Improvement of Nutritive Values of Local Feedstuffs as Mineral Sources for Kampong Laying Hens

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Abstract

Three mineral feeds composed mainly of three locally available materials (limestone originated from Bukit Kamang, freshwater oyster shell and bone ash) were investigated to improve their nutritive values as mineral sources for diet of Kampong laying hens. The first formula was enriched with micro minerals (P1). The second was enriched with micro minerals and supplemented with vitamin (P2). The third was supplemented with both micro minerals and vitamin and amino acid DL-methionin (P3). The minerals were mixed at the level of 6% into basal diet. Two other diets were used as controls. The first was basal diet mixed with 6% of mixture limestone, oyster shell and bone ash (P4), while the second was basal diet mixed with a commercial mineral feed (P5). The five experimental diets were then fed to 150 Kampong laying hens. The hens were divided into 3 groups based on body weight: heavy, medium and light. Each group was subdivided into 5 subgroups in accordance with number of treatments, so that each treatment consisted of 3 replicates containing of 10 hens. Parameter measured included: feed intake, egg production, FCR, eggshell quality, mineral retention and mineral composition of tibia bone. The results showed that laying performances of Kampong hens were significantly improved, when local mineral feeds were fortified with micro minerals, vitamin and amino acid. The hens fed with diet supplemented with local mineral feed and enriched with micro minerals, vitamin and amino acid showed no significantly different performances with that of supplemented with commercial mineral feed.

Keywords: Kampong laying hens, limestone and freshwater oyster shell, mineral feed

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Introduction

Center for intensive rearing of Kampong laying hens in West Sumatra are located in three sub districts: Talawi (Sawahlunto city), Suliki (Lima Puluh Kota district) and Tanjung Emas (Tanah Datar district). Farmers kept the hens of about 1000

– 2000 birds each in individual cages made from wood and bamboos. The eggs produced in term of size and shell strength were found poorer than that of egg from free-scavenging Kampong hens (Anwar and Khalil, 2005).

Poultry under intensive production systems are particularly susceptible to minerals, vitamin and amino acid deficiencies. Laying hens need 3-4% Ca in the diet during production period mainly for eggshell formation (Scholtyssek, 1987). Calcium metabolism and shell formation is dependent upon enzyme systems and various trace minerals are required as co-enzymes. There are six critical micro minerals that are frequently deficient in diet for laying hens, i.e.: cupper (Cu), selenium (Se), iodine (I), iron (Fe), manganese (Mn) and zinc (Zn) (NRC, 1994). Other micro nutrients that are related with mineralization process and frequently deficient in diet for laying hens are vitamin D and B12 and sulfur-containing amino acid. Vitamin D is essential for normal shell calcification (Plaimast and Kijparkorn, 2010) and vitamin B_{12} is an integral part of different enzyme systems (McDowell, 1989), while methionine is generally the first liming amino acid in corn-soybean diet and adequate sulfur amino acids must be present in the diet for maximum egg size (Miles *et al*., 1986, Abd El-Maksoud *et al*., 2011).

Inclusion of mineral-vitamin-amino acid in a premix in formulated diet has become indispensable practice because feed ingredients do not contain all essential minerals, vitamins and amino acid. Such premix might be produced from locally available mineral feedstuffs by fortifying with essential micro minerals, vitamin and amino acid.The province of West Sumatra abounds with mineral feed sources in the form of: limestone, fresh water oyster shell and bone meal. One of the most intensively exploited limestone hill deposit is named Bukit Kamang, located at Kamang Mudik villages, Kamang Magek sub district, Agam district. The meal products not only contains high calcium (Ca) of about 38-40% but are also rich on micro minerals of iron (Fe), manganese (Mn) and selenium (Se) (Khalil and Anwar, 2007). Fresh water oyster (*Corbicula sp*) was abundantly found in fresh water bodies in West Sumatera. The shell parts which are used as feed in coarse ground form contain about 26-30% calcium (Khalil, 2003). Bone meal is produced by small-scale home industries and contained of relatively high Ca and P of about 20.8 % and 12.5%, respectively (Anwar and Khalil, 2005).

The present research aimed to study the effect of supplementation of local mineral formula containing Bukit Kamangs' limestone, fresh water oyster shell and bone meal with micro minerals of Zn, Cu and I and vitamin (D and B12) and sulfur amino acid (methionine) on the laying performances of Kampong hens.

Materials and Methods

Four mineral feeds were formulated which composed mainly of three locally available materials: Bukit Kamangs' limestone, fresh water oyster shell and bone

meal. The first formula, called as local mineral, composed only of Bukit Kamangs' limestone, fresh water oyster shell and bone meal. The second was the local mineral fortified with micro minerals of Zn, Cu and I. The third was the local mineral fortified with both micro minerals and vitamins of D3 and B12. The fourth was the local formula enriched with micro minerals, vitamins and amino acid of methionine. The nutrient compositions of the formulas were justified to the standard requirements for laying hens recommended by Weinreich *et al*. (1994).

Each mineral formula was mixed in the level of 6% with basal diet. Basal diets were prepared by using three main component of commercial layer concentrate, corn and rice bran in the level of 20, 42 and 32 %, respectively. Another diet was mixed with a commercial mineral premix (MINERAL B12 produced by EKA FARMA, Semarang) and considered as control; so that there were in total five experimental diets as treatments:

Treatment 1 (P1): Basal diet + local mineral
Treatment 2 (P2): Basal diet + local mineral + micro minerals
Treatment 3 (P3): Basal diet + local mineral + micro minerals + vitamins
Treatment 4 (P4): Basal diet + local mineral + micro minerals + vitamins + amino acid.
Treatment 5 (P5): Basal diet + commercial mineral feed.

The nutrient and energy compositions were justified to the standard requirements of Kampong laying hens during production period recommended by Mulyono (1999).

The experimental diets were offered to 120 Kampong laying hens for 24 weeks. The hens were divided into three groups based on body weight: light (1150-1349 g/bird), medium (1350-1499 g/bird) and heavy (1500-1800 g/bird). Each group which composed of 40 birds was then subdivided into 5 subgroups in accordance with the number of treatments, so that each experimental unit consisted of 8 birds. Parameters measured included: body weight, feed intake, feed conversion ratio (FCR), hen-day egg production, number and weight of egg production, eggshell quality (weight and percentage of eggshell), mineral retention and weight and mineral composition of tibia bone. All data were subjected to statistical analysis using variance analysis in a completely block design with 5 treatments and 3 blocks as replicates. Duncan's Multiple Range (DMRT) was applied to separate means. Differences were considered significant at $P<0.05$ (Steel and Torrie, 1981).

Results and Discussion

Laying Performances

Results in Table 1 show that total feed intake for 24 weeks ranged 17,655 -18,109 g/bird, while daily feed intake ranged 105 g–108 g/bird. These data did not differ significantly ($P>0.05$). This might be occurred because mineral, vitamin

Table 1. Feed intake, feed conversion ratio and egg production of Kampong laying hens fed diets containing different mineral formula sources for 24 weeks

	Experimental diets with mineral formula sources:				
	P1	P2	P3	P4	P5
Initial body weight, g/bird	1,423.3	1,400.0	1,373.3	1,443.3	1,393.3
Final body weight, g/bird	1,650.0	1,816.7	1,640.0	1,683.3	1,653.3
Total feed intake, g/bird	1,7685.1	18,109.0	17,869.3	17,654.6	17,931.6
Daily feed intake, g/bird	105.3	107.8	106.4	105.1	106.7
Egg production, eggs/bird	47.8^{c}	60.2^{b}	60.7^{b}	70.8^{ab}	74.4^{a}
Egg production, g/bird	2,167.8^{c}	2,551.2^{b}	2,660.8^{b}	2,846.2^{ab}	3,294.4^{a}
Hen-day egg production, %	28.0^{c}	35.9^{b}	36.1^{b}	42.1^{ab}	44.3^{a}
Feed conversion ratio	8.16^{c}	7.09^{b}	6.71^{b}	6.20^{ab}	5.44^{a}

Note: a, b, c, d – values in the rows with different superscript differ significantly (P<0.05).

and amino acid did not have profound influence on body weight and feed intake of birds

Laying performances in terms egg production and feed conversion ratios were significantly (P<0.05) affected by the treatments. Kampong hens fed diet containing local mineral (P1) showed the lowest egg production in term of number, total weight and hen-day egg production and the poorest feed utilization efficiency. Supplementation of local mineral with micro minerals, vitamins and amino acid (P2, P3 and P4) improved laying performances (P<0.05). Egg production increased about 16.1 egg/bird, from 47.7 (P1) to 63.9 egg/bird (P2, P3 and P4), total egg mass 518.3 g/bird (from 2167.8 to 2686.1 g/bird), hen-day egg production 10% (from 28.0 to 38.0%), while feed conversion ratios decreased of about 1.49 (from 8.16 to 6.67). Previous study with commercial laying hens showed that supplementation of local mineral with micro minerals Zn, Cu and I improved laying performances (Khalil, 2010). The beneficial effects of Cu, Zn and I supplementation on laying performances of commercial layers were reported by Swiatkiewicz and Koreleski (2008), El-Husseiny *et al*. (2009) and Cepuliene *et a*l. (2008).

Although the results were not significantly difference, supplementation of local mineral with mixture of micro minerals, vitamins and amino acid gave positive effect on laying performances. As presented in Table 3, Kampong hens fed with diets containing local mineral and fortified with micro minerals and vitamins (P3) or mixture of micro minerals, vitamins and amino acid (P4) showed higher egg production and lower feed conversion ratio than those of fed with diet containing mineral formula fortified with only micro minerals (P2). When local mineral were enriched completely with mixture of micro minerals, vitamins and amino acid (P4), laying performance were found not significantly different with those of commercial

premix (P5). Kampong hens fed on the diets containing local mineral and fortified with micro minerals, vitamins and amino acid (P4) (average: 71 eggs/bird; 2846 g/bird; 42%, respectively) showed not significantly different in feed utilization efficiency and egg production in term of number, total weight and hen-day egg production with those fed with diet containing commercial premix (P5) (74 egg/bird; 3294 g/bird; 44%).

Egg Weight and Eggshell Quality

The results of egg weight, quality of eggshell and mineral retention are presented in Table 2. Average egg weight ranged 38.7 to 40.5 g/egg. There were not significant effect (P>0.05) of supplementation of local mineral with micro minerals, vitamins and amino acid. Lack of influence of micro mineral and vitamin supplementation on egg weight were also reported by some researcher. Mabe *et al.* (2003) reported that the addition of 60, 60 and 10 mg/kg of Zn, Mn and Cu, respectively, to basal diet did not significantly influence egg weight in commercial laying hens. Abdallah *et al* (1994) suggested that remove supplemental iron or some other kinds of minerals (Cu, Zn or Mn) from laying hens diets did not affect the egg weight of hens. Kato *et al*. (2003) reported that supplementation of vitamin B_{12} at 10µg/kg in a corn soy based diet in Lohmann laying hens during the second cycle of production gave no significant effect on egg mass.

The data presented in Table 2 also show that fortifying local mineral with micro minerals, vitamins and amino acid did not significantly (P>0.05) influence shell weight, shell thickness, shell per cent and mineral and ash content of shell. These results were confirmed by Holoubek *et al*. (2002) who reported that the addition

Table 2. Average egg weight, shell weight, per cent of shell weight and shell thickness of Kampong laying hens fed diets containing different mineral formula sources for 24 weeks

Parameter	Experimental diets with mineral formula sources				
	P1	P2	P3	P4	P5
Egg weight, g/egg	40.5	39.7	42.0	38.7	39.7
	(4.2)	*(0.8)*	*(4.1)*	*(1.1)*	*(2.4)*
Eggshell weight, g/egg	3.8	4.5	3.7	3.5	3.8
	(0.4)	*(1.8)*	*(0.1)*	*(0.3)*	*(0.2)*
Per cent egg shell, %	8.7	8.6	8.6	8.5	8.8
	(0.5)	*(0.2)*	*(0.5)*	*(0.6)*	*(0.6)*
Eggshell thickness, mm	0.48	0.50	0.49	0.49	0.50
	-0.01	*(0.00)*	*(0.01)*	*(0.01)*	*(0.00)*

Value in italic parentheses: standard deviation (SD) (±).

of micro minerals of Cu and Fe to feed mixture has not significant impact on the quality of egg shell of commercial layers.

It is concluded that the nutritive values of local mineral formula composed of Bukit Kamangs' limestone, fresh water oyster shell and bone meal were improved by fortifying with micro minerals, vitamins D and B12 and methionine. Laying performances of Kampong hens fed diet containing local mineral and fortified with micro minerals, vitamins and methionine were found not significantly different with those fed diet supplemented with commercial mineral feed.

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