Growth Performance and Lipids Profile of Meat of Native Chicken Fed with Feed Substituted with Fermented Banana Peel

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ABSTRACT

This study aims to determine the growth performance, and lipids profile of meat native chicken fed substitution fermented banana peel in feed. Using a completely randomized design, male native chickens (n=200) were randomly distributed into four treatment groups (5 replicates with 10 chickens per replicate). The treatments consisted of T1 (basal diet without substitution), T2, T3, and T4 substitution of fermented banana peel 5, 10, and 15%, respectively. The results showed that the nutrient digestibility of the feed was not affected by the substitution treatment of fermented banana peel in the feed. The performance of native chickens increased significantly (P<0.05) in the feed treatment with fermented banana peel substitution by up to 10%. Dietary substitution with supplementation of banana peel in native chickens decreased the total cholesterol, triglycerides, and HDL levels. It may be concluded that the fermented banana peel can be used as an alternative nutrient in native chicken feed, increasing productivity.

Key words: Banana peel, Digestibility, Lipid, Performance, Native chicken.

INTRODUCTION

The Indonesian poultry sector plays an important role in improving the status of food security. Both commercial and small-scale poultry companies are growing rapidly, thereby increasing the demand for poultry feed. The poultry industry is a contributor to the national economy, supplies 65% of the total animal protein needs, and employs 10% of the national labor force.

Indonesia is a country that is rich in the genetic resources of native chickens. There are 31 native chickens breeds in Indonesia. Native chickens are generally kept in many areas of Indonesia and play an important role in providing animal protein for the community (Henuk and Bakti 2018). People usually raise native chickens for religious, feed, ornamental, and trade purposes. Native chicken products are very popular in many areas of Indonesia and play an important role in improving the status of food security. Both commercial and small-scale poultry companies are growing rapidly, thereby increasing the demand for poultry feed. The poultry industry is a contributor to the national economy, supplies 65% of the total animal protein needs, and employs 10% of the national labor force.

Indonesia is a country that is rich in the genetic resources of native chickens. There are 31 native chickens breeds in Indonesia. Native chickens are generally kept in many areas of Indonesia and play an important role in providing animal protein for the community (Henuk and Bakti 2018). People usually raise native chickens for religious, feed, ornamental, and trade purposes. Native chicken products are very popular in the Indonesian market, so in Indonesia, the price of native chicken meat is higher than broiler meat. This is because the chicken meat has a certain texture, preferred taste by most of the Indonesian people (Hidayat and Asmarasari 2015).

Chicken meat is one of the most consumed food products of animal origin throughout the world (Abdel-Naeem et al. 2022) and chicken meat is acceptable to many religions (Pas et al., 2020). The increased demand for meat-type chicken has had a direct effect on the price of feed (Diarra 2018). The main constraint of poultry production is the high cost of commercial diet (Abdelnour et al. 2018). The cost of feed has always been a significant problem in the production of native chickens. Production costs continue to increase due to fluctuations in the price of raw materials such as soybeans, corn, and others and their availability is often disrupted because some of the materials are imported.

Lately, consumers are increasingly selective in choosing animal meat as food. The main concern is the reduction of individual energy intake, prevention of foods with high fat and carbohydrate content. Also, texture, tenderness, smell, and taste are the most important features of meat that influence consumer judgment before buying meat products (Mir et al. 2017). The high-fat content in foodstuffs tends to be a major consideration to avoid being consumed. High-fat content is a source of cholesterol and this can have an impact on health. Consumers are interested in meat that can contribute to their satisfaction (Mickvand et al. 2022). Consumers prefer the meat of chicken

exclusively fed with vegetable sources because vegetable waste could be improved lipid oxidation status (Raza et al. 2019). Due to health and cost considerations, several initiatives have been put in place, such as finding cheaper and locally available materials as a feed supplement in chicken diets (Azizi et al. 2021).

Most agricultural industries produce large amounts of residue every year. The waste materials have great potential in biomass with valuable solutions to animal nutrition problems (Mechkirrou et al. 2021). In Indonesia, waste agro-industrial products including bananas are found in abundance. A large quantity of peel is produced from the processing of bananas. Banana peel contains high crude fiber, crude fat and carbohydrate (Hassan et al. 2018; Hassan and Peh 2018), are high in β-carotene content (Budhalakoti 2019) as an antioxidant that functions to inhibit the formation of cholesterol and also rich in many health-promoting bioactive phytochemicals (Sidhu and Zafar 2018).

The phytochemical content in banana peels is proven to have antimicrobial and antioxidant properties (Padam et al. 2014). It has abundant phenolic content, including flavan-3-ols and flavanols. In dried banana peel powder, there are catechins, epicatechins, gallocatechin and procyanidins (Vu et al. 2018). The beta-carotene in banana peel flour can function as an antioxidant (Sad et al. 2018; Abdel-Naeem et al. 2022) so that it can prevent the oxidation of unsaturated fatty acids and produce meat products with good fatty acid composition. This study was planned to investigate the effects of the fermented banana peel on the performance and lipids profile of native chickens.

MATERIALS AND METHODS

Ethical Approval

This experimental protocol used in this research was approved by the Animal Ethics Committee, Faculty of Veterinary Medicine, Udayana University, Indonesia with an approval number. B/26/UN14.2.9/PT.01.04/2021.

Experimental Design and Animal Management

A total of 200 male native chickens and weighed individually. The chicken was vaccinated according to standard veterinary practices. The chicken was randomly distributed into four treatment groups (5 replicates with 10 chicken per replicate) using a completely randomized design. The treatments consisted of T1 (basal diet without substitution), T2 (substitution of fermented banana peel 5%), T3 (substitution of fermented banana peel 10%), and T4 (substitution of fermented banana peel 15%). The diets were formulated to meet the nutrient requirements of native chicks (Table 1).

The compositions of the diets are shown in Table 1. The diets contain ingredients yellow corn, coconut cake, fish meal, tapioca flour, soybean flour, fermented banana peel, rice bran, coconut oil, NaCl, and mineral mix. Diets were formulated to the same energy content (2800 kcal/kg) and the same protein content (17.5%).

Nutrient Digestibility

The fresh feces were collected from chicken in the morning and air-dried in the sun. The feces were baked for 5 days at 100-105 °C. The baked dried feces were used for analysis. Energy content in dry roasted feces was measured using a bomb calorimeter and protein excretion was measured by Kjeldhal analysis. Nutrient digestibility was calculated as follow:

\[ KC = \frac{(A - B)}{A} \times 100\% \]

**Description:**

KC: Nutrient Digestibility (%)
A: Consumption of nutrients (g)
B: Amount of nutrients in feces (g)

Meat Lipid Profiles

The total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides were measured enzymatically in meat using according to the Boehringer method (1996).

Chicken Performance

Body weight gain is calculated as the bodyweight difference between the weight of the chickens at the end and the beginning of the weight during each of the weighing periods. Feed consumption is the quantity of feed ingested by chicken during the experiment. Feed consumption was calculated as taking at a total amount of feed given and refusal was subtracted from offered. Feed Conversion Ratio (FCR) was estimated based on the ratio between weight gain and feed consumption.

Statistical Analysis

Data obtained were analyzed using the general linear model (GLM) and was performed with a software program IBM SPSS Statistics 25. The Least Significant Difference (LSD) test was applied to compare the differences means.

RESULTS

**Growth Performance**

The dry matter digestibility, efficiency of converting GE to DE, and crude protein digestibility were not affected (P>0.05) by substitution of fermented banana peel into diets native chickens (Table 2). The results showed that chickens were given feed treatment without substitution of fermented banana peel (T1) caused dry matter digestibility 73.35%, feed treatment with fermented banana peel substitution 5% (T2), 10% fermented banana peel substitution (T3), and fermented banana peel substitution 15% (T4) were 73.93, 74.38 and 74.04%, respectively (Table 2).

Chicken body weight at the beginning of the study that received T1 (feed treatment without fermented banana peel supplementation), T2, T3, and T4 were 101.57g; 103.56g; 105.63g and 100.05g respectively. The initial body weight of chicken in T1, T2, T3, and T4 were not different (P>0.05). This indicates that the chicken presented a uniform body weight at the start of the experiment. After 10 weeks, the body weight in T1, T2, T3, and T4 were 745.62g, 845.34, 852.95, and 759.39, respectively (Table 3). The results revealed that the group fed a substitution with fermented banana peel had a higher significance in body weight compared with T1 (without substitution with fermented banana peel) (P<0.05). The effect of treatment with the substitution of a fermented banana peel on weight gain is presented in Table 3. Chicken fed with substitution fermented banana peel 15% in diets had similar weight gain
Table 1: Ingredients and nutrient content of experimental diet

<table>
<thead>
<tr>
<th>Composition (%)</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Corn</td>
<td>34.4</td>
<td>40</td>
<td>38</td>
<td>28</td>
</tr>
<tr>
<td>Coconut Meal</td>
<td>10.9</td>
<td>13</td>
<td>13</td>
<td>9.9</td>
</tr>
<tr>
<td>Fish flour</td>
<td>15.2</td>
<td>14.6</td>
<td>13.2</td>
<td>15</td>
</tr>
<tr>
<td>Tapioca flour</td>
<td>12.6</td>
<td>6.7</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Soy Flour</td>
<td>11.6</td>
<td>10.5</td>
<td>12</td>
<td>11.5</td>
</tr>
<tr>
<td>Fermented Banana Peel</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Rice Bran</td>
<td>13.5</td>
<td>6.5</td>
<td>1.8</td>
<td>3.8</td>
</tr>
<tr>
<td>Coconut oil</td>
<td>1.1</td>
<td>2.9</td>
<td>4.2</td>
<td>8</td>
</tr>
<tr>
<td>NaCl</td>
<td>0.25</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Mineral Mix</td>
<td>0.44</td>
<td>0.9</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2: Digestibility of nutrients in native chickens fed with fermented banana peels with different levels

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Matter Digestibility (%)</td>
<td>73.35a</td>
<td>73.93a</td>
<td>74.38a</td>
<td>74.04a</td>
<td>1.89</td>
<td></td>
</tr>
<tr>
<td>Efficiency of Converting GE to DE (%)</td>
<td>84.38a</td>
<td>84.89a</td>
<td>85.78a</td>
<td>85.34a</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>Crude Protein Digestibility (%)</td>
<td>70.2a</td>
<td>70.91a</td>
<td>71.58a</td>
<td>71.03a</td>
<td>0.98</td>
<td></td>
</tr>
</tbody>
</table>

Feed treatment without fermented banana peel supplementation (T1); fermented banana peel supplementation 5% (T2); 10% fermented banana peel supplementation (T3); 15% fermented banana peel supplementation (T4). Values bearing same letters in a row differ significantly (P<0.05).

Table 3: Performance of native chickens fed with fermented banana peels at different levels

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Body Weight (g)</td>
<td>101.57a</td>
<td>103.56a</td>
<td>103.43a</td>
<td>100.05a</td>
<td>1.74</td>
<td></td>
</tr>
<tr>
<td>Final Body Weight (g)</td>
<td>745.62b</td>
<td>845.34a</td>
<td>852.95a</td>
<td>759.39b</td>
<td>22.67</td>
<td></td>
</tr>
<tr>
<td>Weight Gain (g/day)</td>
<td>11.50b</td>
<td>13.25a</td>
<td>13.38a</td>
<td>11.77b</td>
<td>0.47</td>
<td></td>
</tr>
<tr>
<td>Feed Consumption (g/bird/day)</td>
<td>33.93b</td>
<td>38.56a</td>
<td>38.67a</td>
<td>34.84b</td>
<td>1.22</td>
<td></td>
</tr>
<tr>
<td>Feed Conversion</td>
<td>2.95a</td>
<td>2.91a</td>
<td>2.89a</td>
<td>2.96a</td>
<td>0.16</td>
<td></td>
</tr>
</tbody>
</table>

Feed treatment without fermented banana peel supplementation (T1); fermented banana peel supplementation 5% (T2); 10% fermented banana peel supplementation (T3); 15% fermented banana peel supplementation (T4). Different letters in the same line showed significant differences (P<0.05).

Table 4: Cholesterol of native chicken meat treated with feed treatment with fermented banana peels substitution with different levels

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cholesterol (10%mg/dL)</td>
<td>145.07a</td>
<td>88.93b</td>
<td>92.85b</td>
<td>78.09b</td>
<td>34.18</td>
<td></td>
</tr>
<tr>
<td>Triglycerides (mg/dL)</td>
<td>80.17a</td>
<td>74.11b</td>
<td>73.85b</td>
<td>76.01b</td>
<td>8.84</td>
<td></td>
</tr>
<tr>
<td>HDL Cholesterol (mg/dL)</td>
<td>38.18a</td>
<td>33.35b</td>
<td>32.86b</td>
<td>31.16b</td>
<td>4.87</td>
<td></td>
</tr>
<tr>
<td>LDL Cholesterol (mg/dL)</td>
<td>90.86a</td>
<td>90.76a</td>
<td>89.42a</td>
<td>88.73a</td>
<td>13.78</td>
<td></td>
</tr>
</tbody>
</table>

Feed treatment without fermented banana peel supplementation (T1); fermented banana peel supplementation 5% (T2); 10% fermented banana peel supplementation (T3); 15% fermented banana peel supplementation (T4). Different letters in the same line showed significant differences (P<0.05).

compared to the chicken fed without substitution with banana peel (P>0.05). Substitution diets with 5% and 19% fermented banana peel significantly (P<0.05) influenced weight gain.

Chicken fed with substitution fermented banana peel 15% in diets had a similar feed consumption rate compared to the chicken fed without substitution with banana peel (T1). Substitution diets with 5% and 19% fermented banana peel significantly (P<0.05) influenced feed consumption. Feed conversion was not affected (P>0.05) by substitution of fermented banana peel into diets native chickens (Table 3).

Meat Lipid Profiles

As presented in Table 4, the substitution of basal diets with fermented banana peel affected total cholesterol, triglycerides, and HDL Cholesterol of native chicken (P<0.05). Fermented banana peel decreased total cholesterol, triglycerides and HDL Cholesterol significantly. The LDL cholesterol was not affected by substitution diets with fermented banana peel (P>0.05).
DISCUSSION

In this study, the dry matter digestibility, efficiency of converting GE to DE, and crude protein were similar with the treatment without substitution with a fermented banana peel. In the present study, the comparative effect of banana peels on the dry matter digestibility, efficiency of converting GE to DE, and crude protein were non-significant. The results of the present study are different from those reported by Abel et al. (2015), who reported that the treated banana peels on the digestibility. This study indicated that the similar digestibility of banana peel due to the native chicken can digest the nutrients in the feed.

The results of the productive performance (Table 3) showed that the final live weight increased significantly (P<0.05) as the level substitution of 5 and 10% banana peel, however increasing level of banana peel have effect decreasing the body weight. Also, the increasing weight gain trend until level substitution 10% banana peel. The fermented banana peel could be used maximally 10% in broiler ration (Koni 2013). The substitution of 5 and 10% banana peel provider adequate non-fiber carbohydrates. The higher non-fiber carbohydrates in banana peels have an increasing effect on body weight (Pimentel et al. 2017). Banana is rich in carbohydrates (22.84g/100g), provides energy of about 370kJ/100g, and is considered to be one of the best sources of potassium (358mg/100g) (Ranjha et al. 2022).

The decreasing of final body and weight gain in native chicken treated with 15% banana peel could be due to the effect of the increasing levels of the banana peel in the diet. The substitution of up to 10% fermented banana peels causes an increase in the crude fiber content of the feed which can also reduce the palatability of the feed which in turn affects the decreased body weight gain. The lowering value could be due to the inability of the birds to digest the nutrients more than 10% substitution of banana peel. The result of this study is in line with the report, that stated banana peel meal can be added up to 10% to broiler chicken diet without any adverse effect on the performance of the birds (Duwa et al. 2014; Abel et al. 2015). In contrast, reported in rabbits, the effect of banana peels on the bodyweight of male growing rabbits was not significantly changed (Rehman and Shah 2020). Also different in cattle, feeding 60% banana peel in diets represents a viable alternative as it causes no change in cows with average production (Pimentel et al. 2017).

Fermented banana peel substitution up to 15% level in the feed causing a decrease in the use of other ingredients that could decrease the palatability of the feed. The substitution of up to 15% fermented banana peels causes an increase in the crude fiber content of the feed which can also reduce the palatability of the feed. This research is also supported by the research results of Nuriyasa et al. (2020). Feed consumption was closely related to feeding palatability. The higher the palatability of the feed, the higher the feed consumption. Palatability is a performance property of feed ingredients as a result of their physical and chemical properties. Differences in feed consumption are influenced by feed quality, feed palatability, and processing (Wahju 2015). The feed consumption will affect the growth rate and final weight because the formation of weight, shape, and body composition is essentially an accumulation of nutrients consumed with crude fiber feed which can also reduce feed delicacy.

In the current study, the native chicken was fed with diets where substitution of banana peel showed a positive effect on the total cholesterol, triglyceride, and HDL cholesterol. Substitution with banana peel up to 15% revealed a decrease in the total cholesterol, triglyceride, and HDL cholesterol level in the chicken while LDL levels were similar compared with feeding diets without the banana peel. The crude fiber contained in the banana peel can bind fat thereby increasing the excretion of fat through feces. Consequently, blood cholesterol is lowered. In the present study, lowering of total cholesterol, and triglyceride, and no significant effect in LDL levels indicate the anti-atherosclerotic effect of supplemental banana peel. Antioxidant compounds contain in banana act to reduce the risk of diseases like cardiovascular diseases (Siji and Nandini 2017). Banana peels are known to contain ß-sitosterol, malic acid, succinic acid, palmitic acid, 12-hydroxy stearic acid, glycoside, which act as an anti-cholesterol (Mokbel and Hashinaga 2005) and has a high antioxidant capacity. (Chuang et al. 2019). The banana peel has considerable antioxidant activity and can be employed in animal feed for variant health enhancement uses (Bashmil et al. 2021).

Similar results were reported by Chuang et al. (2019) in terms of cholesterol and triglycerides levels were decreased in native chickens fed dietary fermented banana peel. This is consistent with result of the study in mice that banana peel proved to decrease total cholesterol (Berawi and Bimandama 2018). These findings are contrary to those reported by Haryanto et al. (2017) who reported that supplementation of banana peel was not significantly changed in the total cholesterol and increased triglyceride levels in broiler chicken. The differences in results might be due to the difference in chicken breeds. It is thus clear that bananas as much as the flesh compartments have a host of nutritionally and pharmacologically significant values to chicken diets, health, and dietary quality (Oyeyinka and Afolayan 2020).

Conclusion

It was concluded that the substitution of fermented banana peel into native chicken feed had may improve the growth performance. In addition, supplementation of banana peel in native chickens decreased the total cholesterol, triglycerides, and HDL level.

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Authors Contribution

IMN and AWP designed, executed the research, and wrote the manuscript. IKP all authors contributed equally to the writing of the final manuscript.

Conflict of Interest

The author declares no potential conflict of interest in this research.
REFERENCES