OVARIAN MORPHOMETRY OF NOILER, NIGERIAN HEAVY ECOTYPE CHICKEN AND THEIR CROSSES GIVEN VARYING AQUEOUS LEVELS OF NEEM LEAF AND GINGER ROOT EXTRACTS

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ABSTRACT

The effect of neem and ginger extracts on the ovarian morphometry of Noiler, Nigerian Heavy Ecotype chickens and their crossbred was investigated. A total of 180 sixteen week old chicken from 3 genetic groups consisting; 60 hens from a cross between Noiler cocks × Noiler (NN) hens, 60 hens from a cross between Heavy Ecotype cocks × Heavy Ecotype (HH) hens and 60 hens from a cross between Noiler cocks × Heavy Ecotype (NH) hen were used for the study. Birds from each genotype were randomly assigned to four treatments with 15 birds per treatment: T1 (control, no extract), T2 (200 ml neem), T3 (200 ml ginger) and T4 (100 ml neem + 100 ml ginger). Results revealed significant ($p < 0.05$) effects of genotype, treatment and their interaction on ovarian morphometric parameters including age at sexual maturity (ASM), body weight at sexual maturity (BWSM), egg weight at sexual maturity (EWSM), ovary weights, oviduct weights and follicular development traits. Noiler birds on GE200 and NE100+GE100 had the best reproductive performance with significantly earliest ASM, heaviest reproductive organs and highest follicle counts. Main cross birds on GE200 also showed marked improvements in ovarian development, performing better than HH birds across most traits. Heavy Ecotype birds recorded the lowest ovarian weights and highest post-ovulatory follicle (POF) counts with minimal response to treatment. Based on the findings, GE200 and NE100+GE100 were most effective in improving ovarian morphometry and reproductive performance in Noiler and Main cross genotypes without deleterious effects.

Keywords: Neem, ginger, ovarian morphometry, Noiler, Main Cross

Description of the Problem

Nigeria faces a growing challenge in meeting animal protein demand due to rapid population growth and widespread food insecurity. Poultry, particularly chicken meat and eggs offers a viable solution owing to its efficiency and nutritional value. Indigenous breeds like Noiler, the Nigerian Heavy Ecotype and their crosses are well adapted to local conditions and hold significant genetic potential for sustainable production (1). However, the use of antibiotics to boost poultry productivity has raised concerns over cost, health risks and residue accumulation prompting the search for safer and natural alternatives (2). Medicinal plants such as neem (*Azadirachta indica*) and ginger (*Zingiber officinale*) have shown to be promising due to their antimicrobial, antioxidant and immune-enhancing properties (3). Despite their potential, little is known about the effects of aqueous neem and ginger extracts on reproductive traits in indigenous and crossbred Nigerian chickens. Given the central role of ovarian morphology in reproductive efficiency and egg production, this study investigates the impact of these phytogenic additives on ovarian development, aiming to identify natural strategies for improving poultry productivity in a sustainable manner.

Materials and Methods

Experimental Site

The study was conducted at the Poultry Unit of the Department of Animal Science, Teaching and Research Farm, University of Nigeria, Nsukka, located in Enugu State, South Eastern Nigeria. Nsukka lies within longitude 6˚ 45′E and 7˚ E and latitude 7˚ 12.5 ′N and on the altitude 447 m above sea level (Ejere and Okpara, 2010). The climate of the study area is typically tropical with relative humidity ranging from 65 to 80% and mean daily temperature of 26.8 ˚C (4).

Experimental Birds and Design: A total of 180 sixteen weeks old chicken from 3 genetic groups consisting; 60 hens from a cross between Noiler cocks × Noiler (NN) hens, 60 hens from a cross between Heavy Ecotype cocks × Heavy Ecotype (HH) hens and 60 hens from a cross between Noiler cocks × Heavy Ecotype (NH) hen were used for the study. The hens from each genetic group were randomly assigned to 4 treatments with 15 birds per treatment as follows: T1: No plant extracts, T2: 200 ml neem, T3: 200 ml ginger and T4: 100 ml neem + 100 ml ginger. Each treatment group consisted of 3 replicates (n=5) with uniform body weight.

Management of Experimental Birds

Birds were housed under controlled environmental conditions. Temperature was maintained at 22°C throughout the study. Lighting was provided for 23 hours daily, with 1 hour of darkness. Relative humidity was maintained at 70-75% during the first week and adjusted to 55-65% thereafter. Birds had *ad libitum* access to clean water and freshly prepared experimental diets.

Data Collection at Sexual Maturity

At first oviposition, three hens per genotype per treatment (n = 36) were selected. Data collected included age (ASM), body weight (BWSM) and egg weight (EWSM) at sexual maturity.

Slaughter and Tissue Collection

Feed was withdrawn for 8-12 hours prior to humane slaughter. Birds were exsanguinated by severing major blood vessels without head removal. Oviduct and ovary were excised and weighed using a precision balance.

Ovarian Morphometry

Large yellow follicles (LYF) were counted and individually weighed with the largest designated as F1. Post-ovulatory follicles (POF) and small yellow follicles (SYF, 5-10 mm) were also recorded. Dissections were carefully performed to avoid ovarian damage.

Results and Discussion

Effect of Plant Extract on Ovarian Morphometry

Administration of aqueous neem and ginger extracts significantly influenced ovarian development (Table 1). Birds treated with 200 ml ginger extract (GE200) and the combination of neem and ginger (NE100+GE100) exhibited earlier age at sexual maturity (ASM) ($p < 0.05$), higher body weight at sexual maturity (BWSM), egg weight at sexual maturity (EWSM) and increased ovary and oviduct weights ($p < 0.01$). These effects are likely due to enhanced follicular recruitment mediated by elevated FSH levels (5). Follicular traits including large yellow follicles (LYF) and small yellow follicles (SYF) in both number and weight were significantly enhanced in GE200 and NE100+GE100 groups ($p < 0.01$). This may be attributed to bioactive phytochemicals such as flavonoids and phenolics in ginger that modulate estrogen and progesterone balance and support steroidogenesis (6). Post-ovulatory follicle (POF) numbers were significantly lower in treated groups ($p < 0.01$) indicating reduced atresia or internal ovulation and more efficient ovulation. F1 follicle weight was not significantly affected ($p = 0.254$) implying that the treatments enhanced follicle recruitment but not necessarily final follicle growth.

Effect of Genotype on Ovarian Morphometry

Genotype had a strong impact on reproductive traits ($p < 0.05$). Noiler (NN) birds matured significantly earlier than Heavy Ecotype (HH) and Main Cross (MC) birds by 50.37 and 30.37 days, respectively. NN also had the highest BWSM, EWSM and ovarian and oviduct weights as well as greater LYF and SYF counts and weights ($p < 0.01$) reflecting intense genetic selection for egg production (7). MC birds showed moderate ovary weights, follicle counts and egg production potential suggesting some degree of genetic improvement though less pronounced than in NN. Conversely, HH birds had the lowest reproductive performance and highest POF counts ($p < 0.01$) suggesting increased internal ovulation or follicular atresia. These deficits likely contributed to the reduced productivity of HH birds.

Genotype × Plant Extract Interaction

Significant interactions between genotype and plant extract (G × PE) were observed for ASM, BWSM, EWSM, ovary and oviduct weights and follicle traits ($p < 0.01$). NN birds showed the strongest response to GE200 and NE100+GE100 with marked improvements in ovarian metrics. MC birds also responded positively but to a lesser degree showing intermediate gains in follicle number and organ weights. In contrast HH birds showed minimal improvement potentially due to slower follicular growth and possible inhibitory effects of neem on granulosa cell proliferation (8). These findings suggest that phytogenic supplements particularly ginger extract, enhanced reproductive traits more effectively in genetically superior birds like NN. These findings underscore that ginger-based phytogenic supplementation is most effective in genetically improved breeds like NN and to a lesser extent, MC. The reproductive performance in less-selected birds like HH is less amenable to enhancement through such treatments.

Conclusion and Application

This study showed that aqueous ginger and neem extracts significantly influenced ovarian development and reproductive traits in chickens with genotype-specific responses. Ginger extract (200 ml) and its combination with neem (100 ml each) improved sexual maturity and ovarian morphology in Noiler (NN) and Main Cross (NH) birds. Conversely, Heavy Ecotype (HH) birds exhibited limited response suggesting a need for alternative strategies. These results highlight the potential of ginger alone or with neem as a natural reproductive enhancer in improved or crossbred genotypes. Further studies should explore optimal dosages and underlying mechanisms to support sustainable poultry productivity across diverse genetic lines.

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Table 1. Effect of aqueous neem leaf and ginger extract on ovarian morphometry of Noiler, Nigerian Heavy Ecotype chickens and their crossbred

Parameters	ASM (days)	BWSM (g)	EWSM (g)	Ovary (g)	Oviduct (g)	LYF (n)	SYF (n)	LYF (g)	SYF (g)	F1 (g)	POF (n)
Genotype (G)											
NN	138.75±4.67^{c}	2259.89±48.02^{a}	45.25±0.77^{a}	47.50±3.14	50.25±1.63^{a}	6.87±0.31^{a}	6.50±0.31^{a}	35.75±2.62^{a}	10.50±0.46^{a}	10.00±0.31^{a}	2.25±0.33^{c}
HH	189.50±3.68^{a}	1060.33±15.91^{c}	34.87±0.47^{c}	38.38±1.60^{c}	43.65±2.11^{c}	6.00±0-38^{b}	5.50±0.38^{b}	28.50±1.57^{b}	7.25±0.46^{c}	8.25±0.38^{c}	5.12±0.49^{a}
Main cross (MC)	169.12±4.14^{b}	1516.63±38.31^{b}	39.50±1.08^{b}	42.87±1.88^{b}	47.05±1.10^{b}	5.88±0.32^{b}	5.75±0.32^{ab}	29.38±1.32^{b}	8.50±0.40^{b}	9.13±0.32^{b}	3.25±0.40^{b}
P-value	0.000	0.000	0.000	0.000	0.000	0.007	0.033	0.000	0.000	0.001	0.000
Plant extract (PE)											
Control	174.33±7.46^{a}	1478.71±133.50^{b}	36.50±1.41^{b}	33.67±0.37^{d}	37.33±1.69^{c}	5.50±0.28^{b}	5.00±0.38^{c}	23.05±0.71^{d}	7.67±0.81^{b}	8.87±0.48	4.33±0.86^{a}
NE200	165.33±8.22^{ab}	1606.05±167.08^{a}	41.67±1.49^{a}	40.50±1.20^{c}	50.00±0.71^{ab}	5.67±0.22^{b}	5.67±0.44^{bc}	30.33±0.41^{c}	8.10±0.38^{b}	9.17±0.53	2.00±0.57^{b}
GE200	160.33±6.88^{c}	1684.73±165.18^{a}	40.50±1.40^{a}	52.83±1.40^{a}	50.67±1.42^{a}	7.17±0.40^{a}	6.50±0.28^{ab}	38.83±0.97^{a}	9.83±0.44^{a}	9.67±0.33	2.77±0.41^{b}
NE100+GE100	163.17±8.61^{ab}	1679.66±143.71^{a}	40.83±1.58^{a}	44.67±3.61^{b}	48.67±1.42^{b}	6.67±0.22^{a}	6.67±0.33^{a}	32.67±3.34^{b}	9.50±0.64^{a}	9.11±0.22	2.83±0.76^{b}
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.254	0.001
G × PE											
NN × Control	150.50±12.41^{cd}	2052.34±87.69^{c}	43.00±0.00^{bcd}	35.10±0.57^{gh}	42.00±1.15^{ef}	5.50±0.28	6.00±0.57^{abc}	23.00±1.73^{f}	8.50±0.86^{cd}	9.00±0.57^{ab}	2.00±0.57
NN × NE200	131.50±0.86^{de}	2350.65±83.72^{ab}	45.50±0.28^{ab}	36.00±0.57^{g}	48.00±1.15^{cd}	6.00±0.57	4.50±0.28^{cd}	29.00±0.57^{de}	8.00±0.57^{cd}	10.00±0.57^{ab}	4.00±0.57
NN × GE200	127.00±2.88^{e}	2408.07±36.22^{a}	47.50±0.28^{a}	61.20±0.57^{a}	55.00±1.15^{a}	8.50±0.28	6.00±0.57^{abc}	48.00±1.15^{a}	11.00±0.57^{ab}	11.00±0.57^{a}	3.00±0.57
NN × NE100+GE100	146.00±12.12^{de}	2228.54±73.20^{b}	45.00±2.88^{abc}	58.10±1.73^{b}	56.00±1.15^{a}	7.00±0.28	7.00±0.57^{a}	43.00±1.15^{b}	12.00±0.57^{a}	10.00±0.57^{ab}	2.00±0.57
HH × Control	174.00±1.15^{ab}	1056.43±9.40^{g}	35.50±0.28^{e}	33.10±0.57^{h}	45.00±0.57^{de}	5.50±0.28	5.00±0.57^{bcd}	23.00±1.15^{f}	7.00±0.57^{d}	8.00±0.57^{bc}	7.00±0.57
HH × NE200	187.00±9.81^{a}	1007.28±32.33^{g}	34.00±0.57^{e}	32.50±0.28^{h}	30.00±1.15^{g}	5.00±0.57	4.00±0.57^{d}	23.00±1.15^{f}	5.00±0.57^{e}	7.00±0.57^{c}	5.00±0.57
HH × GE200	170.00±0.57^{ab}	1090.43±11.38^{g}	34.50±0.86^{e}	40.50±0.88^{f}	52.00±1.73^{ab}	6.50±0.28	7.00±0.57^{a}	31.00±0.57^{d}	9.00±0.57^{bcd}	10.00±0.57^{ab}	5.00±0.57
HH × NE100+GE100	187.00±0.00^{a}	1087.18±48.11^{g}	35.50±0.28^{e}	47.50±0.28^{d}	45.00±0.57^{de}	6.50±0.28	6.00±0.57^{abc}	31.00±0.57^{d}	8.00±0.57^{cd}	8.00±0.57^{bc}	6.50±0.57
MC × Control	165.50±3.88^{ab}	1376.50±8.56^{f}	32.50±0.28^{e}	33.51±0.28^{gh}	40.00±1.15^{f}	5.50±0.28	5.00±0.57^{bcd}	23.00±1.15^{f}	7.00±0.57^{d}	8.50±0.86^{bc}	4.00±0.57
MC × NE200	175.00±1.44^{ab}	1411.09±42.51^{f}	41.50±0.28^{d}	40.00±1.15^{f}	50.00±1.15^{bc}	6.50±0.57	6.50±0.28^{ab}	31.00±0.57^{d}	9.00±0.57^{bcd}	9.00±0.57^{ab}	6.00±057
MC × GE200	146.50±0.28^{de}	1555.71±31.79^{e}	41.50±0.28^{d}	45.00±1.15^{e}	52.00±0.57^{ab}	6.00±0.28	7.00±0.57^{a}	37.00±0.57^{e}	9.50±0.86^{bc}	10.00±0.57^{ab}	4.00±057
MC × NE100+GE100	169.50±8.94^{bc}	1723.25±38.31^{d}	42.00±1.15^{cd}	53.00±0.57^{c}	46.00±1.03^{d}	7.000.57	7.00±0.57^{a}	36.50±0.28^{c}	8.50±0.86^{cd}	9.00±0.57^{ab}	5.00±057
P-value	0.006	0.001	0.002	0.000	0.000	0.282	0.004	0.000	0.002	0.021	0.096

Note: a,b,c,d,e,f means with different letters in the column represent significant differences at $p<0.05$. SEM: standard error of means. Control - Birds on 0 ml of extract; NE200 - Birds on 200 ml neem extract; GE200 - Birds on 200 ml ginger extract and NE100+GE100 - Birds on 100 ml of neem + 100 ml ginger extract. ASM: age at sexual maturity; BWSM: body weight at sexual maturity: EWSM: egg weight at sexual maturity, LYF: large yellow follicle, SYF: small yellow follicle; POF: post ovulatory follicle.