio, while reproductive hormones evaluated were Follicle Stimulating Hormone (FSH), Luteinizing Hormone (LH), Testosterone, and Estrogen. Results showed no significant differences ($P>0.05$) in growth parameters across all treatment groups. However, significant differences ($P<0.05$) were observed in reproductive hormones. FSH levels were similar and superior in T1, T2, and T4 compared to T3. LH levels increased with the test diets, with T4 recording the highest values. Testosterone was significantly lowest in T4, while estrogen was highest in the control group (T1) and lowest in T3. The study concludes that while moringa and ginger extracts did not adversely affect growth performance, they significantly influenced reproductive hormone levels in rabbits, suggesting potential applications in reproductive management of rabbit production. The combination of both extracts (T4) showed the most pronounced effects on reproductive hormones, particularly LH levels.

Keywords*: Zingiber officinale, Moringa oleifera, rabbit reproduction, growth performance, reproductive hormones*

INTRODUCTION

The growing demand for animal protein in developing nations, particularly Nigeria with its population exceeding 160 million, has necessitated the exploration of alternative livestock sources that are both economically viable and nutritionally adequate. Rabbit (*Oryctolagus cuniculus*) has emerged as a promising mini livestock species that could significantly contribute to addressing this protein deficit in both rural and urban settlements (Henry *et al.*, 2018). The shift from conventional animal protein sources to non-conventional livestock has gained momentum, with

rabbits offering numerous advantages in terms of production efficiency and nutritional value (Lyon, 2011).

Rabbits possess several economic attributes that make them particularly suitable for small-scale production: short generation interval, rapid growth rate, genetic diversity, large litter size, and the ability to utilize forage and agricultural by-products (Abu *et al.,* 2008). Furthermore, rabbit meat offers superior nutritional qualities, containing approximately 22% protein, 4% fat, and 5% cholesterol, making it a healthier alternative to conventional meat sources (Nistor *et al.,* 2013). Rabbit meat is also rich in essential minerals, containing 21.4 mg/100g of calcium and 347 mg/100g of phosphorus, while maintaining lower fat (9.2 g/100g) and cholesterol (56.4 mg/100g) levels compared to other meat types (Nistor *et al.,* 2013). Despite these advantages, rabbit production has not met the increasing demand, largely due to challenges in reproductive efficiency and weaner survivability (Wariboko *et al.,* 2019). These challenges may be attributed to various factors including environmental, nutritional, physiological, managerial, or pathogenic influences (Iwuji, 2017). The optimization of reproductive ability is crucial for improving the currently rudimentary rabbit production industry in Nigeria (Iwuji *et al.,* 2019).

Mammalian reproduction is regulated by the hypothalamic-pituitary-gonadal axis, with gonadotrophin releasing hormone (GnRH) controlling the secretion of luteinizing hormone (LH) and follicle stimulating hormone (FSH), which in turn regulate gonadal function (Ajuogu *et al.,* 2018). While conventional fertility treatments using imported human fertility drugs have been attempted, their high cost and scarcity have led to increased interest in identifying locally available alternatives (Chibundu, 2005). Natural herbs such as ginger (*Zingiber officinale*) and moringa (*Moringa oleifera*) have shown promise in influencing reproductive performance in farm animals (Davies *et al.,* 2012).

Previous studies have demonstrated that moringa leaf powder supplementation at various concentrations (5, 10, and 15 g/kg) can improve reproductive hormone levels in female rabbits (Ajuogu *et al.,* 2019). However, contrasting findings have been reported regarding ginger's effects on reproductive hormones, with some studies showing increased testosterone levels but no significant impact on LH and FSH levels in laboratory animals (Afzali and Jamshid, 2018). While natural herbs are generally considered beneficial for fertility (Olatunji-Bello *et al.,* 2009), some may potentially hinder reproductive function (D'Cruz *et al.,* 2010). Given these conflicting findings and the potential of natural herbs to influence reproductive performance, there is a need to investigate the combined and individual effects of moringa and ginger extracts on growth parameters and reproductive hormones in rabbits. This study aims to evaluate these effects and contribute to the development of cost-effective, locally available solutions for improving rabbit production efficiency in Nigeria.

MATERIALS AND METHODS

The experiment was carried out in the Rabbitry unit of the University of Port Harcourt Teaching and Research Farm, Choba campus, Port Harcourt, Rivers State, which lies on latitude 40 53' 30" N and longitude 40 53' 30" and 60 54' 45" E (Ayeloja and Adedeji, 2015). Port Harcourt records a

mean annual temperature of 28ºC; with a mean annual relative humidity of 85%. The peak of rainy season usually occurs from June to October, with the total annual rainfall of more than 2500 mm (Eludoyin *et al.*, 2015). A total number of twenty-four (24) rabbit bucks were randomly assigned to four treatment groups of three (3) replicates, with two (2) rabbits per replicate, in a Completely Randomized Designed (CRD). The rabbits were housed in metal hutches where they had adequate ventilation and 12-hour light/dark cycle for a duration of 8 weeks. The rabbits were given a one-week adjustment period with the feed before the commencement of the feeding trial and all daily routine management practices associated with rabbit production were carried out.

Ginger and Moringa were procured from commercial dealers in Rumokoro and Igwuruta market respectively, at Obio-Akpor Local Government Area of Rivers State. The fresh ginger was washed in running tap water to remove adhering debris and cut into small sizes of about 1 cm after which they were air-dried at room temperature for four days. The dried ginger was then ground to coarse powder using a mechanical blender (CF-158 Hammer Muhle 2, 2 Kw 380 V-cissonius). Fresh Moringa leaves were air-dried for five days and ground into fine particles using a simple hammer mill. 100g of ground ginger was mixed in 800 ml of water, and 100g of ground moringa was also mixed in 800ml of water, separately and was mixed for 30 minutes with the aid of an orbital shaker. The test extracts were added into the drinking water of the rabbits at different inclusion levels as follows; T1 (Control, no extracts), T2 (5ml of ginger extract/L of water), T3 (5ml of moringa extract/L of water) and T4 (5ml of ginger extract + 5ml of moringa extract/L of water).

Data Collection and Analysis

During the experiment, performance parameters such as feed intake, body weight gain, feed conversion ratio and % mortality were recorded.

Feed intake (g)

Feed intake was calculated by subtracting left over feed from feed served after 24hours. It can be expressed as: Feed intake (g) = Feed served (g) – Feed left over (g)

Body weight gain (g)

Body weight gain was calculated by subtracting initial body weight from final body weight. Body weight gain (g) = Final body weight (g) – Initial weight gain (g)

Feed conversion ratio (g)

Feed conversion ratio was calculated by dividing feed consumed by body weight gain as expressed below: Feed conversion ratio (g) = $^{\text{Feed consumed (g)}}/_{\text{Body weight gain (g)}}$

% Mortality

% Mortality was calculated by dividing the number of dead rabbits by the initial number stocked and then multiplying by 100. This is expressed as: % Mortality = ($^{\text{Number of dead birds}}/_{\text{Initial stock size}}$) X 100

At the end of the feeding trial, blood samples were taken from the marginal ear vein of 16 experimental rabbits representing the 4 treatment groups. The blood samples were collected into a set of sterile plastic bottles and allowed to coagulate to produce sera for hormonal analyses. The test for hormonal parameters in the blood serum (Testosterone, luteinizing hormone (LH), follicle stimulating hormone (FSH), and estrogen) were carried out using the tube-based enzyme immunoassay (EIA) method. The protocol used for the hormone assay was according to the method of Micaleft *et al.* (1995) as described for the kit (BioCheck ELISA Assay, USA).

Statistical Analysis

Data obtained were subjected to Analysis of Variance (ANOVA) and significant means ($P<0.05$) were separated using Duncan Multiple Range Test (DMRT) according to Duncan (1955), using the Statistical Package for Social Science (SPSS version 20.0) software.

The following statistical model was used:

$Xij = \mu + Ti + eij.$

Where: Xij = individual observation on j^{th} rabbit in the i^{th} treatment.

μ = population mean

Ti = effect of the i^{th} treatment diet on the weight changes or reproductive parameters.

RESULTS

Table 1 presents the effects of ginger and moringa extracts on growth parameters in rabbits. The results indicated no significant differences ($P>0.05$) across all treatment groups for any of the measured growth parameters. Initial weights ranged from 521.33g to 825.33g, with T4 (combination of moringa and ginger extract) showing the highest initial weight. Final weights varied from 1483.00g to 1566.33g, with T4 maintaining the highest value, though not statistically significant. Weight gain showed a decreasing trend from T1 (123.33g) to T4 (92.63g), but these differences were not statistically significant. Feed intake ranged from 1228.04g to 1859.17g, with the control group (T1) showing the highest intake, while T3 (moringa extract) had the lowest. Feed Conversion Ratio (FCR) remained relatively consistent across treatments (0.06-0.08), suggesting similar feed utilization efficiency across all groups. Mortality rates were minimal and similar across treatments (0.33), except for T3 which showed a slightly higher value (1.00), though not statistically significant.

Table 1: Effect of ginger and moringa extract on growth parameters of rabbit bucks

Parameters	T_1	T_2	T_3	T_4	SEM
Initial weight (g)	521.33	628.33	757.67	825.33	98.03
Final weight (g)	1508.00	1483.00	1552.00	1566.33	197.64
Weight gain (g)	123.33	106.83	99.30	92.63	13.59
Feed intake (g)	1859.17	1720.21	1228.04	1738.84	199.31
FCR (g)	0.07	0.07	0.08	0.06	0.01
Mortality (%)	0.33	0.33	1.00	0.33	0.58

Table 2 represents the effect of ginger and moringa extracts on reproductive hormones of rabbit bucks. The table shows significant effects ($P<0.05$) of the treatments on reproductive hormone levels. Follicle Stimulating Hormone (FSH) showed statistically similar values in T1 (0.87), T2 (0.86), and T4 (0.78), which were significantly higher than T3 (0.53). Luteinizing Hormone (LH) demonstrated significant variations across treatments, with T4 showing the highest value (1.48), significantly different from all other treatments. T2 recorded the lowest LH value (0.86), while T1 and T3 showed intermediate values (1.14 and 1.18 respectively). Testosterone levels showed significant differences across treatments, with T1 and T3 showing similarly high values (0.52), followed by T2 (0.46), and T4 showing the lowest value (0.41). Estrogen levels showed significant variations, with the control group (T1) showing the highest value (86.00), significantly different from all other treatments. T3 showed the lowest estrogen level (46.00), while T2 and T4 showed intermediate values (63.67 and 65.00 respectively).

Table 2: Effect of ginger and moringa extract on reproductive hormones of rabbit bucks

Parameters	T_1	T_2	T_3	T_4	SEM
FSH	0.87^{a}	0.86^{a}	0.53^{b}	0.78^{a}	0.01
LH	1.14^{b}	0.86^{c}	1.18^{b}	1.48^{a}	0.01
TET	0.52^{a}	0.46^{b}	0.52^{a}	0.41^{c}	0.01
EST	86.00^{a}	63.67^{b}	46.00^{c}	65.00^{b}	1.16

^{ab} *Means within rows with different superscripts differ significantly at ($P<0.05$). SEM: Standard Error mean, FSH- Follicle stimulating hormone, LH- Luteinizing hormone, TET- Testosterone, EST- Estrogen*

DISCUSSION

The non-significant differences observed in growth parameters across all treatment groups align with findings reported by Emmanuel and Ocheful (2020) and Ogbuewu and Mbajiorgu (2018), who similarly found no significant effects when administering ginger and moringa extracts separately to growing rabbits. However, these results contrast with earlier studies by Onu and Aniebo (2011), Djakalia *et al*. (2011), and Olugbemi *et al.* (2010), who reported significant improvements in growth parameters with moringa leaf meal and ginger supplementation. The comparable final weights and weight gains across treatments suggest that the extract inclusion levels adequately supported growth and development, consistent with observations by Olatunji *et al.* (2013). The consistent feed conversion ratios align with observations by Akbarian *et al.* (2011) and Cross *et al.* (2007), who reported that herbs and plant extracts generally do not affect feed efficiency in monogastric animals. The low mortality rates across treatments support Safa and Eltazi's (2014) findings regarding the antimicrobial potential of these extracts in maintaining animal health.

Results on reproductive hormone levels was in agreement with Ogbuewu *et al*. (2014) who also recorded significant ($P<0.05$) difference on reproductive hormones of rabbits fed graded levels of ginger rhizome powder, but contradicts the works of Afzali and Jamshid, (2018) who opined that orally gavage ginger at 100, 200 and 300mg had no significant effect on reproductive hormone levels ($P>0.05$) in Wistar rats. According to Amao *et al.* (2013), follicle stimulating hormone (FSH) is secreted from the anterior pituitary cells of animals (gonadotrophs) with the aim of stimulating the gonads - in males, the testes and in females, the ovaries. Ahemen *et al.* (2013) reported that diminished secretion of FSH can result in failure of gonadal function (hypogonadism), thus leading to poor sperm cell production, therefore, the superior values of FSH among those in the Control, T2 and T4 suggest that the test diet didn't alter the proper functioning of the testes in the male rabbits. More so, the hormonal variations observed in gonadotropins (FSH and LH) suggest that these extracts may modulate the hypothalamic-pituitary-gonadal axis, supporting earlier findings by Ajuogu *et al.* (2018). This is also consistent with Banihani *et al.* (2018), who reported that ginger's active compounds, particularly gingerols and shogaols, can stimulate the release of gonadotropin-releasing hormone (GnRH), subsequently elevating LH and FSH levels. Similarly, Moringa's rich antioxidant profile, particularly its flavonoids and vitamin E content, has been shown to support pituitary function (Abdull *et al.,* 2014).

Testosterone is responsible for maintaining optimum conditions for spermiogenesis, spermatozoa transport and semen deposition near the site of fertilization in the female (Kay, 2014). The enhancement of testosterone levels observed in T3 may be attributed to multiple mechanisms. Moringa leaves contain some androgenic analogue which influence the optimal condition and activities of spermiogenesis as earlier reported by Castellini, (2003). Additionally, ginger has been demonstrated to increase testicular cholesterol levels, a crucial precursor for testosterone synthesis (Kamtchouing *et al*., 2019). Also, the zinc and selenium content in Moringa likely contributed to improved testosterone production, as these minerals are essential cofactors in steroidogenic enzymes (Pourmorad *et al.,* 2016). Regarding estrogen levels, the positive modulation observed

could be linked to the phytoestrogenic compounds present in both plants. Moringa leaves contain significant quantities of quercetin and kaempferol, which have been shown to exhibit mild estrogenic activity (Santos *et al.,* 2017). Ginger's contribution to improved estrogen levels might be indirect, through its enhancement of aromatase activity, the enzyme responsible for converting androgens to estrogens (Lee *et al.*, 2015). The combination treatment's (T4) distinct effects, particularly on LH levels, indicate potential synergistic actions of moringa and ginger bioactive compounds. This supports the growing evidence for using natural compounds in reproductive management, as suggested by Davies *et al.* (2012). The antioxidant properties of both plants likely play a crucial role in their hormonal effects. Oxidative stress can negatively impact reproductive hormone production and signaling (Wilson *et al.*, 2020). The combination of ginger's gingerols and moringa's flavonoids provides comprehensive antioxidant protection, potentially creating an optimal environment for hormone synthesis and function.

CONCLUSION

This study has demonstrated that while ginger and moringa extract, both individually and in combination, do not significantly affect growth parameters in rabbits, they exert notable influences on reproductive hormone profiles in rabbits. The absence of significant difference in growth parameters suggest that these natural extracts can be safely incorporated into rabbit diets without compromising growth performance or feed utilization efficiency. Results on reproductive performance of rabbits suggest that these natural extracts may offer reproductive benefits, thus the locally available natural extracts can be effectively utilized to modulate reproductive hormone profiles in rabbits. This study therefore contributes to the growing body of knowledge on natural alternatives in rabbit production and provides a foundation for developing cost-effective, locally sourced solutions for improving reproductive efficiency in rabbit breeding programs.

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