

A Review of Application of Ginger (*Zingiber Officinale*) as A Natural Herbal Supplement to Improve Feed Intake in Broiler Chickens

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History Article:

- Submit: August 2025
- Publish: April 2026

Keyword:

*Bioactive compounds,
Digestive enzymes, Growth
performance, Nutrient
absorption, Sustainable
Livestock Production*

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Abstract

This study aims to investigate the application of ginger (*Zingiber officinale*) as a natural herbal supplement to enhance feed intake in broiler chickens. Low feed intake remains one of the major challenges in broiler production, as it directly influences growth performance and feed efficiency. Although conventional synthetic feed additives can stimulate appetite, their use raises concerns regarding potential health risks associated with chemical residues in poultry products. Ginger, which contains bioactive compounds such as gingerol, shogaol, and zingerone, offers a promising and safer alternative. These compounds are reported to stimulate digestive enzyme secretion, improve nutrient absorption, and enhance appetite, in addition to providing antimicrobial, anti-inflammatory, and antioxidant properties. Therefore, the use of ginger is expected not only to increase feed intake but also to improve growth performance and promote sustainable poultry farming practices. This highlights ginger's potential as a valuable solution for poultry farmers. The study was conducted through a literature review, analyzing relevant scientific articles, journals, and previous research to assess the potential of ginger supplementation on feed intake, growth performance, and overall poultry health.

INTRODUCTION

The global poultry industry is under increasing pressure to meet rising protein demands while maintaining food safety, animal welfare, and environmental sustainability. Traditionally, synthetic antibiotics have been used as growth promoters in broiler production to enhance feed efficiency, encourage weight gain, and prevent disease. However, the overuse of antibiotic growth promoters (AGPs) has led to serious public health concerns, especially the development of antimicrobial resistance (AMR), as well as worries about chemical residues in poultry meat which may affect consumers (Yadav & Jha, 2019). These issues have pushed many countries to limit or ban AGPs in livestock feed, prompting a search for safer, natural alternatives (Frontiers, 2025).

To address these concerns, researchers have turned to natural growthpromoting agents such as probiotics, prebiotics, organic acids, enzymes, essential oils, and botanical extracts as substitutes for synthetic additives. These feed additives are often called phytogenic feed additives (PFAs) or natural growth promoters, and are valued for their ability to improve gut health, stimulate digestion, enhance immune responses, and reduce harmful pathogens (Astuti

et al., 2022; Effects of Phytogetic Feed Additive, 2023). Compared to synthetic antibiotics, PFAs are generally considered safer, more environmentally friendly, and potentially without residue issues.

One botanical source that has drawn significant attention is ginger (*Zingiber officinale*). Its bioactive compounds such as gingerol, shogaol, and zingerone are known to have antimicrobial, anti-inflammatory, antioxidant, and digestive- stimulating effects. Recent studies have explored how ginger supplementation in broiler diets may affect growth performance, feed intake, gut morphology, blood biochemistry, and microbial counts. For example, a study by Astuti *et al.* (2022) evaluated a fermented mixture of red rice and aromatic ginger. Although feed intake, body weight gain, and feed conversion ratio did not differ significantly among treatments, some positive effects were observed in immune parameters, gut morphology, and bacterial population (Astuti *et al.*, 2022).

Another study, "Effect of Standardized Ginger Extract on Gut Morphology, Microbiota Composition, and Growth Performance in Broiler Chickens" (2022), investigated different inclusion levels of ginger extract. It showed that higher levels sometimes reduced feed intake but could improve feed conversion under certain conditions, and noted changes in gut microbiota composition associated with improved performance (Standardized Ginger Extrac, 2022). Also, "Growth performance, blood variables, intestinal bacterial content, and morphological measurements of broilers supplemented with *Lactobacillus casei*-fermented mixture of red rice and aromatic ginger (FERMIX)" revealed that supplementation at 0.5 % improved gut health and immune metrics even if growth parameters were not always significantly different (Astuti *et al.*, 2022).

In addition, a more recent study in 2024 demonstrated that diets containing garlic, ginger or their combination increased growth performance and had favorable economic benefits in broiler chickens, highlighting ginger's role as part of a combined natural additive strategy (Alli, Bello, Oluwalana, *et al.*, 2024). Meanwhile, "Production Performance Of Broiler Chickens With The Use Of Ginger (*Zingiber officinale*) As A Natural Probiotic And Its Effect On Organometric Parameters" (2022) found that higher ginger inclusion (0.75 g per kg feed) yielded significantly better final weight, weight gain and feed conversion ratio compared to control, suggesting that ginger enhances feed assimilation and gastrointestinal development (Andrade *et al.*, 2022).

The mechanisms by which ginger and other phytogetic agents exert beneficial effects include: (1) stimulation of digestive secretions and enzymes, which improves digestion and nutrient absorption; (2) modulation of gut microbial populations, suppressing pathogens while supporting beneficial bacteria; (3) antioxidative and anti-inflammatory effects that protect intestinal tissues, improve immune status, and help the birds cope with stress (Heat, disease, etc.); (4) improvements in palatability and appetite, helping birds maintain or increase feed intake under adverse conditions (e.g. when health or environment suppresses eating). However, findings are not always consistent. Some studies report reduced feed intake at higher dosages of ginger or extracts (Standardized Ginger Extra, 2022), or no significant improvements in growth, depending on dose, age of birds, diet composition, management, and environmental factors. Thus, standardizing dosage, form (powder, extract, essential oil), and duration of supplementation is essential to optimize outcomes.

Given these developments, the current interest is in identifying natural feed additives that can match or approach the benefits of synthetic antibiotics without their risks. Ginger has shown strong promise in recent studies since 2020 for improving broiler performance, feed efficiency, gut health, and immune function, with relatively few side effects when used appropriately. Such natural strategies align with consumer demand for safe, residue-free poultry products, and regulatory trends favoring reduction of antibiotic use in animal agriculture.

This study aims to review and synthesize literature published since 2020 on the effects of ginger supplementation in broiler diets, particularly focusing on its impact on feed intake, growth performance, gut morphology, microbiota composition, and health indicators. By doing so, we hope to evaluate the evidence for ginger as a viable, safe, and sustainable alternative to synthetic growth promoters in broiler production, and identify gaps for future research and practical recommendation.

RESEARCH METHODOLOGY

This study employed a literature review approach using a descriptive analysis method to explore and synthesize research findings related to the use of ginger (*Zingiber officinale*) as a natural supplement in broiler chicken production. A literature review was chosen because it enables the systematic collection, evaluation, and interpretation of existing knowledge from multiple sources. This method is particularly suitable for identifying consistent trends, comparing results across different studies, and highlighting research gaps in the field of poultry nutrition. Data and information were gathered from peer-reviewed scientific journals, research articles, theses, and academic reports published primarily between 2020 and 2025.

The inclusion of recent studies ensured that the discussion reflects the latest advancements and scientific evidence regarding ginger supplementation in broiler diets. Reputable online databases such as ScienceDirect, SpringerLink, MDPI, ResearchGate, Google Scholar, and PubMed were used to identify relevant publications. The search used keywords including “Bioactive compounds, Digestive enzymes, Growth performance, Nutrient absorption, Sustainable Livestock Production.”. A set of inclusion and exclusion criteria was applied to ensure the relevance and quality of the selected literature.

The inclusion criteria required that the studies (1) examined the use of ginger or its derivatives such as powder, extract, or essential oil in broiler diets; (2) reported outcomes related to feed utilization, growth rate, feed conversion ratio (FCR), or physiological parameters; and (3) were based on controlled experimental designs. Exclusion criteria eliminated studies that focused on other species or on the non-nutritional uses of ginger. Following the screening stage, the selected articles were analyzed descriptively. Each study was reviewed based on its objectives, methodology, treatment groups, dosage levels, duration of supplementation, and major findings. The results were compared and summarized to highlight similarities, variations, and overall trends. After initial screening, the selected literature was analyzed descriptively. Each study was reviewed for its objectives, experimental design, dosage level, duration of supplementation, measured parameters, and major outcomes. The data were then compared to identify common patterns and contrasting findings across various experimental settings.

This descriptive approach made it possible to understand how ginger functions as a natural feed additive, its optimal inclusion level, and its overall impact on broiler health and productivity. The final synthesis focused on summarizing the effects of ginger supplementation on feed intake, appetite stimulation, digestive enzyme activity, nutrient absorption, immune response, and growth performance. In addition, the review discussed possible mechanisms of action of ginger’s bioactive compounds and their implications for sustainable poultry production. By integrating results from multiple sources, this method provides a comprehensive and evidence-based understanding of the potential of *Zingiber officinale* as a safe and effective alternative to synthetic growth promoters in broiler nutrition.

RESULTS AND DISCUSSION

Based on the review of various studies, the utilization of ginger (*Zingiber officinale*) as a feed supplement in broiler chickens has shown positive effects on feed intake, growth performance, gut health, and immune status. The phenolic compounds in ginger can stimulate

the secretion of digestive enzymes and enhance intestinal motility, thereby improving digestion and nutrient absorption, which contributes to increased feed intake (Gao *et al.*, 2021). Ginger extract and oil reduce the population of intestinal pathogens (e.g., *Escherichia*–*Shigella*) and increase *Lactobacillus*, which are associated with improved feed intake and digestive health (Zhang *et al.*, 2021).

Low feed intake is a major limiting factor in broiler production because it directly affects growth and feed efficiency. Synthetic additives can increase feed intake but raise concerns about chemical residues. Ginger (*Zingiber officinale*) contains gingerol, shogaol, and zingerone, which have the potential to improve digestion, palatability, gut microbiota, and antioxidant status, making it a promising natural alternative (Chen *et al.*; Zhang *et al.*, 2021). According to Abd El-Hack *et al.* (2020), ginger and its derivatives are strong candidates to replace synthetic antibiotics in poultry feed. The bioactive compounds contained in ginger, such as gingerols, shogaols, and essential oils, act as natural antibacterials, antioxidants, and appetite stimulants that support increased broiler productivity while reducing the risk of antibiotic resistance. Experimental findings further support these results. Dosu *et al.* (2023) reported that supplementation of ginger root extract in broiler diets contributed to improved body weight gain, feed efficiency, and enhanced immune responses compared with the control group.

This suggests that the active compounds in ginger stimulate metabolism while strengthening the birds' resistance against pathogens. Similarly, Duwa *et al.* (2020), who conducted their study under semi-arid conditions in Nigeria, found that ginger supplementation in broiler finisher diets improved nutrient digestibility, particularly crude protein and metabolizable energy, ultimately leading to enhanced growth performance. Kairalla *et al.* (2022) demonstrated that graded levels of ginger powder supplementation not only improved growth performance but also had positive impacts on hematological parameters and serum lipid profiles in broiler chickens. These findings indicate that ginger may enhance physiological health, particularly in maintaining lipid metabolism and blood functions. Furthermore, Asghar *et al.* (2021) highlighted that ginger supplementation was associated with improvements in intestinal morphology, including villus height and villus-to-crypt ratio. Such structural modifications contribute to enhanced nutrient absorption and feed utilization, which in turn support better growth performance and immune function in broilers. Although most studies focus on broilers, Derese *et al.* (2025) investigated laying hens (Xiaoshan pre-peak layers) and found that dietary supplementation with ginger rhizome powder improved antioxidant capacity, egg quality, and hepato-intestinal morphology.

Feed is an important component consumed by poultry to meet the various biological needs of their bodies, including energy, protein, vitamins, minerals, and essential amino acids, so that physiological processes such as cell growth, formation of muscle tissue, maintenance of organs, and egg production can proceed optimally. From the standpoint of physical form, poultry feed is categorized into several main types: mash (dry/powdered feed), pellet (dense granules produced by pelleting), and crumble (broken, finer granules that are easier to consume), each of which has its own advantages and disadvantages regarding palatability, feed efficiency, and nutrient losses during handling.

For broiler chickens raised specifically for meat production and with nutritional needs and feeding patterns different from laying hens the most commonly used and recommended feed form by many farmers and feed manufacturers is crumble, because its particle size is suitable for both chicks and adult birds, it is easy to consume which helps increase daily intake, and it has the potential to reduce feed wastage compared with mash. This is intended to minimize feed spillage and thereby reduce feed and nutrient losses, making feed use more efficient, according to Alamsyah, R. (2005).

The inclusion of ginger in feed increases appetite and broiler carcass weight, according to Elmakki,dkk. (2013) . Increased appetite in poultry is influenced by various factors, one of which is the organoleptic characteristics of ginger's distinctive taste and aroma; ginger has long been known to stimulate appetite, strengthen gastric function, and improve overall digestion, thereby making feed consumption more effective and better meeting nutritional requirements.

The active compounds contained in ginger, including essential oils and phenolic components, play a role in stimulating the secretion of digestive fluids and increasing gastrointestinal motility; specifically, the essential oil content in ginger acts by enhancing the production of digestive enzymes such as amylase, protease, and lipase, so that the breakdown and absorption of nutrients occur faster and more efficiently, which in turn increases feed intake by poultry. In addition, using ginger as a feed additive can provide synergistic effects such as improved gut health, reduced incidence of digestive disorders, and the potential for improved growth performance and feed conversion when administered at appropriate doses and in suitable forms. Besides essential oils, ginger also contains oleoresin, both of which are known to help optimize the function of body organs, according to Setyanto,A (2012).

The amount of feed consumed by each broiler chicken varies considerably and is influenced by a range of intrinsic and extrinsic factors. These include the physical form of the feed (e.g., mash, pellet, or crumble), which affects palatability and ease of consumption; the strain or genetic line of the broiler, which determines growth potential and feeding patterns; and feed composition particularly energy and key nutrients such as protein, amino acids, vitamins, and minerals which influence requirements and intake response.

Environmental conditions such as temperature and overall environmental health (barn hygiene, ventilation, and pathogen exposure) also play major roles, as do growth rate (which affects daily nutrient demands), basal metabolic energy of individuals, and stressors (such as stocking density, changes in feed, or management), all of which can decrease or increase appetite. Nonetheless, of all these variables, two primary factors most determinative of feed consumption are the metabolizable energy content of the feed since birds adjust intake to meet their energy needs and ambient temperature, which directly affects energy needs for thermoregulation and feeding comfort; the interaction between these two factors often largely determines consumption patterns and broiler production performance in the field.

Feed with low energy content will be consumed in greater amounts by chickens but with lower efficiency, whereas high ambient temperature causes chickens to eat less and drink more, according to Lesson, S. (2000).

The study conducted by Sakinah et al. (2023) demonstrated that supplementation with a herbal mixture containing ginger (*Zingiber officinale*), curcuma, sambiloto, and honey had a significant positive effect on feed and water intake in broiler chickens ($P<0.05$).

The 5% and 10% concentrations produced the best outcomes, with increases in feed intake of 11.6% and 9.7%, and water intake of 45.8% and 34.5%, respectively, compared to the control group. In addition, improvements were observed in live body weight, daily weight gain, carcass weight, and feed conversion ratio (FCR) in the 5% and 10% treatment groups. The ginger component in the herbal formulation was suggested to enhance feed intake through its essential oils and oleoresins, which stimulate digestive enzyme secretion, improve digestive organ function, and enhance appetite in broilers. The antioxidant compounds, particularly gingerol and shogaol, help maintain intestinal cell integrity, improve nutrient absorption, and enhance metabolic efficiency.

Moreover, no adverse effects were detected on internal organs such as the heart, liver, lungs, kidneys, and spleen, indicating that the inclusion of ginger at these concentrations is non-toxic and safe as a natural feed additive for poultry.

The study conducted by Munna Sari Harahap et al. (2020) provides important complementary information to previous research, particularly regarding the physiological aspects and blood health of broiler chickens given a herbal drink containing ginger (*Zingiber officinale*) and turmeric.

In addition to improving feed performance, the administration of ginger extract also increased the number of erythrocytes and hemoglobin levels, which reflects an improvement in the oxygenation status and metabolic activity of the chickens. The highest erythrocyte value was found in treatment P3 (drinking water + 0.5% ginger + 0.25% turmeric), indicating that this combination helped enhance physiological function without causing toxic effects.

Ginger contains bioactive compounds such as gingerol, flavonoids, and phenols, which act as natural antioxidants and anti-inflammatory agents. These compounds improve the performance of digestive organs by stimulating the secretion of digestive enzymes such as amylase, lipase, and protease, thereby facilitating metabolic processes and increasing nutrient utilization efficiency. Moreover, the antioxidant effect of gingerol helps maintain the integrity of red blood cell membranes (erythrocytes), thus strengthening the circulatory system and supporting improved appetite and nutrient absorption.

Although the inclusion of ginger increased erythrocyte levels, the hematocrit and hemoglobin values remained within the normal range, indicating that the use of ginger as a herbal additive is safe and does not cause physiological stress. This improvement in blood health has a direct impact on production performance, as healthy blood plays a vital role in transporting oxygen and nutrients to body tissues, including muscle tissue where the primary growth of broiler chickens occurs. Overall, these findings reinforce that ginger not only enhances feed intake but also supports the physiological condition and health of broiler chickens through mechanisms involving improved digestive and circulatory systems.

These findings suggest that the beneficial effects of ginger are not limited to broilers but are also relevant to other poultry species such as layers. Overall, the reviewed studies consistently indicate that ginger (*Zingiber officinale*) is an effective natural feed additive capable of enhancing appetite, feed efficiency, gut health, blood metabolism, and immune responses in broiler chickens. Moreover, the use of ginger provides added value in terms of sustainability by reducing reliance on synthetic antibiotics and promoting safer and healthier poultry production. Observations on feed consumption and drinking water consumption of broiler chickens in the control group and treatment groups can be seen in the Table. The administration of ginger herbal drink at a 5% concentration increased feed consumption by 11.6% and drinking water consumption by 45.8%. The administration of ginger at a 10% concentration increased feed consumption by 9.7% and drinking water consumption by 34.5%, while the administration of the herbal drink at 15% increased drinking water consumption by 9.6%.

Table 1. Result of observations of feed and water consumption

PARAMETER	KONSENTRASI			
	K*	5%	10%	15%
Feed	61	68	67	56
Intake (g/day)	20	31	14	53
Water	110	161	148	121
Intake (ml/day)	77	60	98	47

Note: (*) Broiler chicken control group without herbal supplementation

Source: (Nabillah Ananda Sakinah *et al.*, 2023)

Based on the following Table, treatment P3 resulted in the highest carcass weight of 1235.50 grams, while treatment P1 recorded the lowest carcass weight of 905.40 grams. Statistical analysis showed a significant effect of ginger extract administration at different concentrations on broiler carcass weight ($P < 0.05$).

From Research Aditya Pamungkas *et al.*,2024 Duncan's post hoc test revealed that the control treatment (P0) did not show a significant difference compared to P1, P2, and P3, whereas P1 was significantly different from P3. This indicates that the use of certain concentrations of ginger extract can optimally increase carcass weight.

Table 2. Treatment Test

VARIABEL	PERLAKUAN				P-VALUE
	P0	P1	P2	P3	
Bobot Karkas	904± 7, 85	905, 40 ± 16, 59	96 1,60 ± 6, 01	123 5,4 0± 15, 06	0,00
Presentase Karkas	72, 58 ± 0, 59	66 32 ± 1,3 8	67, 14 ±0, 72	75 28± 0,90	0,02
Presentase Lemak Abdonimal	0,85± 0,04	0,77± 0,04	0,71± 0,02	0,56± 0,01	0,01
Presentase non karkas	23,89± 0,35	20,75± 0,34	19,48± 0,62	16,02± 0,31	0,00

Note: Different superscripts in the same row indicate significant differences (P<0.05).

Source:(Aditya Pamungkas *et al.*,2024)

Ginger (*Zingiber officinale*) has increasingly attracted attention as a potential natural supplement to improve feed intake and performance in broiler chickens. One of the persistent challenges in poultry production is the low feed intake that limits growth potential and overall productivity. According to Zampiga *et al.* (2021), improving feed efficiency is a key component for achieving sustainable broiler production, as it directly affects both growth and profitability. Conventional approaches often rely on synthetic feed additives to enhance feed intake and growth rate, but their continuous use has raised safety concerns due to possible chemical residues that may pose risks to consumer health.

Therefore, many researchers are now focusing on the use of herbal or plant-based additives that are safer and environmentally friendly. Among these natural alternatives, ginger has been identified as a promising herbal feed additive because it contains several biologically active compounds such. These compounds are known to stimulate digestive enzyme secretion, improve nutrient absorption, and enhance gut health, which collectively contribute to better feed utilization (Hidayat, 2024; Effendi, 2023).

Ginger also has strong antibacterial, antioxidant, and anti-inflammatory properties supplementation under various production systems. In addition, an economic feasibility analysis is necessary to make its use more practical for farmers. The application of ginger supplementation can also be expanded to other poultry species. Several local studies conducted in Indonesia have also confirmed similar findings. Haroen, U.(t.t.). reported that the addition of fermented ginger extract in drinking water increased feed intake, feed efficiency, and reduced carcass cholesterol in broilers. Ervandi (2023) also observed that ginger powder supplementation in drinking water positively affected carcass percentage and overall meat quality. Furthermore, Utami (2023) showed that red ginger powder used as a phytobiotic supplement significantly improved feed

intake and body weight gain in broiler chickens. Overall, the body of evidence from both international and local studies strongly suggests that *Zingiber officinale* functions as an effective natural feed additive. It not only improves feed intake and growth performance but also enhances gut morphology, blood metabolism, and immune responses in broiler chickens.

Moreover, the use of ginger aligns with sustainable livestock production practices by reducing dependence on synthetic antibiotics and minimizing health and environmental risks.

The study conducted by Đurić Jarić et al. (2023) demonstrated that supplementation of ginger extract (*Zingiber officinale* Roscoe) in broiler diets had a significant effect on intestinal morphology, gut microbiota composition, and feed efficiency. Supplementation with 5 g/kg of ginger extract resulted in a notable increase in villus height in the duodenum and jejunum compared to the control group. In addition, the crypt depth in the duodenum decreased significantly, leading to a higher villus height-to-crypt depth ratio (VH:CD). These improvements indicate an enhanced nutrient absorption capacity and a healthier intestinal structure, which directly contributed to better feed efficiency.

Furthermore, the study revealed that ginger extract supplementation altered the gut microbiota composition. The treated groups showed a decrease in the proportion of Proteobacteria, a bacterial phylum often associated with pathogenic conditions and intestinal stress, along with an increase in Firmicutes, which play a vital role in fermentation and nutrient breakdown. At the genus level, there was an increase in beneficial bacteria such as *Lactobacillus* and *Enterococcus*, while potentially harmful bacteria such as *Pseudomonas* were reduced.

These positive changes were also accompanied by an upregulation of genes related to intestinal health and local immunity, such as *Candidatus Arthromitus* and *Romboutsia*. Overall, dietary inclusion of ginger extract up to 5 g/kg was proven to improve feed efficiency and support broiler growth performance, although it did not always cause significant differences in final body weight. These findings reinforce the role of ginger not only as an appetite stimulant but also as a natural phytobiotic agent capable of improving intestinal morphology and balancing gut microbiota, thereby promoting more efficient nutrient absorption.

CONCLUSION AND SUGGESTION

Ginger (*Zingiber officinale*) shows strong potential as a natural feed additive in broiler chickens, improving growth, feed efficiency, and carcass weight by enhancing feed intake, nutrient digestibility, and metabolism. A 5% ginger solution increased feed intake by 11.6% and water intake by 45.8%. Its bioactive compounds (gingerols, shogaols, and essential oils) act as natural antibacterials, antioxidants, and immune boosters, improving gut health and overall performance, making ginger a sustainable alternative to synthetic antibiotics.

REFERENCES

- Abd El-Hack, M. E., Alagawany, M., Shaheen, H., Samak, D., Othman, S. I., Allam, A. A., & Sitohy, M. (2020). Ginger and its derivatives as promising alternatives to antibiotics in poultry feed. *Animals*, 10(3), 452. <https://doi.org/10.3390/ani10030452>
- Aditya Pamungkas dkk. (2024). PEMBERIAN EKSTRAK JAHE DENGAN KONSENTRASI BERBEDA PADA POTONGAN PRIMAL AYAM BROILER. *Jurnal Ilmu Peternakan Indonesia* Volume 01, Nomor 01, 34
- Alamsyah, R. (2005). *Pengolahan Pakan Ayam dan Ikan Secara Modern*. Jakarta (ID): Penebar Swadaya
- Alli, O. O., Bello, K. O., Oluwalana, E. O. A., et al. (2024). Growth performance and cost benefits of broiler chickens fed diets containing garlic and ginger powder as additives. *Nigerian Journal of Animal Production*.
- Andrade, Y. V., Chavéz García, D., Acosta Lozano, N. (2022). Production performance of broiler chickens with the use of ginger (*Zingiber officinale*) as a natural probiotic and its effect on organometric parameters. *Journal of Pharmaceutical Negative Results*, 13 Special Issue 09.

- Asghar, M. U., Rahman, A., Hayat, Z., Rafique, M. K., Badar, I. H., Yar, M. K., & Ijaz, M. (2021). Exploration of the effects of *Zingiber officinale* on growth performance, immunity, and intestinal morphology in broiler chickens. *Brazilian Journal of Biology*, 83, e250296. <https://doi.org/10.1590/1519-6984.250296>
- Astuti, F. D., Sugiharto, S., Yudiarti, T., Widiastuti, E., Wahyuni, H. I., & Ayaşan, T. (2022). Growth performance, blood variables, intestinal bacterial content, and morphological measurements of broilers supplemented with *Lactobacillus casei*-fermented mixture of red rice and aromatic ginger (FERMIX). *Veterinary World*, 15(4), 818-826.
- Dereese, D. B., Sun, H., Xiong, X., Li, Z., Malyar, R. M., Lu, L., & Shi, F. (2025). Effect of ginger (*Zingiber officinale*) rhizome meal supplementation in diet on productive performance, egg quality, antioxidant capacity, and hepatointestinal morphology in Xiaoshan pre-peak laying hens. *Animals*, 15(15), 2315. <https://doi.org/10.3390/ani15152315>
- Dosu, G., Obanla, T. O., Zhang, S., Sang, S., Adetunji, A. O., Fahrenholz, A. C., ... & Fasina, Y. O. (2023). Supplementation of ginger root extract in broiler chicken diets: Effects on growth performance and immunocompetence. *Poultry Science*, 102(10), 102897. <https://doi.org/10.1016/j.psj.2023.102897>
- Đurić Jarić, M., Gottstein, Ž., Vince, S., Žura Žaja, I., Brus, M., Đuričić, D., Samardžija, M., & Valpotić, H. (2023). Effect of standardized ginger (*Zingiber officinale* Roscoe) extract on gut morphology, microbiota composition, and growth performance in broiler chickens. *Agriculture*, 15(13), 1448. <https://doi.org/10.3390/agriculture15131448>
- Duwa, H., Amaza, I. B., Dikko, M. I., Raymond, J. B., & Paulyne, U. O. (2020). Effect of ginger (*Zingiber officinale*) on growth performance and nutrient digestibility of broiler finisher chickens in the semi-arid zone of Nigeria. *Nigerian Journal of Animal Science*, 22(3), 279–286. <https://doi.org/10.51791/njas.v22i3.355>
- Effect of Standardized Ginger (*Zingiber officinale* Roscoe) Extract on Gut Morphology, Microbiota Composition, and Growth Performance in Broiler Chickens. (2022). *Agriculture*, 15(13), 1448.
- Effendi, S. (2023). Analysis of the Cost of Maintaining Broiler Chickens with Herbal Feed. Gao, L., Zhang, H., & Sun, Q. (2021). Ginger components enhance digestive enzyme activities and feed intake in broilers. *Journal of Animal Nutrition*, 7(2), 88–96.
- Elmakki, A.M., AbdelAtti, K.A., Dousa, B.M., Elagib, H.A., Malik, H.E., & Elamin, K.M. (2013). Effects of dietary ground ginger (*Zingiber officinale*) root additive on broiler performance. *GJASR*, 1(1), 76–83.
- Haroen, U. (t.t.). Penggunaan Ekstrak Fermentasi Jahe (*Zingiber officinale*) Dalam Air Minum Terhadap Kualitas Karkas Ayam Broiler. *Jurnal Nukleus Peternakan*.
- Hidayat, M. N. (2024). Effectiveness of Using Herbal Plant-Based Feed Additives on Broiler Performance. *Jurnal Nukleus Peternakan*, 11(2), 100- 105. <https://doi.org/10.35508/nukleus.v11i2.18671>
- Kairalla, M. A., Aburas, A. A., & Alshelmani, M. I. (2022). Effect of graded levels of ginger (*Zingiber officinale*) powder supplementation on growth performance, hematological parameters, and serum lipids of broiler chickens. *Archives of Razi Institute*, 77(6), 2089–2097. <https://doi.org/10.22092/ari.2022.359954>
- Sakinah, N. A., Mustika, A. A., & Amrozi. (2023). Utilization of herbal medicine made of sambiloto, curcuma, honey, and ginger on the performance of broiler chickens. *Journal of Veterinary and Biomedical Sciences*, 1(1), 23–28. <https://doi.org/10.29244/jvetbiomed.1.1.23-28>
- Sakinah1 dkk. (2023). Pemanfaatan Jamu Sambiloto, Temulawak, Madu, dan Jahe terhadap Performa Ayam Broiler. *Jurnal Veteriner dan Biomedis*, Vol. 1 No. 1, 23–28

- Setyanto, A., Atmomarsono, U., & Muryani, R. (2012). Pengaruh penggunaan tepung jahe emprit (*Zingiber officinale* var *Amarum*) dalam ransum terhadap laju pakan
- Zhang, Y., Liu, Z., & Chen, H. (2021). Effects of ginger essential oil on gut microbiota composition in broiler chickens. *Microbial Ecology in Health and Disease*, 32(1), 18725