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Effect of Garlic Infusion on Growth Performance, Carcass Traits, and Meat Quality of Ducks

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ABSTRACT

The use of antibiotic growth promoters (AGPs) has been increasingly restricted due to concerns regarding antimicrobial resistance and food safety. Consequently, natural feed additives have gained significant attention as sustainable alternatives in poultry production systems. This study aimed to evaluate the effects of garlic (*Allium sativum*) infusion on growth performance, carcass characteristics, and meat quality of Tegal ducks. A total of 120-day-old ducks were randomly assigned to four treatments in a completely randomized design with six replicates per treatment. The treatments consisted of a basal diet (control) and basal diet supplemented with garlic infusion at levels of 3%, 6%, and 9%. The experiment was conducted for 8 weeks. The results showed that garlic infusion significantly improved ($P < 0.01$) live weight, carcass weight, and carcass percentage. The highest values were observed in ducks supplemented with 9% garlic infusion. However, no significant effect ($P > 0.05$) was found on non-carcass weight and percentage. In terms of meat quality, garlic infusion significantly reduced fat content ($P < 0.05$), while collagen, protein, and moisture contents were not affected ($P > 0.05$). The reduction in fat content is associated with the bioactive compounds in garlic, particularly allicin, which plays a role in inhibiting lipid biosynthesis and improving metabolic efficiency. In conclusion, garlic infusion can be used as a natural feed additive to improve growth performance, carcass yield, and meat quality of ducks by reducing fat content without negatively affecting other physicochemical properties. This study highlights the potential of garlic infusion as a sustainable alternative to antibiotic growth promoters in poultry production

Keywords: Garlic infusion, Ducks, Carcass traits, Meat quality, Phytogenic feed additive

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1. Introduction

Duck production plays an important role in meeting the increasing demand for animal protein, particularly in developing countries. Improving growth performance, carcass yield, and meat quality of ducks remains a major focus in poultry research. However, the use of antibiotic growth promoters (AGPs) has been increasingly restricted due to concerns regarding antimicrobial resistance and food safety. Consequently, natural feed additives have gained significant attention as sustainable alternatives in poultry production systems [1–3].

Garlic (*Allium sativum*) is widely recognized as a phytogenic feed additive with multiple biological properties, including antimicrobial, antioxidant, and hypolipidemic effects. These properties are mainly attributed to bioactive compounds such as allicin, flavonoids, and other organosulfur compounds. Previous studies have demonstrated that garlic supplementation can enhance growth performance, improve immune response, and promote gut health by modulating intestinal microbiota and increasing nutrient digestibility [4,5].

Recent studies have confirmed that garlic supplementation significantly improves production performance and physiological responses in poultry. In broilers and quail, garlic has been shown to enhance feed efficiency, body weight gain, and carcass characteristics [6–8]. More specifically in ducks, Suprayogi et al. [5] reported that dietary garlic powder significantly increased final body weight, average daily gain, and carcass yield. In addition, garlic supplementation improved blood serum profiles by reducing cholesterol and triglyceride levels, indicating its hypolipidemic effect. The study also demonstrated that garlic positively modulated caecal microbiota composition by increasing beneficial bacteria and suppressing pathogenic microorganisms, thereby enhancing nutrient utilization efficiency.

The beneficial effects of garlic are strongly associated with its active compound, allicin, which exhibits antimicrobial and antioxidant properties. Allicin plays a crucial role in improving digestive enzyme activity, enhancing nutrient absorption, and maintaining gut health by inhibiting harmful microbial populations [2,5]. Furthermore, garlic supplementation has been reported to reduce lipid deposition and cholesterol levels in poultry meat by inhibiting key enzymes involved in lipid biosynthesis, thereby improving the nutritional quality and health value of meat [7,9].

Despite extensive research on garlic powder and extracts, limited information is available regarding the use of garlic infusion as a feed additive, particularly in ducks. Garlic infusion, produced through aqueous extraction under controlled heating, may enhance the solubility and bioavailability of active compounds and provide a practical method for application in poultry production systems. However, its effects on carcass traits, non-carcass components, and meat quality parameters in ducks have not been thoroughly investigated. Therefore, this study aimed to evaluate the effects of garlic infusion on growth performance, carcass traits, non-carcass components, and meat quality (collagen, fat, moisture, and protein content) in ducks. The findings of this study are expected to provide scientific evidence supporting the use of garlic infusion as a natural and sustainable alternative to antibiotic growth promoters in duck production.

2. Materials and Methods

2.1. Animals and Experimental Design

A total of 120 day-old ducks (DOD) were used in this study. The ducks were randomly assigned to four treatment groups using a completely randomized design (CRD), with six replicates per treatment and five ducks per replicate. The treatments were as follows: T1: Basal diet (control), T2: Basal diet + 3% garlic infusion, T3: Basal diet + 6% garlic infusion, and T4: Basal diet + 9% garlic infusion. The experimental period lasted for 8 weeks, and each replicate group was considered as an experimental unit.

2.2. Housing and Management

The experiment was conducted in a litter-based floor pen system. The pens were constructed using metal frames and bedded with rice husk litter. Each pen was equipped with plastic feeders and drinkers. Prior to the experiment, all pens and equipment were cleaned and disinfected using a disinfectant solution (15 mL per 10 L of water), followed by drying and liming. Ducks were randomly distributed into 24 pens. Environmental temperature was monitored using a room thermometer, and artificial lighting was provided at night using incandescent lamps to support feeding activity. Feed and water were provided ad libitum throughout the experimental period.

2.3. Experimental Diet

The basal diet was formulated to meet the nutrient requirements of ducks during the finisher phase. The diet consisted of corn, rice bran, soybean meal, full-fat soybean, palm oil, amino acid supplements (DL-methionine and L-lysine), vitamins, and minerals.

Table 1. Composition of Tegal Duck Finisher Diet

Feed ingredient	Proportion (%)
Yellow corn	42,2
Rice bran	15,0
Palm oil	0,3
Soybean meal	20,0
Full-fat soybeans	17,8
DL-Methionine	0,2
L-Lysine	0,4
TopMix Medion	1,7
Mineral B12 Medion	2,0
Salt	0,4
Total	100

Table 2. Nutrient Composition of Tegal Duck Finisher Diet

Nutrient component	Content (%)
Metabolizable Energy (ME, kcal/kg)	3.100
Crude fiber (CF)	2,22
Crude fat (EE)	5,98
Calcium (Ca)	1,64
Phosphorus (P)	1,21
Aflatoxin	Max 50 ppb
Lysine	1,44
Methionine	1,21

Nutrient composition was determined according to AOAC [10].

2.4. Measurement of Live Weight, Carcass, and Non-Carcass Traits

Live weight was measured at the end of the 8-week experimental period using a digital scale with an accuracy of 0.1 g. Birds were weighed individually prior to slaughter. At the end of the experiment, selected ducks from each replicate were slaughtered following standard poultry processing procedures. Carcass weight was determined after removal of feathers, blood, head, feet, and internal organs. Non-carcass weight was calculated as the difference between live weight and carcass weight. It included all non-edible parts such as viscera, blood, feathers, head, and feet. Carcass percentage was calculated as the ratio of carcass weight to live weight and expressed as a percentage:

$$\text{Carcass percentage} = \frac{\text{Carcass weight}}{\text{Live weight}} \times 100$$

Non-carcass percentage was calculated as the proportion of non-carcass weight relative to live weight:

$$\text{Non-carcass percentage} = \frac{\text{Non-carcass weight}}{\text{Live weight}} \times 100$$

2.5. Meat Quality Analysis

The chemical composition of duck meat was determined using Near-Infrared (NIR) spectroscopy with a FoodScan Meat Analyzer (FOSS, Denmark), following the method described by Warner [11]. Meat samples were first ground using a meat grinder to obtain a homogeneous mixture. Approximately 30 g of each sample was weighed and placed into a sample cup (15 cm diameter), then leveled to ensure a uniform and compact surface. The FoodScan instrument was connected to a computer, and the analysis program was initiated. Measurement parameters were set to determine collagen, fat, moisture, and protein content, with a wavelength range of 800–1400 nm. The prepared sample cup was inserted into the scanning chamber, and the analysis was performed by activating the "Run" function. The scanning process lasted approximately 15 minutes, during which the instrument detected and calculated the percentage of collagen, fat, moisture, and protein. At the end

of the analysis, each sample was assigned a unique identification code, and the results were recorded and stored electronically for further statistical analysis

2.6. Statistical analysis

Data were analyzed using one-way analysis of variance (ANOVA) based on a completely randomized design (CRD). When significant differences among treatments were detected ($P < 0.05$), means were separated using Duncan's multiple range test. All statistical analyses were performed using *IBM SPSS Statistics for Windows*, version 25.0 (IBM Corp., Armonk, NY, USA).

3. Results and Discussion

3.1. Effects of Garlic Infusion on Live Weight and Carcass Traits

The results of this study showed that garlic infusion had a highly significant effect ($P < 0.01$) on the live weight of Tegal ducks. The highest average live weight was observed in treatment T4 (9% garlic infusion), reaching 1,290.25 ± 43.40 g, compared to the control group (T1), which recorded 1,158.42 ± 26.39 g. Analysis of variance (ANOVA) indicated significant differences among all treatment groups ($P < 0.01$), with an increase in final body weight ranging from 58.33 to 131.83 g.

Table 3. Effect of treatments on live weight, carcass, and non-carcass characteristics of Tegal ducks

Variable	Treatments			
	T1 (control)	T2 (3%)	T3 (6%)	T4 (9%)
Live weight (g)	1.158,42±26.39^{c}	1.216,75±57.34^{b}	1.273,58±23.91^{a}	1.290,25±43.40^{a}
Carcass weight (g)	617.42±20.79^{d}	669.25±42.32^{c}	701.33±19.36^{b}	732±33.59^{a}
Non-carcass weight (g)	541.00±17.07	547.50±30.24	572.25±22.73	558.25± 42.41
Carcass percentage (%)	53.30±0.01^{c}	55.08±0.02^{b}	55,07±0.01^{b}	56.73±0.03^{a}
Non-carcass percentage (%)	46.70±0.01	44.92±0.02	44.93± 0.01	43,27± 0.04

Notes: Values are presented as mean ± standard deviation. Different superscripts within the same row indicate significant differences ($P < 0.05$).ns = not significant ($P > 0.05$). T1 = basal diet (control); T2 = basal diet + 3% garlic infusion; T3 = basal diet + 6% garlic infusion; T4 = basal diet + 9% garlic infusion.

The live weight obtained in this study was comparable to or higher than previous findings under similar rearing conditions. For instance, a study reported final body weights of 1,131–1,211.5 g in 8-week-old ducks, while Daud et al. [12] reported higher values at older ages (16 weeks). These differences suggest that garlic infusion may accelerate growth performance at earlier stages. The improvement in live weight observed in this study is consistent with previous reports indicating that garlic supplementation enhances feed intake, feed conversion efficiency, and body weight in poultry [7,13,14]. The growth-promoting effect of garlic is mainly attributed to its bioactive compounds, particularly allicin and other organosulfur compounds, which play important roles in improving digestive efficiency and nutrient utilization.

Garlic supplementation has been reported to stimulate pancreatic enzyme activity, thereby enhancing feed digestion and nutrient absorption in the small intestine [15]. Improved digestion increases the availability of nutrients required for muscle growth, resulting in higher body weight gain. In addition, phenolic compounds in garlic are known to protect intestinal villi and enhance nutrient absorption, particularly protein, which contributes to increased body mass [16].

Furthermore, garlic contains various phytochemical compounds such as flavonoids, saponins, fructans, and allicin, which exhibit antimicrobial, antioxidant, and immunomodulatory properties. These compounds help reduce pathogenic bacterial populations in the digestive tract, including *Escherichia coli* and *Salmonella*, while promoting gut health and overall physiological function [4,17]. As a result, nutrient utilization becomes more efficient, leading to improved growth performance.

The observed increase in live weight with higher levels of garlic infusion indicates a dose-dependent response. This suggests that garlic infusion acts as an effective natural feed additive that enhances metabolic processes, improves appetite, and supports immune function, ultimately contributing to better growth performance in ducks.

3.2. Carcass Weight and Carcass Percentage

The results of the analysis of variance (ANOVA) showed that garlic infusion had no significant effect ($P > 0.05$) on non-carcass weight and percentage of Tegal ducks. The average non-carcass weight in this study was 554.76 g, with a percentage of 45.15%. The highest non-carcass weight was observed in treatment T3 (572.25 g), while the highest non-carcass percentage was recorded in the control group (T1) at 46.70%.

Non-carcass components were calculated as the difference between live weight and carcass weight, excluding major edible portions such as breast, thighs, wings, and back. The absence of significant differences among treatments indicates that garlic infusion supplementation did not influence the proportion of non-carcass components.

This result suggests that the primary effect of garlic infusion is directed toward improving muscle deposition rather than altering non-carcass tissues. The increase in carcass yield observed in this study was not accompanied by a corresponding reduction in non-carcass components, indicating that garlic supplementation enhances productive tissue growth without significantly affecting the relative proportion of non-edible parts.

The lack of significant effect may also be associated with the biological activity of garlic compounds such as allicin and flavonoids, which primarily function as antimicrobial and antioxidant agents. These compounds contribute to improved gut health by inhibiting pathogenic bacteria such as *Escherichia coli* and *Salmonella*, while maintaining intestinal integrity and physiological balance [18].

In addition, organosulfur compounds such as alliin and allicin play a role in modulating intestinal microbiota by promoting beneficial microorganisms and suppressing harmful bacteria [5]. However, these effects are more closely related to nutrient utilization and metabolic efficiency rather than changes in non-carcass tissue development. Therefore, the influence of garlic infusion was not sufficient to produce significant differences in non-carcass weight and percentage among treatments

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3.4. Effects of Garlic Infusion on Meat Quality of Ducks

The chemical composition of meat from male Tegal ducks supplemented with garlic infusion is presented in Table 4. The parameters analyzed included collagen, fat, moisture, and protein content. The results showed that garlic infusion had a significant effect ($P < 0.05$) on meat fat content, whereas collagen, moisture, and protein contents were not significantly affected ($P > 0.05$). These findings indicate that garlic infusion primarily influences lipid composition, while other meat quality parameters remain relatively stable.

Table 4. Chemical composition of meat from male Tegal ducks supplemented with garlic infusion

Variables	Treatment			P-value
	T1 (Control)	T1 (Control)	T1 (Control)	
Collagen (%)	1.93 ±0.32	2.13±0.39	2.04±0.20	0.663

Fat (%)	4.21±0.17a	3.01±0.49b	3.76±0.23a	0.002
Moisture (%)	74.21±0.27	73.80±0.64	73.63±1.02	0.517
Protein (%)	21.38±0.52	20.94±0.70	21.35±0.33	0.456

Notes: Values are presented as mean ± standard deviation. Different superscripts within the same row indicate significant differences ($P < 0.05$). ns = not significant ($P > 0.05$). T1 = basal diet (control); T2 = basal diet + 3% garlic infusion; T3 = basal diet + 6% garlic infusion.

In this study, garlic infusion significantly reduced fat content in duck meat, particularly at higher inclusion levels (6% and 9%), as observed in treatments T3 and T4. These results are consistent with previous findings reported by Bawish et al. [19], who observed that garlic supplementation as a feed additive did not significantly affect collagen and protein content in duck meat. The fat content observed in this study was also lower than previously reported values for duck meat, which typically range between 7–15% [20], suggesting an improvement in meat quality.

The reduction in fat content can be attributed to the bioactive compounds present in garlic, particularly allicin, which plays a crucial role in lipid metabolism. Allicin has been reported to inhibit several key enzymes involved in cholesterol biosynthesis, including HMG-CoA reductase, cholesterol 7α-hydroxylase, squalene monooxygenase, lanosterol-14-demethylase, and sterol-4α-methyl oxidase [21,22]. This inhibitory effect occurs through competitive interaction with enzyme active sites, thereby disrupting the conversion of precursors into cholesterol.

In addition to enzyme inhibition, allicin also affects lipid metabolism by reducing the availability of reducing cofactors such as NADH and NADPH through interaction with sulfhydryl groups in coenzyme A. This reduction limits the redox reactions required for cholesterol synthesis, ultimately decreasing lipid accumulation in tissues [23,24].

Furthermore, garlic has been reported to suppress fatty acid synthesis by inhibiting the activity of fatty acid synthase, thereby reducing triglyceride formation [25]. Allicin may also interfere with acetyl-CoA availability and glycerol-3-phosphate formation, both of which are essential precursors in triglyceride biosynthesis [26,27]. These combined mechanisms contribute to reduced fat deposition in duck meat.

Despite its effect on fat content, garlic infusion did not significantly influence collagen, moisture, or protein levels. This suggests that garlic supplementation primarily affects lipid metabolism rather than protein synthesis or water-holding capacity of muscle tissue. Therefore, garlic infusion can be considered an effective natural additive for improving the nutritional quality of duck meat by reducing fat content without compromising other important quality attributes.

4. Conclusion

Garlic infusion supplementation had a significant positive effect on the growth performance and carcass characteristics of Tegal ducks. The highest inclusion level (9%) resulted in the greatest improvements in live weight, carcass weight, and carcass percentage. However, garlic infusion did not significantly affect non-carcass components, indicating that its primary effect was directed toward enhancing muscle deposition rather than altering non-edible parts. In terms of meat quality, garlic infusion significantly reduced fat content without affecting collagen, protein, and moisture levels. This suggests that garlic infusion improves the nutritional quality of duck meat by lowering lipid content while maintaining essential physicochemical properties. Overall, garlic infusion can be considered an effective natural feed additive to enhance growth performance, carcass yield, and meat quality in ducks. Its use offers a promising alternative to antibiotic growth promoters in sustainable poultry production systems.

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References

[1] Gadde U, Kim WH, Oh ST, Lillehoj HS. Alternatives to antibiotics for maximizing growth performance and feed efficiency in poultry: a review. Anim Health Res Rev. 2017 Jun;18(1):26–45. doi:10.1017/S1466252316000207

[2] Rusli RK, Sadarman S, Hidayat C, Sholikin MM, Hilmi M, Yuniza A, et al. A meta-analysis to evaluate the effects of garlic supplementation on performance and blood lipids profile of broiler chickens. Livestock Science. 2022 Sep;263:105022. doi:10.1016/j.livsci.2022.105022

[3] Perera WNU, Ravindran V. Role of feed additives in poultry nutrition: Historical, current and future perspectives. Animal Feed Science and Technology. 2025 Aug;326:116371. doi:10.1016/j.anifeedsci.2025.116371
[4] Magryś A, Olender A, Tchórzewska D. Antibacterial properties of Allium sativum L. against the most emerging multidrug-resistant bacteria and its synergy with antibiotics. Arch Microbiol. 2021 Jul;203(5):2257–68. doi:10.1007/s00203-021-02248-z
[5] Suprayogi WPS, Ratriyanto A, Prastowo S, Nuhriawangsa AMP, Ismoyowati, Irawan A. Effects of garlic powder on growth, blood serum profile and caecal microbiota composition in meat-type ducks. Italian Journal of Animal Science. 2025 Dec 31;24(1):1943–58. doi:10.1080/1828051X.2025.2556268
[6] Ismail IE, Alagawany M, Taha AE, Puvača N, Laudadio V, Tufarelli V. Effect of dietary supplementation of garlic powder and phenyl acetic acid on productive performance, blood haematology, immunity and antioxidant status of broiler chickens. Anim Biosci. 2021 Mar 1;34(3):363–70. doi:10.5713/ajas.20.0140
[7] Jalal H, Doğan SC, Giammarco M, Cavallini D, Lanzoni L, Pezzi P, et al. Evaluation of dietary supplementation of garlic powder (Allium sativum) on the growth performance, carcass traits and meat quality of Japanese quails (Coturnix coturnix japonica). Poultry Science. 2024 Dec;103(12):104231. doi:10.1016/j.psj.2024.104231
[8] Kairalla M, Alshelmani M, Aburas A. Effect of diet supplemented with graded levels of garlic (Allium sativum L.) powder on growth performance, carcass characteristics, blood hematology and biochemistry of broiler. Open Vet J. 2022;12(5):595. doi:10.5455/OVJ.2022.v12.i5.1
[9] Khan A, Mushtaq M, Shah M, Khan RU, Alonaizan R, Naz S, et al. Synergistic Effects of Garlic Extract and Mannan-Oligosaccharide Prebiotic Supplementation on Growth Performance, Carcass Quality, Immunity, Gut Morphology and Microbiome in Broiler Chickens. Veterinary Medicine & Sci. 2026 Jan;12(1):e70751. doi:10.1002/vms3.70751
[10] AOAC. Official methods of analysis, 20th ed. 2016.
[11] Warner R. MEASUREMENT OF MEAT QUALITY | Measurements of Water-holding Capacity and Color: Objective and Subjective. In: Encyclopedia of Meat Sciences [Internet]. Elsevier; 2014 [cited 2026 Jan 24]. p. 164–71. Available from: https://linkinghub.elsevier.com/retrieve/pii/B9780123847317002105 doi:10.1016/B978-0-12-384731-7.00210-5
[12] Daud M, Fuadi Z, Mulyadi M. Performan dan Persentase Karkas Ayam Ras Petelur Jantan pada Kepadatan Kandang yang Berbeda. J Agripet. 2017 Apr 1;17(1):67–74. doi:10.17969/agripet.v17i1.7557
[13] Karangiya VK, Savsani HH, Patil SS, Garg DD, Murthy KS, Ribadiya NK, et al. Effect of dietary supplementation of garlic, ginger and their combination on feed intake, growth performance and economics in commercial broilers. Vet World. 2016 Mar;9(3):245–50. doi:10.14202/vetworld.2016.245-250
[14] Regmi S, Prakash Tiwari IC, Devkota NR, Sah R, Yadav RK, Pant N, et al. EFFECT OF DIETARY SUPPLEMENTATION OF GARLIC AND GINGER IN DIFFERENT COMBINATION ON FEED INTAKE AND GROWTH PERFORMANCE IN COMMERCIAL BROILERS. Malays j sustain agric. 2021 Mar 18;5(2):95–8. doi:10.26480/mjsa.02.2021.95.98
[15] Canogullari S, Baylan M, Erdogan Z, Duzguner V, Kucukgul A. The effects of dietary garlic powder on performance, egg yolk and serum cholesterol concentrations in laying quails. Czech J Anim Sci. 2010 Jul 31;55(7):286–93. doi:10.17221/126/2009-CJAS
[16] Dozier WA, Kidd MT, Corzo A. Dietary Amino Acid Responses of Broiler Chickens. Journal of Applied Poultry Research. 2008 Mar;17(1):157–67. doi:10.3382/japr.2007-00071
[17] Giannenas I, Bonos E, Skoufos I, Tzora A, Stylianaki I, Lazari D, et al. Effect of herbal feed additives on performance parameters, intestinal microbiota, intestinal morphology and meat lipid oxidation of broiler chickens. British Poultry Science. 2018 Sep 3;59(5):545–53. doi:10.1080/00071668.2018.1483577
[18] Safithri M, Bintang M, Poeloengan M. Antibacterial Activity of Garlic Extract Against some Pathogenic Animal Bacteria. Med Pet. 2011 Dec;34(3):155–8. doi:10.5398/medpet.2011.34.3.155
[19] Bawish BM, Fayed R, Abdel Razek A. Effect Of Garlic As Feed Additive On Performance, Carcass Characteristics, And Meat Quality Of Muscovy Ducks Reared In Different Stocking Densities. Journal of Applied Veterinary Sciences. 2018 Jul 12;3(1):43–51. doi:10.21608/javs.2018.67162
[20] Utami DP. Manfaat Bromelin dari Ekstrak Buah Nanas (Ananas comosus L. Merr) dan Waktu Pemasakan untuk Meningkatkan Kualitas Daging Itik Afkir.
[21] Li M, Yun W, Wang G, Li A, Gao J, He Q. Roles and mechanisms of garlic and its extracts on atherosclerosis: A review. Front Pharmacol. 2022 Oct 3;13:954938. doi:10.3389/fphar.2022.954938

[22] Sun YE, Wang W, Qin J. Anti-hyperlipidemia of garlic by reducing the level of total cholesterol and low-density lipoprotein: A meta-analysis. Medicine. 2018 May;97(18):e0255. doi:10.1097/MD.0000000000010255
[23] Gebhardt R, Beck H. Differential inhibitory effects of garlic-derived organosulfur compounds on cholesterol biosynthesis in primary rat hepatocyte cultures. Lipids. 1996 Dec;31(12):1269–76. doi:10.1007/BF02587912
[24] Gebhardt R, Beck H, Wagner KG. Inhibition of cholesterol biosynthesis by allicin and ajoene in rat hepatocytes and HepG2 cells. Biochimica et Biophysica Acta (BBA) - Lipids and Lipid Metabolism. 1994 Jun;1213(1):57–62. doi:10.1016/0005-2760(94)90222-4
[25] Ibrahim H, Aliyu Z, Oluwawuni TB, Awolola G, Abdulmalik SU. EFFECT OF GARLIC (Allium sativum) SUPPLEMENTATION ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKENS. FUDMAJAAT. 2022 Sep 15;8(1):77–82. doi:10.33003/jaat.2022.0801.077
[26] Focke M, Feld A, Lichtenthaler HK. Allicin, a naturally occurring antibiotic from garlic, specifically inhibits acetyl-CoA synthetase. FEBS Letters. 1990 Feb 12;261(1):106–8. doi:10.1016/0014-5793(90)80647-2
[27] Liu L, Yeh Y. Water-soluble organosulfur compounds of garlic inhibit fatty acid and triglyceride syntheses in cultured rat hepatocytes. Lipids. 2001 Apr;36(4):395–400. doi:10.1007/s11745-001-0734-4