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Growth Performance of Broiler Chicks Fed Varying Dietary Levels of *Artemisia annua* (Sweet Wormwood)

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Abstract
The study was conducted to investigate the growth performance of broiler chicks fed varying dietary levels of *Artemisia annua.* A total of 90 fourteen-day old broiler chicks were used for the study. The study lasted four weeks. The broiler chicks were randomly allocated to five groups and fed diets containing five levels of *A. annua* (0, 50, 100, 150 and 200 g per kg of diet, respectively). Each group was replicated three times with six birds per replicate in a completely randomized design (CRD). The results showed that no significant ($p > 0.05$) differences existed among treatments in average daily weight gain, daily feed intake and total weight gain of birds, but significant ($p < 0.05$) differences occurred in final body weight of birds with treatment 2 birds having the highest mean value(1115.00 g). It was concluded that A*. annua* leaf meal can be included in the diet of starter broilers at 200 g per kg of diet without any deleterious effect on the growth performance of birds.

Keywords: Broiler chicks, *Artemisia annua*, sweet wormwood

Introduction

Animal protein requirement in developing countries has become critical due to a disproportionate growth in human population relative to livestock production. Enhancing poultry production is recognized as one of the viable means of meeting the increasing demand for animal protein globally. Enzymes and antibiotics in feed, for example, which serve as aids to nutrition and are widely used in intensive livestock production systems in developed societies to improve the digestibility of feeds and utilisation of nutrients, are not available to many resource-poor farmers in developing countries. Besides, the fact that some serious disadvantages associated with synthetic drugs such as those used in the treatment of helminthosis and coccidiosis during poultry production have become evident, including resistance and the presence of traces of these drugs at later ends of the food chain due to their indiscriminate use has given farmers further encouragement to seek natural products such as *Artemisia annua*. *Artemisia annua* (sweet wormwood) is a vigorous growing annual weedy herb, usually single-stemmed, reaching up to 2–3 m in height (Ferreira and Janick, 2002). The plant produces a beautiful portfolio of bioactive compounds including flavonoids, coumarins, steroids, phenolics, purines, lipids, aliphatic compounds, monoterpenoids, triterpenoids and sesquiterpenoids (Bhakuni *et al*., 2001; Brisibe *et al*., 2009).

A. Annua and its semi synthetically prepared derivatives such as dihydroartemisinin, artesunate, artemether, arteether, and artemisinin have also displayed unique pharmacological activities against a wide range of parasitic organisms including *Enterobacter and Klebsiella species, Streptococcus faecalis, Staphylococcus aureus, Shigella dysenteriae, Escherichia coli* and *Pneumocystis carinii* (Chen *et al*., 1994), an opportunistic pathogen which causes pneumonia in AIDS and other immune-compromised patients. Undoubtedly, there is growing interest in natural sources of nutrients and health-promoting compounds. Green plants generally are known as sources of bioactive compounds with potential use as antioxidants and immune system modulators.

The present study was therefore conducted to evaluate the growth performance of broilers fed varying dietary levels of *Artemisia annua* (sweet wormwood).

Materials and Methods

The study was carried out at the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. Five broiler starter experimental diets were formulated to contain 0 g, 50 g, 100 g, 150 g and 200 g, respectively of *A. annua* per kg diet. The percentage composition of the diets is shown in Table 1. A total of 90 two weeks old broiler chicks (Arbor Acre strain) were used for the study which lasted four weeks. The birds were randomly divided into five treatment groups of 18 birds each. The groups were randomly assigned to the five experimental diets containing 0 g, 50 g, 100 g, 150 g and 200 g, respectively of *A. annua* per kg diet in a completely randomized design (CRD). Each treatment was replicated three times with 6 birds per replicate and housed in 2.6 m x 3 m deep litter pens of fresh wood shavings. The birds were properly vaccinated as and when due. Feed and water were offered *ad libitum* every morning, from7.00 am to 8.00 am. The weight of the feed offered minus the weight of the left over feed was recorded as the daily feed intake. The birds were weighed at the beginning of the experiment to determine their initial body weights, and subsequently on weekly basis to determine their live body weights. The birds were also weighed at the end of the experiment to determine their final body weights. Experimental diets and the test ingredient (*A. annua*) were subjected to proximate analysis according to AOAC (2006). Data collected were subjected to analysis of variance (ANOVA) for completely randomized design (CRD) as described by Steel and Torrie (1980) and according to the procedure for a one-way analysis in a completely randomized design using a Stat Graphic Computer Package (SPSS, 2007) Model. Significantly different means were separated using Duncan's New Multiple Range Test (Duncan, 1955).

Table 1: Percentage composition of broiler starter diets

	Diets				
Ingredients	1	2	3	4	5
Maize	29.60	29.60	29.60	29.60	29.60
Wheat offal	14.00	13.95	13.90	13.85	13.80
Soya bean meal	16.60	16.60	16.60	16.60	16.60
Groundnut cake	16.80	16.80	16.80	16.80	16.80
P.K. Cake	15.00	15.00	15.00	15.00	15.00
Fish meal	3.0	3.0	3.0	3.0	3.0
Artemisia annua	0.00	0.05	0.10	0.15	0.20
Bone meal	4.00	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25	0.25
Methiomine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Vit. Min. Premix*	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis:					
Crude Protein (%)	24.02	24.02	24.03	24.04	24.04
Crude fibre (%)	6.00	6.04	6.04	6.04	6.03
Energy (Kcal of ME/kg)	2,859	2,862	2,956	3,004	3,053
Determined Analysis (%):					
Dry matter	91.50	90.50	91.50	89.00	91.00
Crude protein	24.01	24.08	24.04	24.03	24.09
Crude fibre	4.50	5.00	5.50	6.00	6.50
Ash	5.50	7.80	6.00	6.80	7.50
Ether extract	2.50	1.50	3.00	2.50	3.00
Nitrogen-free extract	54.99	52.12	52.96	49.67	58.91

*Vit A – 10,000.00 iu, D_3-2,000 iu, B_1-0.75g., B_2-5 g, Nicotinic acid – 25 g, Calcium pantothanate 12.5 g, B_12-0.015 g, K_3-2.5 g, E-25 g, Biotin – 0.050 g, Folic acid –1g, Manganese 64 g, Choline chloride 250 g, Cobalt-0.8 g, Copper 8 g, Manganese 64 g, Iron –32 g, Zn- 40 g, Iodine- 0.8 g, Flavomycin-100 g, Spiramycin 5 g, DL-methionine-50 g, Selenium 0.6 g, Lysine 120 g, BA

Results and Discussion

The result of the proximate composition shows that *Artemisia annua* leaf meal contained 10.50% moisture, 26.27% crude protein, 5.00% crude fibre, 9.60% ash, 2.00% ether extract and 46.63% nitrogen-free extract. Table 2 shows the data on the performance of broiler starters fed diets containing varying levels of *A. annua.* The effect of treatments on final body weight was significant ($p < 0.05$). Birds fed diet 2 (diet containing 50 g of *A. annua* per kg diet) had significantly ($p<0.05$) higher final body weight (FBW) value (1115.00 g) than those fed diet 5 (diet containing 200 g of *A. annua* per kg of diet) which had FBW value of 915.00 g. Birds fed diets 1, 3, 4 and 5 (Diets containing 0 g, 100 g,150 g and 200 g, respectively of *A. annua* per kg of diet) had comparable FBW values (1046.70 g, 1023.30 g, 950.00 g and 915 g, respectively). Birds fed diets 1, 2, 3 and 4 (Diets containing 0 g, 50 g, 100 g and 150 g, respectively of *A. annua* per kg diet) also had comparable FBW values (1046.70 g, 1115.00 g, 1023.30 g, and 950.00 g , respectively). There were no significant ($p > 0.05$) differences between the treatments in average daily feed intake, total weight gain, average daily weight gain, feed conversion ratio and protein efficiency ratio. The CP value (26.27%) obtained in the present study is slightly lower than the value (27.1%) reported by Brisibe *et al.* (2009) and greater than the value (20.3%) reported by Esmaeili *et al.* (2009). The value for ash content (9.60%) agrees with that (9.6%) reported by Brisibe *et al.* (2009) but disagrees with the values (7.5% and 10.26%) reported by Iqbal *et al.* (2012) and Brisibe *et al.* (2008), respectively. The variation in proximate values may be attributed to environmental conditions and stages of plant growth (Khudsar *et al*., 2004; Zhang *et al*., 2004; Aftab *et al*., 2010; Yekuan *et al*., 2010). As shown in Table 2, the inclusion of varying levels of *A. annua* (50 g, 100, 150 g and 200 g/kg, respectively) in the broiler starter diets had no significant ($p>0.05$) effect on daily feed intake, total weight gain, average daily weight gain, feed conversion ratio and protein efficient ratio of the birds. This tends to suggest that *A. Annua* leaf meal can be included in broiler starter diet at 200 g per kg of diet without adverse effects on broiler performance. This agrees with the report of Allen *et al*. (1997). It is likely that Artemisinin, the main bioactive compound in the herb, *A. annua* enhanced the performance of the birds. Artemisinin, the bioactive compound in *A. Annua* leaf meal has a beneficial effect on the gut microbiota. It has immunomodulatory and antioxidant properties and these can result in improvement of production and growth performances (Sugiharto, 2014).

Table 2: Growth performance of starter broilers fed diets containing varying levels of Artemisia annua leaf meal

Parameters/Treatments	1	2	3	4	5	SEM
IBW (g)	544.17	522.50	485.00	515.00	521.67	13.48
FBW(g)	1046.70^{ab}	1115.00^{a}	1023.30^{ab}	950.00^{ab}	915.00^{b}	28.16
TWG(g)	502.50	592.50	538.33	435.00	393.33	31.93
ADWG (g)	27.69	29.33	27.62	27.44	26.52	0.43
DFI (g)	77.62	79.46	79.44	76.33	70.71	1.35
FCR	2.81	2.71	2.88	2.79	5.39	0.52
PER	1.49	1.55	1.45	1.50	1.57	0.03

^{ab}Means on the same row with different superscripts are significantly($p<0.05$) different. SEM = Standard error of mean; DFI = Daily feed intake, IBW = Initial body weight, FBW =Final body weight, TWG = Total weight again, ADWG = Average daily weight gain, FCR = feed conversion ratio, PER = Protein efficiency ratio.

Conclusion

The results obtained in this study show that A. *annua* leaf meal can be included in the diet of starter broilers at 150g per kg of diet without any deleterious effect on the growth performance of birds.

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