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FERMENTED PURPLE SWEET POTATO IN THE RATIONS ON CARCASS IMPROVEMENT, ANTIOXIDANT PROFILE, MEAT AND EGGS LIPID PROFILE OF BALI DUCKS

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ABSTRACT

This study aims to determine the effort of fermented purple sweet potato in the rations to improve carcass, antioxidant profile, meat and eggs lipid profile of bali ducks. Completely randomized design with three treatments were used in this study. A total of 60 baliducks were subjected into 3 treatments that provision by rations A: without purple sweet potato, B: with 10% purple sweet potato, C: with 10% fermented purple sweet potato. The experiment using four replications to each treatment which 5 layer ducks as a repetition in each unit of experiment. The experiment were done for 12 weeks. Antioxidant consumption were counted during the experiment. In the end of experiment the ducks were killed and meat antioxidant profile namely antioxidant capacity, malondialdehyde (MDA) and superoxide dismutase (SOD), carcass profile including slaughter weight, carcass weight, carcass percentage, and physical carcass composition (meat, bone, fat including skin) were recorded. Meat and egg lipid profile (total cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL) and triglycerides) were also counted at the end of experiment.

The results showed that fermented purple sweet potato in the rations significantly (p < 0.05) increases the consumption of antioxidants, accompanied by increases in slaughter weight, carcass weight, carcass percentage, and meat percentage. Fermented purple sweet potato in the rations also significantly (p<0.05) reduces the percentage of sub-cutaneous fat and skin. Fermented purple sweet potato improves antioxidant profile by significantly (p < 0.05) increases antioxidant capacity, and superoxide dismutase (SOD), and decreases the levels of malondialdehyde (MDA). Lipid profiles in meat and eggs which characterized by total cholesterol, HDL, LDL and triglycerides were decrease significantly (p<0.05) by fermented purple sweet potato. The research result can be concluded that 10% fermented purple sweet potato in the rations be able to improve the antioxidant consumption, carcass, antioxidant profile, meat and eggs lipid profile of first laying phase of bali ducks.

Keywords: fermented purple sweet potato, antioxidant, meat and egg lipid profile, baliducks.
INTRODUCTION

The needs of animal protein increases from year to year along with the increases of population growth. Animal protein can be obtained from ruminant and non-ruminant livestock including poultry such as duck. Meat and eggs are the main source of animal protein. Meat and eggs can get from the duck. But the old of twelve weeks duck meat is a fatty smelling rejected meat (Setyawardaniet al., 2001). Meat with full of fat is adversely for health. Fatty meat tend to contained of high cholesterol levels which positively correlated to atherosclerosis (Hasim dan Yusuf, 2008). To reduce the levels of fat or cholesterol can be done by changing the formulation of rations with the addition of materials or substances that contains antioxidant. Purple sweet potato is one of many substances withcontains antioxidant (Harsojuwono et al., 2011). Purple sweet potato contains protein, fat, calcium, phosphorus, anthocyanin, and antioxidants (Yadnya and Trisnadewi, 2011), and also vitamin A, vitamin E, Zn and Se elements that are as antioxidants (Ishida et al., 2000) reported that increases the nutrient levels of the sweet potato by fermentation, especially the increase of protein content, anthocyaninantioxidants will decreases level of tannin and cellulose. Anthocyanin an antioxidants substances that can bind fat or cholesterol which is partially excreted through the feces, so the fat content of carcass can be reduced. This is due to the provision of fermented purple sweet potato increase protein content and then protein reduce fat retention in 15 weeks old bali ducks (Yadnyaet al., 2012). Decrease fat retention will affect the percentage of fat in the carcass and duck meat production. Yadnya and Candrawati (2004) reported the delivery by leaf powder as a source of antioxidants in the diet can lower carcass fat and blood cholesterol levels in duckling phase of growth. Prangdimurtiet al., (2006) reported the administrations of suji leaves ( Plieomeleongustifolio ) as a source of antioxidants can increase the antioxidant capacity, superoxide dismutase (SOD) and affected on lowering blood cholesterol levels in mice. Yadnya et al., (2009) reported the provision seaweed flour as a source of antioxidants can lower cholesterol levels in the eggs of first nesting phase ducks. This study attempted to find scientific data of the effect of fermented purple sweet potato in rations on carcass improvent, antioxidant profile, lipid profile of eggs and meat in first nesting phase of bali duck. Its due to the lack of relevant information with the use of fermented purple sweet potato flour in the diet of bali ducks on the nesting phase appearance.

MATERIAL AND METHODS

Place and period of experiment.

The experiment was conducted for 12 weeks at Guwang village, Gianyar regency, Bali. The determination of antioxidant capacity in the rations was conducted in the Laboratory of Chemical and Microbiology, Faculty of Agricultural Technology, Udayana University for 4 weeks. Meat antioxidant profile analysis was conducted in the Analytic Laboratory of Udayana University for 4 weeks. Carcass analysis was conducted in the Laboratory of Animal Technology Product for 2 weeks. Meat and egg lipid profile were conducted for 4 weeks in the Feed and Animal Nutrition Laboratory, Faculty of Animal Husbandry, Udayana University.
Material and Equipment.

The experiment using 24 weeks old layer bali ducks, from Ketewel village, Gianyar regency, Bali, which total number of 60 ducks. The rations that used in this study consisted of yellow corn, soybean, copra meal, rice bran, fish meal, purple sweet potato meal, salt (NaCl), and premix. The percentage of each composition were differentiated according to the treatment of the research (Table 1). Fermentation processes using Aspergillusniger.

Table 1. Rations Composition in Each Treatment.

<table>
<thead>
<tr>
<th>Ingredients (%)</th>
<th>Treatment 1)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Yellow corn</td>
<td>55.35</td>
<td>49.98</td>
<td>49.98</td>
</tr>
<tr>
<td>Soybean</td>
<td>9.37</td>
<td>12.45</td>
<td>12.45</td>
</tr>
<tr>
<td>Copra meal</td>
<td>11.30</td>
<td>9.82</td>
<td>9.82</td>
</tr>
<tr>
<td>Fish meal</td>
<td>10.13</td>
<td>8.10</td>
<td>8.10</td>
</tr>
<tr>
<td>Rice bran</td>
<td>13.20</td>
<td>9.00</td>
<td>9.00</td>
</tr>
<tr>
<td>Purple sweet potato meal</td>
<td>-</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Fermented purple sweet potato meal</td>
<td>-</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Premix</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Salt (NaCl)</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
</tbody>
</table>

1) A : Rations without purple sweet potato  B : Rations with 10% purple sweet potato  C : Rations with 10% fermented purple sweet potato.

Table 2. Nutrient Content of the Rations in Each Treatment

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Treatment Rations 1)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Metabolism Energy (Kcal/kg)</td>
<td>2907.07</td>
<td>2878.20</td>
<td>2886.10</td>
</tr>
<tr>
<td>Crude protein (%)</td>
<td>17.03</td>
<td>16.68</td>
<td>16.67</td>
</tr>
<tr>
<td>Crude Fibre (%)</td>
<td>4.56</td>
<td>4.42</td>
<td>4.36</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>5.75</td>
<td>5.92</td>
<td>5.85</td>
</tr>
<tr>
<td>Calcium (%)</td>
<td>1.00</td>
<td>0.94</td>
<td>0.94</td>
</tr>
<tr>
<td>Phosphor avaible (%)</td>
<td>0.60</td>
<td>0.50</td>
<td>0.51</td>
</tr>
<tr>
<td>Cystine (%)</td>
<td>0.30</td>
<td>0.30</td>
<td>0.27</td>
</tr>
<tr>
<td>Lysine (%)</td>
<td>1.37</td>
<td>1.35</td>
<td>1.34</td>
</tr>
<tr>
<td>Methionine (%)</td>
<td>0.52</td>
<td>0.56</td>
<td>0.57</td>
</tr>
</tbody>
</table>

Notes :

1) A : Rations without purple sweet potato  B : Rations with 10% purple sweet potato  C : Rations with 10% fermented purple sweet potato
2) Scott et al. (1982).

Design of the experiment

A completely randomized design was used in this experiment consisted of three treatments and four replications with five repetitions in each unit of experiment for total number of sample were 60 ducks. Composition of the rations (Table 1) different in each treatments consisted of the rations without purple sweet potato (A), rations with 10% purple sweet potato (B), and rations with 10% fermented purple sweet potato. The variables which measured in this study were: antioxidant consumption (g/head) which was counted by assessment of antioxidant concentrations in rations during the experiment, slaughter weight (kg/head): weight of the duck in the end of experiment, carcass weight: slaughter weight minus non-carcass weight (kg/head), carcass percentage: carcass weight divided by slaughter weight in percent, physical composition was measured by counted the weight of meat, bone,
fat including skin divided by carcass weight. Lipid profile of meat and egg determined using Liberman–Burchad method (Plummer, 1977). The data were analyzed statistically with analysis of variance, and further analysis was continued using Duncan test (Steel and Torrie, 1989).

RESULT AND DISCUSSION
Antioxidant Consumption and Carcass

Rations consumed by the ducks fed without purple sweet potato was 10.086 kg/head for 12 weeks (Table 3). The ducks fed with rations containing purple sweet potato and fermented purple sweet potato significantly (P < 0.05) reduce the feed consumption, whereas the consumption of antioxidants increased significantly (P < 0.05). Present of oligosaccharides in purple sweet potato stimulate the growth and proliferations of nonpathogenic bacteria, and competes to decrease the numbers of pathogenic bacteria. Thus increasing the digestibility of the feed with accompanied by increased nutrients absorption, so the energy and other substances needed can be met (Yadnya, 2012). Increased of antioxidants consumption in the treatment B and C due to the presence of anthocyanin as an antioxidants and containing vitamin A, vitamin C, Zn and Se (Ishida et al., 2000). While to increase antioxidant capacity, causes consumption of antioxidants in treatment B and C increased significantly compared with treatment A. Addition of purple sweet potato and fermented purple sweet potato in the rations of treatment B and C increased significantly (P < 0.05) for 5.12% and 8.14% compared with the rations without purple sweet potato in treatment A. Increased slaughter weight in treatment B and C which accompanied by an increase in carcass weight and carcass percentage were significantly different (P < 0.05) compare with the treatment A.

Table 3. Statistical Data Measured in Each Treatment of the Research.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment 1)</th>
<th>Treatment 2)</th>
<th>Treatment 3)</th>
<th>SEM 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed Consumption (kg/Head/12 weeks)</td>
<td>10.086 a, b</td>
<td>9.673 b</td>
<td>9.245 c</td>
<td>0.004</td>
</tr>
<tr>
<td>Antioxidant Consumption (g/Head/12 Weeks)</td>
<td>90.77 c</td>
<td>94.57 b</td>
<td>101.42 a</td>
<td>0.036</td>
</tr>
<tr>
<td>Slaughter Weight (kg/head)</td>
<td>1.425 c</td>
<td>1.498 b</td>
<td>1.541 a</td>
<td>16.73</td>
</tr>
<tr>
<td>Carcass Weight (kg/ head)</td>
<td>0.881 c</td>
<td>0.946 b</td>
<td>1.014 a</td>
<td>33.288</td>
</tr>
<tr>
<td>Carcass Percentage (%)</td>
<td>61.39 b</td>
<td>63.15 b</td>
<td>66.17 a</td>
<td>0.665</td>
</tr>
<tr>
<td>Carcass Physical Composition (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat</td>
<td>40.54 b</td>
<td>43.73 a</td>
<td>44.54 a</td>
<td>0.86</td>
</tr>
<tr>
<td>Bone</td>
<td>29.04 ab</td>
<td>27.81 b</td>
<td>30.20 a</td>
<td>0.53</td>
</tr>
<tr>
<td>Skin and subcutan fat</td>
<td>30.42 a</td>
<td>28.46 b</td>
<td>25.26 c</td>
<td>0.59</td>
</tr>
</tbody>
</table>

Notes:
1) A : Rations without purple sweet potato
   B : Rations contain a 10 % unfermented purple sweet potato
   C : Rations contain a 10 % fermented purple sweet potato
2) Different superscript in the same row are significantly different (P < 0.05).
3) SEM : " Standard Error of the Treatment Means ".


Increase in slaughter weight, carcass weight, and carcass percentage of the ducks fed with rations containing purple sweet potato and fermented purple sweet potato caused by anthocyanin content and enzymes of *Aspergillus niger*, such as cellulase, lipase and proteolytic enzyme in the rations (*Muchtadi et al.*, 1992), which increases the digestibility of the rations and digestibility of nutrients, that led more substances were absorbed which affect and increased the body weight gain. This finding agreed with *Yadnya et al.* (2012) reported that diet containing fermented purple sweet potato to 15 weeks male ducks increase weight gain accompanied by higher slaughter weight compared with duck fed without fermented purple sweet potato. The greater weight cut will affect the larger carcass weight. Carcass weight is strongly influenced by the weight of feathers, blood, leg, head and internal organs (*Yadnya and Candrawati*, 2004).

Carcass weight will affect carcass percentage. Greater carcass weight will result in a greater percentage of carcass. *Morran and Orr* (1977) states that the percentage of carcass is strongly influenced by the strain in addition to giblet meat, livestock size, sex and age. Giving purple sweet potato and fermented purple sweet potato in the ration treatment B and C improve carcass composition at the age of 36 weeks of laying ducks. This proved an increase in meat production and decrease fat carcass is significantly different (*P*<0.05) (Table 3). *Fermentation significantly* (*P*<0.05) increase the protein content of purple sweet potato from 3.83 % to 8.47 % which is accompanied by decrease the fat content of 0.81 % to 0.14 %. Levels of anthocyanin and antioxidants were also significantly (*P*<0.05) increased (*Yadnya and Trisnadewi*, 2011). *Yadnya et al.*, (2012) reported the administrations of fermented purple sweet potato in the diet to 15 weeks old male ducks increase protein retention of 5.60 g/day to 7.85 g/day. This has led to increase meat carcass production. *Kumalaningsih* (2008) suggested that the anthocyanin are antioxidants that can bind fat covalently by cyclical bonding, which in part absorbed and partially excreted through feces, so the carcass fat content decreased significantly. *Roni et al.*, (2010) reported the provision of *Syzygium polyanthum* Walp leaves in diets can increase the production of meat and decrease the fat duck carcass in the growth phase.

**Meat Antioxidant Profil**

*Yadnya* (2013) reported that states the antioxidant profile of meat consists of antioxidant capacity, *Malondialdehida* (MDA) and *Superoxide Dismutase* (SOD) content. Rations containing purple sweet potato and fermented purple sweet potato in treatment B and C may increase antioxidant capacity, SOD and decrease levels of *Malondialdehyde* were significantly (*P*<0.05) compare with control treatment (treatment A).

Table 4. Meat Antioxidant Profile of Bali Ducks Fed with Fermented Purple Sweet Potato in Rations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment 1)</th>
<th>SEM 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
</tbody>
</table>

1) Percent

2) Milieu (mg/g)

3) P.<0.05
Notes:
1) A : Rations without purple sweet potato
   B: Rations contain 10% purple sweet potato
   C: Rations contain 10% fermented purple sweet potato
2) Different superscript in the same row are significantly different (P<0.05).
3) SEM : “Standard Error of the Treatment Means”.

Increased antioxidant capacity of duck meat in treatment B and C, are due the higher of antioxidants consumption compared with treatment A, so that the capacity of antioxidants in treatment B and C was significantly (P<0.05) higher than treatment A. Prangdimurti et al., (2006) reported the administration of sụjileaves (Pleomeleongustifolio) as a source of antioxidants increase the antioxidant capacity and superoxide dismutase (SOD) and decrease the levels of Malondialdehide (MDA). Similar with Sumardika and Jawi (2011) reported that the leaf extract of purple sweet potato increase superoxide dismutase (SOD) and decrease blood cholesterol level of mice. Higher the consumption of antioxidants in treatment B and C, higher the ability to capture free radicals, thus higher antioxidant capacity with higher SOD and lower MDA, so more and more free radicals can be neutralized by antioxidants.

**Meat Lipid Profile.**

Meat lipid profile in the treatment A was 159.5 mg/100g; 143.50 mg/100g; 82.85 mg/100g and 47.95 mg/100g for total cholesterol, triglycerides, HDL and LDL respectively (Table 5). Rations containing purple sweet potato and fermented purple sweet potato in treatment B and C improve the lipid profile. This indicated that the levels of total cholesterol, triglycerides, HDL and LDL were significantly (P< 0.05) lower than the duck provision with treatment A. Decrease in cholesterol levels due to the increase of meat antioxidants consumption, so the ability to inhibit the activity of 3Hydroxy 3Methyl Ko.AGluteryl-reductase enzyme greater to produce mevalonic acid and diminishing hearts disease, and cholesterol distribution into the blood is reduced, so that accumulated cholesterol in the meat were also reduced (Kumalaningsih, 2008). Yadnya (2012) reported rations containing fermented purple sweet potato on a 15-week -old male ducks can lower cholesterol levels significantly.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholesterol Total (Mg/100g)</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>159.5\textsuperscript{a2)}</td>
<td>150.75\textsuperscript{b}</td>
</tr>
<tr>
<td>Triglycerida (Mg/100g)</td>
<td>143.5\textsuperscript{a}</td>
<td>135.5\textsuperscript{b}</td>
</tr>
</tbody>
</table>

Table 5. Meat Lipid Profile of Bali Ducks Fed with Fermented Purple Sweet Potato in Rations
High density lipoprotein (HDL)  82.85 \textsuperscript{a}  81.57 \textsuperscript{ab}  80.65 \textsuperscript{b}  0.59  
Low density lipoprotein  47.95 \textsuperscript{a}  42.07 \textsuperscript{b}  37.45 \textsuperscript{c}  1.01  
(Mg/100g)

Notes :
1)  A : Rations without purple sweet potato  
   B : Rations contain 10% purple sweet potato  
   C : Rations contain 10% fermented purple sweet potato  
2)  Different superscript in the same row are significantly different (P<0.05)  
3)  SEM : “Standard Error of the Treatment Means”.

Figure 1 shows that the administrations of rations containing fermented purple sweet potato (treatment C) significantly (P< 0.05) reduce of total cholesterol level, TGA, HDL, and LDL compared to treatment A or B. This is due the antioxidant consume in treatment C higher than treatment A or B. Hillbom (1999) reported that the antioxidants substances neutralize free radicals so that cholesterol produced in the liver is reduced.

Figure 1. Duck Meat Lipid Profile Fed by Purple Sweet Potato Fermented offered in Rations  
Notes : A : Rations without purple sweet unfermented potato ; B : Rations contain a 10 % purple sweet potato ; C : Rations contain a 10 % fermented purple sweet potato, TK : Total Cholesterol ; TGA : Triglycerida ; HDL : High Density Lipoprotein ; LDL : Low Density Lipoprotein.
The relationship between total antioxidant capacity levels and meat cholesterol concentrations can be described by the equation $Y = 253.84 e^{0.03X}$, where $Y$ is the meat cholesterol levels, and $X$ is the concentrations of antioxidant capacity with $R^2 = 0.65$. This means that the higher levels of the antioxidant capacity will be less and less effect on the cholesterol levels of meat.

**Egg Lipid Profile.**

Egg lipid profile consisting of total cholesterol, triglycerides, HDL and LDL in ducks receive treatment A are 280.00; 180.84; 105.13 and 70.72 mg/100g respectively (Table 6). Rations containing fermented purple sweet potato (treatment C) reduce levels of total cholesterol, triglycerides, HDL and LDL significantly ($P<0.05$) lower than that of treatment A.

Table 6. The Effect of Offered Fermented Purple Sweet Potato in Diets on Egg Lipid Profil of Bali Duck, aged 36 weeks

<table>
<thead>
<tr>
<th>Variabel</th>
<th>Perlakuan</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Total Cholesterol (Mg/100g)</td>
<td>280.00 a 2</td>
<td>249.52 b</td>
</tr>
<tr>
<td>Triglycerida (Mg/100g)</td>
<td>180.84 a</td>
<td>156.48 b</td>
</tr>
<tr>
<td>High Density Lipoprotein (Mg/100g)</td>
<td>70.72 a</td>
<td>55.53 b</td>
</tr>
<tr>
<td>Low Density Lipoprotein (Mg/100 g)</td>
<td>185.13 a</td>
<td>157.60 b</td>
</tr>
</tbody>
</table>

Notes: A: Rations without purple sweet potato, B: Rations contain 10% purple sweet potato, C: Rations contain 10% fermented purple sweet potato. Different superscript in the same row are significantly different ($P<0.05$). SEM: “Standard Error of the Treatment Means”.

![Graph showing the relationship between antioxidant capacity and duck meat cholesterol](image-url)
The content of cholesterol in the body is highly dependent on endogenous (80%) and exogenous (20%) factors (Siswono, 2001). Presence of anthocyanin in purple sweet potato, especially fermented anthocyanin, antioxidant content higher than unfermented purple sweet potato (Yadnya and Trisnadewi, 2011). Susila et al., (2016) reported that offering diets containing fermented rice hull and purple sweet potato leaves supplemented can reduce of the cholesterol in meat of bali duck. Yadnya et al., (2009) reported rations containing seaweed as a source of antioxidants and supplemented with Starbio and Pignox (Starpig) can lower eggs cholesterol. Cholesterol content in eggs is closely related to the antioxidant is consumed. Kumalaningsih (2008) reported giving diet containing antioxidants can lower cholesterol levels. Higher consumption of antioxidants causing cholesterol levels in eggs produce will be reduced.

![Figure 3](image)

Figure 3 shows that administrations of fermented purple sweet potato in the diet (treatment C) can improve the lipid profile of eggs, proven levels of total cholesterol, triglycerides, HDL and LDL is lower than the provision of treatment A or B. Decreases of eggs lipid profile levels is strongly influenced by the amount of antioxidants consumption in ducks receiving treatment C which higher than treatment A or B. Prangdimurtiet al., (2006) reported that the extract sujileaf (*Pleomeleongustifolio*) can increase the antioxidant capacity of serum cholesterol and lowering blood mice.

**CONCLUSION**

Provision of 10% fermented purple sweet potato in the diet increase the consumption of antioxidants and can increase carcass weight, meat production and lower fat
includingskin. Provision of 10% fermented purple sweet potato in the diet can improve antioxidant profile, lipid profile, meat and eggs lipid profile of the baliduck.

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