PERFORMANCE AND SERUM BIOCHEMISTRY OF BROILER CHICKEN FED GRADED LEVELS OF GARLIC (*Alliumsativum*) POWDERAT STARTERPHASE IN SOKOTO, NIGERIA

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ABSTRACT

This experiment was carried out at the Research Unit of the Department of Animal Science, UsmanuDanfodiyo University Sokoto which is located at Veterinary Clinic, Aliyu Jodi Road, Sokoto.120 day old broiler chicks were studied in this research to determine the effect of garlic (Allium sativum) powder on the performance and serum biochemistry on the broiler chickens at starter phase. This experiment lasted for 4 weeks. Birds were randomly alloted to 5 treatments with 3 replicates each using CRD. Each treatment consisted of 24 birds and 8 birds per replicate. Treatment 1 was positive control with experimental diet only, treatment 2 was negative control with experimental diet with Neomycin antibiotic supplement and treatments 3, 4 and 5 were experimental diets with 1%, 2% and 3% garlic powder supplement.Results of the experiment showed significant ($P<0.05$) differences in average daily feed intake/bird, BWG and average daily weight gain/bird. There were no significant differences in initial body weight, final body weight, feed conversion ratio and mortality. There were also no significant difference in ALP, ALT, AST, Na, Cl and K.This experiment observed garlic had no effect on broiler growth performance and serum biochemistry at starter phase statistically. Although, numerically garlic supplemented treatments showed decreased liver enzyme activity in relation to antibiotic which indicated a healthy status. It was also concluded that these effects may not be observed due to the short duration of the experiment.

Introduction

Background of the Study

Broiler production has gained prominence in Nigeria since independence in order to meet the average daily protein requirement of Nigerians (Adene and Oguntade, 2006). Meat is an important composition of the diet for healthy living as it is a good source of essential amino acids. Broiler production involves the rearing of chicken for meat. The main requirements of broiler production are feed, housing and health management. The main concern of producers is to achieve growth of birds within a short period of time and prevent loss. In an attempt to achieve this, producers use substances that can improve growth and health status of the birds (Butaye*et al*., 2003).

Feed additives are added in poultry feed to improve nutritive value of ingredients, improve quality, improve feed conversion efficiency, increase growth rate and enhance performance (Brussels, 2005). Antibiotic growth promoters are feed additives which are primarily added in feeds to improve growth, improve feed utilisation and prevent diseases (Brussels, 2005). Antibiotics are chemical substances produced by a microorganism which can kill or inhibit the growth of another microorganism, most common of which are penicillin, oxytetracyline and tetracycline (Dantas*et al*., 2008). Antibiotics have been extensively used to prevent disease infections in poultry and to improve growth and carcass quality. However, the increased use of antibiotics leads to development of resistance in bacteria, residual drug effect and drug toxicity. Also, antibiotics have side effects on animals and humans consuming the animals' product due to drug residue (Sharma *et al.*, 2008).

Alternatives to antibiotics have gained interests in poultry production many of which are plants and their extracts. Recently, many countries have banned the use of antibiotics because of their harmful side effects and increased awareness about the alternatives of antibiotics such as herbs and medicinal plants to eliminate these threats (Manesh*et al.*, 2012).

Alternatives to antibiotics recognized include probiotics, phytogenics and organic acids growth enhancers (Borazjanizadeh*et al*., 2011). Many bio-active ingredients which include alkaloids, flavonoids, mucilage, saponin and tannin are new generation antibiotics (Wang *et al*., 1998; Wenk, 2000). Nutritionists are shifting their attention from the utilisation of chemical growth promoters to phytogenic growth promoters in recent years (Iji*et al*., 2001).

Common plants and herbs gaining interest as phytogenic growth promoters include; ginger, garlic, onion, turmeric, rosemary, oregano and thyme (Panda, 2009). These plants and their extracts have been used in human and animal medicine without knowledge of their exact effect and potency. Some growth promoters act as pro-nutrients because of the role they play in enhancing the physiology and microbiology of the animal. Many active ingredients from plant are considered as pro-nutrients and recently been tried in animal feed (Biovet, 2005). Active principles of the plant or plant chemicals present in certain parts of the plant confer therapeutic effect (Zhang *et al*., 2009).

Garlic (*Allium sativum*) has many beneficial uses in many regions worldwide. The use of garlic for its flavour is common across the world for a long time. It has been used as medicines for both humans and animals especially in the treatment of cold. Garlic plants have active ingredients and phenolic compounds that can reduce numbers of intestinal pathogens, minimize nutrient loss and improve performance; garlic also has pharmacological, antimicrobial and antioxidant effects (Al-amin*et al*., 2006; Tapsell*et al*., 2006; Ali *et al*., 2008). It acts on the appetite, intestinal micro flora and stimulate the pancreatic secretions to increase endogenous activity and immune system. Garlic can be used as good alternative for common artificial growth promoters like antibiotics (Demir*et al*., 2003).

One of the main concerns in poultry production in Nigeria is disease outbreak. Antibiotic growth promoters have been used to promote growth, prevent infection and control diseases. The use of antibiotic growth promoters is presently facing serious criticism and has raised global concerns as some reports revealed their ill effects among which is development of microbial resistance to the products and their potential harmful effects on human health (Rahmatnejad*et al*., 2009).

The use of antibiotic growth promoters can result in the development of drug-resistant bacteria (Alexander *et al*., 2008). Those resistant bacteria can infect humans through the food chain and thus it is a public health concern (Torres *et al*., 2010; Bekele and Ashenafi, 2010). Also, drug residues may be consumed by humans and this can lead to toxicity in humans. With all these side effects and harmful effects known there is need for decrease in the use of antibiotics but also there is need to find safer alternatives that can provide the benefits of antibiotic growth promoters.The major aim of this research is to determine the effect of garlic on the performance and serum biochemistry of broilers fed graded levels of Garlic powder as an additive from plant extract.

Materials and Methods

Study Area

The experiment was carried out at the Teaching and Research Unit of the Animal science Department, Faculty of Agriculture, UsmanuDanfodiyo University Sokoto located at the Veterinary Clinic, Aliyu Jodi road, Sokoto. Sokoto State is located at the extreme North –western part of Nigeria and lies at latitude 13.057^{o}N and longitude 5.2457^{o}E. It has an altitude of 350m (Mammam*et al*., 2000). The climate is dry and hot with temperature range of 16.3^{o}C – 40.6^{o}C, an average temperature of 28.4^{o}C and average humidity of 43%. Sokoto is a tropical area and has an annual average rainfall of 629 mm (Kowal and Knabe, 1972).

Experimental Materials

A Total of 120 day old broiler chicks were used for the experiment. They were grouped into 3 replicates and assigned to 5 treatments, with each treatment having 24 chicks and 8 chicks in each replicate using Complete Randomized Design. Garlic was purchased from the Sokoto central market, dried, ground into powder and added to the feed at graded levels (1%, 2% and 3%). Antibiotics (Neomycin) was purchased from veterinary drugs store and used according to manufacturer's instruction.

Experimental Diets

All ingredients for the experimental diets were purchased from the Sokoto central market, processed and properly mixed. Five treatments diet were formulated which include; the basal diet with no supplement labelled as treatment 1 (T1) served as positive control, the basal diet with antibiotic supplement as treatment 2 (T2) served as negative control, basal diet with 1% garlic powder supplement as treatment 3 (T3), basal diet with 2% garlic powder supplement as treatment 4 (T4) and basal diet with 3% garlic powder supplement as treatment 5 (T5). The antibiotic supplement was used according to label instruction.

Table 1. Gross Composition of the Experimental Diet

Ingredients	Starter phase
Maize	56.85
Soya bean meal	37.85
Soya bean oil	1.11
Calcium	1.00
Limestone	1.00
Salt	0.20
Methionine	0.41
Lysine	1.08
Premix	0.50
Total(kg)	100
Nutritional Composition	
Metabolisable energy (Kcal/kg)	2988
Crude protein (%)	21.00
Methionine (%)	0.46
Lysine (%)	1.20
Phosphorus	0.50

Management of Experimental Animals
Birds were reared for 4 weeks in a deep litter system pen. Birds were brood and allowed to acclimatize to the environment for seven days. Same basic management care of broiler production was given to all the birds. Feeds and water was provided *ad-libitum*.

Feed intake was calculated daily by measuring the weight of feed given and weight of any left over. Weight gain was taken on weekly basis and feed conversion ratio was calculated from it. All required vaccinations were administered. At the end of the experiment 2 birds were randomly selected from each treatment and blood samples were taken from the birds. Blood samples were taken from the jugular veins of the birds for serum biochemical analysis. 26 mortalities were recorded at the end of the experiment: 4 in treatment 1, 5 from treatment 2, 8 from treatment 3, 4 from treatment 4 and 6 from treatment 5.

Experimental Design
Complete Randomized Design (CRD) was used.

Data Collection
The parameters measured were growth performance parameters (feed intake, live weight gain and feed conversion ratio) and serum biochemical parameters (alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, sodium (Na), potassium (K) and chloride (Cl)).

Growth Performance
Weight of feed given and feed residue were measured daily and difference of the two was recorded as daily feed intake. Live weight gain was measured weekly and recorded. Weight gain was determined as the difference between the weight of birds at the end of the experiment and the initial weight at the beginning of the experiment. Feed conversion ratio was determined as the ratio of feed intake by weight gain (FI\BWG).

Serum Biochemical Analysis
Blood samples were collected in plain bottles at the end of the experiment from the using sterile syringe. The biochemical analysis was conducted at UsmanuDanfodiyo University Teaching Hospital (UDUTH). The blood ALT, AST, ALP, Na, K and CL were determined.

Data Analysis
The Data obtained from the experiment was subjected to analysis of variance (ANOVA) using SPSS. Least significant difference (LSD) was used to separate between the means.

RESULTS AND DISCUSSION

Growth Performance of the Broiler Chickens

Table 2. Growth Performance of the Broiler Chickens

	Treatments					
Parameter	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Average daily Intake (g)/ bird	41.5[a]	39.15[ab]	38.41[b]	37.35[b]	37.63[b]	0.69
Initial body weight (g)/ bird	109.63	104.17	120.55	108.92	110.13	5.92
Final body weight (g)/bird	428.57	503.97	411.43	423.81	389.29	42.91
Weight gain (g)/ bird	318.94[b]	399.8[a]	290.88[b]	314.89[b]	279.16[b]	16.71
Average daily weight gain (g/day)	11.39[ab]	14.28[a]	10.39[b]	11.25[ab]	9.97[b]	1.02
Mortality (%)	3.13	5.25	8.38	4.13	6.25	2.38
Feed conversion ratio (FCR)	3.6	2.74	3.70	3.32	3.77	0.48

There were significant (P<0.05) differences among the treatments in average daily intake (g)/bird, weight gain (g)/bird and average daily weight gain/bird. Birds in treatment 1 (positive control) with no supplement have similar value to treatment 2 (T2) with antibiotic supplement and show significantly (P<0.05) higher average daily feed intake compared to the other treatments. Birds in treatment 2 (negative control) supplemented with antibiotic were significantly (P<0.05) higher in weight gain/bird in comparison to the other treatments. Treatments 1, 3, 4 and 5 all have similar body weight gain (g)/bird. Treatment 2 showed relatively higher significance (P<0.05) in average daily weight gain (g/day). Treatment 1 (positive control) and treatment 4 (2% garlic supplementation) showed similar average daily weight gain statistically, while treatment 3 (1% garlic) and treatment 5 (3% garlic) were least significant (P<0.05) on average daily weight gain (g/day).

There were however non-significant differences among the treatments in feed conversion ratio, initial and final body weight (g)/bird and mortality.

Serum Biochemistry of the Broiler Chickens

Table 3. Results of Serum Biochemistry of the Broiler Chickens

Parameters	**Treatments**					
	T1	**T2**	**T3**	**T4**	**T5**	**SEM**
ALP (u/l)	317.5	226.5	328.5	347.5	200.5	0.621
AST (u/l)	93.5	88	127.5	101	108	0.132
ALT (u/l)	22	129	69.5	23.5	55.5	0.264
Na (mmol/l)	142	142	138	142.5	140	0.957
K (mmol/l)	5.15	4.0	4.65	5.85	5.1	0.466
CL (mmol/l)	106.5	116.5	100.5	102.5	101.5	0.827

There were non-significant differences among the treatments in ALP, AST, ALT. Na, Cl and K. ALP values of all the treatments were higher than the reference range values. Treatment 5 and treatment 4 recorded the lowest and highest values for ALP. AST values of all the treatments were within the reference range values. Although no significance between the treatments statistically, treatment 3 had the highest value numerically and treatment 2 had the lowest. ALT values of treatments 1and 4 were within the reference range while treatments 2, 3 and 5 had values higher than the reference range. Treatment 1 had the lowest value and treatment 2 had the highest.

Na values of the treatments were within the reference range. Treatment 1 and 2 recorded the same values. Treatment 4 and treatment 3 had the highest and lowest values respectively. K values of all the treatments were higher than the reference range except treatment 2 which was within the range. Cl values of all the treatments were within the reference range. Treatment 2 had the highest Cl value while treatment 3 had the lowest.

DISCUSSION

Growth Performance of the Broiler Chickens

Supplementation of garlic as feed additive did not have effect on feed intake of broiler chickens in this experiment. A significant (P<0.05) decreased feed intake was observed among the treatments fed garlic and this may be due to the strong odour of garlic as reported by Onu (2010). This result is in agreement with the result of Rahmanetjad*et al.* (2009) which reported that the inclusion of garlic as a feed additive at 1000 g/tonne did not have effect on the feed intake as well as on weight gain and feed conversion ratio in broiler chickens. Horton *et al.* (1991) also reported that inclusion of garlic in the diets of male broiler chickens did not improve performance of the chickens. The studies of Rahardja*et al*. (2010) is in contrast with this result as it observed an increase in feed intake of laying hens fed garlic at 1%, 2% and 4%.

Chickens fed with garlic supplemented diet had the least body weight gain in this experiment. Also, chickens fed with garlic had the highest FCR although not statistically significant (P>0.05) it is indicative of poor feed conversion efficiency. This maybe as a result of the short period of the experiment as some of the effect may take a longer time to manifest and may not be noticeable at the starter phase Antibiotic had more effect on body weight gain of broiler chickens in this research. This result correlates the reports of other studies that supplementation of garlic in the diets of broiler chickens had little or no influence on the performance of broiler chickens (Freitas et al., 2001; Demir et al., 2003). Fadlalla*et al*. (2010) reported non-significant effect on the body weight and feed conversion ratio of birds fed garlic powder. Aji*et al*. (2011) also reported non-significant effect of garlic on feed conversion ratio. Farhad*et al*. (2011) reported a significant decrease in the body weight and daily weight gain of birds fed with blends of medicinal herbs: garlic, cinnamon, thyme, rosemary and anise in comparison with the control treatment. However, this research is not in conformity with the results of Kumar et al. (2010) which reported a significant increase in the body weight of broilers given garlic as growth promoter at starter level.

Among the treatments fed garlic treatment 4 had a better FCR (3.32) as compared to treatment 3 (3.70) and treatment 5 (3.77). Treatment 4 also had the highest weight gain/ bird and daily weight gain (314.89g, 11.25g/day) in comparison to treatment 3 (290.88g,10.39g/day) and treatment 5 (279.16g,9.97g/day) although they were all statistically same. Treatment 4 also had the highest final body weight (423.81g) numerically although statiscally non-significant (P>0.05). These values can suggest best dosage of garlic for performance of broiler chickens at starter phase.

Serum Biochemistry of the Broiler Chickens

ALP, ALT and AST are also referred to as liver enzymes as they are liver bio-markers. They are used to indicate an injury or damage to the liver. Serum ALP, AST and ALT were not significantly different between the treatments in this research. This is in line with the results of Kumar *et al.* (2013) which stated no significant changes in ALP of broiler fed garlic. Also, Demir*et al.,* (2003) and Dieumou*et al.* (2009) reported garlic had no significant effect on serum AST and ALT which is in agreement with this result. However, Rehman*et al.* (2011) reported a significant decrease in the serum ALP, AST and ALT of broilers given aqueous extract of a mixture of garlic, berberine, aloe vera and ginger. ALP values were higher than the reference range in this research. This may be as a result of the age of the birds as ALP level is higher in young animals as a result of rapid bone growth (Kaneko *et al.,* 2010). ALP is an indicator of liver health and can also be used to assess renal function (Basten, 2010). It is found in the bile duct, bone and kidney. AST values of treatments in this research were within the reference range and this indicates a normal liver function. An increase in AST value indicates liver injury, shock or chronic liver problem (Basten, 2010). Treatments 2, 3 and 5 showed high level ALT above the reference range. High level ALT may indicate active hepatitis due to drug, virus or toxins (Basten, 2010). Treatment 2 had the highest ALT value in this study which may be an indication of effect of the antibiotic on liver.

Na, K and Cl are blood electrolytes and help to maintain blood and tissue fluids in balanced state. All the serum electrolytes were within normal range except potassium values of T1, T3, T4 and T5. A study by Aka *et al.* (2010) observed a significant decrease in the serum Na and Ca with increase in garlic supplementation which is usually the result of increase in excretion of the Na and Ca. This is associated with increased water loss and suggests that increased dosage of garlic leads to hyponatranaemia and hypocalcaemia. In this study the supplementation of garlic at 1% (T3) showed lower sodium level while at higher dosage 2% (T4) and 3% (T5) there was an increase in the Na level.

Conclusion

Based on the results obtained from this experiment, garlic powder as feed additive did not have an effect on the growth performance of the broiler chickens at starter phase. There was also no effect on the serum biochemistry statistically. However, the treatments supplemented with garlic powder showed a lower level of liver enzymes activity an indication of a more healthy liver status. Treatment 4 (2% garlic) was concluded as the most effective

dosage on BWG, FCR and FI as compared to other garlic supplemented treatments. More research need to be done on garlic as a natural growth promoter; the best dosage to be supplemented, the best form of supplementation (powder, aqueous or oil) and the duration of usage to obtain best result. Also, studies on processing methods that will decrease the strong odour of garlic without reducing its beneficial compounds should be done so as to avoid the risk of decreased feed intake which may be due to the odour as observed in this research. Researches on other plants and herbs such as ginger, turmeric, cloves and onion should be done to ascertain the benefits of natural compounds as growth promoters and their effect on animal production. These plants and herbs can be studied singly or as mixtures to obtain the best results that will make commercial producers embrace their use.

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