The Effect of Fermented Purple Sweet Potato (*Ipomoea batatas* L) Skin in Diets on Feed and Anthocyanin Consumption, Carcass Characteristics, Antioxidant Profile and Meat Texture of Bali Duck

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**Abstract**
An experiment was carried out to determine the effect of fermented purple sweet potato (*Ipomoea batatas* L) skin in diets on feed and anthocyanin consumption, carcass characteristics antioxidant profile and meat texture of Bali duck. Five treatment diets were used in a completely randomized design (CRD) consisted of control diet A (diet without containing purple sweet potato skin), diet B containing 10% purple sweet potato skin, diet C containing 10% fermented purple sweet potato skin, diet D containing 20% purple sweet potato skin, diet E containing 20% fermented purple sweet potato skin. Each treatment consisted of four replications and each replicate had five ducks. The variables observed were feed and anthocyanin consumption, slaughter weight, carcass weight, carcass percentage, carcass physical composition, meat antioxidant profile (capacity antioxidant (CA), malondialdehyde (MDA), and superoxide dismutase (SOD). Experiment results showed that diets with fermented or unfermented purple sweet potato diets treatments B, C, D, and E increased the anthocyanin consumption, slaughter weight, carcass weight, carcass percentage and meat percentage of duck carcass but decreased their fat and skin. Fermented purple sweet potato (*Ipomoea batatas* L) skin in C and E increased the antioxidant capacity (AC) and superoxide dismutase (SOD) while treatment B and D were not significantly different (P>0.05) to the control group. Malondialdehyde (MDA) of the duck meat in treatment B, C, and D were significantly lower (P<0.05) compared to the control diet. Treatment E significantly increased the perimysium and endomysium of meat texture, but its experiment was not significantly different to the control group. It was concluded that substitution of fermented purple sweet potato (*Ipomoea batatas* L) skin in diets could improve of feed and anthocyanin, carcass characteristics, antioxidant profile, and meat texture of bali duck.

**Keywords:**
- anthocyanin;
- antioxidant profile;
- bali duck;
- carcass characteristics;
- fermented purple sweet potato skin;

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1. Introduction

Duck as a source of poultry meat has disadvantages fish as high fat, tough meat and “fish” odor (Yadnya et al., 2013). High-fat meat has a bad risk for health. One effort to reduce fat content meat. Ishida et al., (2000) was reported by feeding ducks with purple sweet potato (Ipomoea batatas L). However, when the purple sweet potato too much in the feed it will reduce the protein content of the feed. To prevent the protein reduction of the purple sweet potato as one of the feed ingredients was by fermentation process (Yadnya and Trisnadewi, 2011). According to Kumalaningsih (2008), antioxidants have functions in neutralizing free radicals and bind fat, and take to the aromatic group which is the partially throw out through the feces and some will be absorbed by the body and deposit as fat in the carcass. A diet containing fermented purple sweet potato (Ipomoea batatas L) was reported increased slaughter weight, carcass weight, and carcass composition (Yadnya and Susila, 2014). Witariadi, et al. (2013) reported that purple sweet potato (Ipomoea batatas L) in the diet was as a source of antioxidant and could improve the quality of duck meat, reduced the meat stench and softened the meat texture. Abustam (2004) stated tenderness of meat influenced by the nature of myofibril as a major component of connective tissue in the muscle. Connective tissues play an important role in determining the toughness of histological value of meat including epimedium, perimysium and endomysium were observed in this study. Fermentation of ration ingredients highly correlated with an antioxidant profile which are consisted of malonaldehyde (MDA), antioxidant capacity (AC), and superoxide dismutase (SOD). Yadnya et al., (2015) described that purple sweet potato leaves could reduce the level of malondialdehyde (MDA) in blood serum of 22 weeks Bali ducks.

This research was carried out to study the effect of fermented sweet potato (Ipomoea batatas L) skin in diets on feed and anthocyanin consumption, carcass characteristics, antioxidant profile and texture of Bali duck meat.

2. Materials and Methods

Place and Period of Experiment

This experiment was conducted at Guwang village, Gianyar district, Province of Bali for 10 weeks. Antioxidant capacity was tested at Microbiology and Chemistry Laboratory, Faculty of Agricultural Technology, Udayana University. Carcass test was carried out at Nutrition Laboratory, Faculty of Animal Science, Udayana university for 4 weeks. Test of antioxidant profile carried out at Analysis Laboratory, Udayana University for 4 weeks. Texture analysis histology of duck meat was studied at Veterinary Institute at Pegok, Denpasar, Bali for 4 weeks.

Material and Equipment

A total of 12 weeks old male ducks with similar live weight were bought from duck farmer (I Ketut Pindah) at Gianyar district were used in this experiment. Skin of purple sweet potatoes (Ipomoea batatas L) were obtained from former (K.Selamet) at Gianyar, and Aspergillus niger from the Institute of Agricultural Technology (BPTP), Denpasar. The experiment diets composed based on nutrient content recommended by Scott et al., (1982) The diets consisted of yellow corn, coconut meal, soybean, the skin of the purple sweet potato, premix and NaCl. The component and composition of the diets were presented in Table 1. Diets and water were given ad libitum. This study was designed using a completely randomized design (CRD). The treatments consisted of a control diet without purple sweet potato skin (A), (B) diet containing 10 % purple sweet potatoes skin, (C) diet containing 10%
fermented purple sweet potatoes skin, (D) diet containing 20% unfermented purple sweet potatoes and (E) diet containing 20% fermented purple sweet potatoes. Each treatment consisted of four replication consisted of five ducks with homogenous age and live weight.

*Fermentation of Purple Sweet Potato (Ipomoea batatas L) Skin*

Before the fermentation process takes place purple sweet potato skin implemented fist activation process *Aspergillus niger*. The activation process requires tools include a clean plastic tub, aerator, whereas the necessary are sugar and 1% NPK and urea as much of the volume 10 liter of water. Well, water without chloride was used in this process. The water was sterilized by boiling at 100°C and then was cooled and 1% *Aspergillus niger* seed was added (Guntoro, 2008). Skin of purple sweet potatoes (*Ipomoea batatas* L) is already in form of flour sack place on a bed on placed on top of the bamboo strips, then spayed with *Aspergillus niger* that has been activated until the water solution 50% (when first are not broken) The cover then covered by a sack and left for 7 days, after fermentation for 7 days and then dried in the sun, it was ready to be used in the treatments.

Variables measured in this study were carcass physical compositions including carcass weight, carcass percentage, carcass physical composition (meat, bone and fat) (Soeparno, 2005) and feed antioxidant consumption (Tillman *et al.*, 1986), antioxidant profiles consisted of antioxidant capacity with spectrophotometer method (Okawa, *et al.*, 2001), malonaldehyde with Thiobarbituric acid reactive substance (TBARS) (Wuyastuti, 1996), SOD test with Oxiselect superoxide dismutase activity assay Kit method (Cell Biolab, 2004) and meat texture with Histology method (Luna, 1968).

| Feed Components and Chemical Composition | A       | B       | C       | D       | E       |
|-----------------------------------------|---------|---------|---------|---------|---------|
| Feed Components:                        |         |         |         |         |         |
| Yellow corn (%)                         | 55,36   | 49,98   | 42,32   | 49,98   | 42,32   |
| Soybean (%)                             | 9,37    | 12,45   | 13,88   | 12,45   | 13,88   |
| Coconut meal (%)                        | 11,31   | 9,82    | 7,28    | 9,82    | 7,28    |
| Fish meal (%)                           | 10,13   | 8,10    | 10,20   | 8,10    | 10,20   |
| Rice bran (%)                           | 13,26   | 9,00    | 5,08    | 9,00    | 5,08    |
| Purple sweet potato skin (%)            | -       | 10      | 20      | -       | -       |
| Fermented purple sweet potato skin (%)  | -       | -       | 10      | 20      | -       |
| Premix (%)                              | 0,50    | 0,50    | 0,50    | 0,50    | 0,50    |
| NaCl (%)                                | 0,15    | 0,15    | 0,15    | 0,15    | 0,15    |
| Oil coconut (%)                         | -       | -       | -       | 2,00    | 2,00    |
| **Chemical Composition**                |         |         |         |         |         |
| Metabolic Energy (Kcal/kg)              | 2900,00 | 2926,18 | 2926,25 | 2928,90 | 29,35,18 |
| Crude Protein (%)                       | 18,28   | 17,93   | 18,18   | 17,86   | 18,08   |
| Ether Extract (%)                       | 5,94    | 5,46    | 5,42    | 5,84    | 5,45    |
| Crude Fiber (%)                         | 4,80    | 5,46    | 4,38    | 4,52    | 4,32    |
| Calcium (%)                             | 1,40    | 1,21    | 1,04    | 1,14    | 0,91    |
| Phosphor available (%)                  | 0,73    | 0,71    | 0,69    | 0,71    | 0,50    |

Description: A is control diet (without purple sweet potato), B is diet containing 10.0% purple sweet potatoes, C is diet containing 10% fermented purple sweet potatoes skin, D is diet containing 20% purple sweet potatoes skin, E is diet containing 20.0% fermented purple sweet potatoes skin.
Data Analysis

The data in the control diet could increase the antioxidant analyzed using analysis of variance (Steel and Torrie, 1989). When the results were significant, the analysis was continued by using Duncan's Multiple Range test to find out the significance between the treatments (P<0.05).

3. Results and Discussions

3.1 Feed and anthocyanin consumption antioxidant capacity

Feed consumption of Bali ducks in treatment C, D, and E, except treatment B, were significantly lower (P<0.05) than those in the control diet (Table 2). On the contrary, the anthocyanin consumption of ducks in treatment B, C, D, and E was significantly higher than in the control diet and substitution of purple sweet potato skin in the control diet increase the antioxidant capacity (Table 2).

| Variables                  | Treatments | SEM  |
|----------------------------|------------|------|
| Feed consumption (kg/duck) | A          | B    | C    | D    | E    | 38.26 |
| Anthocyanin intake (g/duck)| 6.594a     | 6.592a| 6.452b| 6.410b| 6.247c| 38.26 |
| Antioxidant capacity       | 160.66d    | 175.35c| 173.70c| 183.32b| 298.00a| 0.47  |
| (IC %)                     | 59.60d     | 74.26c| 74.28c| 76.86b| 80.53a| 18.85 |

Description: A is control diet (without purple sweet potato), B is diet containing 10.0% purple sweet potatoes, C is diet containing 10% fermented purple sweet potatoes skin, D is diet containing 20% purple sweet potatoes skin, E is diet containing 20.0% fermented purple sweet potatoes skin.

SEM: “Standard Error of The Treatment Means”

Values followed by different letters in the same row are significantly different (P<0.05).

These results indicated that fermented purple sweet potato skin in diets could increase anthocyanin intake and antioxidant capacity. Yadnya et al. (2014) found that purple sweet potato reduced feed consumption, but increased anthocyanin in taking and followed by increasing on antioxidant capacity. Yadnya and Trisnadeni (2011) reported that fermentation of purple sweet potatoes increased the concentration of their anthocyanin dan antioxidant.

Substitution of fermented purple sweet potato (Ipomoea batatas L.) skin in diet was significantly increased carcass weight, carcass percentage, meat percentage, and bone percentage. Bali duck (P< 0.05). On the other hand, their fat percentage was significantly lower than the control diet (Table 3). The increase of slaughter weight in ducks fed diets containing fermented or without fermented purple sweet potato skin due to the increased digestibility of the diets, protein and fat (Yadnya, et al., 2014). These were related to the increase of their body weight gain which ultimately affected their slaughter weight and consequently their carcass weight. Yadnya, et al., (2013) reported that fermented purple sweet potato in diets also improved physical composition of duck carcasses.

| Variables                  | Treatments | SEM  |
|----------------------------|------------|------|
| Slaughter Weight (kg)      | A          | B    | C    | D    | E    | 11.68 |
| Carcass Weight (kg)        | 1.475c     | 1.513b| 1.1.517b| 1.527b| 1.572a| 11.68 |
| Carcass Percentage (%)     | 0.951d     | 0.994c| 1.005c| 1.045b| 1.122a| 0.90  |
| Carcass Physical Composition: | 64.50d | 65.75c| 66.25c| 68.50b| 71.40a| 0.33  |
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| Variables                  | Treatments | SEM |
|----------------------------|------------|-----|
|                | A          | B    | C    | D     | E     |
| Capacity Antioxidant (%)  | 45.97c     | 48.64bc | 50.81b | 48.90bc | 55.76a |
| Malondialdehyde (mmol/g)  | 4.50a      | 4.44ab | 4.30b | 4.32b  | 4.03c  |
| Superoxida dismutase (µ/ml)| 0.83b      | 0.84b | 0.88a | 0.86ab | 0.89a  |

Description: A is control diet (without purple sweet potato), B is diet containing 10.0% purple sweet potatoes, C is diet containing 10% fermented purple sweet potatoes skin, D is diet containing 20% purple sweet potatoes skin, E is diet containing 20.0% fermented purple sweet potatoes skin.
SEM: “Standard Error of The Treatment Means”
Values followed by different letters in the same row are significantly different (P< 0.05)

3.3 Meat Texture

The epithelium, perimysium, and endomysium of duck meat in the control diet were 362.43µm, 23.29µm, and 10.32µm (table 5). Diets with 20% fermented purple sweet potato skin (treatment E) was significantly increased the perimysium and endomysium (P < 0.05) but treatments B, C and D were not significantly different to the control group. All feeding treatments were not significantly affected the epimedium of duck meat. The increase of endomysium and perimysium of duck meat in treatment E might be due to the increase of the antioxidant capacity of the meat which could losing the fibers bond of the meat. Robert et al., (1979) reported that the provision as a source of bilberry anthocyanins fibers, and may inhibit proteolytic enzymes such as of metabolism of collagen biosynthesis than polymer (Boniface et al., 1982). Endomysium magnitude and perimysium of meat were influenced by species, breed, and sex (Caceci, 2007). Skeletal muscle fibers can have a large diameter or longer sizer because of increase in the number of myofibrils – myofibril preparation (Lawrie, 1995).

| Variable            | A             | B             | C             | D             | E             | SEM |
|---------------------|---------------|---------------|---------------|---------------|---------------|-----|
| Epimysium (µm)      | 362.43        | 412.10        | 417.86        | 465.06        | 517.23        | 91.76 |
| Perimysium (µm)     | 23.29b        | 24.90b        | 24.76b        | 33.39b        | 57.99a        | 4.80 |
| Endomysium (µm)     | 10.32b        | 11.18b        | 11.22b        | 11.75ab       | 16.37a        | 1.52 |

Description: A is control diet (without purple sweet potato), B is diet containing 10.0 % purple sweet potatoes, C is diet containing 10% fermented purple sweet potatoes skin, D is diet situation potatoes skin
SEM: “Standard Error of The Treatment Means”
Values followed by different letters in the same row are significantly different (P< 0.05)

4. Conclusion

It was concluded that substitution of fermented purple sweet potato (Ipomoea batatas L.) skin in the diet increased feed and anthocyanin consumption, carcass characteristics, antioxidant profile and meat texture of Bali duck. Percentage of carcass very the affect of slaught weight and carcass weight (Witariadi et al., 2012). Yadnya et al., (2013) reported diets containing purple sweet potato (Ipomoea batatas L) contain anthocyanin which are antioxidants that can increase carcass weight and carcass percentage were significantly (P<0.05) from those without purple sweet potato.

Conflict of interest statement and funding sources
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Statement of authorship
The author(s) have a responsibility for the conception and design of the study. The author(s) have approved the final article.

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