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Effects of substitution of antibiotics with medicinal plant leaf meals on egg-laying performance and egg qualities

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ABSTRACT

One hundred and forty-four (144) Isa brown laying hens, were used in a one hundred- and twenty-days (120) feeding study to evaluate the effects of substitution of antibiotics with selected medicinal plant leaf meal on their production indices. The study consists of eight treatment groups designated as T_1 to T_8. T_1 was the control, T_2 (5% Moringa oleifera leaf meal), T_3 (5% Neem leaf meal) T_4 (5% Spondias mombin leaf meal), T_5 (2.5% combination each of moringa and Neem leaf meal), T_6 (2.5% combination each of Moringa and Spondias mombin leaf meal) T_7 (2.5% combination each of Neem and Spondias mombin leaf meal), and T_8 (1.66% each of Moringa, Neem and Spondias mombin leaf meal) respectively. Productive performance indices such as the number of eggs laid, egg weight, hen house average, feed intake, internal and external egg parameter and biochemical parameters were evaluated for the laying hens. Data collected were subjected to a one-way analysis of variance using SPSS,22. Mean separation was done using the least significant difference. The result of the experiment showed that T_8 and T_5 had the highest ($P<0.05$) average number of eggs laid monthly. The weight of eggs laid was highest for T_2; while T_4, T_6 and T_7 had the lowest average weight of eggs laid. Egg shape index and shell thickness ($P>0.05$) did not differ. However, albumen weight, albumen height, yolk weight, yolk height and yolk diameter all differed significantly ($P<0.05$). The work therefore, recommends that medicinal plant leaf meal can be used in place of antibiotics growth promoters as they positively affect the number of eggs laid, egg weight.

1.0 Introduction

Antibiotics are naturally occurring synthetics or semi-synthetic substances with antibacterial action. They are used in human and veterinary medicine to cure and prevent disease as well as for other purposes such as growth promotion in food animals. They can be delivered orally, parenterally, or topically (Phillips et al., 2004) Antibiotic water treatment aids in the recovery of birds from some disorders with bacterial origins. Antibiotic use, however, may also be problematic due to drug toxicity, long-term consequences, and bacteria resistance. Concern has also been expressed about the detrimental consequences that lingering effects may have on consumers of meat or poultry products. As a result, the European Union has prohibited the use of antibiotics as growth boosters since 2006. (Gill, 2001; Igugo e*t al*., 2014). Furthermore, it was soon discovered that using synthetically created chemicals, particularly antibiotic growth promoters, had unfavourable side effects. Antibiotic use regardless of environment or route of administration, including antibiotic administration to animals used for food production contributes to the emergence of antibiotic resistance. Depending on the medications and infections of concern, the effects of resistance on human health and the economy can vary greatly. The World Health Organization (WHO) has determined that the public health issue of administering certain antibiotics for production goals (growth promotion or increased feed efficiency) exists. Antibiotic-resistant infections have made it necessary to look for less expensive alternatives to antibiotics. Probiotics, prebiotics, organic acids and their salts, and phytogenic additions are some examples of this alternative (a wide range of plants and spices and their derivatives). Herbs are often derived from plants, and plants create specific compounds as part of their biological processes, known as phytochemicals. Phytochemicals can be categorized based on their therapeutic benefits, according to DalleZotte *et al*. (2016) (antibacterial, antifungal, anti-inflammatory, antiulcer, antioxidant, antiviral, anticancer, and immune stimulants). Given that there are around 500,000 medicinal plants around the globe and that many of their therapeutic characteristics have not been researched, medicinal plants represent a potential source of medicine with a bright future.

The study's goals were to assess the egg-laying efficiency of laying hens and the internal and external egg quality of laying chickens whose antibiotics were replaced with particular medicinal herbs leaf meal.

2.0Materials and methods

2.1 Description of the study area.

Two field trials were conducted at the Poultry Unit, Teaching and Research Farm of the Faculty of Agriculture and Natural Resources Management, Enugu State University of Science and Technology, (ESUT) Agbani. The site is at latitude $67^0$4 North, longitude $8^0$3 East and an altitude 450 meters above sea level (Anikwe *et al.*, 2017). The area's annual rainfall ranges from 1700-2010m. The climatic pattern is bimodal with rainfall between April and October, and the dry season between November and March. The soil textural class is sandy loam with an isohyperature regime (Anikwe *et al*, 2017) and has been classified as Typic paleudults of the Order ultisol (Anikwe *et al*.,2016).

2.1.1 Experimental Animals

The study consists of one hundred and forty-four (144) healthy 35-weeks old Isa Brown.

2.1.2 Experimental materials and Preparation

The experimental materials are *Moringa oleifera* (drum stick) and *Azadirachta indica leaf* (neem) *Spondias mombin* leaf. The leaves were dried on a well-cleaned cemented floor. They were evenly spread and regularly turned to encourage fast and even drying. The leaf when they became crispy but still retaining the greenish colouration were milled separately using a hammer mill to produce each leaf meal.

2.2.0 Design of the experiment

One hundred and forty-four (144) healthy 35 weeks old laying Isa-brown hens were randomly assigned to eight (8) treatment diets, designated as $T_{1\ (Control)}$ $T_{2,}$ (5% MOLM), T_3, (5% AILM), T_4, (5% SMLM), T_5, (2.5 MOLM+ 2.5% AILM), $T_{6,\ (2.5\%\ MOLM+\ 2.5\%\ SMLM),}$ T_7, 2.5% AILM+ 2.5% SMLM) and $T_{8\ (}$1.66% MOLM+1.66% + 1.66 SMLM). Eighteen (18) birds were assigned to each treatment. Each treatment was replicated three times, with six hens per replicate. The experiment lasted for 120 days.

2.3.0 Data collection for laying hens.

Data were collected on the following parameters average number of eggs laid, the average daily weight of eggs, the average monthly weight of eggs, hens-day egg production average monthly feed intake as well as external and internal egg parameters.

2.4.0 Experimental birds and management.

One hundred and forty-four Isa brown laying birds were randomly allotted to 18 compact type wire cages each measuring 54 x 44 x 46 cm and capable of holding three hens per cage. The battery cages had a manual feeding trough and nipple drinkers. The cage system consists of six cage arrangements in three tiers adjacent to each other. Eighteen (18) birds were allotted to each treatment group each treatment was replicated three (3) times with (6) six birds per replicate.

2.4.1 Experimental Design.

One hundred and forty-four (144) clinically healthy 35 weeks old laying Isa-brown hen were randomly assigned to eight (8) treatment diets, designated as $T_{1\ (control)}T_{2,}$ (5% MOLM), T_3, (5% ALM), T_4, (5% SMLM), T_5, (2.5 MOLM+ 2.5% ALM), $T_{6,\ (2.5\%\ MOLM+\ 2.5\%\ SMLM),}T_7$, 2.5% ALM+ 2.5%SMLM) and $T_{8\ (}$1.66% MOLM+1.66%+ 1.66 SMLM). Eighteen (18) birds were allotted to each treatment in a randomized design. The experiment lasted for 120 days for the laying birds.

Table1: Composition of laying hen experimental diet (kg/100kg)

Ingredients			**TREATMENT**					
	T_1	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**
Maize	53	53	53	53	53	53	53	53
G/nut case	8	8	8	8	8	8	8	8
Oxytetracycline	0.03		-					
Soya bean	17	17	17	17	17	17	17	17
Moringa	-	5.00	-	-	2.5	2.5	-	1.66
ASL	-	-	5.00	-	2.5	-	2.5	1.66
SMLM	-	-	-	5.00		2.5	2.5	1.66
Wheat offal	9.97	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Premix (layer)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Methione	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Total	100kg	100kg	100kg	100kg	100kg	100kg	100kg	100kg
Calculated Analysis								
Crude protein (%)	16.62	16.76	16.63	16.62	16.66	16.64	16.62	16.62
Metab energy (Kcal/Kg)	2550	2550	2550	2550	2550	2550	2550	2550
Crude fibre (%)	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Calcium (%)	3.70	3.76	3.70	3.72	3.72	3.70	3.70	3.70
Av Phos (%)	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41

*30g/100kg of feed for non-therapeutic use

2.4.2 Experimental diet

Eight experimental diets were formulated for the laying birds. The experimental diets were designed as follows T_1 (control), T_2 (5%MOLM), T_3 (5%ALM), T_4 (5% SMLM), T_5 (2.5% each of *Moringa Oleifera* leaf meal (MOLM) + *Azadirachta indica* leaf meal (ALM), T_6 (2.5% each of (MOLM) + SMLM), T_7 (2.5% each of ALM + SLM) and T_8 (1.66 combination of MOLM + ALM+ SMLM), that is 1.66 percent of each leaf meal. The composition of the experimental diet is shown in Table 1 above.

2.6.0 Statistical analysis.

The data collected were subjected to a one-way analysis of variance (ANOVA), using SPSS statistical software version 22.00 for windows (SPSS, 2012). Where statistical differences were found between means, they were separated using the least significant differences (LSD) procedure at a significance level of 5% in the same statistical package.

3.0 Result and Discussion

The result of the effects of substitution of antibiotics with graded levels of selected medicinal plant leaves meal on the productive performance of Isa Laying hen is presented in table 4.4 below,

Table 2: Effect of various leaves meal on productive performance of Isa brown laying hen.

Treatment

Means within a row with different superscripts differ ($P<0.05$) significantly

Monthly egg production

The result of the average number of eggs laid monthly reveals that T_5 (105.64) was the highest followed by T_8 (100.08), T_2 (98.18), T_1 (90.66), T_3(90.45), T_6(83.51), T_4 (76.00) and T_7 (72.16) respectively. The result also showed that the monthly egg production for T_7 and T_4 were significantly ($P>0.05$) lower than the other treatment groups. The good performance of T_5 and T_8 ($P<0.05$) regarding monthly egg production were because of the antimicrobial and growth -promoting effect of neem which is most effective when administered between 2 to 2.5 percent as well the antioxidant properties of *Moringa oleifera* leaf meal (Windisch *et al*., 2008, Jacela *et al*., 2010).

Average daily weight of egg (g)

The average daily weight of egg as influenced by the treatments diet was highest for T_2(60.36g), T_8(56.31g), T_1 (54.85g), T_3(54.85g), T_5 (53.34g), T_6(50.28g), T_4(48.15g) and T_7(47.52g) in this other. The significantly ($P<0.05$) better performance of the T_2 over the control was due to the antioxidant properties of *Moringa oleifera* leaf meal which resulted in its ability to efficiently use the nutrient in the feed, thus resulting in a higher weight of the egg. Mo*ringa oleifera* leaf meal is also known to be rich in protein, minerals and vitamins which may also have contributed to the good performance of the birds fed *Moringa oleifera* leaf meal (Richter *et al*., 2003).

Average monthly weight of egg (g)

The average monthly weight of egg for the treatments groups was highest for T_2(25,314g), followed by T_5(24,174), T_8 (24,162), T_3 (21,480), T_1 (21,222), T_6 (18,090), T_4 (15,786) and T_7 (15,018). This treatment means revealed significant ($P<0.05$) differences among the treatment groups. The high monthly weight of the egg shown by the birds fed *Moringa oleifera* leaf monthly (T_2) was also due to the rich vitamin, minerals and protein content of moringa which has a biological function that positively affected the egg laid. High egg weight has been associated with improved digestion and absorption of nutrients and the general health of the digestive system (Shahryar *et al.,* 2011).

4.4.4 Hen day egg production (%)

The hen day egg production for the feeding trial was highest for T_5 (73.19), T_8 (69.30), T_2 (67.73), T_1 (62.92), T_3 (62.78), T_6 (58.12), T_4 (52.77) and T_7 (50.26) percent. The significantly ($P<0.05$) superior hen day egg production shown by T_5 (2.5% combination of moringa and neem leaf meals) over the control were due to antimicrobial content of the leaf's meals and lower level of neem used and high vitamin, minerals and protein content of *moringa oleifera* leaf meal. This thus resulted in higher productivity (Sarwatt *et al*., 2004). The result of the work agreed with the finding that a lower level of *moringa oleifera* leaf meal (2%) inclusion improved egg production and egg quality but a higher level of inclusion results in lower hen-day egg production (Greg, 2008).

3.4.5 Monthly feed intake (g)

The monthly feed intake of the birds among the treatment groups showed that T_5 (66,504)g was the highest followed by T_8 (66,240)g. T_2 (65,094)g, T_6 (64,740)g, T_3 (64,416)g, T_1 (64,266)g, T_4 (63,432) and T_7 (63,402)g. The result showed that the feed intake among the treatment groups was significant (P>0.05) lower in T_7 and T_4 than in the other treatment groups. This low feed intake in T_7 and T_4 was due to the bitter taste of neem and high saponin content of both neem and *Spondins mombin*. Saponins reduced feed intake due to their bitter taste or decreased absorption and utilization of nutrients by inhibition of the metabolic or digestive enzyme (Corthout *et al*., 1994; Corthout *et al*., 2019).

Effect of substitution of antibiotics with selected leaves meals on external egg quality

parameter of Isa brown laying hen is presented in Table 3 below;

Table 3: Effect of the leaf meal on external egg parameter

	Treatment								
Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**SEM ±**
Egg wgt (g).	54.85^{b}	60.36^{a}	54.75^{b}	48.15^{c}	53.34^{bc}	50.27^{c}	47.52^{c}	56.32^{ab}	0.68
Egg length(cm)	5.57^{a}	5.67^{a}	5.41^{a}	5.21^{b}	5.29^{b}	5.15^{b}	5.78^{a}	5.62^{a}	0.036
Egg width (cm)	4.2^{ab}	4.72^{a}	4.48^{b}	4.17^{b}	4.35^{b}	4.18^{b}	4.37^{b}	4.74a	0.038
Shape index (%)	75.19	74.22	74.57	74.43	74.49	74.47	74.23	74.61	0.07
Shell Thickness (mm)	0.39	0.41	0.38	0.40	0.40	0.42	0.37	0.39	0.002

Means within a row with different superscripts differ (P<0.05) significantly

The result of the effect of graded levels of selected leaf meals on the external egg quality showed that egg shape index and shell thickness did not differ (P>0.05) significantly among the treatment groups.

The shape of all the eggs produced was normal, as the shape index value obtained (74.22 to 75.18) fell within the range of 72-76 percent for normal eggs (Altuntaş and Şekeroğlu,2008). The shell thickness was also unaffected (P>0.05) by the dietary treatments. However, shell thickness was numerically higher in T_6 (0.42), followed by T_2 (0.41) T_4 and T_5 (0.40), T_8 (0.39), T_3 (0.38) and T_7 (0.37). The result of the study showed that egg weight, egg length and egg width all differed (P<0.05) significantly from the treatments. Egg length was significantly (P<0.05) higher for T_7 and lowest for T_6 and T_4. The result agrees with that of female Wistar rats administered with various doses of *Spondias mombin* leaf extract which showed a decrease in the weight of the pituitary, ovaries and uterus of the treated animals (Taylor and Terranovg, 1996; Memullin *et al*., 2004). Hence all the female Wistar rats treated with *Spondias mombin* leaf extract all showed significant reduction (P<0.05) in the hormonal levels of follicle-stimulating hormone, luteinizing hormones, progesterone and estradiol (Brann *et al*., 1995)., decreasing reproductive rates.

The effect of Substitution of antibiotics with selected medicinal plant leaves meals

on internal egg parameter is presented in table 4 below;

Table 4: Effect of the leaf meal on internal egg parameter

	Treatment								
Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**SEM ±**
Albumen wgt (g)	32.33^{ab}	35.58^{a}	32.28^{ab}	28.92^{b}	31.45^{ab}	29.62^{b}	28.02^{b}	33.20^{ab}	0.40
Albumen Height (mm)	6.44^{ab}	7.48^{a}	$6.30b^{c}$	6.12^{c}	6.70^{ab}	7.45^{a}	6.47^{ab}	7.46a	0.88
Yolk wgt (g)	16.69^{ab}	18.37^{a}	16.67^{ab}	14.65^{c}	16.23^{b}	15.49^{b}	14.79^{c}	16.74^{ab}	019
Yolk height (mm)	18.64^{ab}	19.28^{ab}	18.49^{ab}	16.21^{c}	7.66^{b}	17.25^{b}	16.21^{c}	18.47^{ab}	0.18
Yolk diameter (mm)	12.22^{ab}	45.05^{a}	42.01^{ab}	40.97^{c}	42.0^{ab}	42.54^{ab}	40.30^{c}	42.59^{ab}	0.22

Means within a row with different superscripts differ ($P<0.05$) significantly.

The internal egg parameters of this trial revealed that Albumen weight, Albumen height, Yolk weight, York height and yolk diameter were significantly ($P<0.05$) higher in T_2 than in all other treatment groups. Though T_2 did not differ significantly ($P>0.05$) from T_1 (control) numerical values were higher for T_2 than T_1. T_4 had significantly ($P>0.05$) lower values for Albumen height, yolk weight, yolk height, yolk diameter and albumen weight. The result agrees with that of female Wistar rats administered with various doses of *Spondias mombin* leaf extract which showed a decrease in the weight of the pituitary, ovaries and uterus of the treated animals (Taylor and Terranovg, 1996; Memullin *et al*., 2004). Hence all the female Wistar rats treated with *Spondias mombin* leaf extract all showed significant reduction ($P<0.05$) in the hormonal levels of follicle-stimulating hormone, luteinizing hormones, progesterone and estradiol (Brann *et al*., 1995)., decreasing reproductive rates. This reduction in the reproductive organs and hormones may have resulted in the small egg laid by hen-fed *Spondias mombin* leaf meal.

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