ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

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International Journal of Poultry Science 13 (3): 168-172, 2014
ISSN 1682-8356

Performances and Egg Quality of Quail Offered Feed Containing Sterol from Katuk (*Sauropus androgynus*) and Mulberry (*Morus alba*) Leaf Meal

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Abstract: *Katuk* (*Sauropus androgynus*) and mulberry (*Morus alba*) leaves meal contain cholesterol, campesterol, stigmasterol, sitosterol and 2-4alpha-methylsterol. These active substances were expected to increase nutrients metabolism in laying poultry including quail. Poultry in layer period have high nutrients requirement and mobilization. Usage of *Katuk* and mulberry leaves meal in the diet was expected to increase egg quality. Four dietary treatments and 5 replications of 15 quails of 6 weeks of age each, were allocated in a completely randomized design. Parameters observed were feed consumption, egg weight, quail day production and egg quality. The results showed that feed consumption and egg weight were not affected by the treatments, while egg production was significantly decreased by feeding the 10% mulberry leaf meal as well as the mixture of 5% *katuk* and mulberry leaf meal ($P<0.05$). Feeding 10% katuk leaf meal did not affect the performances of the quail but the egg indicated the highest vitamin A and yolk colour score. It was concluded that 10% *katuk* leaf meal could be fed to the laying quail to increase the egg quality without decreasing the production.

Key words: Egg, yolk, katuk, quail, mulberry

INTRODUCTION

Quail is one of poultry that is potential as source of a good quality animal protein as egg and meat. In laying period, nutrients requirement and utilization are very high. Imbalance nutrients intake and mobilization decreases egg production and quality. Quail productivity was influenced by nutrients content of diet offered in rearing period. Dietary nutrients must be in balance and have high digestibility.

Katuk leaf meal (*Sauropus androgynus*) is one of vegetable usually consumed by people in Asia to increase breast milk production, as anti fever medicine, diuretics and frambesia, as well as food coloring. Malik (1997) reported that *katuk* contains volatile oil, sterol, saponin, flavonoid, organic acid, amino acid, alkaloid and tannin. *Katuk* leaf meal is a source of pro vitamin A in the carotene form. The important carotene for human is beta-carotene that has highest activity of provitamin A (Yuliani and Marwati, 1997). Carotene contained in *katuk* leaf meal is 10, 020 µg per 100 g (Azis and Muktiningsih, 2006). Mulberry (*Morus alba*) leaf meal also contains many phytochemicals, such as alkaloid, polyphenol flavonoid, anti cyanic (Song *et al*., 2009) and sterol (cholesterol, campesterol, stigmasterol, sitosterol and two 4alpha-methylsterol) (Zambakhidze *et al*., 2005).

Katuk and mulberry leaf meal can be used as sources of potential phytochemical in quail diet. Subekti *et al*. (2008) reported that usage of *katuk* leaf meal in the diet resulted in better reproduction performance of the quail. Piliang *et al*. (2009a) showed that usage of *katuk* leaf meal, mulberry leaf meal and its mixture in quail diet yielded high vitamin A of egg and meat but the treatments decreased egg quantity. The decreasing of egg production was due to the high crude fiber in the diet.

The aimed of this research was to evaluate quail performances and egg quality fed diets composed of *katuk* or mulberry leaf meal and its mixture.

MATERIALS AND METHODS

The research was conducted during six month (April to September 2012), at Laboratory of Poultry Nutrition, Laboratory of Feed and Technology, Laboratory of Dairy Nutrition, Faculty of Animal Science and Laboratory of Research Centre for Bioresources and Biotechnology, Bogor Agricultural University, Bogor.

Three hundreds female quail of 6 weeks of age were reared during 11 weeks (from 6-17 weeks). Quails were reared at battery cages. Wooden feeder were placed in the front of cages, while 1 liter bell drinkers were placed besides the cages. A fan was turned on at noon, to reduce air temperature inside the barn.

Katuk and mulberry leaf used in the experiment was sun dried or oven dried at 55°C until the moisture content of 10-15%. The dried leaf was grinded into meal form.

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Diet: Experimental diets were formulated based on the recommendation of Lesson and Summers (2005), those contained 2950 kcal/kg metabolizable energy; 18% crude protein; 3.1% Ca; 0.45% available P; 0.52% methionine and <6% crude fiber. Composition and nutrients content of the experimental diets are showed in Table 2.

Rearing period: Experimental diets were offered gradually started at the age of quail at six weeks old. Diet was offered *ad libitum* and dietary consumption was calculated weekly. Water was given *ad libitum*. Egg production was recorded daily. Egg quality was measured during the production period at last three days in a week from quail age at 13-17 weeks.

Dietary treatments were as follows: T_0 = Control diet (without *katuk* and mulberry leaf meal); T_1 = Diet with 10% *katuk* leaf meal (KLM); T_2 = Diet with 10% mulberry leaf meal (MLM) and T_3 = Diet with 5% KLM and 5% MLM. The treatments were allocated in a Completely Randomized Design (CRD) with four treatments, five replications and 15 quail in each. The data were analyzed using analysis of variance and significant data were further analyzed using Duncan multiple range test (Steel and Torrie, 1995). Parameters observed in the period of 13-17 weeks of age were feed consumption, egg weight, quail day production and egg quality.

RESULTS AND DISCUSSION

Nutrients content of experimental diets: *Katuk* Leaf Meal (KLM) contained higher crude protein and Zn than Mulberry Leaf Meal (MLM) but MLM contained higher crude fiber, gross energy and Ca than KLM (Table 1). Chemical composition of KLM and MLM indicated that the KLM and MLM were potential as component of quail diet as the sources of protein and minerals. Al-Kirshi *et al*. (2009) reported that MLM was a good source of protein for poultry feed. However, *katuk* and mulberry leaf meal also contain tannin and saponin (Table 1). Tannin content of MLM almost 2.5 times higher than that of KLM.

Composition and nutrients content of the diets are showed in Table 2. Nutrients content of the diets met the nutrients requirements of laying quail recommended by Leeson and Summers (2005).

Tannin and saponin content of feed and calculated tannin and saponin content in the diets are shown in Table 1 and 2, respectively. Diets containing KLM and MLM or its mixture contained higher tannin and saponin than control diet. These antinutrients reduced protein digestibility (Francis *et al*., 2002) and feed efficiency (Medugu *et al*., 2012).

Quail performances of 10-17 weeks of age

Feed consumption: Feed consumption of the quails (20.02-22.87 g/bird/day) was not affected by the

Table 1: Nutrient composition of katuk leaf meal (KLM) and mulberry leaf meal (MLM) dry matter basis (%DM)

	KLM	MLM
Dry matter (%)[1]	88.06	93.86
Ash (%)[1]	12.13	12.21
Crude protein (%)[1]	29.15	22.14
Ether extract (%)[1]	4.62	4.11
Crude fiber (%)[1]	8.19	12.28
Gross energy (kkal/kg)[2]	4014.31	4197.74
Metabolizable energy (kkal/kg)[3]	1603.98	1730.13
Ca (%)[4]	2.06	4.34
Total P (%)[4]	0.30	0.24
Mg (%)[4]	8.28	5.10
Zn (ppm)[4]	202.38	49.55
Tannin (g/100 g)[5]	0.46	1.09
Saponin (g/100 g)[5]	2.84	1.28

Note:

[1]Analyzed by Lab. of Bioresources and Biotechnology Centre, Bogor Agricultural University (2012) Pusat Penelitian Sumberdaya Hayati dan Bioteknologi, IPB

[2]Analyzed by Lab of Feed Science and Technology, Faculty of Animal Science, Bogor Agricultural University (2012)

[3]ME_n = 46.7 x DM-46.7 x Ash-69.54 x CP+42.94 x EE-81.95 x CF (NRC, 1994)

[4]Analyzed by Lab. of Dairy Nutrition, Faculty of Animal Science, Bogor Agricultural University, Bogor (2012)

[5]Analyzed by Lab of Indonesian Research Institute for Animal Production, Ciawi, Bogor (2011). KLM: Katuk leaf meal, MLM: Mulberry leaf meal

Table 2: Composition of laying quail diet

	T_0	T_1	T_2	T_3
Yellow corn	46.003	46.00	46.00	46.00
Rice bran	13.20	7.20	4.65	6.60
Soybean meal	21.00	18.00	20.00	18.30
Fish meal	5.00	3.60	4.00	4.00
Palm Oil	6.50	6.50	6.60	6.50
KLM	0.00	10.00	0.00	5.00
MLM	0.00	0.00	10.00	5.00
DCP	0.00	0.50	0.70	0.50
$CaCO_3$	7.30	7.00	7.00	7.00
NaCl	0.30	0.30	0.30	0.30
Premix	0.50	0.50	0.50	0.50
L-Lysine	0.00	0.00	0.00	0.00
Dl-Methionine	0.20	0.40	0.25	0.30
TOTAL	100.00	100.00	100.00	100.00
Calculated nutrient composition				
Dry matter (%)	90.21	89.96	90.51	90.25
ME (kkal/kg)	2961.80	2874.05	2916.74	2891.87
Crude protein (%)	18.21	17.85	18.19	17.87
Ether extract (%)	9.11	9.18	9.15	9.15
Crude fiber (%)	3.41	3.31	3.50	3.47
Lysine (%)	1.10	0.90	0.97	0.93
Methionine (%)	0.56	0.70	0.56	0.61
Cystine (%)	0.29	0.24	0.26	0.25
Met+Cys (%)	0.85	0.94	0.82	0.85
Calcium (%)	3.15	3.15	3.18	3.16
Available Phosphor (%)	0.43	0.44	0.46	0.44
Sodium (%)	0.19	0.17	0.18	0.18
Chlorine (%)	0.26	0.24	0.24	0.25
Linoleic acid (%)	1.50	1.26	1.18	1.24
Tannin (%)	0.00	0.046	0.109	0.078
Saponin (%)	0.00	0.284	0.128	0.206

Note:

T_0: Control diet (without KLM and MLM)

T_1: Diet with 10% KLM: Katuk leaf meal

T_2: Diet with 10% MLM: Mulberry leaf meal

T_3: Diet with 5% KLM and 5% MLM. ME: Metabolizable energy

Table 3: Average performances of laying quail 10-17 weeks of age

	T_0	T_1	T_2	T_3
Feed consumption (g/bird/day)	22.24±0.17	20.02±0.39	22.87±0.28	22.10±0.13
Egg weight (g/egg)	9.53±0.35	9.22±0.16	9.59±0.28	9.48±0.21
Quail day Production (%)	45.19±9.40[a]	39.16±9.04[a]	22.82±8.66[b]	20.87±7.32[b]

Note: T_0: Control diet (without KLM and MLM), T_1: Diet with 10% katuk leaf meal (KLM), T_2: Diet with 10% mulberry leaf meal (MLM), T_3: Diet with 5% KLM and 5% MLM

Table 4: Average tannin and saponin consumption in the diet from katuk leaf meal (KLM) and mulberry leaf meal (MLM)

	T_0	T_1	T_2	T_3
Tannin consumption (g/bird)	0.00±0.00	0.92±0.03	2.49±0.29	1.71±0.12
Saponin consumption (g/bird)	0.00±0.00	5.69±0.18	2.93±0.34	4.55±0.32

Note: T_0: Control diet (without KLM and MLM), T_1: Diet with 10% katuk leaf meal (KLM), T_2: Diet with 10% mulberry leaf meal (MLM) T_3: Diet with 5% KLM and 5% MLM

treatments (Table 3). This results showed that diets using KLM, MLM or its mixture, have the same palatability as control diet. Tannin in the diet containing 10% MLM did not effect the feed consumption.

Egg weight: The average of egg weight was not influenced by usage of KLM, MLM or its mixture in the diet (Table 3). The quail egg weight (9.22-9.59 g/egg) are normal quail egg weight. The use of KLM and MLM could be included into the diet of laying quail. However sterol contained in these feed components had no effect on the egg weight.

Quail day production: Inclusion of MLM and the mixture KLM and MLM in the diet decreased the quail day production (Table 3). This results showed that KLM inclusion in the diet of laying quail had the same effect with control diet but feeding of MLM or its mixture of MLM and KLM decreased ($P<0.05$) quail egg production. Reduction in egg production was likely associated with the sterol content of the MLM and the mixture in MLM and KLM. However the sterol components in these feeds were different. Tannin content in the diets might also contributed to the reduction of egg production.

Weekly quail day production (Fig. 1) showed that quail fed diet composed of 10% KLM reached earlier 5% QD production at 7 weeks of age and the quail offered the diet containing 10% MLM took more time to reach the stage. Subekti *et al*. (2008) indicated a similar pattern that quail fed KLM laid egg faster than the quail fed control diet or diet containing *katuk* extract meal. The result confirmed that phytosterol and antioxidant contained in KLM enhanced the reproductive performance of the quail.

The peak egg production of the control diet was reached at 16th weeks with 54.8% QDP and that of T_1 (using 10% KLM) at 15th weeks with 52.5% QDP and that of T_2 (using 10% MLM) at 14th weeks with 34.5% QDP and that of T_3 (using 5%KLM and 5% MLM) at 16th weeks with 39.3% QDP.

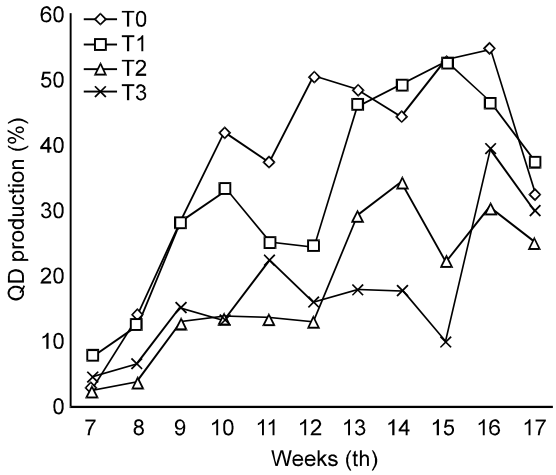

Fig. 1: Quail day production of laying quail 7 to 17 weeks of age. T_0: Control diet (without KLM and MLM), T_1: Diet with 10% katuk leaf meal (KLM), T_2: Diet with 10% mulberry leaf meal (MLM), T_3: Diet with 5% KLM and 5% MLM

Egg quality in 13-17 weeks of ages

Egg weight: Egg weight produced during 13 to 17 weeks of ages was affected ($P<0.05$) by the treatments (Table 5). Feeding 10% KLM (T_1) or the mixture of 5% KLM and 5% MLM (T_3) decreased ($P<0.05$) the egg weight of quail. On the other hand, feeding 10% MLM did not affect the egg weight. MLM included was likely reduced the negative effect of decreasing egg weight. The egg weight yielded in this research was in the normal egg weight, since Song *et al*. (2001) showed that average egg weight are 10.34±0.93 g, while Kalsum *et al*. (2012) have egg weight about 11.04 g.

Weight and percentages of yolk: Egg yolk yielded from quail fed diet composed of KLM, different ($P<0.05$) from the other dietary treatments (Table 5). Weight and percentage of yolk yielded from quail with KLM, lower than the other treatments. It might due to the lower intake of nutrients. Percentage of yolk yielded from quail fed diet with 5% KLM and 5% MLM, was the highest ($P<0.05$) among quail in other treatments. The weight and percentage of egg yolk yielded in this research were in the normal condition with Yolk weight 3.25±0.40 g with

Table 5: Average egg quality of laying quail 13-17 weeks of age

	T_0	T_1	T_2	T_3
Egg weight (g/egg)	10.05±0.46^{a}	9.53±0.21^{b}	9.97±0.33^{ab}	9.53±0.23^{b}
Yolk weight (g)	3.23±0.16^{a}	3.03±0.09^{b}	3.34±0.15^{a}	3.24±0.09^{a}
Percentage of yolk weight (%)	32.14±0.67^{bc}	31.8±0.96^{c}	33.34±0.99^{ab}	33.99±1.02^{a}
Albumen weight (g)	5.25±0.27^{a}	4.98±0.16^{ab}	5.14±0.18^{a}	4.78±0.28^{b}
Percentage of albumen weight (%)	52.20±0.87^{a}	52.19±1.10^{a}	51.46±0.69^{ab}	50.33±0.66^{b}
Shell weight (g)	1.39±0.06^{a}	1.39±0.06^{a}	1.32±0.12^{ab}	1.27±0.03^{b}
Percentage of shell weight (%)	13.97±0.36^{ab}	14.66±0.55^{a}	13.23±1.12^{b}	13.55±0.53^{b}
Shell thickness (mm)	0.24±0.06	0.26±0.04	0.22±0.03	0.23±0.06
Yolk color score	6.93±0.29^{d}	10.03±0.22^{a}	8.34±0.53^{c}	9.31±0.56^{b}
Vitamin A of yolk (mg/100g)	2061.00^{d}±36.20	2560.62^{a}±68.67	2190.12^{c}±63.82	2390.05^{b}±34.48

Note: T_0: Control diet (without KLM and MLM), T_1: Diet with 10% katuk leaf meal (KLM), T_2: Diet with 10% mulberry leaf meal (MLM) T_3: Diet with 5% KLM and 5% MLM

yolk percentage 31.4±1.98% (Song *et al*., 2001) and 31.58% Kalsum *et al.* (2012).

Weight and percentage of albumen: Weight of egg albumen yielded from quail fed diet with MLM was the same as that fed control diet, while quail in the diet with mixture KLM and MLM, was lower (P<0.05) than that in the other treatments (Table 5). Albumen percentage of quail fed diet with KLM was similar with that in control diet, while quail fed the mixture of KLM and MLM was lowest (P<0.05) than from the others. The weight and percentage of albumen weight in this research were lower than the albumen weight from Song *et al.* (2001) of 6.33±0.59 g and 61.2±2.32% but in the same as Kalsum *et al.* (2012) of 51.84%.

Weight and percentage of egg shell: Weight of egg shell yielded from quail fed diet with KLM was the same as that in control diet (P<0.05) but gave the highest (P<0.05) egg shell percentage than the other treatment (Table 5). It might be due to the content of phytosterol in KLM, that stimulate Ca deposit in the egg shell. The weight and percentage of egg shell were higher than Song *et al.* (2001) that resulted quail egg shell weight of 0.76±0.01 g with percentage of 7.3±0.69%.

Egg shell thickness: Egg shell thickness was not affected by dietary inclusion of KLM, MLM, or its mixture in the diet (Table 5). Egg shell thickness was compared with the study of Song *et al.* (2001) (174±15.5 μm) and Kalsum *et al.* (2012) (0.194 mm). Egg shell thickness in this study was more thick because the quail was in the early laying phase.

Yolk color score: Yolk color score yielded by quail gave diet with 10% KLM significantly (P<0.05) highest from the other treatment (Table 5). It could be due to the presence of carotenoid in KLM. The carotenoid (beta-carotene) support the high yolk color score since it has the same function with xanthophylls. Subekti *et al.* (2008) and Piliang *et al.* (2009b) have the same results that quail gave Katuk Leaf Meal (KLM) yielded higher yolk color score than that gave katuk extract meal. Indarsih and Tamsil (2012) also had the same results in duck egg yolk color with given duckweed in the feed.

Vitamin A of yolk: Vitamin A content of yolk from quail gave KLM, MLM and its mixture, were higher (P<0.05) than control diet (Table 5). It could be due to beta-carotene content as vitamin A precursor in KLM and MLM, that converted to vitamin A. It is showed that KLM, MLM and its mixture are good sources of provitamin A. The usage of that 2 kind of leaf meal resulted quail egg with high vitamin A.

Conclusion: The author thanks to the Institute of Research and Community Empowerment of Bogor Agricultural University (LPPM IPB) for fund gave by LPPM IPB through Strategic Research IPB 2012 (Penelitian Unggulan/Strategis Institut Pertanian Bogor tahun Anggaran 2012) Number: 477/IT3.11/PG/2012 Date: 28 Mei 2012.

ACKNOWLEDGMENT

The author thanks to LPPM IPB for fund gave by LPPM IPB through Penelitian Unggulan/Strategis Institut Pertanian Bogor tahun Anggaran 2012 Nomor: 477/IT3.11/PG/2012 Tanggal: 28 Mei 2012.

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