Fermented Purple Sweet Potato in Rations on Carcass Improvement, Antioxidant Profile, Meat, and Eggs Lipid Profile of Bali Ducks

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ABSTRACT

This study aimed 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 was used in this study. Sixty baliducks were divided 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 used four replications to each treatment which 5 layer ducks were used as a repetition in each unit of experiment. The experiment was done for 12 weeks. Antioxidant consumption was counted during the experiment. In the end of experiment the ducks were killed and meat antioxidant profile namely antioxidant capacity, *malondialdehida* (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, highdensity lipoprotein (HDL), low density lipoprotein (LDL) and triglycerides) were also counted in the end of experiment.The results showed fermented purple sweet potato in the rations significantly increased the consumption of antioxidants, accompanied by increasing in slaughter weight, carcass weight, carcass percentage, and meat percentage. Fermented purple sweet potato in the rations also significantly reduced the percentage of sub-cutaneous fat and skin. Fermented purple sweet potato improved antioxidant profile significantly, increased antioxidant capacity, and *superoxide dismutase* (SOD), and decreased the levels of *malondialdehide* (MDA). It also decreased significantly the total cholesterol, HDL, LDL and triglycerides in meat and eggs. The conclusion of the research is a 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, bali ducks

INTRODUCTION

The demand of animal protein increases from year to year along with the increases of population. Animal protein can be obtained from ruminant and non-ruminant livestock including poultry such as duck. Meat and eggs are the main sources of animal protein.Meat and eggs can be obtained from the duck. However, the twelve-week old duck meat is a fatty smelling rejected meat (Setyawardani *et al*., 2001). Meat with full of fat is adversely for health. Fatty meat tend to contain high cholesterol levels which positively correlated to atherosclerosis (Hasim and Yusuf, 2008). To reduce the levels of fat or cholesterol can be done by changing the formulation of rations with the additional materials or substances that contains antioxidant.

Purple sweet potato is one of many substances which contains 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 those are antioxidants. The increases of nutrient levels of sweet potatoes by fermentation, especially the increase of protein, anthocyanin antioxidants will decrease level of tannin and cellulose. Anthocyanin is an antioxidants substances that can bind fat or cholesterol which is partially excreted through the feces, as a result fat content of carcass can be reduced. This is due to the provision of fermented purple sweet potato increases protein content and then protein reduce fat retention in 15week old bali ducks (Yadnya *et al*., 2012). Decreasing 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. Prangdimurti *et 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 improving, antioxidant profile, lipid profile of eggs and meat in first nesting phase of bali duck. It 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.

MATERIALS 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, Facultyof Animal Husbandry, Udayana University.

Material and Equipment

The experiment using 24 week old layer bali ducks, from Ketewel village, Gianyar regency, Bali, which total number are 60 ducks. The rations 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). The proximate composition of each treatment showed in Table2. Fermentation processes using *Aspergillus niger*.

Table 1. Rations Composition in Each Treatment.

Ingredients (%)	Treatment [1)]		
	A	B	C
Yellow corn	55.35	49.98	49.98
Soybean	9.37	12.45	12.45
Copra meal	11.30	9.82	9.82
Fish meal	10.13	8.10	8.10
Rice bran	13.20	9.00	9.00
Purple sweet potato meal	-	10	-
Fermented purple sweet potato meal	-	-	10
Premix	0.50	0.50	0.50
Salt (NaCl)	0.15	0.15	0.15

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

Nutrient	Treatment Rations[1)]			
	A	B	C	Standard [2)]
Metabolisme Energy (Kcal/kg)	2907.07	2878.20	2886.10	2800 - 2900
Crude protein (%)	17.03	16.68	16.67	15 – 17
Crude Fibre (%)	4.56	4,42	4.36	4 – 7
Fat (%)	5.75	5.92	5.85	5 – 9
Calsium (%)	1.00	0.94	0.94	0.80
Phosphor avaible (%)	0.60	0.50	0.51	0.50
Cystine (%)	0.30	0.30	0.27	0.27
Lysine (%)	1.37	1.35	1.34	0.80
Methionine (%)	0.52	0.56	0.57	0.51

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).

Experimental Design

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–Burchadmethod (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 reduced significantly ($P<0.05$) the feed consumption, whereas the consumption of antioxidants increased significantly ($P<0.05$). Present of oligosaccharides in purple sweet potato stimulated 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 B and C treatment due to the presence of anthocyanin as an antioxidants and vitamin A, vitamin C, Zn, Se content. Whereas increased antioxidant capacity, caused 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 slaughter weight significantly ($P<0.05$) for 5.12 % and 8.14 % compared with the rations without purple sweet potato in treatment A. The slaughter weight increased in treatment B and C which accompanied by increaseing in carcass weight and carcass percentage were significantly different ($P<0.05$) compare with the treatment A.

Table 3. Statistical Data of Each Treatment.

Variable	Treatment [1)]			SEM [3)]
	A	B	C	
Feed Consumption (kg/Head/12 weeks)	10,086 [a 2)]	9,673 [b]	9,245[c]	0,004
Antioxidant Consumption (g/Head/12 Weeks)	90,77 [c]	94,57 [b]	101,42 [a]	0,036
Slaughter Weight **(**kg/head)	1.425 [c]	1.498[b]	1.541[a]	16,73
Carcass Weight (kg/ head)	0.881 [c]	0.946 [b]	1.014 [a]	33,288
Carcass Percentage (%)	61.39 [b]	63.15 [b]	66.17 [a]	0.665
Carcass Physical Composition (%):				
Meat	40.54 [b]	43.73[a]	44.54 [a]	0.86
Bone	29.04 [ab]	27.81 [b]	30.20 [a]	0.53
Skin and subcutan fat	30.42 [a]	28.46 [b]	25.26 [c]	0,59

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 " .

Increasing 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 cellulose, lipase and proteolytic enzymein the rations (Muchtadi *et al*., 1992), which increased 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 week male ducks increased 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 rations treatment B and C improved carcass composition at the age of 36 week laying ducks. This proved an increased in meat production and decreased fat carcass is significantly different (P<0.05)(Table3). Fermentation significantly (P<0.05) increased the protein content of purple sweet potato from 3.83 % to 8.47 % which was accompanied by decreasing the fat content of 0.81 % to 0,14 %. Levels of anthocyanin and antioxidants were also increased significantly (P<0.05) (Yadnya and Trisnadewi, 2011). Yadnya *et al.* (2012) reported the administrations of fermented purple sweet potato in the diet to15 week 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 Profile

Yadnya (2013) reported that the antioxidant profile of meat consist of antioxidant capacity, *Malondialdehida* (MDA) and *Superoxide Dismutase* (SOD). Rations containing purple sweet potato and fermented purple sweet potato in treatment B and C may increased antioxidant capacity, SOD and

significantly (P<0.05) decrease levels of *Malondialdehyde* compare with control (treatment A) (Table 4.) .

Antioxidant capacity increased of duck meat in treatment B and C, were 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 suji leaves (*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 levels 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 radicals can be neutralized by antioxidants.

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

	Treatment [1)]			
Variable	A	B	C	SEM [3)]
Antioxidant Capacity (% IC)	15. 84 [c2)]	17.20 [b]	18.35 [a]	0.245
Malondialdehida (mg/kg)	1.977 [a]	0.77 [b]	0.66 [c]	0.018
Superoksida dismutase (µ/kg)	0.50 [c]	0.58 b	1.26 [c]	0.032

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

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 improved the lipid profile. This indicated the levels of total cholesterol, triglycerides, HDL and LDL were significantly (P< 0.05) lower than the duck provision with treatment A. Cholesterol levels decreased due to the increased of meat antioxidants consumption, moreover the ability to inhibit the activity of 3-Hydroxy 3-Methyl Ko.A Gluteryl-reductase enzyme greater to produce mevalonic acid and diminishing hearts disease,and cholesterol distribution into the blood was 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.

The administrations of rations containing fermented purple sweet potato (treatment C) reduced significantly (P< 0.05) total cholesterol level, TGA, HDL, and LDL compared to treatment A or B. This was due to the antioxidant consumed 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 (Fig.1).

The relationship between total antioxidant capacity levels with meat cholesterol following the equation $Y = 253.84\ e^{0.03\ X}$, which 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 (Fig.2).

Table 5. Meat Lipd Profile of Bali Ducks Fed with Fermented Purple Sweet Potato in Rations

Variable	Treatment [1)]			SEM [3)]
	A	B	C	
Cholesterol Total (Mg/100g)	159.5 [a2)]	150.75[b]	145.25 [c]	0.85
Trigliserida (Mg/100g)	143.5 [a]	135,5 [b]	127,25 [c]	0.92
High density lipoprotein (HDL)	82,85 [a]	81.57 [ab]	80.65 [b]	0.59
Low density lipoprotein (Mg/100g)	47.95 [a]	42.07 [b]	37,45 [c]	1.01

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 r0w are signicntly different (P<0.05)
3) SEM : Standard Error of the Treatment Means

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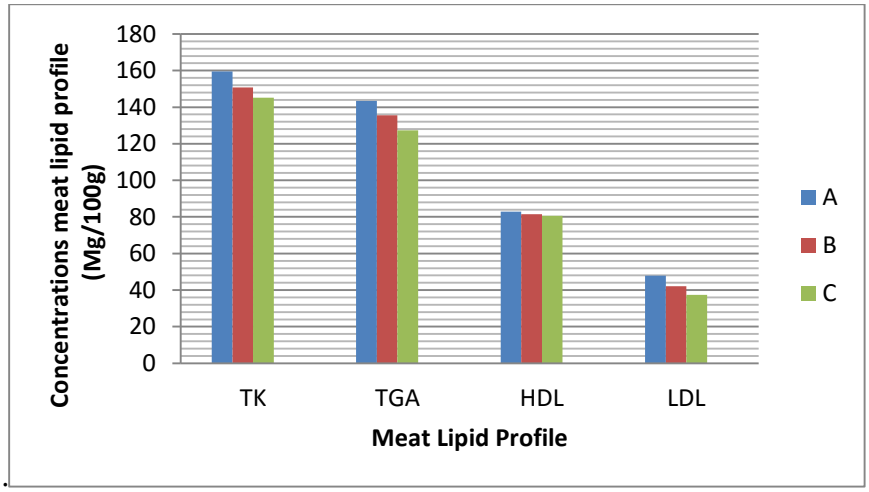

Figure 1. Duck Meat Lipid Profile Fed by Purple Sweet Potato Fermented Offered in Rations. :A: Rations with out purple sweet unfermented potato; B: Rations contain a 10 % purple sweet potato; C: Rations contain a 10 % fermented purple sweet potato, TK : Total Cholesterol TGA : Triglyceride ; HDL : High Density Lipoprotein ;LDL : Low Density Lipoprotein.

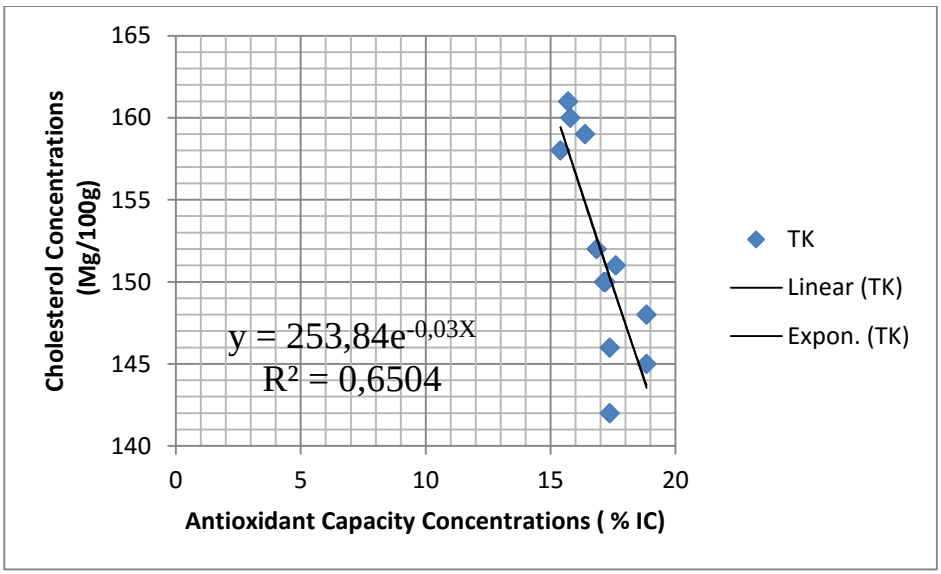

Figure 2. Relatioship of Antioxidant Capacity with Duck Meat Cholesterol Fed by fermented Purple Sweet Potato in rations.

Egg Lipid Profile.

The total cholesterol, triglycerides, HDL and LDL in eggs receiving the treatment A were 280.00; 180.84; 105.13 and 70.72 mg/100g respectively (Table 6). Rations containing fermented purple sweet potato (treatment C) reduced the levels of total cholesterol, triglycerides, HDL and LDL significantly (P<0.05). The content of cholesterol in the body is highly dependent on endogenous (80%) and exogenous (20%) factors (Siswono, 2001), and it relate to the level of antioxidants.

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

Variabel	Perlakuan[1)]			SEM [3)]
	A	B	C	
Total Cholesterol (Mg/100g)	280,00 a 2)	249,52 b	230,56 c	5,26
Triglycerida (Mg/100g)	180,84 a	156,48 b	120,69 c	6,78
High Density Lipoprotein (Mg/100g)	70,72 a	55,53 b	49,27 c	2,21
Low Density Lipoprotein (Mg/100 g)	185,13 a	157,60 b	151,61 b	4,19

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

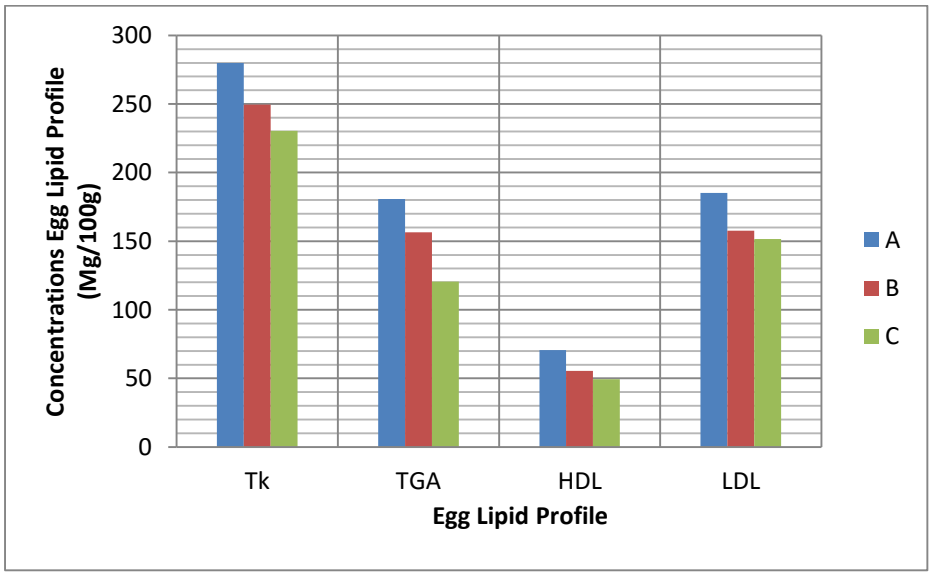

Figure 3 . Duck Egg Lipid Profile Fed with Purple Sweet Potato Fermented in Rations. A: Rations with out purple sweet potato; B: Rations contain a 10 % purple sweet potato; C: Rations contain a 10 % fermented purple sweet potato; TK: Total Cholesterol; TGA: Triglycerida; HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein

The presence of the fermented anthocyanin in purple sweet potato yields the antioxidant content higher than those of unfermented purple sweet potato (Yadnya and Trisnadewi, 2011). Yadnya *et al*. (2009) reported that the rations containing seaweed as

antioxidants source 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 that giving diet containing antioxidants can decrease cholesterol levels. Consuming a higher antioxidants causes the cholesterol levels in eggs reduced.

The 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 was lower than the provision of treatment A or B. Decreases of eggs lipid profile levels was strongly influenced by the amount of antioxidants consumption in ducks receiving treatment C which higher than treatment A or B. Prangdimurti *et al*. (2006) reported that the extract suji leaf (*Pleomeleongustifolio)* can increase the antioxidant capacity of serum cholesterol and decrease blood mice (Fig.3).

CONCLUSION

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

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