Effect of Mung bean as Local Feed Ingredients to Substitute Soybean Meal in the Diet on the Performance of Broilers

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ABSTRACT

In response to feed antibiotics ban and feed security, a research was carried out to study the effect of local feed ingredients in the diet based on corn or sorghum in combination with soybean meal or mung beans on broilers performance. A completely randomized design with 4 treatments and 5 replicates was employed. Each replicates consisted of twelve birds. Two hundreds and forty day old broiler chicks with initial body weight of 45.85 ± 3.01 gr were randomly assigned into four treatment diets i.e. D-1 (diet based on corn and soybean meal), D-2 (diet based on corn and mung bean), D-3 (diet based on sorghum and soybean meal), D-4 (diet based on sorghum and mung bean). Isoenergy and isoprotein diet and water were given ad libitum. Body weight, feed consumption, feed conversion ratio, apparent metabolizable energy (AME), protein digestibility, and protein efficiency ratio were measured and determined on day 35. All data were analyzed by ANOVA, and Duncan’s multiple range test was conducted when means were significantly different (p<0.05).

The results showed that local feed ingredients in the diet affect significantly all performance parameters of broilers except for protein digestibility. Diet-1 had the highest body weight and AME. Diet 2 and 4 had similar AME and lower than Diet 1 and 3. Diet-1, 2, and 4 had similar feed conversion ratio. Diet-3 had the lowest consumption and feed conversion ratio and the highest protein efficiency ratio. However, considering the ability of mung bean to substitute imported soybean meal, it can be concluded that Diet-2 or Diet-4 with similar feed conversion to Diet-1 can be used as local feed ingredients to substitute imported soybean meal. Further research is needed to optimize these local feed ingredients to support broiler performance.

Keywords: local feed, sorghum, mung beans, soybean meal, broiler, performance

INTRODUCTION

Feed ingredients accounts for approximately 70% of total cost in broilers production. Corn and soybean meals are the most common feed ingredients used in broilers diet worldwide including in Indonesia, and such diet creates global dependency and demand on “single” feed ingredients. Alternatives to corn and soybean meal have been suggested, encouraging diversity and flexibility in feed formulation and feed resources to sustain local poultry production (Utomo, 2009; Leary, 2009; Sodiq, 2009).
One of locally available vegetable protein is mung bean which are abundantly available in Central Java during the harvest season. Mung bean protein content varies from 22-25% and it can be used as feed ingredients (El Khimsay et al., 1998; Indriani and Murwani, 2005). Other locally available grain is sorghum which has been well studied to substitute for corn and contains a potent antioxidants poliphenolic tannin (Awika and Rooney, 2004; Awika et al., 2000; 2005; Hikosaka et al., 2006). The use of locally available feed grains such as corn, sorghum, or mung beans provide not only macro- and micro-nutrients but also other bioactive nutrients such as carotenoids in corn and mung beans, and poliphenols in sorghum and mung beans.

The antioxidant and immunomodulating properties of carotenoids and poliphenols have been well demonstrated. They can affect immune response by protecting against oxidative stress and lipid peroxidation, improving humoral and cellular immune response indicated by increase in B and T cell proliferation (Bendich, 2004; Chew, 2004; Scalbert et al., 2005; Hikosaka et al., 2006). Such naturally occurring bioactive nutrients in feed ingredients such as mung bean and sorghum in the diet conceivably could also exert immunomodulating function in vivo. Several studies using such local feed ingredients have been shown to improve antibody titres against NDV vaccination (Muwani, 2008a; 2008b; Murwani and Murtini, 2009) and provide relevance approach in response to in-feed antibiotic ban. However such application pose a new challenge to obtain optimal or best performance.

The following study was carried out to investigate local feed ingredients i.e. corn or sorghum in combination with mung bean to substitute soybean meal in the diet on the performance of broilers. The results of this study added weight in the importance of optimizing broilers diet based on local feed ingredients to substitute competing protein source such as soybean meal, MBM, PMM, and CGM in broilers diet and may contribute to local feed empowerment.

**MATERIALS AND METHODS**

**Birds and Diets**

All feed ingredients were obtained from local feed producers except for soybean meal which was obtained from commercial feed producers. Corn, sorghum and mung bean were obtained in grain form with moisture content around 10 to 11%. These feed ingredients were
ground separately and stored in clean water tight plastic drum until mix. They were also checked for the presence of mycotoxin under UV light and no mycotoxin was detected.

A total of 240 Ross CP 707 one day old unsexed broilers with body weight 45.58 ± 3.01 g were used in this experiment. They were given free access to sugar containing water at their arrival. The experimental chicks were then selected randomly and assigned into 4 large groups in floor pen (in a warm brooder) with 50 birds in each group so that each group has similar average body weight. The groups were given the following treatment diets: D1 (diet based on corn and soybean meal), D2 (diet based on corn and mung bean), D3 (diet based on sorghum and soybean meal), D4 (diet based on sorghum and mung bean). Mung beans were used to replace soybean meal (Table 1). Local fish meal and rice meal were added to complete and formulate the diets so it meets nutrient requirement for broilers. Chicks were given ad libitum access to the diet and drinking water. Antibiotic-free vitamin and mineral mixture were given through drinking water and diet respectively to meet micronutrients needs (Murwani, 2008a; 2008b). On day 7, the birds from each large group were further allocated randomly into 5 replicates with 12 chickens in each replicate. Birds were vaccinated with commercial NDV La Sota vaccine (Medion) on day-4 via eye drop and on day-21 intramuscularly (inactive vaccine). The dose and vehicle of vaccine was used according to instruction sheet. Intramuscular route was given by technical personnel from Local Veterinary Health Office with automatic injector so that each bird received the same amount of NDV vaccine. The experiments were performed in an open broiler-house at the Faculty facilities with similar condition as that used by most small to medium scale broiler chicken producers in the region (Murwani and Bayuardhi, 2007).

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Diet 1 (D1)</th>
<th>Diet 2 (D2)</th>
<th>Diet 3 (D3)</th>
<th>Diet 4 (D4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>43.0</td>
<td>12</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sorghum</td>
<td>-</td>
<td>-</td>
<td>44</td>
<td>11.5</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>21.5</td>
<td>-</td>
<td>22</td>
<td>-</td>
</tr>
<tr>
<td>Mung-beans</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>50.5</td>
</tr>
<tr>
<td>Rice meal</td>
<td>20</td>
<td>20</td>
<td>13.5</td>
<td>19</td>
</tr>
<tr>
<td>Fish meal</td>
<td>15.5</td>
<td>18</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Coconut oil</td>
<td>-</td>
<td>-</td>
<td>0.5</td>
<td>-</td>
</tr>
</tbody>
</table>
Nutrient Contents :

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>Treatment 3</th>
<th>Treatment 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td>20.10</td>
<td>20.06</td>
<td>20.04</td>
<td>20.04</td>
</tr>
<tr>
<td>Crude lipid</td>
<td>4.92</td>
<td>4.07</td>
<td>4.39</td>
<td>3.85</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>2.91</td>
<td>3.27</td>
<td>2.81</td>
<td>3.26</td>
</tr>
<tr>
<td>Metabolic energy</td>
<td>2980.1</td>
<td>2980.8</td>
<td>2967.9</td>
<td>2966.9</td>
</tr>
</tbody>
</table>

1. Vitamin contents per kg vitamin mix (Medion) : 6000000 IU vitamin A, 1200000 IU vitamin D3, 2.5 IU vitamin E, 3 g vitamin K, 2 g vitamin B1, 3 g vitamin B2, 1 g vitamin B6, 2 mg vitamin B12, 20 g vitamin C, 15 g Nicotinate acid, 5 g Ca-D Pantothenate, 750 g Na, Ca, K and Mg electrolite. This mix was used at 1g/l drinking water according to recommended instruction.

2. Mineral contents per kg mineral mix (Medion): 32.5% Ca, 10% P, 6 g Fe, 4 g Mn, 0.075 g I, 0.3 g Cu, 3.75 g Zn, 0.5 g vitamin B12, 50000 IU vitamin D3. This mix was used at 20 g/kg diet according to recommended instruction.

3. Based on feed composition table (Hartadi et al., 1986) and verified by proximate analysis.

4. Based on feed composition table (Hartadi et al., 1986).

**Determination of Broilers Performance**

Body weight of birds from each replicates were weighed weekly on 5 kg scale. Feed consumption was recorded everyday by substracting the amount of feed given per day (ad libitum) to each replicate birds with the amount remained. Feed conversion ratio was calculated from feed consumption divided by final body weight.

**Metabolic Energy**

Apparent Metabolizable Energy (AME) values of each treatment diets were determined in a classical energy balance study involving measurements of total feed intake, total excreta output during feeding, and subsequent measurement of gross energy values of feed and excreta by bomb calorimetry. As the treatment diets were fed from day one, the excreta for AME values were collected for 24 hr. Prior to excreta collection birds were fasted to void the excreta from previous feeding. Gross energy values of dried excreta and feeds were measured with a Parr bomb calorimeter(Parr Instrument Company, USA). The AME of treatment diets were calculated by subtracting the total energy intake from feed with the energy of excreta.

**Protein Digestibility**

Protein digestibility was calculated from the following equation : (N in feed – (N in excreta-N-endogenous))/ (N in feed) x 100%. N in feed and excreta was analysed by Kjeldahl method.
Protein Efficiency Ratio (PER)

PER was calculated by dividing body weight to protein consumption. Protein consumption was obtained from feed consumption x protein content in feed.

Statistical Analysis

A completely randomized design with 4 treatments and 5 replicates was employed. All data were analyzed by ANOVA, and Duncan’s multiple range test was conducted when means were significantly different (p<0.05).

RESULTS AND DISCUSSION

Figure 1 showed that treatment diets affected significantly feed consumption (p<0.05). Broilers with corn-soybean meal base diet (D1) had the highest average feed consumption followed by corn-mung bean (D2), sorghum-mung bean (D3), and the lowest one sorghum-soybean (D4). However corn-soybean meal base diet was not significantly different to corn-mung bean, but significantly higher than sorghum-mung bean and sorghum-soybean base diet (p<0.05). This data indicated that corn base diet either combined with soybean or mung bean has no effect on feed consumption. However sorghum base diet combined either with soybean or mung bean significantly reduced feed consumption. Reduced consumption in sorghum base diet (D3 and D4) led to the effect of tannin containing sorghum.

Tannin sorghum has been well known to reduce feed consumption and body weight gain, reduce intestinal absorption of sugar and amino acids, and increase liver and protein...
catabolism (Marzo et al., 2002). Tannin sorghum in the diet at 1% or 2.5% equivalent to tannic acid resulted in reduce body weight gain and liver protein synthesis and significant increase in liver proteolytic activity (Fuller et al, 1967; Badawy, et al., 1969; Marzo et al., 2002). On the other hand raw red sorghum can be used up to 33% (0.475% tannin) in the diet replacing 50% corn with no significant difference in body weight gain and feed intake (Mandal et al., 2005, Kumar et al., 2005, 2007). Tannin contents in sorghum-soybean base diet (D3) and sorghum-mung bean (D4) in our experiments were approximately 0.43% and 0.13% respectively. These level of tannin were lower than previous findings, however it had affected significantly on feed consumption. The lowest consumption was found in sorghum-soybean base diet in which tannin content from sorghum was highest i.e. 0.43%. Tannin can interact with salivary protein leading to astrigency which resulted in low palatability and hence low consumption (Nyachoti et al., 1996; Bennick, 2002). Furthermore, sorghum base diet can increase the requirement for essential amino acids such as lysine and methionine. In high tannin sorghum lysine is the first and methionine is the second limiting amino acid showing decrease availability of essential amino acids when tannin content in sorghum increased (Ebadi et al., 2005). There is also an increase of endogenous loss of these essential amino acids by tannic acid (Mansoori and Acamovic, 2006). Our results support this possibility as we did not add essential amino acids i.e. lysine and methionine in our experimental diets which could led to essential amino acid imbalance.

The combination of sorghum-mung bean or sorghum-soybean meal may also increase the requirement for micronutrients such as calcium. Dietary tannins have been shown to transiently alter apparent calcium absorption (Chang et al., 1994). Mung bean is known to contain antinutrients such as phytic acid and other phenolic substance which can bind to minerals such as calcium, leading to reduce availability of this mineral absorption (Chitra et al., 1996, Mubarak, 2005). Such reduce availability of calcium in mung bean and sorghum or their combination in broilers diet could increase mineral requirement which could not be met by the mineral mixture added in the diet. In overall, reduce feed consumption is a consequences of antinutrient content, low availability of essential micronutrients, as well as nutrients imbalance.
Reduce feed consumption in broilers fed sorghum base diets i.e. D3 and D4 was followed by similar pattern of reduce body weight (Figure 2). Reduce body weight therefore is a consequence of reduce feed intake, as body weight is a reflection of muscle or protein synthesis in broilers. All factors affecting reduce feed consumption apply for reduce body weight. The amount of major nutrients, low availability and provision of limiting amino acids and calcium important for protein accretion led to decrease in body weight.

Interestingly, broilers fed sorghum-soybean base diet (D3) had the lowest or best feed conversion ratio, followed by the other three treatment diets which were not significantly different to one another (Figure 3). This FCR may reflect birds attempt to compensate nutrient imbalance by lowering feed intake and effectively use it for growth. Therefore the lowest feed consumption in D3 divided by final weight which is also lowest of all treatment produced the lowest FCR.
AME was significantly affected by treatment diets, with corn-soybean meal base diet (D1) having the highest value followed by sorghum-soybean meal, and the lowest value in corn-mung bean and sorghum-mung bean base diet. These results indicated that the use of mung bean to substitute soybean meal in broilers diet resulted in lower AME value. As AME value represents energy derived from feed that can be used for broilers need, this result indicated that the energy derived from mung bean containing diets (D2, D4) were lower than soybean containing diets. Lower AME from former diets could be due to lower digestibility of nutrients in mung bean associated with disturbance of gastro-intestinal enzymatic activities. This disturbance could be due to antinutritional contents in mung bean such as antitrypsin, phytic acids and poliphenolic compounds which can interfere with the action of digestive enzymes. However, such anti nutritional compounds were also found in sorghum, but AME value in sorghum-soybean base diet (D-3) was higher compare to sorghum-mung bean base diet, inspite of the fact that the percentage of sorghum in D-3 was higher than D-4. This led to the possibility that there was indigestible constituents in mung bean which can not be digested by the host digestive enzymes. This possibility is supported by several studies which showed that mung bean contained indigestible carbohydrates which could certainly lower its digestibility (Machaiah et al., 2005; Mubarak, 2005; Aman, 2006).
Protein digestibility determination showed that there was no significant difference among treatments. This result indicated that from overall protein content in each diet which came from vegetable protein either soybean meal or mung bean together with animal protein i.e. fish meal provided similar digestibility. However, it should be noted that the numerical value of digestibility in sorghum-soybean meal base diet was lowest followed by sorghum-mung bean base diet, although not statistically different. This must be born in mind when future optimization is to be made.

Protein efficiency ratio determination showed a similar pattern as FCR. This again indicated that broilers had made attempts to efficiently use protein intake into muscle protein accretion in spite of antinutrient effect of sorghum in diet D3 which is higher than D4.

CONCLUSIONS

Mung bean can be used to replace soybean meal in corn-mung bean or sorghum-mung bean base diet with important note. As final body weight and AME of corn-mung bean or sorghum-mung bean base diet are still lower than corn-soybean meal base diet, this problem must be solved and the possible source of this shortcoming must be found. On the basis of this shortcoming our recent attempts to optimize mung bean as substitute for soybean meal have made a good progress where body weight gain of corn-mung bean base diet is nearly the same as the body weight of broilers fed commercial diets (Murwani, 2009).
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