Improved Feed Efficiency and Nutritional Property Effects of Honey from *Apis mellifera* L. as an Additive for Broiler Chickens’ Drinking Water

Rosemarie O. Tattao¹²*, Joseph A. Panas¹, David T. de Castro¹, Mishima P. Soliba¹, Ison A. Calimpang¹², Rolyne Mae C. Pajarillo¹

¹Don Mariano Marcos Memorial State University-National Apiculture Research Training, and Development Institute 2515, Philippines
²Don Mariano Marcos Memorial State University-North La Union Campus 2515, Philippines

ABSTRACT

Antimicrobial usage is particularly high in poultry production. Honey as a water supplement to poultry has been explored as a natural and safe antibiotic alternative. This study aimed to investigate the effects of different levels of honey as a water supplement on broilers’ growth performance and chemical properties. Five dietary treatments were used: no supplement (T1), commercial electrolytes (T2), 5mL honey (T3), (7.5mL honey (T4), and 10mL honey (T5) per liter of water. The experiment used 150 1-day-old Cobb-400 broiler chicks, assigned to five treatments with three replications of ten (10) birds each (N=30) employing the Complete Block Design (RCBD) in three blocks. Results indicated that 5mL/L-10mL/L honey supplementation led to a significant (p < 0.05) decrease of 4.3% to 7% in feed consumption compared to those with electrolytes. Similarly, using 5mL/L of honey showed 12.5% lower FCR compared with T2 and 24.3% compared with T1. However, a higher level of honey was comparable to T2, indicating that honey supplementation improved feed utilization and reduced feed cost at a certain level. Results of the proximate analysis, particularly on moisture content (MC), crude protein (CP), crude fat (CF), and total carbohydrates ((TC), revealed numerical differences. Samples with

How to cite:

Tattao RO, Panas JA, de Castro DT, Soliba MP, Calimpang IA, and Pajarillo RMC. 2023. Improved feed efficiency and nutritional property effects of honey from *Apis mellifera* L. as an additive for broiler chickens’ drinking water. *DMMMSU Research and Extension Journal*, 7: 65 – 75. [https://doi.org/10.62960/dmmmsu.v7i.44](https://doi.org/10.62960/dmmmsu.v7i.44)
5mL/L to 7.5mL/L levels of honey showed a higher MC, CP, and TC content and lower CF than T2. This implies that honey as a drinking water supplement offers practical advantages in feed consumption and efficiency and in improving the chemical and nutritional properties of chicken meat. A choice for healthier production.

Introduction

Raising chicken is a usual practice of almost all families in rural areas; it serves as their source of extra income and the primary source of meat protein. In 2020, the Philippines ranked 8th among the highest total chicken meat importers (USDA, 2024). According to the Philippine Statistics Authority (2021), the poultry industry has reached its peak of consumption, surpassing the per capita consumption of pork, Filipinos' preferred meat. The average per capita meat consumption was observed to be constantly highest in the tenth decile for chicken meat, which is equivalent to 13.50 kilograms, compared to pork, which is 12.23, and beef, accounting for 2.71 kilograms. This may be due to the affordability of chicken compared to other meat (Henricksen, 2023). In addition to affordability, consumers were interested in buying products that attest to animal welfare rules (Pinto da Rosa et al., 2021), and chicken meat is widely consumed due to its dietary and nutritional (protein) properties, as well as the lack of barriers to its consumption based on culture or religion (Valceschini, N.D). In addition, flavoring and other sensory factors that could influence the perception of every consumer play an important role in consumers’ preferences and consumption (Imran et al., 2014).

The most commonly used medications in the poultry business are antibiotics, which are naturally occurring, semi-synthetic, or synthetic substances with antibacterial action. The build-up of toxic and detrimental residues in the meat and eggs of treated birds can impact consumer health by causing allergic reactions and spreading microorganisms resistant to antibiotics (Mund et al, 2017). This was supported by Tabon and Domondon (2019), who believed that antibiotic residue could directly threaten consumers’ health. Based on findings, cull broiler has a greater incidence of antibiotic residue than culls, where liver tissue had the highest antibiotic residue, followed by kidney and least in muscles. Detection of antibiotic residue for chickens raised in backyard and commercial farms found both positive with antimicrobials, which include penicillin (ranked highest), aminoglycosides, Tetracycline, and sulfonamides (Baldrias et al., 2008). Accordingly, the livers of broilers and egg-layers had the largest quantities of residue tetracycline (48%), ciprofloxacin (44%), amoxicillin (42%), and enrofloxacin (40%), while the kidneys had residues of 24, 42, 30, and 34% of the corresponding antibiotic compounds (Sattar et al.,2014). Additionally, antibiotics in poultry farming are typically used for three purposes: first, being used as therapeutic, which involves giving animals in high doses for comparatively shorter periods of time; next is prophylactic use, which involves exposing animals to administration of moderate doses at longer periods of time, and lastly, use as growth promotion in which antibiotic was administered in subtherapeutic dosage given throughout the duration of animals’ lives. Overutilization of antibiotics poses significant risks to public health in the form of antibiotic-resistant bacteria, allergic reactions, or changes to the beneficial microflora in the digestive tract, which may replace unhealthy or harmful microflora. Examples
involved are residual β-lactams, including cephalosporin and penicillin, which have been reported to cause dermatitis, cutaneous eruptions, anaphylaxis, and gastrointestinal symptoms in humans via ingestion of contaminated poultry products, while residue of gentamicin and chloramphenicol may be mutagenic, nephropathic, and hepatotoxic they may lead to reproductive abnormalities or bone marrow toxicity. Whereas the persistence of sulfamethazine, oxytetracycline, and furazolidone residues is known to pose immunopathological effects such as autoimmunity and carcinogenicity (Mund et al., 2017).

The inclusion of honey as a drinking water additive to poultry has been explored as a natural and safe alternative to antibiotics or chemical substances. A study of honey supplementation at 0.5%, 1%, and 1.5% levels on the diet of broiler chicken was conducted and 1.5% was found to be significantly improved in body weight, daily weight gain, and protein efficiency ratio. It demonstrated superiority without adversely affecting birds’ performance and organs (Obuna et al., 2011). Furthermore, the supplementation of honey in the drinking water for broiler chickens during the hot dry season was found to be positive in improving some stress indices, body weight gain, and relative spleen weight (Oke et al., 2016). Findings of Osunkeye (2016) revealed that honey supplementation in broiler diets could enhance growth, regulate blood pressure, and improve blood plasma protein levels, aiding in maintaining water balance and blood volume regulation. Other Bee pollen, a bee product, can enhance broiler chicken immunity, growth, and meat quality due to its nutritional and bioactive properties, making it a potential alternative to antibiotics in feed. Bee pollen can enhance broiler chicken immunity, growth, and meat quality due to its nutritional and bioactive properties, making it a potential alternative to antibiotics in feed (Hascik et al., 2017). Moreover, Alhagi honey polysaccharides as a supplement improved growth, immunity, intestinal function, and gut microbiome in chickens, suggesting benefits for broiler chickens' health and productivity (Cai et al., 2022).

Findings of Alkhyat and Maqta’ri (2014), honey is a natural product that has the potential to be a useful adjuvant to traditional antibiotics, generally in case of pathogenic infections in wounds, particularly burn wounds, where it can promote healing. Honey has a wide range of positive effects on nutrition and health. Such unique attributes contain proteins, minerals, vitamins, polyphenols, vitamins, enzymes (diastase, invertase, and glucose oxidase), organic acids, and volatiles. Honey has been shown to possess antioxidant, antimicrobial, antiviral, antiparasitic, anti-inflammatory, antimutagenic, and anticancer effects. The low water activity of honey inhibits microbial growth. The antibacterial effect of honey is mostly against gram-positive bacteria. It is a good source of natural antioxidants, effectively reducing the risk of many diseases (Gundogdu, 2019). The unique attributes of honey, as cited by Saranraj and Sivasakthi (2018) was found to be an effective antibacterial agent, antimicrobial, and has a laxative effect, beneficial effect on blood glucose levels, anti-inflammatory, immune-stimulating properties, and potentially cancer-preventative action. In addition, honey also contains antiviral, fungicidal activity, and a prebiotic effect.

Researchers highlight the benefits of using biological products instead of antibiotics as poultry in-feed growth enhancers as evidence of consumer protection and to increase the safety of poultry products for human consumption. The chicken industry has grown rapidly, coinciding with the careless use of antibiotics to boost profit and cut production costs (Rafiq et al., 2022). The findings of Lika et al. (2021) revealed that honey as a natural feed additive enhances chicken growth and health and improves body weight, egg production, and meat quality of chickens. Furthermore, it reduces pathogenic bacteria while enhancing beneficial gut
microflora (Memon et al., 2019). Honey in water also improves stress indices and body weight gain in chickens and improves the relative spleen weight (Oke et al., 2016). Accordingly, it could improve immunity and reduce chicken death rate significantly, besides enhancing growth and chicken health effectively (Tiangui, 2014). In addition, honey contains antiviral and fungicidal activity, a prebiotic effect, and antimicrobial properties (Ahmed et al., 2014). Honey is truly a high-value nutritional commodity for both humans and animals; nevertheless, research on the benefit of honey to the broiler industry in the Philippines is still limited.

This study was conceptualized to produce a healthier option of chicken meat, which both the young and old love to eat. Further, the conduct of this study is locally anchored in the Health Research Development Agenda of the Harmonized National Research and Development Agenda 2017-2019, focusing on health determination of health benefits and safety assessment of food and food components to reduce the risk of disease occurrence (DOST National Research Council of the Philippines). This study also supports the 2030 Agenda for Sustainable Development (2018), specifically on goal number 3, ensuring healthy lives and promoting well-being for all at all ages, and number 12, ensuring responsible/sustainable consumption and production.

**Materials and Methods**

**Research Design**

The Randomized Complete Block Design (RCBD) was employed with 150 one-day-old Cobb-400 broiler chicks assigned to five drinking additive treatments replicated three times with 10 birds each (n=30). Five (5) dietary groups were formulated as T1 (No supplement/plain water), T2 (Tiamulin and Doxycycline fortified with Vitamins A and B12), T3 (5 mL Honey/Liter of water), T4 (7.5 mL Honey/Liter of water), and T5 (10 mL Honey/Liter of water). Experimental birds were given honey-infused drinking water from day 1 to 35 days. The water used was ordinary tap water coming from the impounding water source of the poultry farm.

**Housing Preparation and Brooding Management**

The experimental cages were prepared to have a dimension of 2 ft x 5 ft (to provide the minimum requirement of 1 square foot/bird), cleaned, and disinfected with Sodium hypochlorite/household bleach (1 part water:36 part bleach) three (3) days before the arrival of the experimental birds. The flooring of the cages was covered with old newspapers topped with rice hulls and sawdust about two inches thick, which served as their bedding. Each cage had three (3) kilogram automatic feeders, five (5) liter drinkers, and 15-watt incandescent bulbs. A marker, pen, weighing scale, and a notebook for recording were also prepared. Birds were placed directly in their respective treatment cages as their brooding cage. The brooding period occurred from day 1 to 14, where proper temperature (1-2 watts/bird) was maintained while observing cleanliness and sanitation at all times. Sacks were used as curtains to maintain the warm temperature inside the cage. Each week, the lamp height is raised to reduce the temperature inside the cage; adjustment was done carefully depending on the chicks' behavior. Normally, scattered chicks denote a comfortable temperature, while clustered chicks imply cold/low temperatures inside the cage. The temperature inside must be the same as the outside temperature upon reaching day 14. An unlimited feeding system was employed, giving them boosters during the brooding stage, and gradually shifted to Broiler Starter Crumble (BSC).
Honey supplementation and Feeding

Honey from *Apis mellifera* L. was used as a drinking supplement throughout the conduct of the study. Raw honey at the level of 5 mL, 7 mL, and 10 mL was diluted with one liter of tap water and was provided to the individual drinker and administered throughout the rearing period from day one (1) to 35. Drinking water was prepared every morning and additional was given in the afternoon as needed. Birds were given access to ad libitum water and broiler starter crumble (BSC) from day 15 to 35.

Statistical Analysis

Data were tabulated and analyzed using the Analysis of Variance, which employed the Randomized Complete Block Design (RCBD) (Gomez and Gomez, 1983). Least significance difference test was used for further analysis at 0.05 or 5% level of significance.

Results and Discussion

Production Performance

Natural ingredients such as honeybee products were added to poultry meals in small amounts (between 1% and 3%), both to improve the health of the birds and to provide them with nutrients. Additionally, they may contribute to improving the welfare of the chickens by performing several biological activities in their bodies. These supplements can improve the quality of meat and eggs by over 25% and raise the body weight of broilers (Lika et al., 2021). The growth parameters of birds are presented in Table 1. Analysis of variance in the final weight (kg) and gain in weight (kg) of birds revealed insignificant results. This implied that the birds with different levels of honey as a drinking supplement did not differ compared to birds without supplements. The feed intake of birds is related inversely to the concentration of honey. As the level of honey supplement increases, the feed intake decreases. This supports the findings in human studies that honey suppresses appetite and may be used as a dietary supplement to help prevent obesity and disorders linked to obesity (Muhammad et al., 2022). Furthermore, research by Ramli (2018) demonstrated that consuming honey lowers blood sugar levels and avoids excessive weight gain. Hence, to reap the benefit of honey rearing broiler using honey supplementation at 5 mL/L of water is advisable to achieve the beneficial effect of honey as a growth enhancer.

Analysis of variance revealed significant results regarding the feed consumption of birds (kg) supplemented with different levels of honey in the drinking water. Numerically, results showed that birds supplemented with 10 mL/L honey revealed the least feed consumption with a difference of 1.77 kg – 2.58 kg compared with birds without supplements (T1 and T2). However, low feed consumption of birds negatively affected the gain in weight. The result implied that a lower level of honey supplement may contribute to decreasing the cost of feed consumption.
Table 1. Growth parameters of birds supplemented with different levels of honey in the drinking water of birds

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Final weight (kg)</th>
<th>Gain in weight (kg)</th>
<th>Total Feed Consumption (kg)*</th>
<th>FCR*</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 No supplement</td>
<td>1.54</td>
<td>1.50</td>
<td>26.09a</td>
<td>1.85a</td>
</tr>
<tr>
<td>T2 Commercial electrolytes</td>
<td>1.62</td>
<td>1.58</td>
<td>25.28b</td>
<td>1.60b</td>
</tr>
<tr>
<td>T3 (0.5 mL/L of water)</td>
<td>1.78</td>
<td>1.74</td>
<td>24.21c</td>
<td>1.40c</td>
</tr>
<tr>
<td>T4 (7.5 mL/L of water)</td>
<td>1.66</td>
<td>1.62</td>
<td>23.79d</td>
<td>1.48bc</td>
</tr>
<tr>
<td>T5 (10 mL/L of water)</td>
<td>1.49</td>
<td>1.45</td>
<td>23.51e</td>
<td>1.63bc</td>
</tr>
<tr>
<td>CV</td>
<td>7.93</td>
<td>8.13</td>
<td>2.30</td>
<td>6.11</td>
</tr>
</tbody>
</table>

* Means with the same letter are not significantly different from each other at p< 0.05 level

The effect of honey on the feed intake of birds in this study supported the findings of Meyer et al. (2010) that honey consumption is related to the hormone “Ghrelin,” famously known as the “hunger hormone.” Ghrelin is served to stimulate feed intake; it usually controls hunger and fat deposition. The study by Jimoh et al. (2020) further supported that honey improved growth performance at lower (1.5%) concentrations but reduced feed intake and weight of the birds at higher (3.0%) concentrations. He found that giving 1.5% Honey solution to broilers as an additive had no significant effect but had a higher gain in weight and improved efficiency of feed utilization (EFU). More importantly, it was found that honey could be an alternative to Oxytetracycline by reducing the gut load of Clostridium perfringens in broilers. On the contrary, this study contradicts the findings of Osunkeye (2016) and Hamed et al. (2019) that honey as a supplement did not affect the feed consumption of broilers.

The feed conversion ratio (FCR) of birds denotes the amount of feeds consumed by the birds to convert a kilogram gain weight. It is always a very helpful benchmark to determine a farm's profitability. Results of the current study revealed significant (p< 0.05) differences. The feed conversion ratio of birds with supplementation of honey at 5 mL/L of tap water was significantly lower with a 0.20kg – 0.45kg difference, which is equivalent to a 12.5% significant decrease in the FCR of birds compared with T2 and 24.3% compared with T1. Conversely, a higher level of honey supplementation makes it comparable to T2, indicating that honey supplementation improved feed utilization only at a certain level. Results had a similarity in research conducted using 1-3% of honey bee products specifically 22 g/liter of honey for Japanese quails was found to improve weight gain, feed intake, feed conversion ratio, immune system, blood parameters, and meat quality (Lika et al., 2021).

Proximate Analysis

Table 2 displayed the chemical characteristics of broiler meat in relation to varying concentrations of honey added to the chickens’ drinking water. The ash content in meat can indicate the animal’s diet and how they were raised, impacting the sustainability and ethical standards of meat production. Meat from animals raised on natural, mineral-rich diets may have a higher ash content that is more beneficial (Steinfeld, et al., 2006). Based on the results, treatments showed no differences in Ash content.
The moisture content of meat significantly influences its quality attributes, including tenderness, texture, shelf life, processing quality (Pojic et al., 2015), and palatability. Maintaining optimal moisture content is crucial for achieving desirable meat quality. However, it can also lead to a higher level of spoilage if not properly managed (Wendler et al., 2017).

Results of this study showed that meat properties of birds in T3 and T4 revealed higher moisture content ranging from 0.67% to 43% compared with the negative control and electrolytes supplement (T1 and T2); it was noted that the increased supplementation of honey reduced the moisture content of meat. Hence, honey could improve the moisture content of meat at a lower level of supplementation.

Meanwhile, the crude protein content of meat samples from chicken with honey as a drink supplement numerically showed a higher content (g/100g) ranging from 55%-57% compared with un-supplemented treatments (T1 & T2). According to Chrystal et al. (2020), a decrease in crude protein content in meat typically compromises broiler performance with an associated increase in carcass lipid deposition. It was reiterated by Kralik et al. (2018) that the crude protein content in chicken meat is crucial for its quality, providing high-quality protein essential for human health and influencing nutritional value. The result of the current study implies that honey supplementation to broilers increases the protein content of meat, making it more nutritious.

Crude fat is critical to determine its energy content, nutritional value, and quality. Findings on the crude fat (CF) content result showed that meat birds treated with commercial electrolytes had the highest CF with 3.42 (g/100g), which is 3.17 to 3.22, numerically higher than all other treatments. Consumption of high crude fat-content food contributes to increased caloric intake, which can lead to weight gain and obesity if not balanced with physical activity; in parallel, obesity is always associated with various health issues, including diabetes, hypertension, and certain cancers (WHO, 2024). On the contrary, high-fat content food is a good source of energy, which can be beneficial for individuals with higher energy requirements. The result implies that honey as a water supplement for broilers could contribute to the production of meat with minimal or less fat.

Compared to the typical electrolyte supplement, meat samples from birds with honey-drinking supplements had a greater concentration of 2.11% - 18.12% on the total

**Table 2.** Proximate Analysis of chicken meat supplemented with honey

<table>
<thead>
<tr>
<th>TREATMENTS</th>
<th>ASH (g/100g)</th>
<th>MC (g/100g)</th>
<th>CP (g/100g)</th>
<th>CF (g/100g)</th>
<th>TC (g/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 No supplement</td>
<td>1.42</td>
<td>75.53</td>
<td>1.30</td>
<td>0.22</td>
<td>21.53</td>
</tr>
<tr>
<td>T2 Commercial electrolytes</td>
<td>1.46</td>
<td>74.95</td>
<td>1.24</td>
<td>3.42</td>
<td>18.93</td>
</tr>
<tr>
<td>T3 (0.5 mL/L of water)</td>
<td>1.50</td>
<td>76.04</td>
<td>2.92</td>
<td>0.20</td>
<td>19.34</td>
</tr>
<tr>
<td>T4 (7.5 mL/L of water)</td>
<td>1.42</td>
<td>76.04</td>
<td>2.69</td>
<td>0.23</td>
<td>19.62</td>
</tr>
<tr>
<td>T5 (10 mL/L of water)</td>
<td>1.55</td>
<td>74.05</td>
<td>2.07</td>
<td>0.25</td>
<td>22.08</td>
</tr>
</tbody>
</table>

*Legend: MC - Moisture content; CP - Crude Protein; CF - Crude Fiber; TC - Total Carbohydrates*
carbohydrate (TC - g/100g). The result showed that carbohydrate content increases as the level of honey increases. As stated by Acs et. al., 2022, high carbohydrate content in chicken meat can enhance muscle development and protein accumulation, potentially improving carcass characteristics, but may reduce hatchability in eggs. It further supports the result of this study, where meat samples with high carbohydrate content also have higher crude protein content.

**Conclusion**

Based on the result of the current study, the inclusion of honey at 0.5 mL/L and 10 mL/L of water significantly affected the growth performance of birds, specifically on the feed conversion ratio (FCR) and feed consumption (FC) of birds. It was found that 5mL/L of water is the best level of supplementation based on the effect on final weight, gain in weight, total feed consumption, feed conversion ratio, and in improving the chemical properties of meat, particularly in moisture content, crude protein content which is 40% to 50% higher than other treatments, lower value of crude fat by 93%-94% compared with T2 which implies healthier meat and improved total carbohydrate content, meaning a better source of energy. Compared to the usual plain water and electrolytes, using 0.5mL/L level of honey as a supplement in the drinking water of broilers is recommended for better growth performance of birds and lower production cost. Honey as a water supplement is further recommended for improved MC, CP, CF, and TC of chicken meat.

**Acknowledgment**

The writers highly acknowledge the God Almighty for His blessings, which include the wisdom, strength, and provision needed to complete this study. They would also like to express their sincere gratitude to the DMMMSU-University Research and Extension office for their financial support as well as to Dr. Gregory B. Viste and Dr. Joseph A. Panas, the executive director and head of the Research Division of the National Apiculture and Training Development Institute (NARTDI), for their kind and administrative assistance. We thank you

**Statement of Conflict of Interest**

There was no conflict of interest to disclose.

**References**


DMMMSU Research and Extension Journal / Issue 7 / December 2023


Henriksen, J. 2023. How chicken has become the choice meat to beat inflation. WATT Poultry. 


Tattao et al. – Improved feed efficiency and nutritional property effects of honey in broiler


