



Effects of Supplementing Fresh Garlic on Growth and Meat Production of Minhdu Chicken

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Abstract | In the context of escalating antibiotic resistance, the integration of herbal alternatives in poultry production plays a critical role in enhancing sustainable farming practices and ensuring food safety. The study was conducted at An Giang University with the objective of determining the effects of supplementing fresh garlic (GARL) on growth capacity and meat production of Minh Du chicken. The experiment was carried out on 120 Minh Du broiler chickens from 4 to 14 weeks of age. The experiment comprised 4 treatments with control (no addition), experimental treatment GARL 1, GARL 2, and GARL 3 with adding 1%, 2% and 3% of fresh garlic, respectively. The experiment used 10 chicks per unit and 3 replications. The results showed that the increased body weight of Minh Du broiler chicken in experimental treatments was higher than control treatments ($P < 0.05$). Dietary supplementation of fresh garlic had significant ($P < 0.05$) effect on weight gain (increased 11.54% compare with control) and feed conversion effectiveness (decreased 12.35% compare with control) and the values were observed to be maximum at the highest level of fresh garlic (3%) and the least in control group. Daily feed intake was not affected by the addition of fresh garlic as well as meat quality (carcass percentage, pH value, drip loss, cooking loss and chemical of breast meat) had not difference between experimental and control treatment. The results indicated that supplementation with fresh garlic at 3% increased the final live weight of the bird, as well as improved weight gain and feed conversion ratio.

Keywords | Minhdu poultry, Garlic, Diet addition, Growth performance, Carcasses, Impact

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INTRODUCTION

Minh Du chicken (*Gallus gallus* L.; Lawal and Hanotte, 2021) production is developing in Viet Nam, giving high economic efficiency for producers. Minh Du chicken

is a new coloured broiler strain of the native Mia chicken breed. Adding growth stimulants and antibiotics to chicken diets is known to negatively impacts on consumers' health. Using probiotics, prebiotics, enzymes as supplements in chicken diet is suggested to increase development rate, diet

conversion effectiveness as well the improvement of meat quality (Mund *et al.*, 2017; Sapsuha *et al.*, 2021; Rahman *et al.*, 2022).

Herbal supplements, including garlic, present a potentially sustainable solution, offering locally available, cost-effective, and environmentally friendly alternatives that pose no risk to human health. Garlic (*Allium sativum* L.) contains bioactive compounds such as allicin, alliin, ajoene, vinyldithiins, and flavonoids, which have well-documented antibacterial, anti-inflammatory, and immune-boosting properties (Demir *et al.*, 2005; Amagase, 2006). While garlic supplementation has been studied in commercial broiler breeds, there is a lack of research specifically targeting its effects on the growth performance and meat quality of Minh Du chickens.

This study providing insights the impact of fresh garlic supplementation on growth capacity and meat production in Minh Du broilers, contribute to more sustainable environment.

MATERIAL AND METHODS

LOCATION AND TIME

The experiment was conducted from February to April 2022, on an experimental farm of An Giang University in Long Xuyen city, An Giang province (Vietnam).

EXPERIMENTAL DESIGN AND FEEDS AND FEEDING

A total of 120 Minh Du chickens at 28 days old with similar initial body weights were randomly divided into five treatments with three replicates, with 10 chicks for each unit (5 male and 5 female bird). Chickens received basal diets without (GARL0, Control) or with the addition of 1% (GARL1), 2% (GARL2), and 3% (GARL3) of fresh garlic (calculate in fresh) in the ration throughout the experimental period (start experiment chicken age: 28 days old; end experiment chicken age: 98 days old). Water and feed were offered *ad libitum* according to the chickens' need. They have been vaccinated against contagious diseases.

Table 1: Chemical compositions of basal diet (% DM).

Item	%/DM
DM	90.7
Crude protein	19.7
OM	94.6
EE	5.1
CF	5.0

Fresh garlic was purchased once from a local market and stored in a dry environment. The ingredients were washed, peeled and cut into 1 mm thick slices. They were then ground into powder and fed to chickens. Fresh garlic were

prepared and used daily. The chemical composition of the concentrate (commercial) used in the experiment is shown in Table 1. The nutritional composition of the basic diet is designed to meet the nutritional requirements of chickens at each growth stage (McDonald *et al.*, 2011).

Experimental bird were confined in pens with 2.0 m²/10 bird and floor barn, which were surrounded by iron net and its floor was overlaid with 20 cm of rice husk (Figure 1). This rice husk layer is enriched in bacteria to treat chicken manure.



Figure 1: Minh Du chicken (*Gallus gallus domesticus* L.) in the experimental farm of An Giang university used during the presented research. Each square unit corresponds to one experimental unit (5 male + 5 female chicken for each unit).

MEASUREMENTS TAKEN

The initial body weight (BW) of the bird at 28 days old, as well as the ending body weight at 98 days old, was recorded to calculate average daily gain (ADG). The average daily feed intake (ADFI) was determined on a fresh basis as the difference between the quantity of feed offered and the leftovers. The feed conversion ratio (FCR) was calculated as the ratio of the ADFI to the ADG. The viability thoroughly of the chickens was also monitored.

CARCASS VALUES: 2 birds (1 male and 1 female) per each experimental unit were slaughtered for the evaluation of carcass traits. The pH of breast muscles was measured by digital pH meter (Hanna HI 2550-02) 45 min after slaughter for pH₀ and 24 h after slaughter for pH₂₄ (Sopian *et al.*, 2020). The left part of each breast muscle sample was trimmed to a dimension of 2.0 x 1.0 x 0.5 cm. Each piece was weighed (weight before storage = W1) and put into a sealed plastic bag, with drip loss stored at a chilled temperature (4° C) for 24 h. The sample was then removed from the sealed plastic bag, blotted, and weighed (W2 is the weight after storage). Drip loss was calculated as a percentage of weight loss ((W1- W2))/ W1) x 100 (Sopian *et al.*, 2020). To determine cooking loss, breast muscle sample was measured after being heated in a water bath

Table 2: Growth performance of Minhdu chickens as affected by levels of dietary fresh garlic supplementation.

Parameter	GARL0	GARL1	GARL2	GARL3	SEM	P
Initial body weight (kg)	0.51	0.51	0.51	0.49	0.001	0.477
Final body weight (kg)	1.92 ^c	1.95 ^{bc}	2.00 ^b	2.07 ^a	0.01	0.001
ADG (g/bird/day)	20.19 ^b	20.48 ^b	21.29 ^b	22.52 ^a	0.25	0.003
ADFI (g/bird/day)	66.95	65.95	66.00	65.57	0.77	0.641
FCR (kg feed/kg gain)	3.32 ^a	3.22 ^a	3.10 ^{ab}	2.91 ^b	0.05	0.002

ADG: Average daily gain; **ADFI:** Average daily feed intake. Means in the same row with different superscripts are significantly different ($P < 0.05$).

at 80° C for 10 min. After cooking, the sample was cooled to room temperature and weighed (W3 is the weight after cooking). Cooking loss was calculated as a percentage of weight loss $((W1 - W3) / W1) \times 100$ (Sopian *et al.*, 2020). The samples of breast meat were analyzed by AOAC (2005) methods for: dry matter (DM) by drying at 105°C for 24h; organic matter (OM) by ashing at 550°C for 4h; and crude protein (CP) by Kjeldahl technique.

STATISTICAL ANALYSIS

The data were analyzed with a the General Linear Model option in the Minitab Reference Manual Release 16 (Minitab, 2010) was used and subjected to an analysis of variance (ANOVA).

The correlation between pH values, drip loss, cooking loss and chemicals of breast meat of Minhdu chicken has been checked with a Spearman correlation plot in the corrplot package (Taiyun and Simko, 2021) in R software environment, version 4.3.1 (R Core Team, 2023).

RESULTS AND DISCUSSION

GROWTH PERFORMANCE

The results presented in Table 2 demonstrate the significant impact of fresh garlic supplementation on the growth performance of Minhdu chickens. Chickens fed diets supplemented with fresh garlic exhibited greater body weight and weight gain compared to those on the control diet. Notably, chickens receiving a 3% dietary inclusion of fresh garlic achieved the highest body weight and weight gain, with statistically significant differences ($P < 0.05$). The final body weights at 98 days of age for the GARL0, GARL1, GARL2, and GARL3 groups were 1.92, 1.95, 2.00, and 2.07 kg/bird, respectively ($P < 0.05$). Average daily gain (ADG) followed a similar pattern, with the GARL3 group recording the highest ADG (22.52 g/bird/day), followed by GARL2, GARL1, and GARL0 ($P < 0.05$). These findings align with the study by Jamel *et al.* (2013), which reported that garlic stimulates the intestinal cells of chickens, aiding in the regulation of endogenous digestive enzyme secretion and fostering a balanced intestinal ecosystem that promotes growth. Interestingly, feed intake did not signif-

icantly differ among the groups ($P > 0.05$), suggesting that the improved growth performance observed in the GARL3 group is directly attributable to the garlic supplementation rather than increased feed consumption.

Although feed intake remained consistent across treatment groups, ranging from 65.57 to 66.95 g/bird/day ($P > 0.05$), the feed conversion ratio (FCR) showed significant improvements with garlic supplementation. The FCR values for the GARL0, GARL1, GARL2, and GARL3 groups were 3.32, 3.22, 3.10, and 2.91, respectively ($P < 0.05$).

These findings are consistent with previous studies that reported improvements in ADG and FCR in chickens supplemented with garlic (Oleforuh-Okoleh *et al.*, 2014; Nguyen, 2020; Brzowska *et al.*, 2015; Fadlalla *et al.*, 2010; Abdullah *et al.*, 2010). Similar results were also observed by Bui *et al.* (2015), who found no significant differences in FCR when chickens were supplemented with garlic at levels of 1%, 2%, and 3%. The enhanced weight gain and metabolic efficiency observed in garlic-supplemented treatments underscore garlic's potential as a natural growth promoter that can effectively replace traditional veterinary drugs, including antibiotics, vitamins, and digestive enzymes, in poultry production (Tollba *et al.*, 2003).

Herbal supplements, including garlic, are known for their multifunctional roles in animal nutrition. As Steiner (2010) notes, herbs can promote growth, enhance productivity, act as antioxidants to mitigate stress, and support immune function by inhibiting pathogenic microorganisms. Additionally, most herbs used in animal feed stimulate the olfactory and taste senses, boosting appetite and food intake. This stimulation, coupled with increased endogenous enzyme secretion, improves digestion and nutrient absorption, leading to better feed conversion efficiency and faster, healthier growth (Valenzuela-Grijalva *et al.*, 2017; Krauze, 2021).

CARCASSES TRAITS

The effects of fresh garlic supplementation on carcass characteristics are detailed in Table 3. The analysis revealed no significant differences in the ratios of carcass, thigh, breast, and abdominal fat among the treatment groups ($P > 0.05$).

Table 3: Effects of levels of dietary fresh garlic supplementation on carcass yield (g) and carcass percentage (%) Minhdu chicken.

Parameter	GARL0	GARL1	GARL2	GARL3	SEM	P
Live weight	1,900	1,967	2,017	2,083	0.03	0.014
Carcass, g	1,217 ^c	1,283 ^{bc}	1,342 ^{ab}	1,408 ^a	0.02	0.006
Thigh meat, g	317.0 ^b	360.7 ^{ab}	329.3 ^a	364.7 ^a	9.18	0.015
Breast meat, g	264.7 ^c	280.3 ^{bc}	301.3 ^{ab}	327.3 ^a	7.90	0.003
Abdominal fat, g	26.2	22.17	15.50	25.33	4.89	0.449
Relative to live weight, %						
Carcass	63.76	65.09	66.33	67.37	1.01	0.165
Thigh meat	26.16	27.98	24.66	26.19	0.83	0.140
Breast meat	21.74	21.99	22.48	23.26	0.74	0.523
Abdominal fat	2.09	1.82	1.20	1.92	0.38	0.433

Means in the same row with different superscripts are significantly different ($P < 0.05$).

Similarly, there were no significant variations in the chemical composition of the meat across the groups ($P > 0.05$) (Table 4). These findings are in agreement with those of Kim *et al.* (2008), who reported no significant differences in dry matter and ash content in chicken meat samples supplemented with garlic ($P > 0.05$). In this study, meat quality parameters were not influenced by the experimental diets.

Table 4: Effects of levels of dietary fresh garlic supplementation on pH value, drip loss, cooking loss and chemical of breast meat Minhdu chicken.

Parameter	GARL0	GARL1	GARL2	GARL3	SEM	P
pH ₀	6,33	6,38	6,30	6,56	0,08	0,171
pH ₂₄	5,92	5,93	5,86	5,83	0,08	0,753
Drip loss, %	2,75	2,78	2,88	2,80	0,77	0,671
Cooking loss, %	17,85	17,05	16,98	17,78	0,78	0,785
DM, %	30.10	29.53	29.89	30.55	0.41	0.422
%/DM						
OM	93.74	94.61	92.91	94.17	0.52	0.220
CP	88.34	90.38	86.39	89.49	1.16	0.190
EE	6.16	6.62	6.63	5.45	0.52	0.400

Correlation analysis indicated no significant relationship between garlic supplementation and the OM/DM parameter. However, a slight positive correlation was observed with pH₀, drip loss, and dry matter, while a slight negative correlation was found with pH₂₄, cooking loss, CP/DM, and EE/DM. Additionally, pH₂₄ showed a positive correlation with both cooking loss percentage and OM/DM, while no correlation was observed between pH₂₄ and dry matter or CP/DM (Figure 2).

These results are consistent with those of Nguyen and Nguyen (2020), who found no significant differences in carcass yield, thigh meat, breast meat, or abdominal fat between garlic-supplemented and control groups. Furthermore, factors such as breed, garlic source, harvest time, and

climate may influence the nutritional effectiveness of garlic in poultry feed (Safa *et al.*, 2012). Drip loss and cooking loss were also unaffected by the level of fresh garlic supplementation, aligning with previous studies on various chicken breeds, which reported similar values for these parameters (Mehaffey *et al.*, 2006; Jaturasitha *et al.*, 2008; Tran *et al.*, 2020). Overall, garlic supplementation did not significantly alter the meat quality, particularly in terms of dry matter and ash content ($P > 0.05$) (Kim *et al.*, 2008).

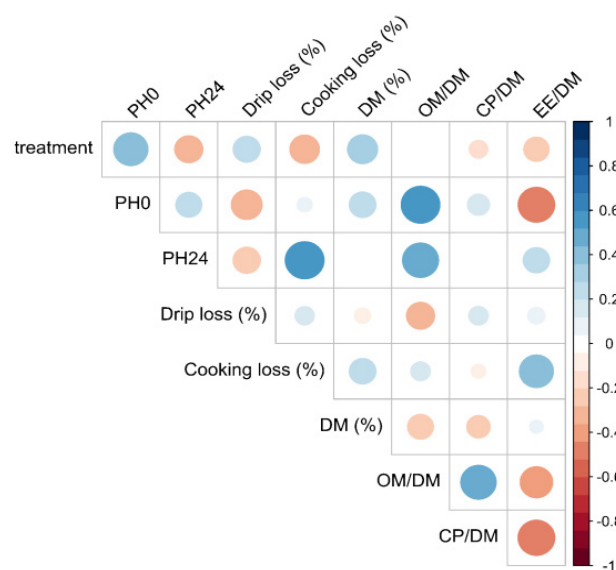


Figure 2: Correlation plot with Spearman method of pH values, drip loss, cooking loss and chemicals of breast meat of Minhdu chicken and the treatments given (GARL0, GARL1, GARL2, GARL3). The legend on the side of the plot shows the coefficient values corresponding to the color graduation. The value of correlation is proportional to the size of the inner circle and color intensity (blue = positive, red = negative). Abbreviations: pH₀: initial pH; pH₂₄: values of pH after 24 hours; DM (%): dry matter percentage; OM/DM: organic matter/dry matter; CP/DM: crude protein/dry matter; EE/DM: ether extracts/dry matter.

In conclusion, a dietary addition of fresh garlic up to 3.0% has a beneficial effect on growth performance of Minh Du chickens affecting the average daily gain and the feed conversion ratio. This same supplementation in the diet led to a significant increase in the weight of breast and thigh of carcass in Minh Du chicken.

FURTHER RESEARCH DIRECTIONS

Environmental sustainability assessment of garlic supplementation in Minh Du chicken feed through of chicken waste

Evaluate the effectiveness of alternative herbal supplements compared to garlic for improving growth performance and feed conversion in Minh Du chickens.

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NOVELTY STATEMENT

At 3% fresh garlic is best for Minh Du chicken.

AUTHOR'S CONTRIBUTIONS

Trang Nguyen Thi Ngoc: Conceptualization, Methodology, Investigation, Formal analysis, Writing- Original draft.
Hong Nguyen Thi Thu: Formal analysis, Writing – review and editing.

All authors reviewed and approved the final manuscript.

CONFLICT OF INTEREST

We certify that there is no conflict of interest

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