Production increase of alabio duck by predicting real nutrients needs on crude proteins and metabolizable energy in feed

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Key words: Alabio ducks, crude protein, metabolizable energy, feed.

http://dx.doi.org/10.12692/ijb/5.3.220-225 Article published on August 14, 2014

Abstract

The purpose of this study was to determine the real of nutrients needs, especially crude protein and metabolizable energy in production phase of Alabio duck, to achieve optimal production. Experimental method was performed through observation and measurement of the parameters on the basic needs of life (basal metabolism and activity), body weight growth and egg production. The study conducted for 4 weeks using 50 Alabio ducks on age of 7 months in the production phase. Protein estimation measured by Sibbald (1989) method, while metabolic energy requirements used Amrullah (2004) method. The results showed that the measurement of the real needs of the protein is 19%, while the metabolic energy requirement is 2650 kcal.kg⁻¹. The results of this study were expected to optimize the nutrient production levels due to the production demand of Alabio duck.

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Introduction

An obstacle in increasing the duck production is the limited information about the nutrient requirements of layer ducks (Farhat et al., 1998; Ketaren, 2002; Pooponpan et al., 2011), even National Research Council (NRC, 2004) only recommend the need for white pekin duck broiler. Ketaren and Prasetyo (2000) stated that nutrient needs for 1-16 weeks aged of layer ducks has lower growth phase at 85-100% of the nutrition table for local layer ducks including Alabio layer ducks from South Kalimantan (Setioko and Rohaeni, 2001). This variation shows the importance of local layer ducks nutrition research (Khanum et al., 2005; Wang et al., 2010).

Currently, Alabio layer ducks using the nutrient recommendations of protein and energy metabolizable derived from the studies of local layer ducks in Indonesia, or been adapted from local researchers without direct measurement based on the basic needs of life, growth and egg production, due to differences in climate, live habitat and genetic of Alabio ducks (Biyatmoko, 2010; Ferdaus, 1999). This condition causes very varied production of Alabio duck and has not optimally match its production potential. Therefore it is very necessary to assess the nutrients to complete the nutrient requirements for Alabio layer duck (Ketaren, 2002). Nutrient requirements of Alabio layer ducks that have been examined are the crude fiber feed (Biyatmoko, 2005; Darmawati, 2007) and minerals for the forming of the egg shell which consists of calcium and phosphor (Ketaren and Prasetyo, 2000). Yet no one has studied real needs of the protein and energy, whereas the allegedly low Alabio duck egg production caused by protein deficiency and excess demand for energy of feed the ducks. In the tropics where the Alabio ducks live the nutrient requirements based on the requirements of the general duck (Setioko and Rohaeni, 2001), not the real needs of Alabio layer duck based on measurement from nutrient requirements of crude protein and metabolizable energy. Thus to support optimum egg production will then study the real requirements of crude protein and metabolizable energy is absolutely necessary. The purpose of this study was to determine the real nutrients needs, especially crude protein and metabolizable energy for Alabio layer duck on production phase to achieve optimal production.

Materials and methods

The experiment was conducted in poultry cages lasted for 4 weeks using 7 months aged 50 layer ducks from duck farms in the Mamar Village, North Hulu Sungai. Ducks feed consisted of BR-1, rice meal, corn, and sago. Feed are prepared according to the needs of energy and protein of 7 months aged ducks with18% protein content and 2750 kcal.kg⁻¹ calories, referred to the recommendations for nutrient requirements of layer duck of NRC (2004).

The estimation method of energy requirements and protein based on the weekly average body weight as the basis for determining the need for weekly measurement of Metabolic Energy (ME) requirements in kcal. Estimation method for food needs refers to the Sibbald (1989) and Amrullah (2004).

Measurement of Metabolizable Energy(ME)

The purpose of ME measurement is to measure the total energy requirement of the ducks to meet all its needs. Both for basic life needs energy include energy for basal metabolism and for the activity; and the energy for the body growth as well as the energy to produce eggs. The requirements of metabolic energy estimated with Sibbald (1989) method as follows:

1. Requirement for basic life, consisted of:
   a. Basal Metabolism; the energy needs for minimum conditions at rest:
      \[ \text{NEm} = 82\% \times \text{ME}m; \quad \text{where NEm} = 83 \times \text{BW}^{0.75} \text{(kg)} \]
   b. Activity in the cage; the energy needs in the activity of cages battery:
      \[ \text{ME activity in cage} = 37\% \times \text{ME}m \]

2. Requirement for Growth; daily energy requirements for growth:
   \[ \text{ME of Growth} = 3.0 \text{ kcal.g}^{-1} \text{BWG} \]

3. Requirements for Egg Production; the energy required to produce an egg:
ME for egg to be weighed 55 g is 79.85 kcal

Description:

- **NEm** = Net Energy Maintenance
- **MEm** = Energy Metabolic Maintenance
- **BW** = Body Weight
- **BWG** = Body Weight Gain

**Measurement of Crude Protein (CP)**

The purpose of CP measurement is to measure the needs of the total crude protein that necessary in life. It include crude protein requirement for tissue growth, for basic living, for the feather growth and producing eggs. Measurements were made based on the average daily requirement of ducks.

Estimation method referred to the nutrient requirements by Amrullah (2004) method, assuming the efficiency of protein utilization in duck layer by 45%. Crude protein needs measured as follows.

**Requirement of Tissue Growth**, to measure the daily crude protein requirement for tissue growth ducks. Carcas was assumed to contain 18% protein then the crude protein (CP) requirement is:

$$CP\ requirement = \frac{BWG\ (g) \times 0.18}{0.45}$$

**Requirement of Basic Life**, to measure the crude protein required in minimum conditions of rest. The assumption of endogenous nitrogen loss is set at 201 mg nitrogen per kg of body weight (BW).

$$CP\ requirement = \frac{BW\ (g) \times 201 \times 6.25}{1000 \times 0.45}$$

**Growth of Feather**, to measure the crude protein requirement for growth duck feather. The assumption is at the age of 7 months, feather achieved 7% of body weight gain (BWG).

$$CP\ requirement = \frac{BWG\ (g) \times 0.07 \times 0.82}{0.45}$$

**Production of Eggs**, to measure the crude protein required to produce an egg. The assumption is the egg contains 13% protein (x), with the efficiency of protein utilization by 45% (y).

$$CP\ requirement = (\ x\ ) \times (\ y\ ) = (\ z\ ) g\ protein.egg^{-1}.day^{-1}$$

**Data Analysis**

Observed variables in this study are feed consumption, body weight gain, body weight, eggs weight and eggs production. Data were analyzed descriptively and presented based on the measurement of nutrition needs, i.e. Metabolizable Energy (ME) and crude protein (CP) on 7 months aged of Alabio layer ducks.

**Results and discussion**

**Metabolizable Energy (ME)**

Estimated energy requirements (ME) and crude protein (CP) of Alabio layer ducks at aged of 7 months based on measurements on feed consumption, average weight gain (AWG), body weight (BW) and egg weight is presented in Table 1. Results showed that the real metabolizable energy (ME) requirement on production phase of Alabio layer duck was 2652.43 kcal.kg⁻¹. This energy requirement measured as the average energy requirement from four weeks. The feed consumption is highly correlated with reported feed energy, similar to the report of Khanum et al. (2005), while Almeida et al. (2012) stated the factor that determines the feed consumption besides the influence of environmental factors (e.g. temperature), it is the level of energy in the feed. These results allow the efficiency of feed energy of 100 kcal.kg⁻¹ which given to Alabio ducks at certain age to reduce the feed cost (Farhat et al., 1998). With the feed price of 2893.25 rupiahs.kg⁻¹, the cost efficiency is 68.8 rupiahs.kg⁻¹.

**Crude Protein**

Crude protein (CP) requirements of Alabio layer ducks were estimated based on the measurements on feed consumption, average weight gain (AWG), body weight (BW) and egg weight (Table 2). The result showed that the real requirement of the crude protein for Alabio duck is 19.47%. The crude protein content in this study is higher than the diet recommendations of 18% of crude protein by NRC (2004). This recommendation was assumed specifically
inappropriate for Alabio ducks originated from South Kalimantan. Protein requirement of Alabio layer ducks by 19.47% is derived from the total daily requirement of 23.89 g CP.day⁻¹ with daily consumption reached 122.71 g.day⁻¹, with the distribution of protein requirements for Basic Life (basal metabolism and activity) of 4.13 g.day⁻¹, tissue growth 1.71 g.day⁻¹, feather growth of 0.54 g.day⁻¹ and production of eggs by 17.51 g.day⁻¹.

### Table 1. Requirement of Metabolic Energy (ME) in Alabio layer ducks.

<table>
<thead>
<tr>
<th>Week</th>
<th>Requirement of energy (kcal.day⁻¹)</th>
<th>Egg Production (kcal)</th>
<th>Total Energy (kcal.day⁻¹)</th>
<th>Feed Consumption (g.day⁻¹)</th>
<th>ME needs (kcal.kg⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basal Life</td>
<td>Growth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Basic Life</td>
<td>Activities (cage)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>146.68</td>
<td>73.34</td>
<td>12.25</td>
<td>87.1</td>
<td>319.39</td>
</tr>
<tr>
<td>2</td>
<td>148.74</td>
<td>74.37</td>
<td>13.40</td>
<td>87.83</td>
<td>324.10</td>
</tr>
<tr>
<td>3</td>
<td>150.79</td>
<td>75.39</td>
<td>13.40</td>
<td>88.56</td>
<td>327.95</td>
</tr>
<tr>
<td>4</td>
<td>152.76</td>
<td>76.38</td>
<td>12.73</td>
<td>88.56</td>
<td>330.43</td>
</tr>
<tr>
<td>Total</td>
<td>598.99</td>
<td>299.49</td>
<td>51.34</td>
<td>352.05</td>
<td>1301.88</td>
</tr>
<tr>
<td>Average</td>
<td>149.74±2.6</td>
<td>74.87±1.3</td>
<td>12.83±0.4</td>
<td>88.01±0.6</td>
<td>325.47±4.8</td>
</tr>
</tbody>
</table>

**Description:**

Needs of energy (ME) = feed density ¹) x 1000 (kcal.kg⁻¹)

Feed density ¹) = total of energy (kcal.day⁻¹) / feed consumption (g.day⁻¹).

### Table 2. Requirement of Crude Protein (CP) in Alabio layer ducks.

<table>
<thead>
<tr>
<th>Week</th>
<th>Requirement of crude protein (g.day⁻¹)</th>
<th>Egg Production (g.day⁻¹)</th>
<th>Total Protein (g.day⁻¹)</th>
<th>Feed Consumption (g.day⁻¹)</th>
<th>Protein Requirement (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basic Life</td>
<td>Tissue Growth</td>
<td>Feather Growth</td>
<td>Basic Life</td>
<td>Tissue Growth</td>
</tr>
<tr>
<td>1</td>
<td>4.04</td>
<td>1.63</td>
<td>0.52</td>
<td>17.33</td>
<td>23.53</td>
</tr>
<tr>
<td>2</td>
<td>4.10</td>
<td>1.75</td>
<td>0.55</td>
<td>17.47</td>
<td>23.89</td>
</tr>
<tr>
<td>3</td>
<td>4.16</td>
<td>1.76</td>
<td>0.56</td>
<td>17.62</td>
<td>24.10</td>
</tr>
<tr>
<td>4</td>
<td>4.21</td>
<td>1.69</td>
<td>0.54</td>
<td>17.62</td>
<td>24.07</td>
</tr>
<tr>
<td>Total</td>
<td>16.52</td>
<td>6.84</td>
<td>2.18</td>
<td>70.05</td>
<td>95.60</td>
</tr>
<tr>
<td>Average</td>
<td>4.13±0.07</td>
<td>1.71±0.05</td>
<td>0.54±0.02</td>
<td>17.31±0.13</td>
<td>23.89±0.2</td>
</tr>
</tbody>
</table>

**Description:**

Requirement of protein ¹) = Total of protein (g.day⁻¹) / Feed consumption (g.day⁻¹) x 100%

Results of this study on nutritional requirements were expected to be recommendation for proper nutrition for ducks on energy need (kcal.kg⁻¹) and protein requirement (%) according to the ducks age (Xuan et al., 2002) and phase of production (Ferdaus, 1999). Thus, it will lead to a positive impact in optimizing of production that would be obtained by the effect of treatment were tested (Xuan et al., 1996).

### Table 3. The Ratio of E-P Nutrient Requirement of Alabio Layer Duck.

<table>
<thead>
<tr>
<th>Week</th>
<th>Requirement of Crude Protein (%)</th>
<th>Requirement of Energy (kcal.kg⁻¹)</th>
<th>The ratio of E/P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19.57</td>
<td>2656.05</td>
<td>13.57</td>
</tr>
<tr>
<td>2</td>
<td>19.56</td>
<td>2653.96</td>
<td>13.56</td>
</tr>
<tr>
<td>3</td>
<td>19.68</td>
<td>2678.26</td>
<td>13.61</td>
</tr>
<tr>
<td>4</td>
<td>19.09</td>
<td>2621.46</td>
<td>13.73</td>
</tr>
<tr>
<td>Total</td>
<td>77.91</td>
<td>10609.75</td>
<td>54.47</td>
</tr>
<tr>
<td>Average</td>
<td>19.47±0.2</td>
<td>2652.43±23.39</td>
<td>13.62±0.07</td>
</tr>
</tbody>
</table>

**Ratio of Energy - Protein**

Fairly high protein needs (19.47%) and decreased metabolic energy requirements (2652.43 kcal.kg⁻¹) is highly suitable for the tropics area as reported by Almeida et al. (2012) which revealed that the increasing of ambient temperature causes the poultry
required less energy, but required a higher protein. Especially for the fibrous feed, the high protein content more improving the productivity of poultry (Janssen and Carre, 1989) including the ever studied Alabio duck (Biyatmoko, 2004; Biyatmoko, 2005; Darmawati, 2007).

The ratio of Energy - Protein (E/P) is 13.62 (2652.43 kcal.kg⁻¹: 194.7 g.kg⁻¹) (Table 3). It is still within the range reported for layer ducks, i.e. 12-14 (Ketaren, 2002), and this ratio approached proper ratio proposed by Pooponpan (2011), which ranged 14.5-16. Pooponpan (2011) and Lloyd et al. (1978) stated that essentially, feeding for layer ducks should take notice to the contained energy-protein ratio (E/P), then extends to the next growth phase, and then re-narrowed at the time and after the eggs lay. Error in calculating the ratio of EP increased the feed cost (Khanun et al., 2005) and brought more profit for duck breeders (Wang et al., 2010).

Acknowledgements
The author thanks to Simlitabmas DP2M Dikti for funding this study.

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