The Use of Tomato Waste Juice as an Antioxidant Source for Broiler Chickens

Hanny Indrat Wahyuni\(^1\), Turrini Yudiarti, Endang Widiastuti, Sugiharto Sugiharto, Isroli Isroli and Tri Agus Sartono

\(^1\)Faculty of Animal and Agriculture Sciences, Diponegoro University, Tembalang Campus, Semarang Indonesia 50275

E-mail: hihannyiw123@gmail.com

Abstract. The purpose of this study was to investigate the impact of using tomato waste juice (TWJ) as a source of antioxidants for broiler chickens. The study used 160 day-old-chicks Lohmann MB-202 broiler strains with an average body weight of 43.5±1.23 g which were randomly allotted to one of four treatment groups. The chicks were provided either with no TWJ (TWJ0), 40 (TWJ40), 80 (TWJ80) or 120 mL/day of TWJ (TWJ120) from days 15 to 35. The blood, internal organs and intestinal digesta were collected at day 35. The results showed that provision of TWJ increased (P<0.05) the relative weight of thymus, duodenum, jejunum, caecum and liver of broilers. The treatment, however, did not affect (P>0.05) growth performance, blood profile and ileal and caecal microbial populations. In conclusion, TWJ could be used as an antioxidant source to maintain the normal health and internal organ development of broiler chicks.

1. Introduction
Broiler chicken genetically was designed to produce meat in a short time period, but on the other hand, the birds was also susceptible to the diseases. Especially if the surrounding macro and micro climates did not support the bird to live in a thermo neutral zone. This would consequently negatively affected to the broiler’s performances. Anticipating the condition, it is common in adding an antibiotic to poultry’s diet as growth promoter (AGPs) [1]. But because of its negative impact in human’s and animal’s health, the use of AGPs in poultry feed was not allowed. In Indonesia it started from the beginning of 2018. There are several alternative compounds had been research to replaced it such as probiotic, prebiotic, essential oil, organic acid and enzyme [2], including the use of phytobiotic [2,3]. Phytobiotic or phytochemical feed additive (PFA) where abundantly found in plants, fruit or herbs would promote broiler’s health and body resistant [2] which in turn would affected it is performances. Plant PFA usually rich in phenolic compounds which plays a role as an antioxidant [3].

The use of various antioxidant like Se, vitamin E and carotenoids in broilers increased liver’s antioxidant concentration and immunity response but not the performance [4]. However, the use of lycopene up to 400 mg/kg feed increased broiler performance reared in heat stress condition [5]. Higher level of synthetic lycopene (500 mg/kg) in broiler ration reared in a thermo neutral zone decreased the weight of spleen and bursa fabricius [6]. Natural antioxidant had also been researched, like ginger, beetroot and tomato puree in broiler ration [7].
One of the fruit that have very high antioxidant of lycopene, phenolic, flavonoids and vitamin C is tomato [8]. Dried tomato wastes contained lycopene of 510.6 mg/kg and β-carotene of 95.6 mg/kg which still good antioxidant properties [9]. But lycopene was easily lost during processing as compare with other carotenoid of tomato [10]. Therefore, this research would evaluate the use of waste tomato juice as antioxidant source in broiler chicken’s diet.

2. Materials and Methods

2.1. Vegetable Tomato Juice Preparation
Choose the good tomatoes from the waste tomato purchase from traditional market. Cleaned the good waste tomatoes and cut into smaller units. It was then blended with a juicer. Add 300 mL of water to the juice for every 1 kg tomatoes. Filtered the mixture to remove the solid part and get the solution. Heat the solution at 65-70°C for 5 minute. Stirred it during heating. The waste tomato juice was put in a refrigerator prior to use as drinking water.

2.2. Experimental Design and Broiler Management
A Total of 160 day-old-chicks Lohmann MB-202 broiler strains with an average body weight of 43.5±1.23 g were assigned into a completely randomized design. The treatments were levels of waste tomato juice: 0, 40, 80 and 120 mL/day as drinking water and provided to the chicks from 15 to 35 days of age.

The broiler chicks raised in an open-sided house with a wire floor pens throughout the experiment with 24 h light provided to the housing. Temperature and humidity of the housing were control through installing plastic curtains and light bulbs to the pens as a heater. Feed and water were provided ad libitum. The nutrient content of starter and finisher diets were shown at Table 1. Three times vaccination were performed to the chicks. On day 3 vaccinated with Newcastle disease-Infectious Bursal (ND-IB) through eye drop. On day 11 and 18 vaccinated with IB and ND La Sota, respectively, both through drinking water.

Table 1. Nutrient content of basal ration during starter and finisher period

| Nutrients                  | Starter | Finisher |
|----------------------------|---------|----------|
| Crude Protein (%)          | 22.00   | 21.27    |
| Eter Extract (%)           | 5.00    | 3.96     |
| Crude Fiber (%)            | 5.00    | 4.19     |
| Ash (%)                    | 7.00    | 6.86     |
| Ca (%)                     | 0.90    | 1.00     |
| P (%)                      | 0.60    | 0.81     |
| Energy Metabolism\(^a\) (Kcal/Kg) | 3,448.00 | 3,435.00 |

\(^a\)Calculated based on the proximate analysis value [11]

2.3. Data Gathering and Analysis
Body weight and cumulative feed intake were recorded. Blood sample was taken from the bird’s wing vein (5 birds per treatments) at the end of the experiment. The blood sampled was then put in an ethylenediaminetetraacetic acid containing vacutainers for the blood profile analysis. It was analyzed using Hematology Analyzer (Prima fully-auto hematology analyzer, PT. Prima Alkesindo Nusantara, Jakarta, Indonesia) for blood parameters based on the manual instruction provided by the manufacturer.

At the end of the study - 35 days of age, the birds were randomly selected from each pen slaughter, de-feathered, and eviscerated. Immediately, the lymphoid and internal organs were obtained and weighed [12]. The population of Lactic Acid Bacteria (LAB) and coliform as well as the pH were
recorded from the digesta of ileum and caecum. The population of LAB was measured using on de Man, Rogosa and Shape while the counting of coliform used MacConkey Agar [13].

All data gathered were subjected to analysis of variance in CRD and the differences among treatment were analyzed using Duncan Multiple Range Test.

3. Results and Discussion
Giving several levels of TWJ as drinking water significantly increased the relative weight of thymus (Table 2) as compare to TWJ0. The result showed that antioxidant of TWJ could improve broiler chicken’s health, since additional antioxidant of external origin would prevent the damage of internal organ through anticipating the present of free radical in the body [14].

Table 2. Lymphoid and internal organ’s relative weight of broilers receiving levels of tomato waste juice (TWJ) as drinking water at the last three weeks of age.

| Parameters      | Levels of TWJ (mL/day) |
|-----------------|------------------------|
|                 | 0          | 40         | 80         | 120        |
| Bursa Fabrisius (%) | 0.11 ± 0.04 | 0.12 ± 0.09 | 0.11 ± 0.06 | 0.09 ± 0.02 |
| Limpa (%)       | 0.14 ± 0.04 | 0.13 ± 0.03 | 0.14 ± 0.04 | 0.13 ± 0.05 |
| Thymus (%)      | 0.25 ± 0.10b | 0.42 ± 0.09a | 0.29 ± 0.06a | 0.29 ± 0.09a |
| Duodenum (%)    | 0.52 ± 0.06b | 0.61 ± 0.06b | 0.69 ± 0.087a | 0.75 ± 0.08a |
| Jejunum (%)     | 1.29 ± 0.19b | 1.31 ± 0.16ab | 1.67 ± 0.19a | 1.41 ± 0.19a |
| Ileum (%)       | 0.67 ± 0.09 | 0.83 ± 0.14 | 0.83 ± 0.11 | 0.85 ± 0.09 |
| Caecum (%)      | 0.46 ± 0.12c | 0.68 ± 0.04a | 0.50 ± 0.13b | 0.62 ± 0.06a |
| Pancreas (%)    | 0.24 ± 0.04 | 0.28 ± 0.03 | 0.28 ± 0.02 | 0.29 ± 0.03 |
| Liver (%)       | 2.10 ± 0.34b | 2.30 ± 0.27a | 2.49 ± 0.26a | 2.01 ± 0.06b |
| Heart (%)       | 0.44 ± 0.02 | 0.49 ± 0.08 | 0.57 ± 0.09 | 0.48 ± 0.046 |

Birds of TWJ40 and TWJ80 had an increased relative weight of liver as compare to control birds (Table 2). Research of adding 500 mg of synthetic lycopene per kg broiler ration showed a decreased relative weight and degenerative lesion of the liver [6]. However, the increased of liver relative weight in this research did not mean that this treatment levels applied (TWJ40 and TWJ80) had a negative impact on the liver’s function, since birds of TWJ120 showed a decreased liver relative weight similar to those of the control group. Beside the blood parameters profile (Table 3) and the birds’ performances (Table 4) were not affected by the TWJ’s level.

Table 3. Blood parameters of broilers receiving levels of tomato waste juice (TWJ) as drinking water at the last three weeks of age.

| Parameters       | Levels of TWJ (mL/day) |
|------------------|------------------------|
|                  | 0          | 40         | 80         | 120        |
| Erythrocyte (x10⁶/mm³) | 2.38 ± 0.45 | 2.19 ± 0.35 | 2.27 ± 0.30 | 2.33 ± 0.32 |
| Haemoglobin (g/dL)   | 9.20 ± 0.84 | 9.00 ± 1.17 | 8.90 ± 1.02 | 9.40 ± 1.47 |
| Haematocrit (%)     | 24.80 ± 5.30 | 22.50 ± 4.18 | 23.30 ± 2.77 | 23.80 ± 3.49 |
| Leucocyte (x10³/mL) | 56.40 ± 5.35 | 60.60 ± 8.30 | 52.50 ± 8.22 | 58.40 ± 10.14 |
The relative weight of duodenum, jejunum and caecum were increased as the increased level of TWJ (Table 2). This result indicates that serving TWJ as drinking water of 40-120 mL/day stimulate the relative weight of those digestive organs. However, the increasing relative weight of those digestive organs could not improve the birds’ performances (Table 4) as well as the microbial population of ileum and caecum (Table 5). This was in contrast with the following finding that the use tomato puree decreased total bacterial count of intestinal digesta as compare to the control group [7].

4. Conclusion
In conclusion, TWJ could be used as an antioxidant source to maintain the normal health and internal organ development of broiler chicks.

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Table 4. Performances of broilers receiving levels of tomato waste juice (TWJ) as drinking water at the last three weeks of age.

| Parameters       | Levels of TWJ (mL/day) |       |       |       |
|------------------|------------------------|-------|-------|-------|
|                  | 0                      | 40    | 80    | 120   |
| CFI (g/35 days)  | 2688.00 ± 49.00        | 2666.00 ± 76.50 | 2628.28 ± 18.22 | 2658.00 ± 77.00 |
| FBW (g)          | 1603.00 ± 67.00        | 1512.00 ± 109.00 | 1449.00 ± 117.00 | 1435.00 ± 132.00 |
| DWG (g/day)      | 44.54 ± 1.95           | 41.96 ± 3.16 | 40.17 ± 3.33 | 39.76 ± 3.76 |
| FCR (g/g)        | 1.68 ± 0.08            | 1.77 ± 0.16 | 1.82 ± 0.15 | 1.86 ± 0.17 |

CFI=Cumulative Feed Intake; FBW= Final Body Weight; DWG= Daily Weight Gain; FCR= Feed Conversion Ratio

Table 5. Microbial population and pH of ileum and caecum in broilers receiving levels of tomato waste juice (TWJ) as drinking water at the last three weeks of age.

| Parameters       | Levels of TWJ (mL/day) |       |       |       |
|------------------|------------------------|-------|-------|-------|
|                  | 0                      | 40    | 80    | 120   |
| Lactic Acid Bacteria (cfu/ml) |           |       |       |       |
| Ileum            | 8.30 ± 0.47            | 8.37 ± 0.44 | 8.38 ± 0.25 | 8.30 ± 0.39 |
| Sekum            | 8.33 ± 0.16            | 8.28 ± 0.23 | 8.42 ± 0.11 | 8.23 ± 0.18 |
| Coliform (cfu/ml) |           |       |       |       |
| Ileum            | 9.75 ± 0.39            | 9.50 ± 0.36 | 9.48 ± 0.26 | 9.46 ± 0.30 |
| Sekum            | 9.75 ± 0.36            | 9.56 ± 0.36 | 9.67 ± 0.31 | 9.64 ± 0.16 |
| pH               |                        |       |       |       |
| Ileum            | 6.00                   | 5.80  | 6.00  | 6.00  |
| Sekum            | 7.00                   | 7.00  | 7.00  | 7.00  |
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