International Research Journal of Engineering, IT & Scientific Research
Available online at https://sloap.org/journals/index.php/irjeis/
Vol. 2 No. 9, September 2016, pages: 73~80
ISSN: 2454-2261
https://sloap.org/journals/index.php/irjeis/article/view/516

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

T.G. Belawa Yadnya [a]
AA. A.S. Trisnadewi [b]
I Ketut Sukada [c]
I Gusti Lanang Oka [d]

Article history:

Received: 9 April 2016
Accepted: 30 July 2016
Published: 30 September 2016

Keywords:

anthocyanin;
antioxidant profile;
bali duck;
carcass characteristics;
fermented purple sweet potato skin;

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. *Malondialdehide* (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.

[a] Faculty of Animal Husbandry, Udayana University, Indonesia
[b] Faculty of Animal Husbandry, Udayana University, Indonesia
[c] Faculty of Animal Husbandry, Udayana University, Indonesia
[d] Faculty of Animal Husbandry, Udayana University, Indonesia

Author correspondence:
T.G. Belawa Yadnya,
Faculty of Animal Husbandry,
Udayana University, Denpasar, Bali, Indonesia
Email address: *belawayadnya_fapet@yahoo.com*

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 threw 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 100º 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).

Table 1
Feed Components and Chemical Composition

Feed Components:	Treatments				
	A	B	C	D	E
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
Calsium (%)	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).

Table 2
Feed consumption, anthocyanin intake and antioxidant capacity

Variables	Treatments					SEM
	A	B	C	D	E	
Feed consumption (kg/duck)	6.594a	6.592a	6.452b	6.410b	6.247c	38.26
Anthocyanin intake (g/duck)	160.66d	175.35c	173.70c	183.32b	298.00a	0.47
Antioxidant capacity (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 Trisnadewi (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 after 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.

Table 3
Carcass Characteristic of Male Bali Ducks

Variables	Treatments					SEM
	A	B	C	D	E	
Slaughter Weight (kg)	1.475c	1.513b	1.1.517b	1.527b	1.572a	11.68
Carcass Weight (kg)	0.951d	0.994c	1.005c	1.045b	1.122a	0.90
Carcass Percentage (%)	64.50d	65.75c	66.25c	68.50b	71.40a	0.33
Carcass Physical Composition :						

Meat (%)	36.75d	38.05c	41.66b	42.25b	44.50a	0.29
Bon (%)	31.55b	35.50a	32.15b	31.90b	31.50b	0.34
Fat + Skin (%)	31.70a	26.45b	26.20b	25.08c	24.00c	0.36

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)

Percentage of duck carcass was affected by its slaughter weight and carcass weight (Witariadi *et al*., 2012). Yadnya *et al., (*2012) reported ration containing fermented purple sweet potato increased protein retention, meat percentage in the body and affected of carcass physical composition. According to Kumalaningsih (2008), the purple sweet potato contains anthocyanin as an antioxidant which could neutralized free radical and reduce accumulation in the body or in carcass by bundle up fat or cholesterol and then come out through feces. Yadnya *et al.,* (2013) also reported that fermented purple sweet potato (*Ipomoea batatas* L) in diets also improved the physical composition of duck carcass by increasing their meat component but decreasing their fat and skin.

3.2 Antioxidant Profile

The antioxidant profiles consisted of antioxidant capacity (AC), malondialdehyde (MDA), and superoxide dismutase (SOD). The results that diets containing 10% and 20% fermented purple sweet potato skin (treatment C and E) increased the antioxidant capacity (P< 0.05), but treatment B and D were not significantly different (Table 4) from the control diet. Yadnya and Trisnadewi (2011) reported that fermented sweet potato could increase the anthocyanin and antioxidant contents. Yadnya *et al*., (2014) found that feeding duck with purple sweet potato leaves could increase antioxidant intake and affected their meat antioxidant profile. Feeding duck with fermented purple sweet potato (*Ipomoea batatas* L.) skin in diets, such as treatments C, D, and E reduced duck's *malondialdehyde* (MDA), while treatment B was not significantly different (P< 0.05) compared to the control diet (A). Kumalaningsih (2008) reported that antioxidant could inhibit free radical activity and affected malondialdehyde (MDA) of meat. Substitution of fermented purple sweet potato (*Ipomoea batatas* L.) skin in diets (Treatment C and E) were significantly increased superoxide dismutase (SOD) of duck meat, while diets without fermented purple sweet potato skin (treatment B and D) were not significantly different (P> 0.05) to the control treatment (A) Prangdimurti *et al.,* (2006) reported that Suji leaf (*pleomele ongusfolio)* could improve superoxide dismutase (SOD) and increase antioxidant capacity. A study in duck feeding with the diet containing fermented purple sweet potato also found increase in SOD and antioxidant capacity, but the reduction in Malondialdehyde (MDA) (Yadnya, *et al*., 2013).

Table 4
Antioxidant profile in bali duck meat

Variables	Treatments					SEM
	A	B	C	D	E	
Capacity Antioxidant (%)	45.97c	48.64bc	50.81 b	48.90bc	55.76a	0.89
Malondialdehide (mmol/g)	4.50a	4.44ab	4.30b	4.32b	4.03c	0.045
Superoxida dismutase (µ/ml)	0.83b	0.84b	0.88a	0.86ab	0.89a	1.074

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).

Table 5
Meat Texture of Male Bali Duck

Variable	Perlakuan					SEM
	A	B	C	D	E	
Epimesium (µm) NS	362,43	412,10	417,86	465,06	517,23	91,76
Perimesium (µm)	23,29b	24,90b	24,76b	33,39b	57,99a	4,80
Endomesium (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
The author(s) declared that (s)he/they have no competing interest. The study was financed by the Udayana University.

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.

Acknowledgments
The authors would like to thank the Directorate General of Education, Ministry of Education and Culture, the Republic of Indonesia funding this through the Rector of Udayana University Cq Charman on the Institute for Research and Community Service with contract Number: 178/UN14.2/PNL.01.03.00/2015, on March 3, 2015

References

Guntoro, S. (2008). *Membuat Pakan Ternak dari Limbah Perkebunan*. AgroMedia.

Ishida, H., Suzuno, H., Sugiyama, N., Innami, S., Tadokoro, T., & Maekawa, A. (2000). Nutritive evaluation on chemical components of leaves, stalks and stems of sweet potatoes (Ipomoea batatas poir). *Food Chemistry*, *68*(3), 359-367. https://doi.org/10.1016/S0308-8146(99)00206-X

Kumalaningsih, S. (2008). Antioksidan Superoksida dismutase (SOD), Antioxidant, Centre. Com.

Setyawardanai, T., D. Ningsih., & Arcarwah. (2001).Pengaruh pemberian ekstrak buah nenas, dan pepaya terhadap kualitas daging ituik petelur afkir. Bulletin Peternakan, Diterbitkan oleh Fakultas Peternakan, Universitas Gadjah Mada, Yogyakarta, ISSN: 0126 – 4400.

Steel, R.G.D & J. Htorrie. (1989). DPPH (1,1 Diphenyl, 2-Picrylhidroxyl)Radical Seavensing Activity of Flavonoid Obtain from Some Medicanal Plants, Biok, Pharm. Bull.24 (10): 1202 – 1205.

Tillman, A., Hartadi, H., Reksohadprojo, S., & Lebdosoekojo, S. (1986). Ilmu makanan ternak. Cetakan ketiga.

Witariadi, N. M. (2006). *Penampilan Kambing Peranakan Etawah yang diberi Pakan Dasar Rumput Lapangan dengan Suplementasi Dedak Padi* (Doctoral dissertation, Tesis Program Pascasarjana Universitas Udayana, Denpasar).

Yadnya, T. B., & Sukmawati, N. S. (2006). Pengaruh penggantian dedak padi dengan sekam padi atau serbuk gergaji kayu yang disuplementasi dengan probiotik terhadap efisiensi penggunaan ransum dan kadar asam urat darah itik bali. *Majalah Ilmiah Peternakan*, *9*(2).

Yadnya, T. G. B. (2013). Kajian Pengaruh Pemanfaatan Ubi Jalar Ungu (Ipomoea batatas L) Terfermentasi dalam Ransum terhadap Penampilan, Kualitas Karkas dan Kadar Kolesterol Daging Itik Bali. *Disertasi. Program Pasca Sarjana, Universitas Udayana, Denpasar, Bali.[Google Scholar]*.

Yadnya, T. G. B., & Trisnadewi, A. A. A. S. (2011). Improving the Nutrition of Purple Sweet Potato (Ipomoea batatas L) through Biofermentation of Aspergillus niger as Feed Substance Containing Antioxidants.

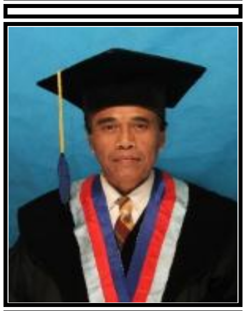
Yadnya, T. G. B., Sukmawati, N. M. S., & Wirawan, I. W. (2013, October). Pemanfaatan daun ubi jalar ungu dalam ransum disuplementasi Starpig terhadap kadar kolesterol serum darah dan karkas itik bali. In *Makalah Seminar Nasional. Fakultas Agroindustri, Universitas Mercu Buana, Yogyakarta* (Vol. 9).

Biography of Authors

Dr. Ir. Tjokorda Gede Belawa Yadnya, MSi was born on July 24, 1952, in Gianyar. He is a senior lecturer at Faculty of Animal Husbandry at the University of Udayana. He had finished his Bachelor Academic at the University of Udayana in 1980. He had completed his Master Degree at the University of Gadjah Mada in 1995 and he graduated his Doctor Degree at the University of Udayana in 2013. Recently, he is active in doing research for online publication or printed publication. On one hand, he dedicated his competence to the societies regularly. On the other hand, he is active in teaching the students in the University of Udayana.
Email: firstauthor@gmail.com

Ir. Anak Agung Ayu Sri Trisnadewi, MP.was born on February 24, in Gianyar. She lives in Jl. Hayam Wuruk Gang 16 No. 3 Denpasar -Bali. She had finished his Bachelor Academic at the University of Udayana in 1992. He had completed his Master Degree at the Institute of Pertanian Bogor in 2009. Recently, he is active in doing research for online publication or printed publication. On one hand, he dedicated his competence to the societies regularly. On the other hand, he is active in teaching the students in the University of Udayana.

Dr. Ir. I Ketut Sukada, M.Si was born on May 21, 1957. He has four children, they are Ni Luh Putu Mahasuari. SE. I Made Indra Pranayama. Ni Nyoman Reni Maharani, S.Par. I Ketut Wiwaswan Danan Jaya, S.Ked. He lives in Jl. Segara Madia. No.2, Lingkungan Tanjung Benoa, Kelurahan Tanjung Benoa, Kecamatan Kuta Selatan, Kabupaten Badung. He had finished his Bachelor of Academic at Faculty of Animal Husbandry in the University of Udayana in 1982. He had completed his Master Degree in the Institute of Bogor Agriculture in 1999. He had been reached his Doctor Degree at Postgraduate of the University of Udayanan in 2013.



Prof. Ir. I Gusti Lanang Oka, M.Agr.Sc., Ph.D. was born on May 5, 1945, in Klungkung. He is a senior lecturer at Faculty of Animal Husbandry at the University of Udayana. He had finished his Bachelor Academic at the University of Udayana in 1972. He had completed his Master Degree at the University of Queensland, Australia in 1985 and he graduated his Doctor Degree at the University of Queensland, Australia in 1994. Recently, he is active in doing research for online publication or printed publication. On one hand, he dedicated his competence to the societies regularly. On the other hand, he is active in teaching the students in the University of Udayana.