Evaluation Of Graded Levels Of Garlic (Allium Sativum) On Growth Performance And Blood Cholesterol (LDL) Levels Of Growing Pigs

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Abstract: The effects of graded levels of garlic were studied on growth performance and cholesterol (LDL) blood levels in growing pigs. 36 growing landrace pigs of average body weight (BW) of 23 ± 0.7 (mean ± SD) kg were used in the study. Pigs were assigned to six dietary treatments in a completely randomized design (CRD). The trial lasted for four weeks (28d). The dietary treatments were: diet 1, control diet (0g garlic/kg of diet, 10g, 20g, 30g, 40g and 50g garlic/kg of diet for diets 2 – 6, respectively. Each dietary treatment was assigned to 6 pigs. Average daily feed intake (ADFI), average daily gain (ADG) and feed efficiency (FE) as well as blood LDL parameters were determined for the study period. Although, there were no significant differences ($P > 0.05$) in the ADFI, the animals on the garlic-diets grew at better rates ($P < 0.05$) compared with the control with animals in treatment 3 (20g/kg of diet) had the best growth rate. FE also mirrored the ADG as the FE of the garlic-diets demonstrated better ($P < 0.05$) FE compared with the control diet with treatment 3 as the diet with most FE. Furthermore, the garlic-diets demonstrated significantly ($P < 0.05$) lowered LDL levels compared with the control with diet 3 showing the least LDL blood content. It was concluded that garlic improved animal performance and also reduced blood LDL levels, especially at 20g garlic/kg of diet.

Key words: Performance, Cholesterol, Garlic and Pig.

1 INTRODUCTION

Weaned and growing pigs are highly susceptible to many enteric and environmental stressors, such as pathogenic bacteria leading to various disease conditions. This often results in reduced growth rate and in extreme conditions results to death of the affected animals [6]. Supplementing swine diets with antibiotics at sub-therapeutic levels has thus been traditionally employed to enhance animal growth rates [3]. At present, due to global growing concerns over antibiotic resistance, the use of antibiotics as growth promoters in swine diets is limited as a result of public and regulatory pressures.These conditions have led to the livestock industry, including the swine industry in search for alternatives to antibiotics that would have at least similar growth-promoting effects of antibiotics without bacterial resistance as to avoid zoonosis while enhancing the quality of animal life. Phytobiotics are plant-derived natural bioactive compounds that can positively affect animal growth and health and thus improve the overall health and welfare of the pig for enhanced productivity. To this point therefore, some phytobiotics possess antimicrobial, antiviral, antifungal and also active against some enteric parasites [5]. Some of these phytobiotics have been used as complementary or alternative medicine in improving human health and even to cure human disease. Science and technology have enabled the identification of active components from selected phytobiotics and investigations of their modes of mechanisms of the components in the animal's body have evolved. With these new knowledge frontiers, animal producers have attempted the use of some of the identified phytobiotics as alternatives to the use of antibiotics in growing pigs and birds [12]. However, results of most of such studies were inconsistent leading to non-clarity in understanding how they can be properly applied as true alternatives to antibiotics. Garlic has been identified as one of the plants with antimicrobial phytobiotics (allicin) properties that can be explored [14]. This area requires further studies to better guide the nutritionist on the best strategy, particularly their dietary concentrations that can result in improved animal productivity without any detrimental effects. This is worthwhile because of garlic relatively low costs, proven effectiveness against pathogens [12; 14] and it's readily available. The potential beneficial effect of garlic on growth performance in growing pigs has not been investigated. Therefore, the objectives of this study is to investigate the effect of graded levels of garlic on the growth performance of growing pigs in terms of feed intake, growth rate and feed efficiency as well as its effect on blood LDL.

2 MATERIALS AND METHODS

Animals, Housing and Management

Thirty six (36) growing pigs of similar age with average initial body weight (BW) of 23 ± 0.7 (mean ± SD) kg were acquired from Songhai farm, Tai, Rivers State. The pigs on arrival at the Animal Wing of the Department of Animal Science, Rivers State University were weighed to obtain their initial BW and randomly assigned to pens. The animals were fed a commercial grower diet for a 7-day adaptation period with water provided ad libitum. At the end of the adaptation period, six pigs were randomly assigned to each of six experimental diets and fed 5% of BW (as-fed basis) twice daily at 0900 h (half of the daily meal) and 1600 h, respectively. Animals had unlimited access to drinking water. Individual BW and pen feed disappearance were monitored daily. Animals received their assigned diets for a total of 28 d. Animal pens were cleaned regularly to ensure their comfort. Overall, the cares of the animals during the experimental period were in compliance with standard procedures.

Experimental Diets and Design

A standard corn-soybean meal-based diet that was formulated to meet or exceed the [11] recommended nutrient levels for 20 to 50 kg BW pigs were used in the study. Diet 1 was the negative control diet while diets 2 – 6 contained garlic at different dietary concentrations. The diets were formulated to be isocaloric (DE 3,525 kcal/kg) and isonitrogenous (20% crude protein) but differed in their dietary garlic contents as: diet 1 (control; 0 g garlic/kg of diet); diet 2 (10 g garlic/kg of diet); diet 3 (20 g garlic/kg of diet); diet 4 (30 g garlic/kg of diet); diet 5 (40 g garlic/kg of diet) and diet 6 (50 g garlic/kg of diet), respectively. The experiment was designed and carried out as a completely randomized design (CRD) with dietary treatments as the source of variation. Individual BW and pen feed disappearance were monitored daily as a measure of feed intake relative to BW gain used in the calculation of gain to feed ratio (feed efficiency).

Experimental Procedures

At the beginning of each day in the week the different diets were weighed into individual pen feeders and then closely monitored its disappearance. Diets were offered at 5% of BW. The animals' initial BW was similar; this resulted in similar feed intakes. On the last day of study (the 28th d), all animals were weighed again to obtain their final BW and blood samples were also collected by standard procedures into EDTA bottles and immediately snap frozen for later analysis for LDL parameters.The difference between final and initial BW represents weight gained during the study period. Average daily feed intake (ADFI) was calculated as the total amount of feed consumed by the pig divided by the number of days (28d) of study. Average daily gain (ADG) was determined by calculating the weight gained by each pig at the end of the experiment and divided by number of days of study. Feed efficiency (FE), that is, gain to feed ratio (gain/feed) was also determined by dividing the ADG by the ADFI, respectively. Blood LDL was analysed according to the method of [10].

Statistical Analysis

The experimental data were analyzed as a CRD. Data were subjected to analysis of variance (ANOVA) using PROC GLM of SAS (SAS Inst. Inc., Cary, NC) according to the experimental model: $Y_{ij} = \mu + D_i + E_{ij}$; where Yij is the observation, μ = overall mean common to all treatments, D_i = the effect of the ith diet and E_{ij} = the error term. Means were compared using Tukey's test and α-level of 0.05 was used for all statistical comparisons to represent significance.

3 RESULTS AND DISCUSSION

All animals in each dietary treatment consumed their rations normally and thus grew throughout the experimental period. The results of the ADFI, ADG and FE are shown in Table 1.

Table 1: *Growth responses of growing pigs fed varied levels of dietary garlic.*

	DIETS							
Item	Diet 1 n = 6	Diet 2 n = 6	Diet 3 n = 6	Diet 4 n = 6	Diet 5 n = 6	Diet 6 n = 6	SEM	P-value
ADFI (kg/d)	1.13	1.14	1.12	1.13	1.14	1.12	0.02	0.21
ADG (kg/d)	0.41^{a}	0.45^{b}	0.58^{c}	0.45^{b}	0.44^{b}	0.44^{b}	0.03	0.04
FE(gain : feed)	0.36^{a}	0.39^{b}	0.52^{c}	0.41^{b}	0.39^{b}	0.39^{b}	0.02	0.03

^{a,b,c}Means with different superscripts within the same row are significantly (P < 0.05) different.

SEM = standard error of the mean; P-value = observed P-value due to the diet effect.

There were no significant differences (P > 0.50) in the ADFI among the different dietary groups. However, this did not transcend to the ADG and FE; as the positive control diets animals gained weight at a better (P < 0.05) rate per day during the study period compared with the animals without garlic in their diets (control treatment). For instance, while animals on the control diet gained about 410 g/d, animals on diets 2 – 6 gained about 450g/d, 580g/d, 450g/d, 440g/d and 440g/d, respectively. The trend observed with the ADG was mirrored in the FE. The FE of diet 1 was 36% whereas those of diets 2 to 6 were 39%, 52%, 41%, 39% and 39%, respectively. The results of the LDL obtained from the different dietary treatment groups are shown in Table 2.

Table 2*. Blood LDL contents of pigs fed varied levels of dietary garlic.*

	DIETS							
Item	Diet 1 n = 6	Diet 2 n = 6	Diet 3 n = 6	Diet 4 n = 6	Diet 5 n = 6	Diet 6 n = 6	SEM	P-value
LDL (mg/dl)	250^{a}	160^{b}	143^{c}	145^{c}	146^{c}	146^{c}	4.20	0.030

Means with different superscripts within the same row are significantly (P < 0.05) different

The control diet demonstrated the highest (P < 0.05) levels of blood LDL (250mg/dl) compared with the garlic-based diets with diet 3 showing the least concentration of blood LDL. A sound knowledge of how much of a feed additive an animal requires to optimize performance and maintain optimal health is of an interest to the animal producer. This however, depends on the animal species, the age and physiological status of the animal [11]. The determination of such requirements involves the inclusion of the additive as a dietary component at different concentrations with other nutrients untouched. The performance of the animal is then measured in response to the different levels of the additive intake. The point at which performance is just optimized is taken as the requirement level of the additive.

In general for young and growing animals growth rate and FE are the easiest responses to measure [11].Table 1 shows the results of growing pigs' responses to dietary garlic consumption. There was no difference in the ADFI of the control and garlic-diets. However, in the ADG the animals that ingested the garlic-diets gained weight at a better rate compared with the control animals. The weight gains linearly increased as the level of dietary garlic increased in the diet and peaked with diet 3 after which it also linearly decreased; showing that growth rate was optimized with diet 3 and the animals of diet 3 also showed the least levels of blood LDL. The findings of improved growth rate and lowered LDL concentrations with garlic in the current study are not surprising. The lowering of LDL levels found in this study agrees with those of [1] and [4]. The utilization of garlic as a dietary supplement with great health benefits has been widely reported [9]. Garlic by its known properties such as inhibitory effects on growth of micro-organisms, including bacteria, viruses and fungi and natural antiseptic and bactericidal effect on the gastro intestinal tract can explain in part the enhanced growth [13]. To this point therefore, it can be speculated that garlic in the diet resulted in an improved gut environment and micro-flora. Furthermore, it has been demonstrated that the susceptibility of pathogenic bacteria to the anti-bacterial components of garlic is higher than that of the physiological desirable intestinal bacteria [2]. Additionally, it has also been shown that the beneficial bacteria are believed to be unaffected by garlic as they are less sensitive to garlic's inhibitory effects. This is further supported by the fact that garlic may have a prebiotic effect, especially as the pigs used in this study are young growing pigs as garlic has been classified as a fructo-oligosaccharide [8]. From the result data of this study, inclusion levels of dietary garlic particularly as with diet 3, it would have been possible that the antimicrobial action of allicin [2] may likely be sufficient to inhibit microbial fermentation. Interestingly, about 6% of net energy in pigs can be lost due to microbial utilization of glucose in the small intestine [11] and these bacteria require amino acids in relatively similar proportional amounts as the pig [11]. Therefore, the possibility exists that at the optimal dietary concentrations of garlic there might have been a nutrient sparing effect leading to the improvements in the ADG and FE relative to the control observed in this current study. Furthermore, at the optimal dietary intake of garlic pig quality of life could be further enhanced via the lowering of LDL which is often implicated in the sudden death syndrome in swine production. It is also worthy of note that it is the concentration of allicin and alliin in the species of garlic that are the bioactive constituents of garlic [7].

4 CONCLUSION

It was concluded that garlic can improve animal performance and also reduce blood LDL levels, especially at 20g garlic/kg of diet. Thus, garlic can help to prevent heart-related diseases, such as heart attack, atherosclerosis and stroke. To this point therefore, it is recommended that garlic can be used to fortify swine diets at the concentration of 20g/kg of diet to improve performance and support the overall health of the circulatory system and thereby reduce the incidence of sudden death syndrome in swine production often linked to high levels of blood LDL.

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