Haematology Profiles and Performance of Broiler Chickens Fed on Commercial Feed

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Abstract. The objective of this research was to investigate the effect of commercial feed on hematological and carcass profiles of broiler chickens. A total of 1800 day old chick (DOC) broilers were administered in a Completely Randomized Design (CRD) furthered by Duncan test. The treatments consisted of Feed A, B, C, D, E, and F. The observed variables included hematology profiles (erythrocyte, hemoglobin, leukocyte, heterophil, lymphocyte, and monocyte) and performance (live weight, carcass percentage, breast, thigh, wings, shank, and head). The result showed that feed treatment did not significantly affect (P>0.05) hematology profiles and performance of broiler chickens, but significantly affected live weight (P<0.05). Conclusively, different types of commercial feed did not render physiological effect to DOC and safe for feeding until 35 days old to increase the live weight of broiler chickens.

Keywords: hematology, broiler, commercial feed

Introduction

Animal protein demand increases as the population grows each year. Broiler chicken is livestock that significantly contributes to fulfilling animal protein demand in Indonesia, and the demand for chicken also escalates due to the reasonable price for the society.

As alternative livestock for meat demand, broiler chicken farming is developing in small to large scale. The characteristics of broilers include fast growth, efficient ration, relatively short harvest, tender meat fibre, thick meat mound, and smooth skin. Broiler growth is highly dependent on feed as well as proper maintenance. Feed is an essential component for growth and animals need nutrition for the physiological process. Sufficient nutrient in quality and quantity is required for improving metabolism to support animal development and growth (Erniasih and Saraswati, 2006).

Broiler chicken farmers generally offer the readily-available commercial feed from the market. Commercial feed refers to various ingredients mixed at particular formulation to meet the animal dietary needs. The feed has been designed to support optimum development, growth, health, and performance. Farmers generally prefer commercial feed to self-made feed, and the
choice is based on practicality, availability, price, and nutrient content. There are various types of commercial feed regarding price and ingredients produced by different companies (feed factory).

Feed efficiency could manifest into hematology profiles and performance of broiler chickens, especially body weight. Hematological blood profile is a parameter of health status because it plays a vital role in managing body physiology (Satyaningtias et al., 2010). Blood assessment may diagnose disease or disorders in blood or body organs of livestock (Napirah et al., 2013).

Blood transports metabolic substrates that all body cells require such as oxygen, glucose, amino acid, fatty acid, and some lipids. Blood also carries metabolic products expelled by each cell, such as carbon dioxide, lactic acid, nitrogen excretion from protein metabolism, and heat (Cunningham, 2002). According to Colville and Bassert (2008), blood plays a function in transportation, regulation, and defence functions. Blood is composed of blood cells (erythrocyte, leukocyte, and thrombocyte) circulating in a fluid called blood plasma (Meyer and Harvey, 2004). Internal factors include health, stress, and nutrition status, while external factors may include the dynamic surrounding temperature and viral infection (Ginting, 2008).

Blood, which is a vital particular circulatory tissue, is composed of cells suspended in a fluid intercellular substance (plasma) with the significant function of maintaining homeostasis (Isaac et al., 2013). Hematological components, which consist of red blood cells, white blood cells or leucocytes, mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration are valuable in monitoring feed toxicity especially with feed constituents that affect the blood as well as the health status of farm animals (Oyawoye & Ogunkunle, 2004). Blood main functions include (1) tissue oxygenation, (2) tissue nutrition, (3) balanced acid-base maintenance, and (4) metabolic waste repellent from tissue (Noercholis et al., 2013). Ali et al. (2013) stated that blood plays an intricate role in maintaining a sound physiological process so that animal productivity is optimum. The contributing factors to blood profile in an animal are age, sex, genus, disease, the surrounding temperature, geographical condition, and physical activity. Hematological values could serve as baseline information for comparison in conditions of nutrient deficiency, physiology, and health status of farm animals (Daramola et al., 2005).

Materials and Method

The research used 1800 broiler chickens reared from DOC to 35 days old and rationed to 36 cage units (50 chicken each). The chickens were offered with commercial feed available in the market. The composition and nutrient content of the feed treatment are presented in Table 1.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Moisture (%)</th>
<th>Protein (%)</th>
<th>Fat (%)</th>
<th>Crude protein (%)</th>
<th>Ash (%)</th>
<th>Ca (%)</th>
<th>P (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment feed A</td>
<td>11.00</td>
<td>22.56</td>
<td>5.51</td>
<td>2.46</td>
<td>4.59</td>
<td>0.88</td>
<td>0.55</td>
</tr>
<tr>
<td>Treatment feed B</td>
<td>10.90</td>
<td>21.94</td>
<td>7.58</td>
<td>2.40</td>
<td>5.57</td>
<td>0.94</td>
<td>0.58</td>
</tr>
<tr>
<td>Treatment feed C</td>
<td>10.50</td>
<td>20.86</td>
<td>6.08</td>
<td>3.68</td>
<td>4.51</td>
<td>0.78</td>
<td>0.55</td>
</tr>
<tr>
<td>Treatment feed D</td>
<td>10.80</td>
<td>21.19</td>
<td>7.62</td>
<td>3.46</td>
<td>5.52</td>
<td>0.99</td>
<td>0.77</td>
</tr>
<tr>
<td>Treatment feed E</td>
<td>11.00</td>
<td>22.28</td>
<td>7.56</td>
<td>2.41</td>
<td>4.71</td>
<td>0.78</td>
<td>0.56</td>
</tr>
<tr>
<td>Treatment feed F</td>
<td>11.40</td>
<td>22.15</td>
<td>7.44</td>
<td>2.61</td>
<td>4.40</td>
<td>0.73</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Source: Analysis result by PT. Cjeil Cjedang Tbk. (2017)
**Measured variables**

Blood sampling was conducted at the end of the study after the chickens have fasted for 9h. Blood was drawn 2-3 ml from vena brachialis that had been cleansed with alcohol using a 3ml syringe (23G x 1 1/4” needle) and put into an EDTA-filled tube. Hematology profile assessment included erythrocyte, hemoglobin, leukocyte, heterophil, lymphocyte, and monocyte. Total erythrocyte was calculated using a hemocytometer, and Hb level was counted following acid Hematin method using a Hemometer Sahli-Hellige (Frandsen et al., 2009).

The performance of broiler chickens was measured by calculating the live weight at the end of treatment. Carcass, breast, thigh, wings, shank, and the head percentage was obtained after cutting the chicken at the jugular venous and removed the blood. Feathers, abdominal fat, feet, head, neck and innards except for the giblet (liver, heart, and gizzard). Carcass percentage was calculated by multiplying the live weight by 100%. The percentage weight of breast, thigh, wings, shank, and head was recorded by weighing each organ, divided by live weight and multiplied by 100%.

**Research Methode and Data Analysis**

The experiment was conducted in a Completely Randomized Design (CRD) and the obtained data were subject to a single factor analysis of variance (ANOVA) followed by Duncan test when differences were resulted (Steel and Torrie, 1980).

**Results and Discussion**

The result of hematology profilesis presented in Table 2. The analysis of variance showed that different commercial feed did not significantly affect (P>0.05) hematology profiles of broiler chickens. Therefore, the commercial feed currently offered to the chickens had met quality feed criteria as it did not cause any physiological disorder to the chickens. The result showed that commercial feed did not significantly affect (P>0.05) the erythrocyte level of 35-day-old broiler chickens as the total erythrocyte was within the normal range i.e. 2.41–2.83 (10⁶/ml). It indicated that the commercial feed did not contain a harmful substance or potentially caused disorder on total body cell. The result confirmed previous findings on total erythrocyte 2.3–3.5 (10⁶/mm³) (Dharmawan, 2002) and 2.42–2.75 (10⁶/mm³) (Usman et al., 2016a). Talebi et al. (2005) reported that the total erythrocyte of native chicken was 2.17–2.86 (10⁶/mm³) while other findings varied from 2.49±0.38–2.83±0.64 (10⁶/mm³) (Hidayat et al. 2016) to 1.75–2.18 (10⁶/mm³) (Hidayatullah et al., 2016). Additionally, Putriani et al. (2012) stated that the hemoglobin level of broiler chickens was 7.00–13.00 g/dl.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Feed A</th>
<th>Feed B</th>
<th>Feed C</th>
<th>Feed D</th>
<th>Feed E</th>
<th>Feed F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythrocyte (mil/µl)</td>
<td>2.67±0.41</td>
<td>2.63±0.47</td>
<td>2.43±0.65</td>
<td>2.54±0.31</td>
<td>2.41±0.19</td>
<td>2.83±0.39</td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>7.07±0.38</td>
<td>7.17±0.61</td>
<td>6.85±0.87</td>
<td>7.02±0.38</td>
<td>6.87±0.42</td>
<td>7.27±0.55</td>
</tr>
<tr>
<td>Leukocyte (cells/µl)</td>
<td>±2068.82</td>
<td>±1478.65</td>
<td>±1340.30</td>
<td>±1286.07</td>
<td>±2526.59</td>
<td>±2578.11</td>
</tr>
<tr>
<td>Heterophil (%)</td>
<td>34.83±7.96</td>
<td>31.17±6.62</td>
<td>31.00±11.05</td>
<td>33.83±7.25</td>
<td>30.67±8.62</td>
<td>31.67±9.75</td>
</tr>
<tr>
<td>Lymphocyte (%)</td>
<td>60.17±8.66</td>
<td>64.33±16.59</td>
<td>63.33±11.18</td>
<td>61.00±7.21</td>
<td>64.50±9.42</td>
<td>62.50±8.53</td>
</tr>
<tr>
<td>Monocyte (%)</td>
<td>4.33±1.97</td>
<td>4.33±1.03</td>
<td>5.00±2.19</td>
<td>5.17±2.14</td>
<td>4.33±1.03</td>
<td>5.83±2.23</td>
</tr>
</tbody>
</table>
The different erythrocyte levels were due to many factors such as feed, age, maintenance system, the surrounding temperature, altitude, and other climate factors. Piliang and Djiojosoebagio (2006) stated that the contributing factor to the erythrocyte level was nutrient sufficiency. The optimal blood condition significantly supported the productivity of broiler chickens. Erythrocyte is a tissue that transports nutrition substances from the digestion process around body parts for metabolism process (Soeharsono et al., 2010). Erythrocyte (hemoglobin) transports O$_2$ to all body cells with the influence of age, sex, and nutrient status in erythropoiesis process (Revisianto. 2016).

The result of statistical analysis showed that commercial feed did not significantly affect (P>0.05) total hemoglobin of 35-day-old broiler chickens, and the leukocyte was within the normal range, i.e. 6.85±0.87 to 7.27±0.55 g/dl. The crude protein level in the commercial feed was 21.00-23.00 % (starter) and 19.00 - 21.00 % (finisher), which was sufficient for the chickens. Protein, especially amino acid glycine and Fe mineral are the building blocks for hemoglobin; therefore, the total hemoglobin is maintained by the combined protein and Fe (Sriwati et al., 2014).

Previous findings reported hemoglobin level by 6.65–7.40 g/dl (Hidayat et al., 2016) and 5.18–9.30 g/dl (Salam et al., 2013; Varmaghany et al., 2013; Sugiharto et al., 2015). The different hemoglobin level was owing to age and nutrition – the older the chickens, the higher the erythrocyte, hemoglobin, and hematocrit. Micromineral in the form of Fe is hemoglobin precursor. Hemoglobin transports gas (O$_2$ and CO$_2$) in body tissues; therefore, the hemoglobin level significantly affects erythrocyte (Napirah et al., 2013). The other contributing factors to hemoglobin level are species and (Frandsen et al., 2009). Manin et al. (2014) stated that hemoglobin functions as oxygen and carbon dioxide carrier as well as erythrocyte pigment. Total erythrocyte and hemoglobin in blood circulation are dependent on age, sex, genus, disease, surrounding temperature, geographical condition and physical activity (Ali et al., 2013) and different physiological properties (age and activity), environmental factors (temperature and humidity) and feed composition (Wahyuni et al., 2012). An open cage throughout the day supplies adequate oxygen for the chickens which result in the increased hemoglobin. Guyton and Hall (2015) reported that amino acid glycine and Fe mineral are the building blocks of hemoglobin.

Hemoglobin concentration in the blood depends on age, sex, feed nutrition, muscle activity, mental condition, season, weather pressure, and daily habit to stabilize hemoglobin in order to meet protein and Fe$^{2+}$ demand for hemoglobin formation (Kusumasari et al., 2012).

The result of statistical analysis showed that commercial feed did not significantly affect (P>0.05) total leukocyte of 35-day-old broiler chickens, i.e. 8.78±2.58x10$^3$ to 9.86 ±1.48x10$^3$/ml which remains in the normal range, 12–30x10$^3$/ml (Arfah, 2015). Hartoyo et al. (2015) reported that leukocyte level of broiler chickens offered with up to 6% herbal supplement was 25.19±7.97x10$^3$/µl, which remains in the normal range.

The increased leukocyte reflects humoral and cellular response against the pathogenic agent that causes diseases. Moyes and Schute (2008) and Soeharsono et al. (2010) stated that animal health could be measured from the total leukocyte because the increased leukocyte is the parameter of body immune, and the decreased leukocyte may translate into the non-existent infection or pathogenic bacteria in the body. Bacterial infection may cause health disorder as signified by the increased white blood cell (Saputro et al., 2013).

The result of statistical analysis showed that commercial feed did not significantly affect
In the immune system, monocyte serves as the macrophage which swallows and destroy foreign and pathogenic cells, microorganism, and materials, as well as forming body immune (Isroil et al., 2009). Frandson et al. (2009) stated that monocyte could render phagocytosis on 100 pathogenic bacteria cells and serve as homeostasis during inflammation and responds to immunity. Monocyte is mobilized together with heterophil and form the second defense layer against inflammation. Eroschenko (2008) stated that the average threshold of monocyte in broiler chickens is 3-10%. Monocyte is the differential white blood cells that belong to a granulocyte group formed in the bone marrow, matured when entering circulation, turned into macrophage and permeated the tissues. The result of broiler performance is presented in Table 3.

Analysis of variance result showed that commercial feed significantly (P<0.05) increased live weight particularly treatment feed B because feed B contains 21.94% protein, 7.58% fat, 2.4% crude protein, and 5.57% organic matter. Live weight of 5-week broiler chickens in this study was 2.27±0.36 to 2.43±0.27 kg. Risnajati (2012) compared the final weight of Cobb, Hubbard, and Hybro chickens, namely 1.970, 1.976, and 1.898 kg, respectively.

### Table 3. Performance broiler chickens offered with commercial feed

<table>
<thead>
<tr>
<th>Variable</th>
<th>Feed A</th>
<th>Feed B</th>
<th>Feed C</th>
<th>Feed D</th>
<th>Feed E</th>
<th>Feed F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live weight (Kg)*</td>
<td>2.39±0.32</td>
<td>2.43±0.27a</td>
<td>2.34±0.26</td>
<td>2.36±0.23a</td>
<td>2.32±0.25a</td>
<td>2.27±0.36a</td>
</tr>
<tr>
<td>Carcass (%)</td>
<td>73.20±8.64</td>
<td>71.38±4.67</td>
<td>68.52±6.22</td>
<td>66.48±5.28</td>
<td>69.18±2.59</td>
<td>70.16±6.73</td>
</tr>
<tr>
<td>Breast (%)</td>
<td>27.64±2.75</td>
<td>28.13±2.82</td>
<td>26.82±1.20</td>
<td>24.81±2.93</td>
<td>26.68±2.23</td>
<td>27.40±2.88</td>
</tr>
<tr>
<td>Thigh (%)</td>
<td>21.23±2.55</td>
<td>18.95±2.95</td>
<td>19.07±1.76</td>
<td>19.39±1.65</td>
<td>19.69±2.59</td>
<td>20.07±3.08</td>
</tr>
<tr>
<td>Wings (%)</td>
<td>6.16±0.68</td>
<td>6.48±0.40</td>
<td>6.30±0.44</td>
<td>5.96±0.70</td>
<td>6.04±0.33</td>
<td>5.67±0.70</td>
</tr>
<tr>
<td>Shank (%)</td>
<td>3.58±0.71</td>
<td>3.62±0.36</td>
<td>3.39±0.28</td>
<td>3.35±0.58</td>
<td>3.65±0.60</td>
<td>3.38±0.46</td>
</tr>
<tr>
<td>Head (%)</td>
<td>2.20±0.41</td>
<td>2.19±0.38</td>
<td>2.20±0.23</td>
<td>2.05±0.35</td>
<td>2.17±0.19</td>
<td>2.25±0.37</td>
</tr>
</tbody>
</table>
Analysis of variance result showed that commercial feed did not significantly affect (P>0.05) carcass percentage, breast, thigh, wings, shank, and head because the feed contained sufficient protein and energy for the life and growth. Protein significantly (P<0.05) affects tissue growth in chicken. High protein intake would result in faster growth and affect broiler carcass (Rizal, 2006). Carcass percentage of broiler chickens in this study was 66.48±5.28 to 73.20±8.64%, higher than 65.35% to 66.56% by Daud et al. (2007). On the other hand, Massolo et al. (2016) reported that carcass percentage of broiler chickens offered with Dahlia bulb was 66.37±2.96 to 73.29±6.54%. Other findings reported 24.13%–26.79% (Resnawati. 2004) and 27.14%–28.48% (Sari et al., 2014)

The weight percentage of other body parts included breast (24.81±2.93–28.13±2.82%), thigh (18.95±2.95–21.23±2.55%) and wings (5.67±0.70–6.48±0.40%). Massolo et al. (2016) reported average weight percentage including breast (25.05–29.51%), thigh (24.40–27.57%), and wings (10.34–12.06%). Furthermore, Usman et al. (2016b) reported 9.549±0.266–11.400±0.174% of wings and 32.752±2.960–35.767±0.410% of breast.

The result of shank and head percentage in this study was 2.05±0.35–2.25±0.37% and 3.35±0.58–3.65±0.60%, respectively. Similarly, Daud et al. (2016) reported head and neck (2.99±0.20–3.41±0.32%) and shank (3.21±0.32–3.42±0.25%), while other study by Oglohobo et al. (2014) mentioned the percentage of shank (5.13–5.63%), head (0.01–0.36%), wings (10.26–11.25%), breast (17.30–23.75%), and thigh (10.81–12.24%).

Conclusions

Various commercial feed available in the market are safe and nutritious for main broiler feed as evidenced from the hematology profiles, the weight of carcass and its parts, he relatively similar weight of non-carcass parts and the increased live weight.

Acknowledgement

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