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Review Article

Application of Kaempferia galanga (*K. galanga*) as a Phytogenic Feed Additive in Broiler Diets

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Kaempferia galanga L. is a medicinal plant belonging to the Zingiberaceae family that has attracted increasing attention as a phytogenic feed additive in poultry production. The growing concern regarding antimicrobial resistance and the restriction of antibiotic growth promoters have encouraged the exploration of plant-based alternatives in broiler diets. This review summarises current scientific evidence on the biological properties and potential applications of *K. galanga* in broiler nutrition. Data were collected from several scientific databases, including Elsevier, ScienceDirect, ResearchGate, and Google Scholar, using keywords related to K. galanga, ethyl p-methoxycinnamate, essential oil, and poultry. The rhizome of *K. galanga* contains various bioactive compounds, particularly ethyl p-methoxycinnamate, flavonoids, essential oils, and phenolic constituents, which exhibit antioxidant, antimicrobial, anti-inflammatory, and immunomodulatory activities. These properties contribute to improved physiological status, enhanced digestive efficiency, and better immune responses in broiler chickens. Dietary supplementation of *K. galanga* has been reported to improve growth performance, feed conversion ratio, carcass characteristics, and meat quality while reducing blood lipid profiles and abdominal fat deposition. Additionally, its antimicrobial effects may support intestinal health by inhibiting pathogenic microorganisms. Overall, *K. galanga* demonstrates promising potential as a natural phytogenic feed additive for improving broiler productivity and health status. However, further studies are required to determine optimal dosage levels, clarify the mechanisms

Keywords: *Kaempferia galanga* L., ethyl p-methoxycinnamate, essential oil, poultry

INTRODUCTION

The poultry industry plays a crucial role in national development due to its contribution to meeting animal-derived protein requirements (Pertiwi *et al*., 2022). However, the increasing resistance of infectious microorganisms to conventional antibiotics has become a serious challenge in this sector. This situation has encouraged the use of phytogenic feed additives, which possess potential immunomodulatory and antimicrobial properties (Lal *et al*., 2017). The application of phytogenic additives may also enhance broiler production capacity to meet the diverse demands of various consumer groups (Muhammad and Nataamijaya, 2006).

Kaempferia galanga Linn (*K. galanga*) is a medicinal plant that has long been used in tropical and subtropical regions of Asia. It has a history of traditional use in several countries, including Bangladesh, India, China, Japan, and Indonesia (Kumar, 2020). *K. galanga* is well known for its rhizome, which exhibits numerous health-promoting properties and is widely utilized in traditional medicine, culinary applications, and the pharmaceutical and cosmetic industries (Munda *et al*., 2018).

K. galanga naturally grows in moist, slightly shaded open areas and can be found in open forests, forest margins, evergreen forests, lowlands, and mountainous regions (Ajay Kumar, 2020). It is also cultivated in coconut plantations and commonly grows at altitudes ranging from 50 to 400 meters above sea level (Kumar, 2020). The plant is known by various common names in different countries, including Resurrection lily and Sand ginger (English), Abhuyicampa (India), Saan noih and Sa geung (China), Ban-ukon and Kenchoru (Japan), and Kencur, Kunci pepet, and Kunir putih (Indonesia) (Kumar, 2020).

K. galanga belongs to the family Zingiberaceae and is characterized by a short green stem and round leaves measuring approximately 3–6 inches in length (Silalahi, 2019). The plant typically reaches a maximum height of about 30 cm and produces aromatic, cylindrical, fleshy rhizomes (Munda *et al*., 2018). Although all parts of the plant possess medicinal value, the rhizome is the most extensively utilized component. It is rich in phenolic compounds, including flavonoids and phenolic acids (Kaushik *et al*., 2013). The rhizome of *K. galanga* has been reported to be effective in the treatment of various diseases due to its antibacterial, antifungal, anti-inflammatory, anti-hepatotoxic, and antioxidant properties (Kumar, 2020).

Recently, *K. galanga* has attracted considerable research attention as a phytogenic plant with the potential to improve feed palatability. Several studies have demonstrated its antibacterial activity, which is attributed to its lipophilic components (Elnaggar *et al*., 2021). This article summarizes previous findings to evaluate the extent to which *K. galanga* can be utilized to enhance body weight gain, carcass and bone characteristics, and health status, particularly in broiler chickens.

DATA COLLECTION

Data were collected through systematic searches of electronic scientific databases, including Elsevier, ResearchGate, ScienceDirect, and Google Scholar. The literature search was conducted using the following keywords: *Kaempferia galanga* L., ethyl p-methoxycinnamate, essential oil, and poultry.

ANTIOXIDANT EFFECTS OF *K. galanga*

The antioxidant constituents of *Kaempferia galanga* exhibit potential anticancer properties. Compounds present in *K. galanga*, particularly flavonoids, may help maintain intracellular redox balance and provide protection against oxidative stress (Ali *et al*., 2018). Kaempferol, a well-known bioactive flavonoid isolated from *K. galanga* rhizomes, possesses a wide range of pharmacological activities, including antioxidant, anti-inflammatory, anticancer, and anti-obesity effects (Agil *et al*., 2023). This flavonoid shows a strong correlation with nitric oxide scavenging activity. Kaempferol has demonstrated significant anticancer potential, particularly against prostate and ovarian cancers (Shahbaz *et al*., 2023). In addition, kaempferol has been reported to effectively eliminate reactive nitrogen species, mainly through molecular binding mechanisms (Parveen *et al*., 2023).

Kaempferol is also capable of inhibiting intracellular signaling components such as Nuclear Factor-kappa B (NF-κB), Mitogen-Activated Protein Kinases (MAPKs), Cyclooxygenase-2 (COX-2), and Sirtuin 1 (SIRT1) (Shahbaz *et al*., 2023). Beyond its free radical scavenging activity, kaempferol can prevent DNA damage through several mechanisms, including neutralization of reactive oxygen species, stabilization of DNA structure, reduction of chemical-induced damage via phase II enzyme induction, and modulation of signal transduction pathways (Almatroudi *et al*., 2023). Moreover, kaempferol treatment has been reported to stimulate the expression of vasohibin-1, an endogenous angiogenesis inhibitor, through the phosphorylation of Extracellular Signal-Regulated Kinase (ERK) (Zhao *et al*., 2020).

Supplementation with *K. galanga* has been shown to significantly increase total antioxidant capacity, as well as the activities of glutathione S-transferase, superoxide dismutase, catalase, and glutathione peroxidase (Abdel-Azeem and Basyony, 2019). Conversely, malondialdehyde (MDA) levels decrease in a dose-dependent manner following *K. galanga* supplementation, indicating its strong antioxidant capacity.

Other studies, including that of Sulaiman *et al*. (2008), have reported that *K. galanga* leaves exhibit antinociceptive and anti-inflammatory properties. Mechanistically, these activities are associated with major bioactive compounds such as ethyl p-methoxycinnamate, flavonoids, and other phenolic constituents that modulate inflammatory pathways and pain transmission. The antinociceptive activity further supports the potential of *K. galanga* as a phytogenic additive in therapeutic applications (Silalahi, 2019). The presence of bioactive compounds such as flavonoids, triterpenes, tannins, and steroids has been linked to its pharmacological effects, and these constituents are likely responsible for its anti-inflammatory properties (Jagadish *et al*., 2016).

THERAPEUTIC AND ANTIMICROBIAL PROPERTIES OF *K. galanga*

The essential oil contained in the rhizome of *Kaempferia galanga* has been reported to effectively inhibit the growth of various bacterial species, including *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Streptococcus suis*, *Pasteurella multocida*, *Arcanobacterium pyogenes*, and *Erysipelothrix rhusiopathiae* (Khairullah *et al*., 2020). However, the precise mechanisms underlying its antimicrobial activity have not been fully elucidated and require further investigation.

Ethyl p-methoxycinnamate has been identified as one of the major active compounds in *K. galanga*, with reported concentrations reaching up to 94.87% in certain extracts (Nonglang *et al*., 2022). This compound exhibits strong antibacterial activity against pathogenic and spoilage bacteria. Its mechanism of action involves disruption of cell membrane permeability and integrity, leading to reductions in intracellular ATP, DNA, and protein concentrations (Song *et al*., 2021). Such effects contribute significantly to its bactericidal activity.

In addition to its metabolic regulatory functions, the essential oil of *K. galanga* demonstrates notable antinociceptive and anti-inflammatory properties (Munda *et al*., 2018). A study by Sulaiman *et al*. (2008) reported that administration of *K. galanga* resulted in a significant, dose-dependent reduction in paw edema volume. Supplementation at 30 mg/kg produced measurable anti-inflammatory effects within three hours of administration, with inhibition rates ranging from 41% to 66%. Furthermore, doses of 100 and 300 mg/kg significantly reduced edema within one hour (Sulaiman *et al*., 2008).

Research conducted by Haerazi *et al*. (2014) demonstrated that ethanolic extract of *K. galanga* (1 kg/200 mL extraction ratio) exhibited inhibitory activity against Gram-positive bacteria, particularly *Staphylococcus aureus* and *Streptococcus viridans*, at a concentration of 70%. Another study suggested that functional groups present in the essential oil compounds of *K. galanga*, including hydroxyl (-OH), ketone (=O), and ether (-O-) groups, may contribute to interactions with amino acids at bacterial active sites (Tang *et al*., 2018).

Compounds such as α-humulene and pentadecane have demonstrated bactericidal activity against both Gram-positive and Gram-negative bacteria by disrupting membrane systems (Aleksic and Knezevic, 2014). These constituents exhibited strong antimicrobial activity, particularly against *S. aureus* and *Listeria monocytogenes*, with minimum inhibitory concentration (MIC_{50}) values of approximately 582 μg/mL and 703 μg/mL, respectively (Tang *et al*., 2018).

Ethanolic extracts of *K. galanga* have also shown significant inhibitory effects against *Staphylococcus aureus*. However, some studies have reported that *K. galanga* extract did not demonstrate significant inhibitory activity against *Salmonella* spp. and *Escherichia coli* (Khairullah *et al*., 2020). Similarly, Sattar *et al*. (2005) reported no inhibitory activity of *K. galanga* extract against *Bacillus subtilis*.

IMMUNOMODULATORY PROPERTIES OF *K. galanga*

Flavonoids present in *K. galanga* have demonstrated immunomodulatory properties capable of influencing immune system responses (Sudatri *et al*., 2019). Yao *et al*. (2018) successfully isolated and identified novel diarylheptanoids from the rhizome of *K. galanga*. Diarylheptanoids are a class of compounds known to exhibit antiproliferative activity against various cell types (Subositi *et al*., 2020). The isolated diarylheptanoids showed strong inhibitory activity against nitric oxide (NO) production in RAW 264.7 macrophage cells (Yao *et al*., 2018), indicating their potential role in modulating inflammatory responses.

Ekawoti *et al*. (2016) reported that bioactive compounds in *K. galanga* possess the potential to inhibit angiogenesis via modulation of tyrosine kinase enzymes. *K. galanga* has also been shown to provide protective effects on retinal ganglion cells damaged by diabetic conditions (Zhao *et al*., 2020). Since tumour growth depends on the formation of new blood vessels stimulated by chemical signals derived from cancer cells, inhibition of angiogenesis represents an important therapeutic strategy in cancer treatment. *K. galanga* has been reported to exhibit anti-angiogenic properties by suppressing blood vessel formation induced by fibroblast growth factor-β (βFGF) in murine models (Hashiguchi *et al*., 2022).

Furthermore, in vivo antitumour studies demonstrated that *K. galanga* could protect the thymus and spleen of tumour-bearing mice from solid tumour progression (Yang *et al*., 2018). Additionally, *K. galanga* enhanced $CD4^+$ T cell immunoregulatory activity and increased the cytotoxic effects of $CD8^+$ T cells and natural killer (NK) cells, ultimately contributing to the suppression of H22 solid tumour growth (Yang *et al*., 2018).

Ethyl p-methoxycinnamate, a major bioactive constituent of *K. galanga*, exhibits immunomodulatory effects by reducing the excessive production of pro-inflammatory cytokines such as tumour necrosis factor-α (TNF-α) and interleukin-6 (IL-6) (Raina and Abraham, 2016). IL-6 is a key pro-inflammatory cytokine typically elevated during inflammatory conditions and respiratory disorders (Kishimoto, 2005).

Moreover, δ-3-carene present in *K. galanga* has been reported to inhibit 5-lipoxygenase (5-LOX) activity (Dwita *et al*. 2021). Lipoxygenase (LOX) plays a crucial role in the metabolism of arachidonic acid (AA), leading to the production of leukotrienes (LTs) (Rådmark *et* *al*., 2015), which are important mediators of inflammation. Therefore, inhibition of LOX activity reduces leukotriene synthesis and produces non-specific anti-inflammatory effects in both the respiratory system and other tissues (Umar *et al*., 2011).

Under conditions of oxidative stress, characterised by excessive free radical production, supplementation with *K. galanga* may serve as a natural antioxidant source capable of protecting organ systems from oxidative damage (Abdel-Azeem and Basyony, 2019).

Table 1. Major constituents of the essential oil of K. galanga

Chemical constituents	Percentage	Biological activity	References
Etil p-metoksisinamat	28,35–69,96%	Antimicrobial, anticancer, larvicidal, anti-tuberculosis, nematicidal, anti-angiogenic, anticarcinogenic, and anti-inflammatory activities	(Raina *et al*., 2015)
Trans-etil sinamat	11.48–26.56%	Larvicidal, anticarcinogenic, and nematicidal activities	(Munda *et al*., 2018)
δ-3-carene	0,1–6,5%	5-lipoxygenase (5-LOX) inhibition	(Umar *et al*., 2011)
1,8-cineole	0,2–5,2%	Anti-inflammatory and antioxidant activities, primarily mediated through the regulation of NF-κB and Nrf2 signaling pathways	(Cai *et al*., 2021)
Pentadecane	6,0–16,5%	Antimicrobial, larvicidal, and mosquito repellent activities	(Kumar, 2020)

NUTRITIONAL COMPOSITION OF *K. galanga*

Several major constituents of the essential oil of *Kaempferia galanga* include ethyl cinnamate, ethyl p-methoxycinnamate, γ-cadinene, 1,8-cineole, δ-carene, borneol, camphene, linoleoyl chloride, kaempferol, and α-pinene (Subositi *et al*., 2020). This combination of compounds contributes to the characteristic aroma and flavour of *K. galanga* (Yao *et al*., 2018). The predominant constituents are ethyl p-methoxycinnamate and ethyl cinnamate, which exhibit notable pharmacological properties and bioactivities, including antibacterial, analgesic, anti-inflammatory, and antioxidant effects (Silalahi, 2019).

In addition, *K. galanga* is traditionally recognised for its warming sensation, analgesic properties, and appetite-stimulating effects (Herlina *et al*., 2021). The presence of ester and methoxy functional groups is associated with its anti-inflammatory activity (Srivastava *et al*., 2021). Ethyl cinnamate is primarily responsible for the characteristic aroma of *K. galanga* and possesses vasorelaxant properties that may promote vasodilation and improve blood circulation (Hasegawa *et al*., 2016; Lal *et al*., 2017).

The rhizome of *K. galanga* is also rich in nutritional components, containing approximately 5.92% protein and 7.93% fibre, as well as substantial levels of essential minerals, including calcium (137.08 ppm), phosphorus (6400 ppm), and magnesium (520.49 ppm) (Srivastava *et al*., 2019). Furthermore, it contains manganese (1.729 ppm), cobalt (0.03 ppm), and iron (17.430 ppm) (Karim *et al*., 2017). Srivastava *et al*. (2019) reported the absence of detectable toxic heavy metals in *K. galanga* samples.The principal constituents of the essential oil of *K. galanga* are presented in Table 1.

EFFECTS OF *K. galanga* ON BROILER PERFORMANCE

Dietary supplementation of *K. galanga* in broiler chickens has been reported to improve physiological condition and production performance, including significant improvements in feed conversion ratio (FCR), as reflected by enhanced body weight gain and more efficient feed utilisation (Elnaggar *et al*., 2021). Elnaggar *et al*. (2021) reported that the most favourable FCR values were observed at supplementation levels of 0.25% and 1.00%. Inclusion of 0.25% *K. galanga* in the diet significantly improved growth performance and physiological status without adversely affecting haematological parameters in broilers (Elnaggar *et al*., 2021).

Abdel-Azeem *et al*. (2019) demonstrated that supplementation at 500 and 750 mg/kg resulted in significant increases in plasma globulin, albumin, and total protein concentrations. Conversely, all levels of *K. galanga* supplementation were associated with significant reductions in cholesterol, triglycerides, low-density lipoprotein (LDL), and total lipid concentrations.

Body weight gain in broilers is primarily influenced by two main factors: feed intake and the birds' ability to digest and utilise nutrients efficiently. Higher feed intake is generally associated with greater body weight gain. Moreover, digestive efficiency plays a crucial role in ensuring optimal nutrient absorption and utilisation to support growth and tissue accretion (Herlina *et al*., 2021).

Herlina *et al*. (2021) reported that dietary inclusion of *K. galanga* powder up to 0.16% positively affected performance by increasing feed intake by 4%, improving body weight gain by 13%, and reducing FCR by 8% compared with broilers not receiving *K. galanga* supplementation. Similarly, Zulbardi *et al*. (2006) demonstrated that the addition of 0.16% *K. galanga* powder to broiler diets contributed to achieving a body weight of approximately 1 kg within 26 days.

In terms of carcass quality, supplementation with *K. galanga* at 500 and 750 mg/kg body weight increased moisture, crude protein, and ether extract content in breast meat (Abdel-Azeem and Basyony, 2019). Furthermore, fat analysis revealed that at 33 and 40 days of age, broilers receiving phytobiotic supplementation containing *K. galanga* exhibited significantly lower meat fat content compared with birds not receiving phytobiotics (Wardah and Sihmawati, 2020).

EFFECTS OF *K. galanga* ON CARCASS CHARACTERISTICS AND BONE PARAMETERS IN BROILER CHICKENS

Dietary supplementation of *K. galanga* in broiler chickens has been reported to reduce cholesterol levels in meat (Sudatri *et al*., 2019). One of the dietary factors influencing blood cholesterol concentration is crude fibre content (Brown *et al*., 1999). Crude fibre can bind bile acids in the digestive tract, which are subsequently excreted in the faeces. This process reduces lipid absorption and limits the conversion of cholesterol into bile acids. Consequently, total body cholesterol levels in broilers may decline, resulting in meat with lower cholesterol content (Sudatri *et al*., 2019).

Chemical analysis of a spice mixture containing *K. galanga*, as reported by Wardah and Sihmawati (2020), revealed a significant tannin content of approximately 4.3%. The high tannin concentration may contribute to the observed reduction in meat cholesterol levels. Supplementation with *K. galanga* extract at a dietary level of 0.25% resulted in an optimal increase in carcass percentage of up to 7.7% (Elnaggar *et al*., 2021). At a higher inclusion level of 1.00%, a marked reduction in abdominal fat percentage was observed, reaching a decrease of 39.0% compared with the control group (Elnaggar *et al*., 2021).

Although increases in the relative weights of lymphoid organs such as the spleen, thymus, and bursa of Fabricius were observed, these changes were not statistically significant.

Nevertheless, this trend may indicate a potential enhancement of immune system development.

Fat deposition in broilers is influenced by dietary composition, including energy level, protein-to-energy ratio, and dietary fat content. Higher dietary fat levels generally promote greater fat accumulation. Bioactive compounds in *K. galanga* have been shown to inhibit foodborne pathogens, fungi, and gastrointestinal pathogens, thereby improving digestive efficiency and nutrient utilisation (Sari *et al*., 2021). Improved nutrient digestibility may contribute to enhanced carcass yield.

Significant increases in liver, heart, and gizzard weights have also been reported following *K. galanga* supplementation (Mohamed Kamil *et al*., 2024). Furthermore, dietary inclusion of *K. galanga* at 0.3% improved carcass meat quality, as evidenced by increased crude protein, moisture, and ether extract content in breast meat (Lokaewmanee and Sirival, 2022). In contrast, supplementation with 750 mg/kg body weight of *K. galanga* rhizome extract resulted in a reduction in crude protein content in thigh meat (Abdel-Azeem and Basyony, 2019).

EFFECTS OF *K. galanga* ON HEALTH STATUS IN BROILER CHICKENS

Dietary supplementation with *K. galanga* has been shown to inhibit the growth of pathogenic bacteria, thereby contributing to improved gastrointestinal health. Maintenance of intestinal integrity is essential for enhancing digestive efficiency and optimising nutrient absorption necessary for growth performance in broiler chickens (Ulu *et al*., 2022).

Astuti *et al*. (2022) reported that diets containing *K. galanga*, particularly at a supplementation level of 0.5%, significantly increased spleen weight in broilers. In healthy animals, enlargement of immune organs is generally associated with enhanced immune cell proliferation, indicating improved immunocompetence in broilers receiving *K. galanga* supplementation. Furthermore, increasing levels of *K. galanga* supplementation were associated with dose-dependent reductions in mortality (Chen *et al*., 2022). Broilers supplemented with 750 mg/kg exhibited the lowest mortality rate, improved feed conversion ratio, and optimal body weight gain (Abdel-Azeem and Basyony, 2019).

K. galanga supplementation has also been reported to reduce blood triglyceride concentrations in broilers (Rahayu *et al*., 2025). The proposed mechanism involves inhibition of triglyceride synthesis at the early stage of glycerol-3-phosphate formation derived from glycerol, dihydroxyacetone phosphate (GPDH), and NADH (Abdel-Azeem and Basyony, 2019).

An experiment conducted by Putri (2014) demonstrated that administration of herbal preparations containing *K. galanga* at 1 and 10 mL/L of drinking water increased erythrocyte count and haemoglobin concentration without adversely affecting physiological status. This effect is attributed to essential oil components that improve digestive function by modulating intestinal peristaltic activity (Gopalsamy *et al*., 2025). Prolonged gastrointestinal transit time may enhance nutrient absorption and improve the availability of substrates required for erythropoiesis (Putri, 2014).

Tahalele *et al*. (2018) further reported that administration of 5 mL of a beverage containing *Kaempferia galanga* reduced abdominal fat percentage in “super native” chickens. This effect may be associated with stimulation of pancreatic secretions by essential oil constituents. Pancreatic juice contains lipase enzymes that hydrolyse triglycerides into glycerol and fatty acids, thereby reducing fat deposition (Pirahanchi and Sharma, 2025). In addition, chemical constituents of *K. galanga* may contribute to lipid reduction by influencing bile and pancreatic secretions, facilitating lipid excretion via faeces (Tahalele *et al*., 2018). The principal roles of *K. galanga* supplementation in broiler chickens are summarised in Table 2.

Table 2. Principal roles of *K. galanga* in broiler chickens

Dosage	Study Design	Main Findings	References
0.08% *Kaempferia galanga* rhizome powder in the diet	Broiler chickens (strain not specified)	Feed intake (FI) and feed conversion ratio (FCR) were higher No effect was observed on mortality or Income Over Feed and Chick Cost (IOFCC)	(Muhammad and Nataamijaya, 2006)
50 and 75 mg/kg body weight per day of ethanolic *Kaempferia galanga* extract administered via the diet	Broiler (Ross 308)	Increased average daily gain (ADG)	(Bounyavong *et al.*, 2014)
10 mL/L of fermented *Kaempferia galanga* rhizome herbal extract combined with garlic (*Allium sativum*), ginger (*Zingiber officinale*), turmeric (*Curcuma longa*), and Java turmeric (*Curcuma xanthorrhiza*) administered via drinking wate	Broiler (SR 707)	Broiler carcass weight did not show a significant difference; however, an improvement in metabolic capacity was observed	(Syam, 2015)
500 and 750 mg/kg body weight of *Kaempferia galanga* rhizome extract administered via the diet	Broiler (Cobb)	Plasma globulin, albumin, and total protein levels increased significantly	(Abdel-Azeem and Basyony, 2019)
6% mixed powder of *Kaempferia galanga*, garlic (*Allium sativum*), noni (*Morinda citrifolia*), moringa leaves (*Moringa oleifera*), Java turmeric (*Curcuma xanthorrhiza*), and turmeric (*Curcuma longa*) in the diet	Broiler (MB 200)	Did not show a significant difference in feed intake, but exhibited a significant difference in blood cholesterol and breast meat cholesterol levels	(Hartoyo *et al.*, 2019)
0.25–1% *Allium sativum* and 0.02% *Kaempferia galanga* rhizome powder in the diet	Broiler (Cobb CP 707)	Reduces erythrocyte and leukocyte counts Does not affect body weight (BW)	(Prabowo, 2019)

27.51% *Kaempferia galanga* rhizome extract combined with ginger and garlic in the diet	Broiler (Cobb CP 707)	Carcass percentage was higher Abdominal and breast fat contents were lower	(Sari *et al*., 2021)
0.25% *Kaempferia galanga* rhizome powder in the diet	Broiler (Arbor Acres)	Improved growth performance and physiological status of broiler chickens without inducing adverse effects on their hematological parameters	(Elnaggar *et al*., 2021)
0.5% *Kaempferia galanga* rhizome powder combined with red rice, dissolved in 200 mL of skim milk containing *Lactobacillus casei*	Broiler (Lohmann)	Had no effect on growth performance, but improved immune competence in broiler chickens. It increased erythrocyte count, hemoglobin concentration, packed cell volume, and total plasma protein. It also enhanced intestinal health by reducing lactose-negative *Enterobacteriaceae*, increasing duodenal villus height (VH) and crypt depth (CD), and decreasing jejunal crypt depth	(Astuti *et al*., 2022)
5–10% *Kaempferia galanga* extract in the diet and drinking water	Broiler (MB Platinum)	Increased body weight and improved feed conversion ratio	(Widodo *et al*., 2023)
1.2% *Kaempferia galanga* rhizome powder combined with *Curcuma domestica* in the diet	Native chickens	Feed intake (FI) was higher No significant effects were observed on feed conversion ratio (FCR), body weight (BW), mortality, or Income Over Feed and Chick Cost (IOFCC)	(Rahayu *et al*., 2024)
0.9% of body weight as *Kaempferia galanga* powder	Jawa Super chicken	Significantly affected meat weight, abdominal fat deposition, and blood cholesterol levels	(Vidiana *et al*., 2021)
0.5% *Kaempferia galanga* rhizome powder in the diet	Pekin duck	Feed intake (FI) and body weight (BW) were higher No significant effects were observed on feed conversion ratio (FCR) or mortality	(Herlina *et al*., 2021)
4 mL of ethanolic *Kaempferia galanga* extract administered via the diet	Japanese quail (*Coturnix japonica*)	Mitigated the effects of H_2O_2 (hydrogen peroxide)	(Al-Mosawy and Al-Salhie, 2021)

CONCLUSION

Kaempferia galanga L. possesses considerable potential as a phytogenic feed additive in broiler production due to its diverse bioactive compounds, including ethyl p-methoxycinnamate, flavonoids, and essential oils. These constituents provide multiple biological activities such as antioxidant, antimicrobial, anti-inflammatory, and immunomodulatory effects, which contribute to improved physiological status and health in broiler chickens. Dietary supplementation of *K. galanga* has been reported to enhance growth performance, improve feed conversion efficiency, increase carcass yield, reduce abdominal fat deposition, and improve meat quality. In addition, its antimicrobial properties may support gut health by inhibiting pathogenic microorganisms and promoting better nutrient utilisation. Furthermore, *K. galanga* supplementation has shown beneficial effects on lipid metabolism and certain haematological parameters, indicating its potential role in improving metabolic and immune functions in broilers. Overall, K. galanga represents a promising natural alternative to antibiotic growth promoters in poultry diets. Nevertheless, further research is required to establish standardized supplementation levels, evaluate long-term safety and efficacy, and better understand the molecular mechanisms underlying its physiological effects in broiler chickens.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding this study.

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REFRENCES

1. Abdel-Azeem AA, Basyony M. Some blood biochemical, antioxidant biomarkers, lipid peroxidation, productive performance and carcass traits of broiler chicks supplemented with alpinia galangal rhizomes extract during heat stress. Egypt Poult Sci J. 2019;39(2). doi:10.21608/epsj.2019.35009
2. Agil M, Kusumawati I, Muslikh FA, Ma'arif B. Neuroprotective activity of Indonesian traditional herbal medicine: a systematic review. J Appl Pharm Sci. 2023;13(10):14–30. doi:10.7324/JAPS.2023.93645
3. Al-Mosawy AMS, Al-Salhie KCK. The effect of alcoholic extract of rhizomes of greater galangal (*Alpinia galanga* l.) on the serum antioxidant enzymes for japanese quail during oxidative stress induced by hydrogen peroxide. Basrah J Agric Sci. 2021;34(1). doi:10.37077/25200860.2021.34.1.15
4. Aleksic V, Knezevic P. Antimicrobial and antioxidative activity of extracts and essential oils of *Myrtus communis* L. Microbiol Res. 2014;169(4). doi:10.1016/j.micres.2013.10.003
5. Ali H, Yesmin R, Satter MA, Habib R, Yeasmin T. Antioxidant and antineoplastic activities of methanolic extract of *Kaempferia galanga* Linn. rhizome against ehrlich ascites carcinoma cells. J King Saud Univ Sci. 2018;30(3). doi:10.1016/j.jksus.2017.05.009
6. Almatroudi A, Allemailem KS, Alwanian WM, Alharbi BF, Alrumaihi F, Khan AA, Almatroodi SA, Rahmani AH. Effects and mechanisms of kaempferol in the management of cancers through modulation of inflammation and signal transduction pathways. Int J Mol Sci. 2023;24(10):8630. doi:10.3390/ijms24108630
7. Astuti FD, Sugiharto S, Yudiarti T, Widiastuti E, Wahyuni HI, Ayaşan T. Growth performance, blood variables, intestinal bacterial content, and morphological measurements of broilers supplemented with *Lactobacillus casei*-fermented mixture of red rice and aromatic ginger. Vet World. 2022;15(4):818–826. doi:10.14202/vetworld.2022.818-826
8. Bounyavong S, Sangmaneedet S, Rungpiriyadej G, Settavakin S, Hirunsirapat N, Taweenan W. Efficacy of galangal (*Alpinia galanga*) extracts against caecal coccidiosis in broilers. KKU Vet J. 2014;24(1).
9. Brown L, Rosner B, Willett WW, Sacks FM. Cholesterol-lowering effects of dietary fiber: a meta-analysis. Am J Clin Nutr. 1999;69(1):30–42. doi:10.1093/ajcn/69.1.30
10. Cai ZM, Peng JQ, Chen Y, Tao L, Zhang YY, Fu LY, Long DQ, Chun X. 1,8-Cineole: a review of source, biological activities, and application. J Asian Nat Prod Res. 2021;23(10). doi:10.1080/10286020.2020.1839432
11. Chen X, Wang R, Hu H, Zhao X, Yin Z, Zou Y. Antiviral effect of an extract from *Kaempferia galanga* L. rhizome in mice infected with

pseudorabies virus. J Virol Methods. 2022;307:114573. doi:10.1016/j.jviromet.2022.114573
12. Dwita LS, Supandi, Yeni. In vitro study of *Kaempferia galanga* L. compound, δ- 3-carene, against 5-lipoxygenase. In: proceedings of the 4th international conference on sustainable innovation 2020–health science and nursing (ICoSIHSN 2020). Atlantis Press. 2021;443–444. doi:10.2991/ahsr.k.210115.088
13. Ekowati J, Hardjono S, Hamid IS. Ethyl p-methoxycinnamate from *Kaempferia galanga* inhibits angiogenesis through tyrosine kinase. Univ Med. 2016;34(1). doi:10.18051/univmed.2015.v34.43-51
14. Elnaggar A, El-Tahawy W, Osama E, Hassan A. Effect of dietary inclusion of galangal (*Alpinia galanga*) on growth performance and some physiological parameters of broiler chicks. Egypt Poult Sci J. 2021 Dec;41:723–737. doi:10.21608/epsj.2021.213300
15. Gopalsamy RG, Antony PJ, Athesh K, Hillary VE, Montalvão MM, Hariharan G. Dietary essential oil components: a systematic review of preclinical studies on the management of gastrointestinal diseases. Phytomedicine. 2025;140:156630. doi:10.1016/j.phymed.2025.156630
16. Haerazi A, Jekti DSD, Andayani Y. Uji aktivitas antibakteri ekstrak kencur (*Kaempferia galanga* L.) terhadap pertumbuhan bakteri *Staphylococcus aureus* dan *Streptococcus viridans*. J Ilm Biol. 2014;2(1):1–11. doi:10.33394/bioscientist.v2i1.1302
17. Hartoyo B, Iriyanti N, Rimbawanto EA. The use of "fermeherbafit" (mixed herbs) in broiler chicken feed on performance and cholesterol profile. Anim Prod. 2019;20(3). doi:10.20884/1.jap.2018.20.3.709
18. Hasegawa T, Hashimoto M, Fujihara T, Yamada H. Aroma profile of galangal composed of cinnamic acid derivatives and their structure-odor relationships. Nat Prod Commun. 2016;11(10). doi:10.1177/1934578x1601101012
19. Hashiguchi A, San Thawtar M, Duangsodsri T, Kusano M, Watanabe KN. Biofunctional properties and plant physiology of *Kaempferia* spp.: status and trends. J Funct Foods. 2022;92. doi:10.1016/j.jff.2022.105029
20. Herlina B, Suningsih N, Setiyani S. Performance of peking ducks (*Anas plathyrinchos*) adding kencur flour (*Kaemferia galanga*) in their rations. J Ilm Peternak Terpadu. 2021;9(1). doi:10.23960/jipt.v9i1.p19-27
21. Jagadish PC, Latha KP, Mudgal J, Nampurath GK. Extraction, characterization and evaluation of *Kaempferia galanga* L. (Zingiberaceae) rhizome extracts against acute and chronic inflammation in rats. J Ethnopharmacol. 2016;194. doi:10.1016/j.jep.2016.10.010
22. Kamil MAIM, Reduan MFH, Mohd Noor MA, Abu-Bakar L, Shamsuddin SH, Mohd Azmi AF. The effects of piper betle and alpinia galanga feed additives on growth performance, carcass characteristics and histomorphometry of small intestine in broilers. 2024. https://creativecommons.org/licenses/by/4.0/
23. Karim R, Smr K, Nordini NT, Kelantan M, Campus J. Vitamins and mineral contents of ten selected weeds and local plants of Kelantan, Malaysia. IJBPAS. 2017;6(2).
24. Kaushik P, Kaushik D, Yadav J, Pahwa P. Protective effect of *Alpinia galanga* in STZ induced diabetic nephropathy. Pak J Biol Sci. 2013;16(16). doi:10.3923/pjbs.2013.804.811
25. Khairullah AR, Solikhah TI, Ansori ANM, Fadholly A, Ramandinianto SC, Ansharieta R, Widodo A, Riwu KHP, Putri N, Proboningrat A, Kusala MKJ, Rendragraha BW, Putra ARS, Anshori A. A review of an important medicinal plant: *Alpinia galanga* (l.) willd. Syst Rev Pharm. 2020;11(10). doi:10.31838/srp.2020.10.62
26. Kishimoto T. Interleukin-6: from basic science to medicine—40 years in immunology. Annu Rev Immunol. 2005;1–21. doi:10.1146/annurev.immunol.23.021704.115806
27. Kumar A. Phytochemistry, pharmacological activities and uses of traditional medicinal plant *Kaempferia galanga* L. – An overview. J Ethnopharmacol. 2020;253. doi:10.1016/j.jep.2020.112667
28. Lokaewmanee K, Sirival R. Carcass and meat quality of broiler chickens reared on herb residues. J Indones Trop Anim Agric. 2022;47(3):204–214. doi:10.14710/jitaa.47.3.204-214
29. Lal M, Munda S, Dutta S, Baruah J, Pandey SK. Identification of the new high oil and rhizome yielding variety of *Kaempferia galanga* (Jor Lab K-1): A highly important indigenous medicinal plants of North East India. J Essent Oil Bear Plants. 2017;20(5). doi:10.1080/0972060X.2017.1400405
30. Muhammad Z, Nataamijaya AG. Lama pemeliharaan untuk mencapai bobot badan

siap pasar ayam broiler melalui penambahan tepung kencur (*Kaempferia galanga* L). ginger (*Kaempferia galanga* L) supplementation to shorten broiler production period. AZDOC. 2006.
31. Muhammad Z, Nataamijaya AG. Ginger (*Kaempferia galanga* L) supplementation to shorten broiler production period. Anim Prod. 2006;8(1):59–63.
32. Munda S, Saikia P, Lal M. Chemical composition and biological activity of essential oil of *Kaempferia galanga*: A review. J Essent Oil Res. 2018;30(5). doi:10.1080/10412905.2018.1486240
33. Nonglang FP, Khale A, Bhan S. Phytochemical characterization of the ethanolic extract of *Kaempferia galanga* rhizome for anti-oxidant activities by HPTLC and GCMS. Future J Pharm Sci. 2022;8(1):9. doi:10.1186/s43094-021-00394-1
34. Prabowo MW. Pengaruh penambahan tepung bawang putih (*Allium sativum* L) dan tepung kencur (*Kaempferia galanga* L) dalam pakan komersial terhadap berat badan, jumlah eritrosit dan leukosit ayam pedaging ras (*Gallus domesticus*) [Internet]. 2019. http://erepository.uwks.ac.id/id/eprint/3924
35. Putri ZU. Profil darah merah ayam broiler yang diberi jamu bagas waras (jahe, kencur, dan kunyit) melalui air minum. Institut Pertanian Bogor. 2014.
36. Rådmark O, Werz O, Steinhilber D, Samuelsson B. 5-lipoxygenase, a key enzyme for leukotriene biosynthesis in health and disease. Biochim Biophys Acta Mol Cell Biol Lipids. 2015;1851(4):331–339. doi:10.1016/j.bbalip.2014.08.012
37. Pertiwi H, Nur Mahendra MY, Kamaludeen J. Astaxanthin as a potential antioxidant to improve health and production performance of broiler chicken. Vet Med Int. 2022;2022. doi:10.1155/2022/4919442
38. Parveen S, Bhat IUH, Bhat R. Kaempferol and its derivatives: biological activities and therapeutic potential. Asian Pac J Trop Biomed. 2023;13(10). https://journals.lww.com/aptb/fulltext/2023/13100/kaempferol_and_its_derivatives__biological.1.aspx
39. Pirahanchi Y, Sharma S. Biochemistry, Lipase. In: StatPearls. Treasure Island (FL): StatPearls Publishing. 2025.
40. Rahayu ID, Untari T, Widodo W, Sutanto A, Anggraini AD. Patogen bacteria and visceral organ weight of native chicken in feed herbal supplementation. Jambura J Anim Sci. 2024;7(1):1–10.
41. Rahayu ID, Susanto A, Widodo W, Tonda R, Pangestu M, Nurcahyo W. The effect of *Kaempferia galanga* L. extract on blood profile and relative weight of visceral organs Indonesian native chicken. EDP Sci. 2025;201:04003.
42. Raina AP, Abraham Z, Sivaraj N. Diversity analysis of *Kaempferia galanga* L. germplasm from South India using DIVA-GIS approach. Ind Crops Prod. 2015;69. doi:10.1016/j.indcrop.2015.02.052
43. Raina AP, Abraham Z. Chemical profiling of essential oil of *Kaempferia galanga* L. germplasm from India. J Essent Oil Res. 2016;28(1). doi:10.1080/10412905.2015.1077165
44. Sari TV, Harahap RIH, Hasanah U. The efficacy of healthy drinks based on kaempferia galanga, ginger and garlic as phytobiotics on fat content of breast, percentage of abdominal fat and broiler carcass. ICFTNSA. 2021;332. doi:10.1051/e3sconf/202133201004
45. Sattar M, Islam MK, Paul D, Khan MK, Parvez MAK. Antibacterial activity of the ethyl acetate rhizome extracts of *Kaempferia galanga* Linn.(Acane). J Appl Technol. 2005;4:87–89.
46. Shahbaz M, Imran M, Alsagaby SA, Naeem H, Al Abdulmonem W, Hussain M, Abdelgawad MA, El-Ghorab AH, Ghoneim MM, El-Sherbiny M, Atoki AV, Awuchi CG. Anticancer, antioxidant, ameliorative and therapeutic properties of kaempferol. Int J Food Prop. 2023;26(1). doi:10.1080/10942912.2023.2205040
47. Silalahi M. Kencur (*Kaempferia galanga*) dan bioaktivitasnya. J Pendidik Inform Sains. 2019;8(1). doi:10.31571/saintek.v8i1.1178
48. Song L, Wu X, Xie J, Zhang H, Yang H, Zeng Q, Yang X, Xie W. *Kaempferia galanga* Linn. extract – a potential antibacterial agent for preservation of poultry products. LWT. 2021;147. doi:10.1016/j.lwt.2021.111553
49. Srivastava N, Ranjana, Singh S, Gupta AC, Shanker K, Bawankule DU, Luqman S. Aromatic ginger (*Kaempferia galanga* L.) extracts with ameliorative and protective potential as a functional food, beyond its flavor and nutritional benefits. Toxicol Rep. 2019;6. doi:10.1016/j.toxrep.2019.05.014
50. Srivastava N, Mishra S, Iqbal H, Chanda D, Shanker K. Standardization of *Kaempferia galanga* L. rhizome and vasorelaxation effect of

its key metabolite ethyl p-methoxycinnamate. J Ethnopharmacol. 2021;271. doi:10.1016/j.jep.2021.113911
51. Subositi D, Kurnianingrum N, Mujahid R, Widiyastuti Y. *Kaempferia galanga* L. A medicinal plant used by Indonesian ethnic groups: genetic diversity based on inter-simple sequence repeats (ISSR). Agrivita. 2020;42(1). doi:10.17503/agrivita.v42i1.1850
52. Sudatri WN, Wirasiti N, Suartini NM, Bidura IGNG. Anti-diabetic and anti-cholesterol activity of *Kaempferia galanga* L. herbal medicine rhizome in albino rats. Int J Fauna Biol Stud. 2019;6(5).
53. Sulaiman MR, Zakaria ZA, Daud IA, Ng FN, Ng YC, Hidayat MT. Antinociceptive and anti-inflammatory activities of the aqueous extract of Kaempferia galanga leaves in animal models. J Nat Med. 2008;62(2). doi:10.1007/s11418-007-0210-3
54. Syam M. Carcass weight and quality analysis broiler herbal probiotics provided the herbal plants and through water supply. J Galung Trop. 2015;4(2).
55. Tahalele Y, Montong MER, Nangoy FJ, Sarajar CLK. Pengaruh penambahan ramuan herbal pada air minum terhadap persentase karkas, persentase lemak abdomen dan persentase hati pada ayam kampung super. J Zootek. 2018;38(1):160–168.
56. Tang X, Xu C, Yagiz Y, Simonne A, Marshall MR. Phytochemical profiles, and antimicrobial and antioxidant activities of greater galangal [*Alpinia galanga* (Linn.) Swartz.] flowers. Food Chem. 2018;255. doi:10.1016/j.foodchem.2018.02.027
57. Umar MI, Asmawi MZB, Sadikun A, Altaf R, Iqbal MA. Phytochemistry and medicinal properties of *Kaempferia galanga* L. (Zingiberaceae) extracts. Afr J Pharm Pharmacol. 2011;5(14). doi:10.5897/AJPP11.388
58. Ulu F, Putu N, Suryatni F, Dillak SYFG. Effect of addition of herbal ingredients in drinking water on final weight, cecum weight and total salmonella in broiler cecum. J Peternak Lahan Kering. 2022;4(2).
59. Vidiana ST, Harahap RIH, Hasanah U. The efficacy of healthy drinks based on Kaempferia galanga, ginger and garlic as phytobiotics on fat content of breast, percentage of abdominal fat and broiler carcass. EDP Sci. 2021;332:01004. doi:10.1051/e3sconf/202133201004
60. Wardah, Sihmawati RR. Peningkatan performans produksi dan kualitas daging pada ayam broiler periode finisher yang diberi fitobiotik. Stigma J Mat Ilmu Pengetah Alam. 2020;13(2):1–15.
61. Widodo W, Sutanto A, Dwi Rahayu I, Devi Anggraini A, Handayani T, Hendroko Setyobudi R. Herbs as a feed additive in the broilers for the sustainability of local products. ES3. 2023;374. doi:10.1051/e3sconf/202337400037
62. Yang X, Ji H, Feng Y, Yu J, Liu A. Structural characterization and antitumor activity of polysaccharides from *Kaempferia galanga* L. Oxid Med Cell Longev. 2018;2018. doi:10.1155/2018/9579262
63. Yao F, Huang Y, Wang Y, He X. Anti-inflammatory diarylheptanoids and phenolics from the rhizomes of kencur (*Kaempferia galanga* L.). Ind Crops Prod. 2018;125. doi:10.1016/j.indcrop.2018.09.026

Zhao L, Sun J, Shi S, Qin X, Zhang K, Xu J. Kaempferol protects retinal ganglion ceils from high-glucose-induced injury by regulating vasohibin-1. Neurosci Lett. 2020;716. doi:10.1016/j.neulet.2019.134633