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Blood Biochemical Profile, Growth Performance, Carcass Characteristics and Meat Quality of Mallard and Muscovy Ducks Fed Diet Supplemented with Bay Leaves (*Syzygium polyanthum*)

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Abstract: The purpose of this experiment was to investigate the interaction effect between genetic and bay leaf supplementation in the diet on blood biochemical profile, growth performance, carcass characteristics and meat quality of local Mallard and Muscovy ducks. A total of 128 (64 of each breed) day old male ducks were utilized for the study. The experimental design was completely randomized in a factorial pattern. The first factor was breed of duck (Mallard and Muscovy) and the second factor was bay leaf supplementation in the diet at various levels (0%-control, 3, 6 and 9%. The breed type had highly significant ($p<0.01$) effect on blood biochemistry profile viz. plasma proteins, uric acid, glucose, triglycerides, cholesterol, LDL and HDL. Mallard ducks showed higher ($p<0.05$) values for all these parameters than Muscovy ducks, except blood glucose level. The results showed that 3% bay leaves in the diet were able to reduce the uric acid content of Mallard ducks up to 6.71±3.44 mg/dl compared to 19.47±4.5 in the control group. In Muscovy ducks, 6% bay leaves supplementation caused the largest decline in uric acid content up to 2.14±1.29 mg/dl compared to 4.66±1.29 mg/dl in the control group. Breed of ducks had highly significant effects ($p<0.01$) on growth rate, carcass weight, dressing percentage and meat fat content. Muscovy outperformed mallard ducks in term of growth rate, carcass weight and dressing percentage; however, total meat fat was found to be significantly ($p<0.05$) lower in Mallard ducks. Bay leaves supplementation up to 9% did not interfere with growth performance, carcass weight and dressing percentage of both Mallard and Muscovy ducks. There was a significant ($p<0.05$) effect on meat fat and cholesterol between the groups fed bay leaves in the diet and control group, with lowest values in group supplemented with 9% bay leaves in the diet in both Muscovy and Mallard ducks. In conclusion, the supplementation of bay leaves resulted in reduction of meat fat and cholesterol of ducks, thus could prove as a viable for health conscious people.

Key words: Cholesterol, carcass, fat, growth, mallard, Muscovy

INTRODUCTION

In Indonesia, duck is a predominant water fowl that has high contribution to animal protein supply, producing 29.2 tons of meat and 265.8 tons of eggs annually. Furthermore, raising ducks is profitable business with stable and certain markets. Local ducks in Indonesia can be grouped into two groups, namely egg-type ducks such as mallard duck (*Anas platyrhynchos*) and meat-type duck such as Muscovy duck (*Cairina moschata*). The population of ducks in Indonesia increased by 7.45% between 2007 and 2011. The demand for duck eggs increased from 173.8 to 193 kilotons and duck meat from 13.5 to 14.3 kilotons between 2008 to 2010 (Directorate General of Livestock and Veterinary Services, 2013). Duck production plays an important part in the agricultural economy of many Asian countries, with the continent alone accounting for 82.6% of the total duck meat production worldwide (Adzitey and Adzitey, 2011). The increasing demand for duck eggs and meat is closely related to the increasing demand for food. This increased has to be balanced by product quality because today's consumers are more health conscious. One of ways to improve product quality particularly meat, is by improving the feed quality through supplementation of plant derived products.

Nowadays, there are many feed supplements that originate from plants, including bay leaves (*Syzygium polyanthum*). Bay leaves are usually used as a flavoring of food and herbs because of antioxidant content. They contain tannins, flavonoids and essential oils (0.05%), including citric acid and eugenol, carbohydrate, alkaloid, steroid and triterpenoid (Sumono and Wulan, 2008; Kusuma *et al*., 2011). Lelono *et al*. (2009) reported that the extract of bay trees contain phenolic compounds that have antioxidant properties. Bay leaves can be used to improve the immune system, as anti-diarrheal, anti-inflammatory, anti-diabetic (Lelono *et al*., 2009) and to lower the blood cholesterol and uric acid (Suharti *et al*., 2008). Based on these properties of bay leaves, the present study was conducted with the purpose to examine the interaction between breed variation and dietary supplementation of bay leaves at different levels

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on blood biochemical profile, growth performance, carcass characteristics and meat quality of ducks.

MATERIALS AND METHODS

Experimental design and treatments: The study was carried out using one day old Mallard and Muscovy ducklings, 64 each. All ducklings were kept in a brooder for 3 weeks and fed exclusively with broiler feed during that phase. The feed contained metabolize energy of 3000 kcal/kg, 20.5% crude protein, 5% crude fat, 5.75% crude fiber, 0.95% Ca and 0.8% P. The ducks were then reared in experimental cages from 4 weeks of age until the completion of experiment (12 weeks of age) in a completely randomized design factorial pattern. The first factor was breed of duck (B), namely Mallard (b_1) and Muscovy ducks (b_2). The second factor was the level of supplementation of bay leaves (powder form) in the basal feed (P): 0% (control) (p_0), 3% (p_1), 6% (p_2) and 9% (p_3). The details of treatments were as follows:

b_1p_0: Mallard ducks fed basal feed
b_1p_1: Mallard ducks fed basal feed+3% bay leaves meal
b_1p_2: Mallard ducks fed basal feed+6% bay leaves meal
b_1p_3: Mallard ducks fed basal feed+9% bay leaves meal
b_1p_0: Muscovy ducks fed basal feed
b_1p_1: Muscovy ducks fed basal feed+3% bay leaves meal
b_1p_2: Muscovy ducks fed basal feed+6% bay leaves meal
b_1p_3: Muscovy ducks fed basal feed+9% bay leaves meal

Each treatment had 4 replicates, each having 4 ducks. Basal feed consisted of a mixture of rice bran, corn flour and concentrates in the ratio of 40:40:20. Ingredient and nutrient composition of basal diet are presented in Table 1. All ducks were reared in accordance with animal welfare principles. Ducks were kept in colony cages with a size of 80 x 80 cm, which filled with 4 ducks, equipped with feeding and drinking trays. The feed was given in accordance with their needs and water was given *ad libitum*.

Parameters estimated: Growth performance was worked out by recording the body weights at 4 weeks and 12 weeks of age; the difference between the weights were then divided by rearing duration (days) and values were depicted as (ADG) Average Daily Gain in g/day.

At the end of the experimental period, one duck per replicate was utilized for the estimation of blood profile, carcass characteristics and meat quality. Blood sampling was performed 3 h after feeding. Two milliliter of blood samples was taken using syringe in the vein axillaries in accordance with the ethical standards. Blood biochemical parameters estimated were total plasma proteins, uric acid, glucose, triglycerides, cholesterol, Low-density lipoprotein (LDL) and high-density lipoprotein (HDL). Plasma glucose, triglycerides, total cholesterol, LDL, HDL and uric acid were analyzed using a clinical discrete analyzer.

Ducks were slaughtered by kosher method and then processed into carcass and meat. Carcass was defined as ducks that have been slaughtered, de-feathered and eviscerated. Giblet (liver, heart and gizzard) in this study was not included in the carcass. Dressing percentage was calculated as carcass weight divided by body weight before slaughtering multiplied by 100%. Meat samples for fat and cholesterol determination were taken from the breast and thigh without skin in the same proportion. Measurement of the total meat fat content was determined using Soxhlet method (Association of Official Analytical Chemists, 1995) and cholesterol content by using Lieberman Burchard method (Burke *et al*., 1974).

Statistical analysis: The data obtained were analyzed by using analysis of variance followed by Honestly significant difference test as necessary.

RESULTS

The results of various blood biochemical parameters of ducks fed bay leaves in the diet are presented in Table 2. The breed type had highly significant ($p<0.01$) effect on blood biochemistry profile viz. plasma proteins, uric acid, glucose, triglycerides, cholesterol, LDL and HDL. Mallard ducks showed higher ($p<0.05$) values for all these parameters than Muscovy ducks, except blood glucose level. The result also showed that 3% bay leaves in the diet were able to reduce the uric acid content of Mallard ducks to 6.71±3.44 mg/dl compared to 19.47±4.5 in the control group. However, analysis of variance showed the significant differences. In Muscovy ducks, 6% bay leaves supplementation caused the largest decline in uric acid content up to 2.14±1.29 mg/dl compared to 4.66±1.29 mg/dl in the control group.

Breed of ducks had highly significant effects ($p<0.01$) on growth rate, carcass weight, dressing percentage and meat fat content (Table 3). Muscovy outperformed mallard ducks in term of growth rate, carcass weight and dressing percentage; however, total meat fat was found to be significantly ($p<0.05$) lower in Mallard ducks. Bay leaves supplementation up to 9% did not interfere with growth performance, carcass weight and dressing percentage of both Mallard and Muscovy ducks. There was a significant ($p<0.05$) effect on meat fat and cholesterol between the groups fed bay leaves in the diet and control group, with lowest values in group supplemented with 9% bay leaves in the diet in both Muscovy and Mallard ducks.

DISCUSSION

Blood biochemical profile of mallard and Muscovy ducks: Muscovy ducks had lower total plasma proteins than Mallard ducks which could be attributed to their higher growth rate. Plasma proteins consist of three major protein fractions, namely albumin,

Table 1: Ingredient and nutrient composition of basal feed

Ingredient	P0	P1	P2	P3
Grilled corn (%)	40	40	40	40
Rice hull (%)	40	40	40	40
Concentrate (Code KBR2) (%)	20	20	20	20
Total	100	100	100	100
Bay leaves meal (%)	0	3	6	9
Nutrient content*				
Metabolizable energy (kcal/kg)	2972.60	2972.60	2972.60	2972.60
Crude protein (%)	16.92	16.96	16.99	17.03
Crude fiber (%)	7.76	8.37	8.98	9.59
Crude fat (%)	7.4	7.54	7.67	7.81
Calcium (%)	0.508	0.5419	0.5758	0.6097
Phosphor (%)	0.536	0.5573	0.5786	0.5999

*Proximate analysis was conducted at the Nutrition and Feed Laboratory, University of Jenderal Soedirman, Purwokerto Indonesia
P0: Basal feed; P1: Basal feed+3% bay leaves meal; P2: Basal feed+6% bay leaves meal; P3: Basal feed+9% bay leaves meal

globulin and fibrinogen, which serve as protein reservoir in the body. Ducks possessing high growth rate utilize plasma proteins to build their meat protein. Plasma proteins circulate un-statically; they are in a constant exchange with the labile tissue protein, where the amount of protein is proportional to the amount of protein in circulation resulting in a dynamic equilibrium. Whenever there is protein deficiency, the body draws up tissue and plasma proteins for metabolic needs (Harper and Martin, 1985). Plasma protein content is influenced by body fluid balance and disease status (Harvey, 2001). Further, the supplementation of bay leaves had no effect on total plasma proteins in both the breeds of ducks.

The uric acid content in the blood of Mallard ducks was higher than in Muscovy ducks. This condition indicated that genetic factors influence the metabolism of proteins. Uric acid is the by-product of protein metabolism that correlates with proteins efficiency and rate of growth. Darsi *et al*. (2012) reported that chickens fed diet with 18% protein content had lower uric acid levels when compared to group fed 19.5 and 21% protein in the diet. In the present study, all the diets contained 16.92% protein, but the level of uric acid in the blood varied. This difference could mainly be due to differences in the growth rates of Mallard and Muscovy ducks. Mallard ducks had lower growth rate than Muscovy ducks and hence Muscovy ducks were more efficient in utilizing feed protein to be converted into tissue protein. Higher growth in Muscovy ducks caused lower conversion of residual protein in feed into uric acid. Moreover, the supplementation of bay leaves decreased the blood uric acid levels compared to the control group particularly at 3 and 6% level in Mallard and Muscovy, respectively. The results are in accordance with the findings of Ariyanti *et al*. (2007) who reported that the infusion of bay leaves to mice at 2.5 g/kg body weight lowered the uric acid in blood. This decrease of uric acid was attributed to the inhibition of xanthine oxidase, an increase of urine excretion, or combination of both.

Glucose in the blood is the product of carbohydrate metabolism and serve as a source of energy. Muscovy ducks possessed higher glucose content in the blood than mallard ducks. In birds the largest part of carbohydrates in circulation is in the form of d-glucose (180-240 mg/100 mL), d-fructose (1-3 mg/100 mL) and d-galactose (<1 mg/100 mL) (Blem, 2000). Glucose is the largest precursor for the formation of body fat, particularly in poultry. Transport of glucose causes insulin to play a role in the regulation of lipogenesis. An increase of insulin causes an increase of blood glucose and insulin affects triglyceride synthesis through esterification of α-glycerol phosphate (Blem, 2000). Bay leaves contain phytochemical compounds, one of which is α-glucosidase inhibitor (Mun'im *et al*., 2013). α-glucosidase inhibitor is able to control blood glucose levels after meals by inhibiting the activity of α-glucosidase enzyme, so that the intake of glucose is decreased because the breakdown of carbohydrates is inhibited in the gut (Wells *et al*., 2009). Similar findings were reported by Studiawan and Santosa (2005) who reported that ethanol extract of *Eugenia polyantha* leaves at the rate of 2.62 mg/20 g BW and 5.24 mg/20 g BW significantly lowered blood glucose levels in mice. Cholesterol serves as a precursor in the synthesis of several hormones such as progesterone, estradiol, testosterone, cardiole, diethylstilbestrol and ethynodiol diacetate (Almatsier, 2003). Genetic factors influence blood lipid profiles. Mallard ducks contained blood fats (triglycerides, cholesterol, LDL and HDL) higher than Muscovy ducks. In this experiment, cholesterol level in the blood of ducks was reduced when the diet contained 3% bay leaf meal. On the other hand, bay leaves supplementation had no significant effect on blood triglycerides, however, ducks fed diet containing 3% bay leaves had lower blood triglyceride levels than control. Levels of LDL and HDL in the blood reduced in the ducks fed diets containing 3% bay leaves in the diet.

In bay trees, saponin is primarily found in mature fruits. Saponin plays a role in controlling total plasma cholesterol. Blood LDL and HDL are also affected by the presence of saponins. Saponin binds fatty acids in the blood and are converted into bile acids so that they no

Table 2: Blood biochemical profile of male Mallard and Muscovy ducks fed diets supplemented with bay leaves

Breed	Level of bay leaves	Plasma protein (g/dl)	Uric acid (mg/dl)	Glucose (mg/dl)	Triglyceride (mg/dl)	Cholesterol (mg/dl)	LDL (mg/dl)	HDL (mg/dl)
Mallard	0%	4.70±0.90	19.47±4.5	111.33±16.50	281.82±9.09	240.00±30.00	139.9±13.50	100.1±16.50
	3%	3.03±0.06	6.71±3.44	121.67±15.57	234.38±72.81	253.33±5.77	97.47±0.46	52.53±0.46
	6%	5.10±0.70	19.99±5.23	115.00±22.91	313.10±72.36	253.33±49.33	133.17±5.69	93.5±9.90
	9%	4.20±1.20	18.62±5.10	133.33±23.01	275.73±107.72	216.67±40.41	130.67±24.83	86±16.65
Average		4.25±1.08[a]	16.20±6.97[a]	107.46±33.93[b]	276.26±69.98[a]	215.83±50.17[a]	125.30±21.10[a]	83.03±21.98[a]
Muscovy	0%	1.80±0.20	4.66±1.29	161.67±7.64	153.86±27.30	93.33±5.77	57.73±6.73	34.43±1.24
	3%	2.20±0.20	3.93±0.63	192.67±4.62	72.97±18.18	80.67±1.15	47.07±4.30	33.6±5.32
	6%	1.90±1.10	2.14±1.29	119.67±3.79	108.86±36.36	110.00±30.00	57.10±8.00	52.9±22.00
	9%	1.70±0.10	4.07±0.93	172.00±12.00	127.58±36.37	103.33±5.77	64.83±2.93	38.5±5.50
Average		1.90±0.24[b]	3.70±1.34[b]	161.50±28.56[a]	115.82±40.28[b]	96.83±17.59[b]	56.68±8.28[b]	39.86±8.28[b]
Effects of								
Breed (B)		**	**	**	**	**	**	**
Level of bay leaves (P)		NS	NS	**	NS	*	*	*
BxP		NS	NS	NS	NS	NS	NS	NS

[a,b]Means within columns with no common superscripts differ significantly (p<0.01)

longer available for intestinal microflora (Adeneye and Olagunju, 2009). Oyewole and Akingbala (2011) reported that *Jatropha tanjorensis* contains terpenoids, saponins, cardiac glucosides, flavonoids and tannins and inclusion of *Jatropha tanjorensis* extract to white mice at 100, 200 and 500 mg/kg body weight reduced total fat, cholesterol and LDL in the blood, whereas triglyceride and HDL contents were similar to control. Khan *et al*. (2009) reported that diabetic patients who consumed bay leaves of 3 g/d for 30 days showed reduction of total cholesterol and LDL in the blood.

Carcass characteristics and meat quality of ducks: Muscovy ducks had higher ADG, carcass weight and dressing percentage compared to Mallard ducks which could be due their genetic variation. Genetic factors have highly significant effect on growth, carcass production, carcass chemical composition and meat fatness of ducks (Wawro *et al*., 2004).

The increase in the dressing percentage of poultry carcasses is mainly due to the increase in the edible portion of the total body weight of birds (Shahin, 2000). Continuous efforts are being made to increase the proportion of meat in the carcass and to reduce fat in waterfowl species, in which the subcutaneous fat can reach 76% of the total fat (Pingel, 2006). Further, bay leaves supplementation had no effect on the ADG, carcass weight and dressing percentage of both the breeds of ducks.

In general, ducks are waterfowls that produce meat with high fat content. Fat content is influenced by genetic factor such as breed, thus justifying the results of lower meat fat content in Muscovy ducks found in the present study. The reduction of meat fat and cholesterol content was allegedly due to the activity of flavonoids, tannin and saponin of the bay leaves. There was a significant ($p<0.05$) effect on meat fat and cholesterol between the groups fed bay leaves in the diet and control group, with lowest values in group supplemented with 9% bay leaves in the diet in both Muscovy and Mallard ducks. These results could be due to the presence of bioactive compounds like flavonoids, tannins and saponins in bay leaves. Flavonoid is a bioactive substance that prevents LDL oxidation and decreases meat cholesterol and triglycerides (Sellappan and Akoh, 2002). Tannin reduces cholesterol absorption in the intestine, thus decreases lipid concentration (Zhang *et al*., 2011). In the body, tannin is interlinked with protein and produces thin layers in the intestine, hence decelerates fat absorption. Saponin is a bioactive substance that is able to lower biosynthesis of exogenous cholesterol. Saponin was reported to have beneficial effects on blood cholesterol by tying up bile salts and cholesterol in the intestine, which reduces cholesterol level in the blood (Oyewole and Akingbala, 2011). Reduction of triglycerides and

Table 3: Carcas production, fat and cholesterol content of duck meat age 12 weeks with diets supplemented with bay leaves

Breed	Bay leaves level	ADG (g/d)	Carcass weight	Dressing (%)	Total meat fat (%)	Meat cholesterol (mg/g)
Mallard	0%	16.57±1.23	837.61±61.31	62.01±1.39	2.591±0.718^{a}	1.171±0.085^{a}
	3%	17.66±1.69	910.13±89.05	62.00±1.96	1.876±0.176^{a}	1.172±0.057^{a}
	6%	14.94±1.32	817.56±40.42	61.70±1.00	1.327±0.104^{b}	1.100±0.072^{ab}
	9%	16.72±2.18	857.31±74.11	61.63±0.45	1.218±0.023^{b}	1.027±0.080^{b}
Average		16.47±1.61^{b}	855.65±70.92^{b}	61.83±1.19^{b}	1.753±0.654^{A}	1.118±0.091
Muscovy	0	36.63±7.96	1789.02±304.35	64.78±0.55	1.440±0.284^{ab}	1.254±0.057^{a}
	3%	33.79±7.57	1609.13±234.70	64.77±0.75	1.214±0.049^{b}	1.211±0.027^{a}
	6%	34.84±7.51	1839.06±37.71	64.93±0.86	1.267±0.021^{b}	1.155±0.038^{ab}
	9%	31.34±10.95	1599.42±216.71	64.62±0.46	1.251±0.094^{b}	1.019±0.062^{b}
Average		34.97±8.50^{a}	1709.16±226.49^{a}	64.77±0.61^{a}	1.293±0.163^{B}	1.160±0.101
ANOVA	Breed (B)	**	**	**	**	NS
	Bay leaves level (P)	NS	NS	NS	**	**
	B x P	NS	NS	NS	*	NS

^{a,b}Means within columns with no common superscripts differ significantly ($p<0.01$)

cholesterol in the blood resulted in lower fat content and cholesterol in the meat of ducks fed diets supplemented with bay leaves.

Conclusion: It could thus be concluded that the supplementation of bay leaves helped in reduction of meat fat and cholesterol of ducks, thus could prove as a viable for health conscious people.

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