integrity Research Journals

Journal of Animal Science and Veterinary Medicine
Volume 10(5), pages 454-457, October 2025
Article Number: 6212A33E7
ISSN: 2536-7099
https://doi.org/10.31248/JASVM2025.620
https://integrityresjournals.org/journal/JASVM

Full Length Research

Broiler chickens' liver integrity fed garlic- and ginger-based diets

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Received 29th September 2025; Accepted 29th October 2025

ABSTRACT: The effects of the consumption of garlic- and ginger-based diets were studied on liver health and integrity of broiler chickens. 120-day-old CHI broiler chicks were used for the investigation. The chicks on arrival at the study venue were first brooded and similarly managed for 4 weeks to ensure that the chicks were fully adapted to their new environment. At the end of the 4 weeks adaptation period, the birds were randomly allotted to 4 dietary treatments with 30 birds/treatment and 3 replicates of 10 birds/replicate as: T_1(control diet; contained no garlic and ginger), T_2 (contained 10 g of ginger), T_3 (contained 10 g of garlic) and T_4 (contained 5g of garlic + 5 g of ginger)/kg of diet, respectively. The birds were fed their respective experimental diets for 4 weeks (28 days). At the end of the 28 days, 9 birds from each treatment group, consisting of 3 birds from each replicate, were bled, and their blood was collected into non-ethylene diamine tetra-acetic acid (EDTA) tubes and immediately transported to the laboratory for liver biomarker analyses. The 3 liver-biomarkers analysed for were: alanine aminotransferase (ALT), aspartic aminotransferase (AST) and alkaline phosphatase (ALP). Results showed that there were no significant ($p > 0.05$) differences in the serum levels of ALT amongst all treatment groups. However, there were significant ($p < 0.05$) differences in the serum levels of AST and ALP for all the dietary treatment groups. Birds in the T_1 group had the highest levels, whereas the T_2 group significantly ($p < 0.05$) demonstrated the lowest levels of AST and ALP. Ingestion of garlic and ginger had no effect on ALT but had significant lowering effects on AST and ALP. Therefore, it was concluded that dietary garlic and ginger could be used in maintaining the health and integrity of the livers of broiler chickens.

Keywords: Alanine amino transferase, alkaline phosphatase, aspartic amino transferase, health.

INTRODUCTION

Food safety should be regarded as a human right rather than a luxury for the wealthy. As a result of the dishonesty and low-education levels of some poultry farmers' refusal to adhere to protocols, such as periods of withdrawal of antibiotics used as feed additives had resulted in pathogen resistance, leading to the ban of the use of antibiotics in poultry production, especially for broilers. Meanwhile, the high demand for poultry meat places emphasis on intensive poultry production as it is a fast-growing species that can help meet human protein needs. However, it has been recognized that in the intensive system of poultry farming, birds are highly exposed to a variety of diseases and other stressful conditions, typically causing huge financial losses (Sugiharto, 2022).

In the 1950s, poultry farmers used antibiotics in animal feeds to achieve faster growth rates as well as maintaining the health status of birds, thereby ensuring a boost in harvest and better economic gains (Mund *et al.,* 2017).

However, with the ban and hence prohibition of the use of antibiotics in poultry feeds, alternatives are currently being sought. To this point, therefore, natural growth promoters and health-promoting herbs, such as prebiotics, probiotics, synbiotics and phytochemicals and phytonutrients are presently employed in poultry feeds as a replacement for antibiotics without negative impacts on their performances and health status (Borazjanizadeh *et al.,* 2011). These products have different bioactive substances that have demonstrated health benefits, including anti-oxidation ability (Musazadeh *et al*., 2023), antimicrobial activity (Iwiński *et al.*, 2022), enhancing digestion by stimulating endogenous enzymes (Abdel Hafeez, *et al.,*2023), increasing production of digestive enzymes and improving utilisation of digestive products via enhancement of liver functions (Ziarlarimi *et al.,* 2011).

Garlic (*Allium sativum*) has been shown to possess anti-microbial/anti-oxidant properties, anti-viral, anti-fungal, anti-cholesteric, anti-cancerous and vasodilator properties (Verma *et al.,* 2023). These functions were credited to garlic bioactive substances (*allicin*, *alliin* and *di-allyl-sulfide*) and therefore could improve the liver health of animals, leading to optimal animal performance. Furthermore, ginger (*Zingiber officinale*) is another perennial herb with similar functions to garlic (Animashaun *et al.,* 2024). Ginger bioactive substances credited to its functions include: *gingerol*, *gingerdiol* and *ginderdione*. These substances are very effective in controlling free radical production and thus reducing the degree of peroxidation of lipids (Al-Amin *et al.,* 2006). Again, with these functions, ginger may be capable of improving the health status of the liver. Therefore, the objectives of this study are to investigate the effects of garlic and ginger on liver health biomarkers as well as the effects of their combination on liver health biomarkers of broiler chickens.

MATERIALS AND METHODS

Experimental site

This study was carried out at the poultry unit of the Teaching and Research Farm, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt. The farm is located at latitude 4° 48'N and longitude 6° 48'E at the Rivers State University campus. The study was carried out between July and September 2025.

Animals and management

Before the introduction of the experimental birds to the site of the study, the pens, floors, feeders and drinkers were thoroughly washed with detergents and hypochlorite. The pens were washed twice, after which diesel was poured to kill harmful pathogens that might have lodged on the floor. The pen nests were also well-fixed for the comfort of the experimental birds. Thereafter, the pens were allowed to properly dry to ensure that the facility was "pathogen-free". A total of one hundred and twenty (120) CHI unsexed broiler chicks were used for the study. The chicks on arrival at the poultry house were immediately counted to confirm that they were up to the required number. They were then given a glucose solution to ease the stress of transportation and subsequently delivered into their brooding pens. After the brooding period, birds were randomly assigned into four dietary treatment groups of 30 birds/treatment group with 3 replications of 10 birds/replicate. Water was provided to the animals *ad libitum*.

Garlic and ginger collection/preparation and experimental diet

Garlic and ginger were sourced from Mile One Market, Port Harcourt, in their raw form. They were later washed, dried and ground to enable their proper mixing into the diet. At the end of the brooding period that lasted for 4 weeks, the 120 birds were randomly allotted to 4 dietary treatments as: negative control (treatment 1) (T_1, contained no garlic and ginger), treatment 2 (T_2, contained 10 g of ginger), treatment 3 (T_3, contained 10 g of garlic) and treatment 4 (T_4, contained 5 g of garlic + 5 g of ginger)/kg of diet, respectively. The animals were fed their respective garlic- and ginger-based diets for 4 weeks. It is also imperative to state here that all the dietary treatments contained all nutrients at similar levels except their dietary garlic and ginger contents, as stated above.

Blood sample collection and analyses

On the last day of the study, 9 birds from each treatment group were slaughtered by slitting the jugular vein with a sharp knife for blood collection. Three (3) birds were randomly collected from each replicate of the four treatment groups. The blood was collected from each of the birds into non-ethylene diamine tetra-acetic acid (EDTA) 36 tubes, respectively, for later liver enzymes biomarker analyses; namely: alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP).

Liver biomarker analysis

ALT and AST were analysed according to the method of Reitman and Frankel (1957). Briefly, by this method, ALT catalyses the reversible transfer of an amino group from alanine to alpha-ketoglutarate, forming glutamate and pyruvate. The pyruvate so produced is reduced to lactate

Table 1. Effect of garlic and ginger-based diets on liver biomarkers of broiler chicken.

Parameter	Treatments				SEM	p-value
	T_1 (n = 9)	T_2 (n = 9)	T_3 (n = 9	T_4 (n = 9		
ALT (iu/l)	16.0	15.56	16.33	16.56	0.38	0.08
AST (iu/l)	35.69[a]	23.67[d]	24.78[c]	28.44[b]	0.37	0.03
ALP (iu/l)	87.56[a]	55.67[d]	76.33[c]	82.78[b]	1.09	0.001

[a,b,c,d]Means with different superscripts within the same row are significantly ($p < 0.05$) different**. Keys:** T_1 = contained no garlic and ginger, T_2 = contained 10 g of ginger, T_3 = contained 10 g of garlic and T_4 = contained 5 g of garlic + 5 g of ginger.

by lactate dehydrogenase. ALT concentration is then read at 240 nm using the spectrophotometer. For AST, the principle is based on the formation of the chromogenic di-nitrophenylhydrazine of pyruvate. AST concentration is therefore read at an absorbance of 530-550 nm by the spectrophotometer. ALP was determined according to the method of Li *et al*. (2024). ALP hydrolyses p-nitrophenyl-phosphate to form p-nitrophenol and phosphate. The rate of p-nitrophenol formation is proportional to the absorbance of ALP activity read at 405 nm.

Experimental design and statistical analysis

The study was carried out as a completely randomised design (CRD). The data obtained were subjected to analysis of variance (ANOVA) using the general linear model (GLM) procedure of SAS. Treatment means were compared using Tukey's test. The model was: $Y_{ij} = \mu + X_i + E_{ij}$, where Y_{ij} = individual observation of the treatment, μ = population mean, X_i = effect of the i^{th} treatment and E_{ij} = the error term. An *α-level* of 0.05 was used for all statistical comparisons to represent significance.

RESULTS

All birds in the four dietary treatment groups were fed normally, as feed rejection was not observed for any of the treatment groups. Furthermore, all birds were also observed to be in good health status throughout the experimental period as they were monitored daily without any observation of deviation from normal behaviour, suggesting no obvious symptoms of disease infection. Accordingly, therefore, the results of the effects of garlic, ginger or their combination on liver enzyme biomarkers are shown in Table 1.

There were no differences ($p > 0.05$) in the serum levels of ALT amongst birds of all dietary treatment groups. However, there were significant differences ($P < 0.05$) in the AST and ALP levels amongst treatment groups. For AST, T_1 had the highest serum level, followed by T_4 and T_3 birds, respectively, whereas birds of the T_2 group had the lowest level of AST. Similarly, there were significant differences ($p < 0.05$) in the serum levels of ALP amongst dietary treatment groups. T_1 birds had the highest serum levels of ALP, followed by T_4 and T_3 birds, respectively, whereas the T_2 birds had the lowest serum level of ALP.

DISCUSSION

ALT is a well-known liver cell enzyme involved in the metabolism of protein. Therefore, an abnormally high level of ALT is often used to measure or indicate the degree of liver health or malfunctioning. However, in the current study, there were no differences in the serum levels of ALT for all treatment groups, indicating that neither garlic nor ginger affected ALT. This finding, nevertheless, is in agreement with the finding of Panjeshahin *et al.* (2020) that demonstrated that garlic powder had an effect on serum levels of ALT in their studies with human. Also, this result corresponds with the findings of Umoru and Agbaye (2022) investigated the effect of ginger on ALT in serum of broiler chickens and reported that there were no significant difference when garlic and ginger were mixed and supplemented in diets.

AST is another liver enzyme, although it is also found in the muscle. However, AST levels are one of the measures used in determining or diagnosing liver damage. When the liver is damaged or leaks, AST is released into the bloodstream at high levels, suggesting liver leakage or damage leading to abnormal serum AST levels (Xuan *et al.,* 2024). In this study, it was observed that garlic and ginger affected liver health status, as there were significant differences in the serum levels of AST for the different treatment groups. Here, it was demonstrated that all the positive treatment groups (T_2 to T_4) had significantly lower levels of AST compared with the negative control group (T_1). This finding is an indication that garlic and ginger had a soothing influence on the liver of the broiler chickens. This observation is also in agreement with the data of Sarica *et al.* (2005) that demonstrated that garlic and ginger could be used as natural replacements for antibiotics for broilers to aid in maintaining liver health and subsequently its physiological functions even in the presence of oxidative stress, such as the type induced by heat stress.

ALP is another liver and bile duct enzyme, although it is also found in the bone. Therefore, it is an important indicator for liver health testing (Ali *et al.,* 2021). In this study, as was with the AST, all the positive control treatments had significantly lower serum levels of ALP compared with the negative control group. This is another indication that garlic and ginger have good maintenance attributes for liver health in animals. To this point, the findings in this study are in tandem with the findings of Ademola *et al.* (2004) that showed that garlic and ginger had good effects on the liver by their abilities of maintaining low and normal levels of ALP, including that of AST, respectively.

Conclusion

Garlic and ginger are good dietary candidates in maintaining liver heath and integrity using liver biomarkers as yardsticks. However, ginger is a better candidate than garlic or their combinations.

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