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Growth response of Cobb500 broiler chicken *(Gallus gallus domesticus)* treated with different levels of *Apis mellifera* L. honey as a drinking additive

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Abstract

Synthetic feed additives have been widely used in broiler chicken production for decades due to their proven ability to enhance growth rates, improve health, and increase feed efficiency. However, the continuous use of these products poses risks to animal health, which may subsequently impact consumer health. This study evaluates the effect of supplementing a natural-based water additive on Cobb500 broiler chicken production as an alternative to synthetic water additives. The experiment employed a Completely Randomized Design (CRD) with five treatments: T1 (pure water), T2 (doxycycline + tiamulin + vitamin A + vitamin B12 + probiotics), T3 (5 mL honey per liter of water), T4 (10 mL honey per liter of water), and T5 (15 mL honey per liter of water), with each treatment replicated three times. The results revealed that broilers treated with 0.05% honey in drinking water (T3) exhibited the best performance in terms of weight increment, final weight, total weight gain, daily weight gain, feed conversion ratio (FCR), and feed conversion efficiency (FCE), demonstrating significant improvements. Based on these findings, the study recommends supplementing drinking water with 5 mL of honey per liter for Cobb500 broilers, offering a promising natural alternative to synthetic water additives, improving growth performance while contributing to the attainment of Sustainable Development Goals (SDGs), specifically SDG 2 (ending hunger and promoting agriculture), SDG 3 (ensuring healthy lives and promoting well-being for all ages), and SDG 12 (ensuring responsible and sustainable consumption and production).

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Introduction

Global production of broiler meat has been growing, driven by consumer demand, as broiler meat is popular, more affordable, and perceived to offer greater health benefits than red meat.

In fact, the consumption of poultry meat and products globally is projected to reach 160 million metric tons by 2033 (OECD-FAO, 2024), and to meet this rising demand, efficient production strategies are essential. Synthetic feed additives in broiler chicken production have been widespread for decades and remain prevalent today due to their proven ability to enhance growth rates, improve health, and increase feed efficiency. However, the continuous use of these products poses risks to animal health, which can subsequently affect the consumer's health.

Globally, approximately 140 million tons of poultry meat were consumed, making it the most widely consumed type of meat (Shahbandeh, 2023). Similarly, in the Philippines, poultry meat is among the most preferred meat products among local consumers. In fact, in 2023, the consumption of ready-to-cook poultry meat reached 1.81 million tons (Balita, 2024).

The growing demand for broiler meat and its related products underscores the importance of improving production practices, including proper supplementation. Broiler chicken production is one of the most productive agricultural enterprises in the Philippines, contributing 30% to the country's total agricultural output (BM, 2024). Moreover, it serves as a key source of livelihood for many farmers, offering substantial profits within a short production cycle.

In livestock production, synthetic feed additives are commonly used as a feeding strategy to enhance production, promote growth performance, and provide prophylaxis and protection against pathogenic microorganisms (Sneeringer, 2015; Paintsil *et al.*, 2021). However, their use as growth promoters is highly discouraged globally (Chattopadhyay, 2014).

In the Philippines, the enactment of the Organic Agriculture Act of 2010 (Republic Act 10068) emphasizes and encourages the use of sustainable practices including the promotion of non-synthetic feed additives in livestock and poultry production aligning with the principles of organic farming.

Underscoring the potential side effects posed by synthetic feed additives, it is therefore paramount to explore natural feed supplement alternatives that utilizes natural plant- and animal-based products with effect on boosting animal growth and health. In the Philippines, particularly in Cagayan, honey is one of the most extensively documented natural products, highlighting its suitability as a promising alternative additive for sustainable poultry feeding strategy.

Honey is a thick, sweet-tasting liquid containing about 70-80% natural sugars, primarily fructose and glucose, along with minerals, vitamins, and enzymes that provide essential energy sources for chickens and also act as antioxidants (Sukanto *et al.*, 2023). Honey also contains high amount of antibacterial, antiviral, anti-inflammatory and antioxidant properties which is considered to be good for curing certain health issues (Nordqvist, 2023). According to Oke *et al.* (2016), and Abioja *et al.* (2012), honey supplementation in drinking water can lead to improved weight gain and feed conversion ratios during dry seasons. Tattao *et al.* (2023) also argued that inclusion of honey to water significantly affected the growth performance of birds. Additionally, honey has been found to positively influence physiological responses, such as reducing heart rate and improving stress indices in broilers (Abioja *et al.*, 2012).

Considering the nutritional value and other benefits that honey can provide, this study was conducted to evaluate the growth performance of Cobb500 broiler chickens supplemented with different levels of honey as a drinking additive. Furthermore, this study aimed to support the 2030 Agenda for Sustainable Development specifically Goal 2 - end hunger and promote agriculture, Goal 3 - ensure healthy lives and promote well-being for all ages, and Goal 12 -ensure responsible and sustainable consumption and production (UN, 2024).

Materials and methods

Experimental site, design, and treatments

The study was conducted from September 8 to October 18, 2024 at Cagayan State University, Sanchez Mira, Cagayan, Philippines. The Completely Randomized Design (CRD) was employed with three replications. The treatments evaluated were as follows: T1– Pure water (negative control), T2– Commercial additive (positive control), T3– 5 mL honey per liter of water, T4– 10 mL honey per liter of water, and T5– 15 mL honey per liter of water.

Construction of experimental house and cages

The experimental house and cages were constructed using metal, heavy duty welded wire mesh and corrugated galvanized iron sheets for roofing to ensure durability. The experimental house was constructed with 15 experimental cages accommodating the 15 replications. Each cage was designed with dimensions of 2 ft × 3 ft to house the six experimental birds per replication, meeting the minimum space requirement of 1 square foot/bird (PAES 402:2001). Each cage was equipped with a 1-meter-long feeder and a 6-liter drinker. A brooding cage was also constructed with dimensions of 9.84 ft × 3.28 ft. The brooding cage was also equipped with bulbs, feeding troughs, and water troughs.

Procurement, selection, and brooding management of experimental units

A total of 90 Cobb500 broiler chickens were purchased from a reputable supplier in Sanchez Mira, Cagayan, Philippines, to ensure uniformity in age, size, and breed across all experimental units. During the purchase, guidelines for selecting foundation stocks were carefully followed. According to the DA RFO 02 (2018), healthy chicks should be free from diseases and deformities, have a clean, dry navel and vent, well-formed body length and depth, a body weight of 35 grams (at day old), shiny and thick feathers, spaced and straight toes and shanks, broad, clear, and bright eyes, and exhibit an active demeanor.

To further ensure the well-being of the experimental chicks, proper temperature control was maintained during brooding. According to PAES 402: 2001, the temperature inside the brooding area was carefully regulated to provide a comfortable environment. For the first seven days, a brooding temperature of 32°C to 35°C was maintained, which was then gradually adjusted to 29°C to 32°C once the chicks reached the eighth to tenth day.

Assigning the experimental units to experimental cages

The drawing lots randomization scheme was used in the study (Gomez *et al.*, 1984). After the brooding period, all experimental birds were weighed and clustered according to their weight groups. The clustered experimental birds were then randomly assigned to their respective experimental compartments. A total of six experimental units were assigned to each replicate.

Procurement of honey and preparation of drinking water

The honey used in the study was purchased at Don Mariano Marcos Memorial State University – National Apiculture Research, Training, and Development Institute (DMMMSU-NARTDI) to ensure its purity and concentration. The drinking water for the experimental units was prepared in accordance to the formulated treatments and provided to the birds *ad libitum*.

Feeding management

The experimental units were given access to *ad libitum* supply of feed throughout the study. The experimental units were fed booster crumble from day 1 to day 3 of the experiment, then gradually transitioned to starter crumble feed from day 4 to day 12. From day 13 to day 28, the experimental units were provided with finisher feed. To ensure that the experimental units maintain normal feeding behavior, a portion of the feed being introduced is mixed with the feed currently in use during the transition.

Flock health management

Regular cleaning and disinfection were carried out in the experimental area to maintain a clean and healthy environment for the experimental units, consistent with the biosecurity measures. In the event of unexpected disease occurrences, the researcher promptly implemented preventive measures, such as administering vitamins and medicines and utilizing the chlorine footbath at the entrance of the experimental house, to mitigate the spread of infection.

Statistical tool

The data gathered in this study were subjected to Analysis of Variance (ANOVA) in a Completely Randomized Design (CRD) (Gomez *et al.*, 1984). The Pairwise Mean Comparison of Treatment were also used to determine specific treatment means after the ANOVA reveals a significant result.

Results and discussion

Initial weight (g), weekly body weight (g), and final weight (kg)

The initial weight (g), weekly body weight (g), and final weight (kg) of Cobb500 chickens supplemented with different levels of *Apis mellifera* L. honey as drinking additive is presented in Table 1. The experimental birds in Treatment 5 recorded the highest initial mean weight of 373.33 g, followed by experimental birds in Treatments 2 and 1, with mean weights of 372.22 g and 370.00 g, respectively. The lowest mean weight was observed in Treatment 4 with 363.89 g.

The Analysis of Variance (ANOVA) revealed no significant differences among the initial weights of the experimental birds. This result guarantees that the experimental birds were evenly distributed across all experimental cages.

Regarding the weekly body weight of the experimental units, Treatment 5 recorded the highest body weight at 811.11 g during the first week of the study, followed by Treatment 1 with 808.89 g. Treatment 2 and Treatment 3 had the third and fourth heaviest weights, at 808.88 g and 807.78 g, respectively. The lightest weight was recorded in Treatment 4, with a mean value of 800.33 g.

During the second week of the experiment, experimental units treated with commercial electrolytes (+control) recorded the heaviest body weight at 1275.00 g, followed by the -control group (pure water) with a body weight of 1236.66 g. The treatments with *Apis mellifera* L. honey also showed notable weights, with the supplementation of 5 mL recording 1225.00 g, 15 mL recording 1214.44 g, and 10 mL recording the lowest weight value of 1189.33 g.

In the third week of the study, the experimental birds with no supplementation recorded the heaviest body weight of 1673.89 g, followed by the birds treated with the commercial additive with 1668.33 g. Birds treated with honey also showed notable weights, with 5 mL of honey supplementation ranking next to the commercial additive at 1636.11 g, showing no significant difference. The birds treated with 15 mL of honey also performed well, recording a body weight of 1598.89 g. During this period of growth, the recorded data showed significant differences when analyzed using Analysis of Variance (ANOVA).

The significant result could be attributed to the supplementation of honey and the commercial water additive in the drinking water of the experimental units. According to Jimoh *et al.* (2017), honey possesses antimicrobial effects that help control pathogenic bacteria affecting gut health in poultry. This antimicrobial action not only promotes better health but also enhances growth performance by reducing the pathogenic bacterial load in the poultry gut.

Supporting this claim, a study conducted by Tattao *et al.* (2023) on the use of honey as a drinking water additive for chickens demonstrated that adding honey at concentrations of 5 mL to 10 mL per liter of water resulted in a significant decrease in feed consumption, while also significantly increasing weight gain and final weight. When the experimental birds treated with honey were compared with those treated with the commercial additive, no significant difference was observed. However, the commercial additive recorded a higher body weight, leaving a discrepancy between the two treatments.

For the commercial additive, the presence of antibiotics, which are specifically developed to resist harmful diseases and act as growth promoters, likely contributed to better growth outcomes. Mapatac (2015) revealed that commercial additives enhance weight gain in broiler chicks compared to control groups receiving no additives. Nevertheless, some research suggests that natural alternatives, such as certain herbal decoctions, may outperform commercial additives in promoting growth.

Table 1. Initial weight (g), weekly body weight (g), and final weight (kg) of Cobb500 chickens supplemented with different levels of *Apis mellifera* L. honey as drinking additive

Treatment	Initial weight (g)	Body weight (g)			Final weight (kg)
		Week 1	Week 2	Week 3	
Pure Water (-control)	370.00	808.89	1236.67	1673.89	2.02^{ab}
Commercial Additive (+control)	372.22	808.89	1275.00	1668.33	2.05^{ab}
5ml honey per liter water	369.44	807.78	1225.00	1636.11	2.17^{a}
10ml honey per liter water	363.89	800.33	1189.33	1544.78	1.86^{c}
15ml honey per liter water	373.33	811.11	1214.44	1598.89	1.96^{bc}
Level of Significance	NS	NS	NS	NS	**
Coefficient of Variation (%)	1.78	2.51	3.42	3.59	4.00
$LSD_{.05}$					0.14

Means of the same letter superscript are not significantly different from each other using the pairwise mean comparison of treatment at confidence level at 0.05%.

In terms of the final weight (kg) of the Cobb500 chickens supplemented with different levels of honey as presented in Table 1, the experimental birds in Treatment 3 recorded the heaviest final weight of 2.17 kg, followed by Treatment 2 with 2.05 kg and Treatment 1 with 2.02 kg. The lowest recorded final weights were observed in Treatment 4 and Treatment 5, with weights of 1.86 kg and 1.96 kg, respectively.

According to the results of the Analysis of Variance (ANOVA), the data showed a highly significant difference among the treatments. The highly significant result suggests that honey supplementation at a rate of 5ml had a positive effect on the growth of Cobb500 chickens. The result obtained conforms with the reported result by Tattao *et al.* (2023) that 5ml honey supplementation significantly improved the final weight of broiler chickens. Similar result was also obtained by Lika *et al.* (2021) on the effects of honey as a supplement for chickens that honey can increase the body weight of broiler chickens by approximately 7% to 10%. Additionally, according to Obuna *et al.* (2011), honey supplementation at a rate not higher than 5% showed a significant final weight improvement.

However, the reduced weight in treatments with higher honey supplementation suggests that dosage plays a critical role in maximizing its growth promoting effects. This aligns with the findings of Tattao *et al.* (2023) which indicates that the highest final weight was observed at the lowest dosage of 5mL, while final weight declined as the dosage increased to 7.5 mL and 10 mL.

When comparing Treatments 1, 2, and 3, no significant differences were observed suggesting that the type of supplementation had no significant impact on the final weight of the experimental units. This implies that using pure water alone could achieve similar results to using a commercial additive or honey, potentially offering a cost-effective alternative if supplementation does not provide notable benefits. However, since Cobb500 chickens were used in the study, a breed with excellent growth and outstanding performance (Cobb500™, 2024), the metabolism of the animal is considered which may affect the ability of the animal to convert the feed intake into body weight effectively.

Table 2. Weekly weight increment (g) of Cobb500 chickens supplemented with different levels of *Apis mellifera* L. honey as drinking additive

Treatment	Weekly weight increment (g)			
	W_1-W_0	W_2-W_1	W_3-W_2	W_4-W_3
Pure Water (-control)	438.89	427.77	437.22	350.00^{b}
Commercial Additive (+control)	436.67	466.11	393.33	385.56^{b}
5ml honey per liter water	438.33	417.22	411.11	531.94^{a}
10ml honey per liter water	436.44	389.00	355.44	315.17^{b}
15ml honey per liter water	437.77	403.33	384.44	361.39^{b}
Level of Significance	NS	NS	NS	*
Coefficient of Variation (%)	5.12	9.77	7.42	12.76
$LSD_{.05}$			53.46	90.27

Means of the same letter superscript are not significantly different from each other using the pairwise mean comparison of treatment at confidence level at 0.05%.

Table 3. Total weight gain (kg) and daily weight gain (g) of Cobb500 chickens supplemented with different levels of *Apis mellifera* L. honey as drinking additive

Treatment	Total weight gain (kg)	daily weight gain (g)
Pure Water (-control)	1.65^{ab}	72.28^{ab}
Commercial Additive (+control)	1.68^{ab}	73.35^{ab}
5ml honey per liter water	1.80^{a}	77.43^{a}
10ml honey per liter water	1.40^{c}	66.43^{c}
15ml honey per liter water	1.59^{bc}	70.01^{bc}
Level of Significance	**	**
Coefficient of Variation (%)	5.08	4.07
$LSD_{.05}$	0.15	5.31

Means of the same letter superscript are not significantly different from each other using the pairwise mean comparison of treatment at confidence level at 0.05%.

Weekly weight increment (g)

The weekly weight increment (g) of Cobb500 chickens supplemented with honey as a drinking additive is shown in Table 2. During the first three weeks of the study, all experimental birds displayed notable weight increments; however, no significant differences were revealed among the treatments tested.

During the final week of the study, significant results were observed. The highest weight gain was recorded in the experimental units treated with 5 mL of honey per liter of water, achieving an average increment of 531.94 g. This was followed by the experimental units in the control groups, although the difference was not statistically significant when compared to the birds treated with 10 mL and 15 mL of honey as a drinking water additive.

The significant results observed in this study can be attributed to the supplementation of honey in the drinking water of the experimental birds. This finding is supported by the study conducted by Tattao *et al.* (2023), which demonstrated that 5 mL of honey per liter of water is the optimal supplementation level, significantly enhancing weight gain and final weight in broiler chickens. Furthermore, the results are consistent with the findings of Azaka *et al.* (2024), who reported a significant increase in weight gain among broilers supplemented with 5 mL of honey.

This study suggests that supplementing broilers' drinking water with honey enhances their weight gain. Honey, as a natural source of antioxidants, acts as a growth promoter through its antibacterial properties, which inhibit microbial growth. This process leads to the formation of gluconic acid, a compound with antibacterial effects (Gross, 1988; Sayed *et al.*, 1996; Allen *et al.*, 1991; Biagi *et al.*, 2004).

Total weight gain (g) and daily weight gain (g)

Table 3 presents the total weight gain (kg) and daily weight gain (g) of the experimental units. The birds in Treatment 3 recorded the highest total weight gain of

1.80 kg, followed by those in Treatments 2 and 1, with total weight gains of 1.68 kg and 1.65 kg, respectively.

Birds supplemented with 15 mL and 10 mL of honey recorded the lowest total weight gains of 1.59 kg and 1.40 kg, respectively. A similar trend was observed for daily weight gain, with birds in Treatment 3 (5 mL of honey per liter of water) achieving the highest daily weight gain of 77.43 g.

The Analysis of Variance (ANOVA) revealed highly significant differences among the treatments in terms of both total weight gain and daily weight gain. These significant results can be attributed to the supplementation of honey in the drinking water of Cobb500 chickens. Honey, as a natural feed additive, contains dietary flavonoids and phenolic compounds with antioxidative and antibacterial properties, which promote growth.

Table 4. Total feed intake (kg), feed conversion ratio, and feed conversion efficiency of Cobb500 chickens supplemented with different levels of *Apis mellifera* L. honey as drinking additive

Treatment	Total feed intake (kg)	FCR	FCE
Pure Water (-control)	3.15	1.90	52.68
Commercial Additive (+control)	3.24	1.90	51.92
5ml honey per liter water	3.34	1.86	53.77
10ml honey per liter water	2.99	2.00	50.20
15ml honey per liter water	3.05	1.93	51.98
Level of Significance	NS	NS	NS
Coefficient of Variation (%)	6.47	7.29	7.07

Prihambodo *et al.* (2021) and Nath *et al.* (2021) reported that dietary flavonoids in honey enhance broiler growth performance by increasing average daily gain, leading to improved weight gain. Similarly, phenolic compounds, which are also abundant in honey, exhibit potential as feed additives in poultry production. Omar *et al.* (2020) demonstrated that phenols extracted from onions improved the growth rate of broiler chickens. The synergistic effects of flavonoids and phenols in honey contribute to its antioxidant and antibacterial properties, supporting better weight gain and growth performance in broilers (Bogdanov *et al.*, 2008).

Hence, the supplementation of honey in the drinking water of broiler chickens enhances growth performance, as evidenced by improvements in both daily weight gain and total weight gain.

Total feed intake, feed conversion ration, and feed conversion efficiency

Table 4 presents the feed intake, feed conversion ratio (FCR), and feed conversion efficiency (FCE) of Cobb500 chickens supplemented with varying levels of honey as a drinking water additive. The analysis of variance (ANOVA) indicated no significant differences among the treatments for these parameters. Despite the lack of statistical differences, the recorded FCR and FCE values conforms with the acceptable ranges reported in previous studies. Specifically, the FCR values of 1.7 to 1.9 (Gonzales *et al.*, 2012; Sáenz, 2022) and FCE values of 52.6% to 66.7% (Quintana *et al.*, 2023; Janagaran, 2022; Mack, 2023) fall within the expected thresholds for efficient broiler production.

The findings of this study are consistent with the result of Tattao *et al.* (2023), who reported that honey supplementation did not significantly affect feed intake or FCR in broiler chickens. Similarly, Muhammad *et al.* (2022) observed that varying levels of honey supplementation had no significant impact on feed consumption. Tattao *et al.* (2023) further explained that feed intake tends to decrease as the concentration of honey increases, suggesting an inverse relationship between honey levels and feed consumption.

The study by Meyer *et al.* (2010) demonstrated that honey can stimulate the release of ghrelin, commonly known as the "hunger hormone," which enhances appetite and promotes feed consumption.

In the case of Treatment 3, the moderate honey supplementation may have optimized ghrelin release, thereby improving feed palatability and consumption. Conversely, the reduced feed intake observed in treatments with higher honey levels could be attributed to an oversupply of sugars, leading to excessive sweetness. This may have diminished palatability and induced early satiety, resulting in decreased feed intake.

Conclusion

Based on the findings, the 5 mL honey supplementation per liter of water produced the best results and was significantly different in terms of weight increment, final weight, total weight gain, daily weight gain, feed conversion ratio (FCR), and feed conversion efficiency (FCE). This makes it the most effective treatment for enhancing growth performance among those tested, offering a promising alternative to synthetic water additives for improving the growth performance of Cobb500 broiler chickens.

Furthermore, the findings of the study validate the efficacy of incorporating natural-based drink additives, highlighting their potential to enhance broiler growth performance while contributing to the achievement of key Sustainable Development Goals (SDGs), particularly SDGs 2, 3, and 12, and promoting more sustainable animal farming practices.

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