SHORT-TERM LAYING PERFORMANCE OF NOILER, NIGERIAN HEAVY ECOTYPE CHICKEN AND THEIR CROSSES GIVEN VARYING AQUEOUS LEVELS OF NEEM LEAF AND GINGER ROOT EXTRACTS

***Anizoba, N.W., Ugwu, C.M., Nwoga, C.C., Amaefule, B.C., Ezenwosu, C., Obinna, A.L., Onu, E. O., Ugwuoke, J.I., Edeh, H.O., Okafor, P.C., Ugwu, S.O.C. and Machebe, N.S.**
Department of Animal Science, Faculty of Agriculture, University of Nigeria Nsukka, 410001, Nigeria
* Corresponding author: nnenna.nnajiofor@unn.edu.ng; +2348035267075

ABSTRACT
The effect of neem and ginger extracts on the short-term laying performance of Noiler, Nigerian Heavy Ecotype chicken 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. 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. The interactions between genotype and treatment levels showed significant ($p<0.05$) differences in all the laying performance parameters studied except feed conversion ratio. The mean values observed in this study revealed that the Noiler birds on NE200 (3374.79±62.23; 1169.71±31.09) and GE200 (3471.79±41.88; 1218.00±20.81) had better final weight and total weight gain with main cross (MC) on GE200 (1181.19±24.06) than the other treatments. In addition, Noiler birds on GE200 had the best egg mass (51.78±2.86), hen-day egg production (82.94±1.83) and egg weight (64.97±0.62). Based on the obtained results, it could be concluded that NN and main cross on GE200 and NE100+GE100 levels were appropriate probably without exhibiting deleterious effects on the laying characteristics of the birds.
Keywords: Neem, Ginger, Layers, Noiler, Heavy Ecotype

INTRODUCTION
The genetic improvement of the Nigerian indigenous local chickens can help to alleviate the problems of animal protein shortage especially in the rural areas where they are kept by the natives, principally as a source of protein and income. Heavy ecotype chicken is one of the indigenous local chickens from the dry Savannah (Guinea and Sahel Savannah), montane regions and cattle kraals of the North, whose mature body weight ranges from 0.9-2.5 kg at maturity (Momoh *et al.,* 2010). They also lay small sized eggs, grow slowly and can adapt to the local environment better than the exotic types. On the other hand, the Noiler chicken is a hybrid chicken developed in Nigeria by Amo Farm Sieberer Hatchery, after successfully crossing a male broiler with an exotic pullet. It went through several testing procedures under the African Chicken Genetic Gains (ACGG) project. Nweke *et al.* (2022) revealed that the Noiler breeds had higher values for all the short-term egg production characteristics of the four strains of chickens studied and this could serve as baseline information for future improvement and selection. These improved indigenous breeds (Noiler) with distinct genetic characteristics could be used to boost local chicken productivity.

The poultry industry is assuming responsibility towards alleviating the health challenges associated with the consumption of poultry product. This has prompted researchers to consider alternatives to antibiotics growth promoters. Among the potential alternatives are phytogenic plant extracts of medicinal plants such as neem leaf and ginger which are safe, cheap and rich in various bioactive chemicals or secondary metabolites. Beneficial effects of extracts of medicinal plants in animal nutrition include the stimulation of appetite and feed intake, the improvement in endogenous digestive enzyme secretion, activation of immune response and antibacterial, antiviral and antioxidant actions (Egbeyale *et al.,* 2021). Neem tree is a widely researched tree that has attracted worldwide recognition due to its vast range of medicinal potentials like antibacterial, antiviral, antifungal, antiprotozoal, hepatoprotective and anticoccidal effect in poultry and other animals (monogastric and ruminant species. The leaf extract contains nimbin, nimbinene, 6-desacetylnimbiene, nimbadole, nimbolide and quercetin. The most important bioactive components of ginger responsible for its pungent taste and pharmacological activities were shown to be gingerols, including 6-, 8-, 10-gingerol, etc. Gingerols were proven to alleviate oxidative stress of animals induced by mycotoxins, heavy metals, aging, etc. (Li *et al.,* 2019). Ginger has immunostimulant effect that activates the cell mediated immune response and therefore, creates an enhanced response to any future challenges that may be caused by disease organisms. Thus, the objective of this study was to determine the effect of neem leaf and ginger extracts on the laying performance of Noiler, Nigerian Heavy Ecotype chicken and their crossbred.

MATERIALS AND METHODS

Experimental animals and managements

The study was conducted at the Poultry Unit, Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka, Enugu State, South Eastern Nigeria. 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 were randomly assigned into 4 treatments with (30) birds per treatment. Each treatment group consisted of 3 replicates (n=5), with uniform body weight as follows: T1: No plant extracts, T2: 200 ml neem, T3: 200 ml ginger and T4: 100 mL neem + 100 mL ginger. The temperature was kept at 22ºC until the end of the experiment. Light day duration was on 23 h of light and 1 h of dark. Humidity in the first week was 70-75%, and after the second week was 55-65%. The experimental design used was a 3×4 factorial arrangement of treatments in a completely randomized design. Fresh experimental diets and clean water were made available *ad libitum* for the birds throughout the experimental period. All the management practices and ethics associated with animal use for experimentation in the University of Nigeria were strictly adhered to.

Methodology

At sixteen weeks of age, the hens were kept in individual laying pens and monitored for short-term egg production. Birds were individually wing-tagged in order to monitor their individual body weight as well as the group body weight at the start (16 weeks) to finish (32 weeks). Initial and final body weight were obtained by weighing hens at the beginning and at the end of the experimental period. Daily weight gain was obtained by weighing birds individually from each replicate weekly using a 10.1 kg capacity precision weighing balance (models A and D Weighing GK-10K industrial balance) made in China. Mean of each group was taken (A) and that of the previous week (B) was subtracted from weight of present week (A-B). The difference between the two divided by seven days was the daily weight gain for a particular day in a week i.e., (A-B)/7 = daily weight gain (DWG).

Feed intake was determined by offering a known quantity of feed (X) to each replicate, morning and evening and the left over (Y) weighed the following morning. The difference between X and Y (X-Y) was the quantity of feed consumed.

Feed conversion ratio (FCR) was determined as the ratio of the average feed intake to kg egg mass.

FCR (per kg egg mass) = feed Intake (g) / egg Mass (g)

$$\text{Hen day egg Production (\%)} = \frac{\text{No of eggs produced per day} \times 100}{\text{No of hens alive per day}}$$

Egg weight: Egg weight was taken for every egg collected from the hens and the weighing was done for all the collected eggs within one hour of collection using a sensitive electronic balance (D & G sensitive scale) to the nearest 0.01g and the measurements were expressed in grams.

$EM = P \times W/100$

RESULTS AND DISCUSSION

There were highly significant ($p<0.05$) effects of the interaction between the main effects (genotype and aqueous levels of neem leaf and ginger extracts) on EM, EW and HDEP in Table 1. From the results, the superiority in EM, EW and HDEP exhibited by the Noiler birds might be due to the fact that this breed had undergone series of improvement and selection for higher performance. Alex (2001) further reported that an egg weight is proportional to body weight. Big body birds eat more feed to maintain their body size. Therefore, the size of their eggs is greater. The better performance of main-cross further proves that Noiler birds were able to transmit the genes for faster growth into its progenies. The work of Gwaza *et al.* (2018) in Nigerian local strains (Fulani and Tiv ecotypes) and Silversides *et al.* (2006) among exotic commercial layers (Isa Brown, Babcock and Brown Leghorn) respectively showed that genotype had great effect on laying performance of chickens. The authors attributed these differences to varied genetic structure of the studied genotype.

However, the increase in EW (64.97±0.62), EM (51.78±2.86) and HDEP (82.94±1.83) in the NN ginger treated groups may also have been caused by terpenic and phenolic compounds contained in ginger extract. Due to the antimicrobial properties of terpenes and the antioxidant properties of phenolic compounds, it might have contributed to the production of quality eggs by supporting cells and organs involved in egg production. The result obtained from this study agrees with Ademola *et al.* (2012) who reported that mixtures of ginger and garlic significantly increased the egg weight of laying hens. Previous work (Incharoen and Yamauchi, 2009) showed that White Leghorn laying hens fed dried fermented ginger (1 and 5%) showed better egg production and mass in comparison to those of control birds.

Table 1. Effect of aqueous neem leaf and ginger extracts on short-term laying performance of Noiler, Nigerian Heavy Ecotype chickens and their crossbred.

Parameters	IW (g)	FW (g)	TWG (g)	AFI (g)	FCR	EM	EW (g)	HDEP
Genotype (G)								
NN	2055.81±60.37^{a}	3125.63±94.29^{a}	1069.82±37.13^{a}	132.34±2.51^{a}	3.05±0.17^{b}	42.43±1.93^{a}	59.79±1.26^{a}	70.75±2.40^{a}
HH	898.59±29.33^{c}	1419.75±35.04^{c}	521.15±15.56^{c}	95.79±1.22^{c}	4.32±0.11^{a}	22.36±0.53^{c}	42.55±1.23^{c}	52.72±0.68^{c}
Main cross (MC)	1325.80±26.1^{b}	2316.26±63.59^{b}	990.45±43.44^{b}	108.96±1.33^{b}	3.20±0.12^{b}	34.60±1.10^{b}	53.16±1.22^{b}	64.92±0.77^{b}
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Plant extract (PE)								
Control	1241.52±128.17^{c}	1962.72±170.95^{c}	721.19±44.35^{b}	109.54±5.02^{b}	4.01±0.15^{a}	27.84±1.72^{b}	46.67±1.69^{b}	55.07±1.74^{c}
NE200	1442.70±166.86^{b}	2331.01±241.59^{b}	888.31±82.35^{a}	115.88±4.94^{a}	3.33±0.14^{b}	35.68±2.29^{a}	54.29±1.59^{a}	65.06±2.74^{a}
GE200	1535.77±164.53^{a}	2471.05±249.23^{a}	935.28±92.28^{a}	114.17±5.54^{ab}	3.45±0.23^{b}	35.59±3.79^{a}	52.36±2.80^{a}	66.12±3.79^{a}
NE100+GE100	1486.97±128.83^{ab}	2384.09±197.19^{ab}	897.12±89.25^{a}	109.86±4.17^{b}	3.31±0.30^{b}	33.43±2.81^{a}	54.03±3.16^{a}	60.93±2.23^{b}
P-value	0.000	0.000	0.000	0.004	0.003	0.000	0.000	0.000
G × PE								
NN × Control	1729.15±109.44^{c}	2621.64±103.74^{c}	892.49±5.69^{d}	125.17±8.43	3.67±0.10	33.96±1.35^{de}	53.43±0.97^{d}	63.49±1.37^{cd}
NN × NE200	2205.08±31.13^{a}	3374.79±62.23^{a}	1169.71±31.09^{a}	137.46±1.17	3.19±0.04	42.99±0.15^{b}	58.48±1.06^{bc}	73.59±1.06^{b}
NN × GE200	2253.79±21.07^{a}	3471.79±41.88^{a}	1218.00±20.81^{a}	139.34±1.52	2.71±0.12	51.78±2.86^{a}	64.97±0.62^{a}	82.94±1.83^{a}
NN × NE100+GE100	2035.23±57.61^{b}	3034.32±115.51^{b}	999.08±57.89^{bc}	127.39±0.99	2.64±0.58	41.00±3.26^{bc}	62.29±2.08^{ab}	62.98±4.41^{d}
HH × Control	720.34±46.69^{g}	1270.00±75.05^{g}	539.67±28.35^{f}	92.62±2.94	4.50±0.21	20.62±0.35^{j}	40.22±0.19^{g}	51.31±1.13^{e}
HH × NE200	913.99±10.06^{f}	1436.00±16.74^{fg}	522.01±6.68^{f}	99.00±1.44	3.93±0.08	25.18±0.13^{gh}	41.88±3.24^{fg}	52.96±2.08^{e}
HH × GE200	942.14±21.11^{f}	1454.00±34.06^{fg}	511.86±12.94^{f}	97.14±2.27	4.40±0.33	22.32±1.18^{hi}	47.81±2.13^{e}	53.62±1.33^{e}
HH × NE100+GE100	1007.92±18.68^{f}	1519.00±79.09^{f}	511.08±60.41^{f}	94.39±2.48	4.43±0.22	21.32±0.49^{hi}	40.34±1.67^{g}	52.99±0.96^{e}
MC × Control	1265.07±2.37^{e}	1996.51±3.98^{e}	731.44±1.61^{e}	110.84±4.48	3.85±0.26	28.94±0.80^{fg}	46.38±1.22^{ef}	62.41±0.07^{d}
MC × NE200	1411.39±49.21^{d}	2487.37±40.98^{c}	1075.99±8.23^{b}	106.04±0.61	3.25±0.07	32.67±0.54^{ef}	52.89±1.46^{d}	61.82±0.68^{d}
MC × GE200	1417.75±24.76^{d}	2598.95±48.82^{c}	1181.19±24.06^{a}	107.80±0.96	2.85±0.12	37.96±1.29^{cd}	56.77±1.46^{cd}	66.83±0.55^{cd}
MC × NE100+GE100	1209.03±9.73^{e}	2182.23±18.46^{d}	973.19±8.72^{cd}	111.17±2.88	2.87±0.10	38.85±0.43^{bc}	56.62±0.86^{cd}	68.64±0.27^{c}
P-value	0.000	0.000	0.000	0.17	0.15	0.000	0.002	0.000

Note: a,b,c,d,e,f,g – 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 – Bird 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. HW: hatchling weight, FW: final weight, ADG: average daily gain, AFI: average feed intake, FCR: feed conversion ratio, IW: initial Weight; FW: final weight; TWG: total weight gain; AFI: average feed intake; FCR: feed conversion ratio; EM: egg mass; EW: egg weight; HDEP: hen day egg production.

On the contrary, previous studies found that the addition of stevia and ginger did not have any negative effects on egg production, and even stated that there was a numerical increase in the experimental groups (Pirgozliev *et al.,* 2022). However, Yang *et al.* (2017) reported that ginger root supplementation improved laying rate and feed conversion ratio but did not affect egg weight or egg mass. The discrepancy might be due to the physical form and dosage of ginger. In their study, diets were supplemented with 10 g/kg ginger powder that contained not only bioactive compounds but also other nutrients such as carbohydrates and protein. Akbarian *et al.* (2011) showed that feeding ginger at the rates of 0.5 and 0.75% improved egg production although egg weight did not differ between the control and treated groups. There were no significant (p>0.05) interaction between the main effects (genotype and aqueous levels of neem leaf and ginger extracts) on AFI and FCR. The lack of variations in AFI and FCR among the treatment groups was an indication that the concentration of toxicants in the extract was within the tolerable limits of the birds as against the use of whole neem leaf powder or ginger powder.

CONCLUSION

The differences in laying indices observed among the treatment groups indicate differences in their genetic makeup and plant extracts levels. It can be concluded that NN on GE200 had the best egg mass, egg weight and hen-day egg production.

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