UTILIZATION OF HEDGE LUCERNE MEAL (DESMATHUS VIRGATUS) AS PROTEIN SUPPLEMENT IN LAYER DIETS

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Abstract:

The present experiment was conducted to determine the effect of hedge lucerne meal on the laying performance and egg quality of laying hens. Three hundred 22 week-old Hisex brown pullets were randomly divided into 5 groups of 60 hens each. Each group was fed a ration containing 0, 2, 4, 6 and 8% hedge lucerne meal. All diets were isonitrogenous and were fed to the layers continuously for five 28-day periods. The results demonstrated that feeding 8% hedge lucerne meal decreased egg production. No significant differences among the dietary treatments were found in feed intake, body weight gain, egg weight, egg mass, egg composition and general health of the laying hens. In terms of egg quality, it was found that there were no significant differences in specific gravity, shell thickness, albumin height and Haugh units between dietary treatments. However, egg yolk color was significantly affected, with the control group having a yolk color much paler than the other groups, while hens fed 8% hedge lucerne meal in the diet had the highest egg yolk color score ($p<0.01$). The results of this experiment clearly indicate that 6% hedge lucerne meal can be added in the diet of laying hens without any adverse effects on the laying performances and egg quality.

Keywords: **Hedge lucerne meal, Desmanthus virgatus, layer, feed intake, egg production, egg yolk color**

Introduction

In the poultry industry of Thailand tree legume meals such as leucaena are generally added to poultry rations either as a source of protein supplement or as a source of carotenoid pigments to improve yolk color. They may also be sources of other nutrients. However, there have been limited publications on the effects of adding hedge lucerne meals (HLM) to the diet of laying hens on egg production and quality. Much of the research has centered on the effects of HLM on growing chicks.

The main species of tree legumes used in these nutritional studies have been leucaena (Leucaena leucocephala), gliricidia (Gliricidia

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sepium) and cajanus (Cajanus cajan). However, their relatively high levels of fiber or the presence of anti-nutritional factors have tended to limit their use in poultry diets. Chaiyannukuljitti *et al.* (1991), for example, reported that crossbred native chickens fed 15% HLM in their diets significantly lowered average daily gain (ADG), feed conversion ratio (FCR) and also had longer feeding periods than those chicken fed 10% HLM in the diet. Chomchai *et al.* (1992), however, recommended that HLM could be fed up to 15% in broiler diets and had no effect on mortality rate. But they found that chickens on a diet containing only 5% HLM had the best ADG and FCR.

The first consideration when feeding tree legume meals to laying hens is that of protein content, especially amino acids. Different dietary proteins can cause smaller eggs while extra dietary proteins will cause slightly larger eggs (Perry *et al.*, 1999). Protein levels around 13% will result in a significant reduction in egg size (Leeson and Summers, 1997) while protein levels less than this will cause a marked drop in egg numbers.

D'Mello (1995), who experimented with leucaena meal fed to laying hens, suggested that the important attribute of leucaena leaf meal emanated from its relatively generous content of caroteniods which can be utilized by poultry as a source of pigment. Since the pigments deposited in the eggs and carcasses cannot be synthesized by poultry, an exogenous source must be supplied in the diet if an acceptable product is to be obtained. Springhall and Ross (1965), quoted in D'Mello (1995), reported that hens may reach the maximum in their ability to absorb xanthophylls from Leucaena leucocephala when an inclusion rate of 5.0% in the diet is employed. Similarly beneficial effects of feeding *Gliricidia sepium* were reported by Osei *et al.* (1990) and occurred within a week of feeding.

Poultry farmers must always be aware of the desired yolk color to meet market preferences. Fortunately it is not difficult to obtain the desired color of egg yolk ranging from very pale, through orange to a bright red color, as measured on the Roche scale (0 - 15 units). Pigmenting agents can be included in the feed ration either as raw materials or as natural or semi-synthesis additives such as additions of HLM. For example, Udedibie and Igwe (1989) argued that a deeper color intensity of the yolk required by the food processing industry could be achieved by feeding increasing rates of Cajanus cajan leaf meal, but considered that egg production might be depressed as a consequence.

Because of the limited information locally on the effect of feeding hedge lucerne meal to laying hens and the high dry matter potential from locally-grown hedge lucerne, it was considered important to investigate whether the feeding of different levels of HLM to laying hens had any effect on their egg production and egg quality.

Materials and Methods

Experimental Layout

Three hundred 22 week-old Hisex brown pullets were randomly divided into 5 groups of 60 hens each. Each group was further divided into 5 replications of 12 hens each. The hens were kept separately in metal cages in an evaporative cooling system house where feed and water were provided *ad libitum*. A lighting schedule of 16 L : 8 D was maintained throughout the study.

Each group of hens was randomly fed an experimental diet as follows:

Diet 1: A diet containing 0% hedge lucerne meal -control diet
Diet 2: A diet containing 2% hedge lucerne meal
Diet 3: A diet containing 4% hedge lucerne meal
Diet 4: A diet containing 6% hedge lucerne meal
Diet 5: A diet containing 8% hedge lucerne meal

All experimental diets were isonitrogenous and isocaloric which were fed to the birds for five 28-day periods. Feed ingredients and chemical compositions of the experimental diets are presented in Table 1. Chemical analyses of the diets were made for crude protein (Kyltec autoanalyser), crude fibre (Fibertec auto-analyser), ether extract (Soxtec autoanalyser), ash (500°C overnight), and nitrogen-free extract was calculated (AOAC, 1990).

The hedge lucerne meal was made from leaves and small branches harvested from hedge-rows of the hedge lucerne tree, then dried and ground to a coarse powder.

Egg production and quality characteristics

Egg production and feed consumption were recorded in all periods. All eggs produced during the last 3 days of every 28-day period were used for measuring egg weight, egg shell thickness, specific gravity, albumen height, Haugh units, egg yolk color and for separating egg composition for yolk, albumen and shell.

Poultry health

Blood samples were randomly collected from 2 birds in each replicate to assess general health. Blood samples were analyzed for plasma protein and packed cell volume in the last period.

Statistical analysis

The main effects between the treatment groups were statistically analyzed by ANOVA in a completely randomized design (Steel and Torrie, 1986) and significant differences between them were tested by Duncan's New Multiple Range Test (DMRT) according to methods described by SAS (1985).

Results and Discussion

The chemical composition of the diets presented in Table 1 shows that crude fiber levels in the different diets steadily increased as the level of added HLM in the diets increased. There was also a noticeable increase in ether extract (EE) and gross energy (GE) with increasing HLM levels, together with an equally marked decrease in the percentage of nitrogen free extract in the respective diets.

When high fiber ingredients, such as rice bran, sunflower meal or HLM, are included in the diet it is usually associated with a reduction in water-soluble carbohydrates and requires the inclusion of dietary fat in order to balance the energy concentration in the diet. This occurred in the present study with dietary fat (palm oil) being increasingly added as the HLM level increased in the diet. This addition resulted in increasing GE content in the diets, as mentioned above. However, the type of fiber also appears to influence the digestibility of the fat. For example, Janssen and Carré (1989) reported an increase in the digestibility of fat when the added fiber came from sunflower seed meal or alfalfa meal, but a decrease in the digestibility of the fat when the added fiber was based on wheat bran.

Although Smith (1990) reported that, with high crude fiber content above 7%, the diet can limit feed intake, there was no evidence of any reduction in daily feed intake with increasing crude fiber levels in this experiment (Table 2). This is explained by the fact that the highest level of 8% HLM in the diet represented only 4.8% crude fiber in the diet and hence was well below the critical level of 7% reported by Smith (1990).

As also shown in Table 2, body weight gain of hens fed the different diets showed comparable variations between diet treatments, with the hens fed zero or low HLM diets tending to have higher body weight gain than those hens given higher HLM diets. The exception was the 4% HLM diet treatment which showed a significant unexplainable drop in body weight gain compared with the other treatments.

Egg production was significantly reduced at the highest level of HLM (8%), but was not significantly affected at the lower levels of added HLM in the diet (0 to 6%). Berry and D'Mello (1981) also found that egg production was significantly reduced when laying hens were fed high levels of leucaena meal. And Scott *et al.* (1982) reported reduced egg production when laying hens were fed diets with more than 5% HLM. The reduction in egg production in this experiment was probably due to the lower feed intake and high bulkiness of the diet.

The different levels of HLM in the diet had no significant effect on egg weight or egg mass (Table 2), nor on feed intake per egg production. The composition of eggs obtained from hens fed diets containing different levels of HLM is

Table 1. Feed ingredients, chemical composition and calculated composition of feeds used in the trial

Ingredients	Diets				
	1	2	3	4	5
Corn	62.15	60.89	59.14	57.03	54.91
Palm oil	1.00	1.00	1.41	2.11	2.82
Hedge Lucerne meal	-.00	2.00	4.00	6.00	8.00
Soybean meal	23.50	22.86	22.30	21.8	21.31
Fish meal	4.00	4.00	4.00	4.00	4.00
Dicalcium phosphate	1.39	1.40	1.40	1.41	1.42
Oyster shell	7.12	7.02	6.92	6.81	6.71
DL-methionine	0.07	0.06	0.06	0.06	0.06
Salt	0.28	0.28	0.28	0.28	0.28
Pre-mixed	0.50	0.50	0.50	0.50	0.50
Chemical composition					
%DM	89.02	88.77	88.88	88.73	89.12
%CP	17.54	17.49	17.55	17.53	17.59
%EE	4.18	4.37	4.45	5.32	5.88
%CF	3.33	4.22	4.57	4.67	4.83
%Ash	12.40	11.47	12.20	12.28	12.25
%NFE	51.57	51.22	50.11	48.93	48.57
%Ca	3.48	3.58	3.53	3.58	3.55
%P	0.79	0.78	0.84	0.80	0.84
GE (kcal/kg)	3,666.00	3,669.00	3,667.00	3,722.00	3,812.00
Calculated composition					
ME (kcal/kg)	2,790.00	2,760.00	2,750.00	2,750.00	2,750.00
%Lysine	0.96	0.97	0.98	0.99	1.00
%Methionine	0.38	0.37	0.36	0.36	0.35
%Tryptophan	0.21	0.21	0.21	0.21	0.21
%Threonine	0.69	0.70	0.70	0.70	0.70

presented in Table 4 and shows that there was no significant effect of HLM levels on the percentage of egg yolk, albumen and shell contained in the fresh eggs. Nor was there any significant effect of HLM levels on the specific gravity of the eggs, egg shell thickness, albumen height or Haugh units.

Of particular interest to the poultry farmer and also to the consumer is the color of the egg yolk. The common yellow-orange color of egg yolks is influenced by a number of carotenoid pigments, of which the xanthophylls are of particular interest in poultry nutrition. However, naturally occurring xanthophylls are relatively unstable chemically and hence synthetic pigments are commonly used to achieve the desired yolk color.

It is therefore interesting to note that increasing the level of HLM in the diet increased the intensity of egg yolk color significantly, from a score of 4.53 in the absence of added HLM to a maximum of 8.55 from hens fed the highest level of 8% added HLM. As stated by Jeffries (1981) this score is within the range accepted by consumers in many countries. Belyavin and Marangos (1989) also showed that the color intensity of egg yolk increased with increasing levels of natural xanthophylls in the feed. The color score increased markedly from 0.0 to 8.0 when the level of xanthophylls in the diet increased from 0 to 10 mg/kg. Supplementation of xanthophylls beyond that level had little effect on the color score of the yolk. The same was also apparent in the present study where the respective concentrations of xanthophylls, of 14, 20, 25, 31 and 37 mg/kg, were found in the diets containing 0, 2, 4, 6 and 8% HLM, resulting in a color score of 4.53, 7.03, 7.74, 8.09 and 8.53 respectively.

The general health of the hens in the experiment was good and unaffected by the different levels of added HLM in their diet, as indicated by the absence of any significant effect on packed cell volume and plasma protein content in the blood (Table 4). No adverse effect in terms of hen mortality rate was recorded with increasing HLM levels in the layer diet and agrees with the report of Chomchai *et al.* (1992) who stated that diets containing up to 15% HLM in broiler diets caused no effect on mortality rate.

Implication

The present study showed that levels of HLM up to 6% of the poultry diet can be safely fed to laying hens without any detrimental effects on egg production. Beyond that level, however, there was a significant drop in egg production.

It is also of value to note that egg yolk color intensity increased markedly with increasing levels of HLM in the ration, which could be of real benefit to the farmer in terms of market acceptability.

The growing and processing of hedge lucerne for use in poultry diets provides another option to Thai farmers as a source of income. Hedge lucerne is not considered difficult to grow

Table 4. Percentages of egg yolk, egg shell, egg albumin and packed cell volume; and plasma protein in eggs of layers fed five rations

Level of HLM (%)	Egg yolk (%)	Egg shell (%)	Egg albumin	Packed Cell Valume (%)	Plasma protein(g/dl)
0	24.18	9.93	65.89	26.3	6.52
2	25.86	10.47	63.67	28.7	6.6
4	24.06	9.76	66.18	24.2	5.98
6	25.58	10.61	63.81	27.7	7.14
8	23.81	10.59	65.6	26.9	6.4
SEM	0.95	0.49	1.35	1.1	0.37
p-value	0.4322	0.6196	0.5474	0.0887	0.3187

SEM = standard error of the mean

Table 2. Average daily feed intake, body weight gain, egg production, egg weight, egg mass and feed intake per dozen of egg production of layers fed five rations

Level of HLM (%)	ADFI (g)	Body weight gain (g/140 day)	Egg production (%)	Egg weight (g)	Egg mass (g/egg)	FI/egg production (kg/dozen)
0	108	145	88.33ab	58.9	52	1.462
2	108	118	88.94ab	59	52.5	1.462
4	109	81	90.24a	59.4	53.5	1.446
6	107	111	91.16a	58.8	53.6	1.421
8	107	108	86.51b	60.1	52	1.484
SEM	0.7	15	1.05	0.53	0.76	0.018
p-value	0.2955	0.0807	0.047	0.4253	0.3795	0.1909

[a-b] values with no common superscript differ significantly ($p<0.05$) when tested with Duncan's Multiple Range Test.

ADFI = average daily feed intake; FI = feed intake; SEM = standard error of the mean.

Table 3. Specific gravity, egg shell thickness, egg albumin height, Haugh unit and egg yolk color of layers fed five rations

Level of HLM (%)	specific gravity	Egg shell thickness (mm)	Egg albumin height (mm)	Haugh unit	Egg yolk color (score)
0	1.09	0.35	8.77	92.92	4.53e
2	1.0902	0.353	8.73	92.43	7.03d
4	1.0907	0.352	8.84	92.54	7.74c
6	1.0911	0.359	8.44	90.7	8.09b
8	1.0913	0.36	9.06	93.68	8.55a
SEM	0.0005	0.0033	0.1939	1.0285	0.0516
p-value	0.5	0.185	0.2855	0.369	0.0001

[a-e] values with no common superscript differ significantly ($p<0.05$) when tested with Duncan's Multiple Range Test.

Sem = standard error of the mean

and is capable of high dry matter production. Being a legume it also has relatively high crude protein content and therefore is a high quality feedstuff for poultry. However, it is important to appreciate that higher levels of HLM in the layer diet beyond the 6% level, are not recommended due to the relatively high crude fiber and low energy content.

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