EFFECT OF CASSAVA LEAF, *LEUCAENA* LEAF AND *STYLO* GRASS MEAL IN THE DIET CONTAINING THE SAME LEVEL OF ENERGY AND PROTEIN ON EGG PERFORMANCE AND QUALITY OF LUONG PHUONG LAYING HENS

TU QUANG HIEN, TRAN THI HOAN*, TU TRUNG KIEN*
Thai Nguyen University - Vietnam
*College of Agriculture and Forestry – TNU, Vietnam

Leaf meal in general, and meal of stylo grass, cassava leaves and leucaena leaves in particular, has been widely studied because they are quite rich in protein and especially in carotenoids (xanthophylls and caroten). Carotene content of stylo grass meal, cassava leaf meal and *Leucaena* leaf meal is 228-259 mg per one kg of dry matter (**Ho Thi Bich Ngọc,** 2012), 476-625 mg per one kg of dry matter (**Tran Thi Hoan,** 2012) and 227-518 mg per one kg of dry matter (**Tu Quang Hien,** 2008) respectively. In addition, xanthophylls content of the aforementioned leaf meal ranged from 200-800 mg per one kg of dry matter. Many studies have been conducted and proved that these kinds of leaf meal could increase conception rate, postnatal survival rate and growth as well as reduce feed consumption for 1 kg of weight gain in animals; increase egg production, dark color of egg yolk, hatching rate of poultry eggs; increase immunity, egg performance and quality and survival rate of fish (**Tu Quang Hien,** 2013). However, there has been hardly any research comparing the varying effects of the three kinds of leaf meal in a diet with the same level of metabolic energy and proteins on the same object as Luong Phuong laying hens in order to determine which one has a better performance on productivity and quality of eggs. For the above reasons, this study was carried out.

RESEARCH CONTENTS AND METHODS

Study subjects included Luong Phuong laying hens, Stylosanthes guianensis CIAT 184 grass meal (SGM), KM94 cassava leaf meal (CLM), and Leucaena leucocephala leaf meal (LLM).

The experiment was conducted at the Center for Mountainous Livestock Research and Development – Institute of Livestock in 2013.

The studied was carried out with 360 hens and 36 cocks, divided into 4 groups: Control, Experiment 1, Experiment 2 and Experiment 3, with 90 hens and 9 cocks for each group (30 hens and 3 cocks x 3 replicates). The experiment lasted for 10 weeks, from 41 to 50 weeks old (laying weeks 17 to 28). The results of previous studies indicate that: leaf meal had good effects but no significant differences in laying rate and egg production in the early and late laying cycle. It significantly affected the indicators in stage 2 after the peak of the laying rate to before the end of laying a few weeks. Therefore, this experiment was carried out on the laying hens between weeks old 41-50 (laying weeks 17-28).

Feed for the 4 groups was a mixture of ingredients such as corn, wheat bran, soybean by product meal, fish meal, Stylo grass meal, cassava leaf meal, leucaena leaf meal, soybean oil and other supplements.

In detail: feed for the control group did not contain leaf meal while feed for the experimental groups 1, 2 and 3 included 6% Stylo grass meal, 6% cassava leaf meal and 6% leuacena leaf meal respectively. The feed for all four groups had the same level of metabolic energy as a 2700 kcal/kg diet and protein percentage as 16%; soybean oil was used to balance the energy in feed for groups 1, 2 and 3.

The monitoring indicators consisted of: survival rate, egg performance, some chemical and physical indicators of eggs, rate of eggs containing embryos, hatching rate and rate of class 1 chicks, feed cost and FCR for egg and class 1 chick production.

Methods of monitoring indicators are the methods commonly used in livestock studies.

Statistical analysis was done by ANOVA - GLM in Minitab software version 14.

RESULTS AND DISCUSSION

Survival, laying rate and egg performance. Survival, laying rate and egg performance were monitored daily and weekly. The average results of the 10-week experiment are presented in Table 1.

Table 1. **Laying rate and egg performance**

Indicators	unit	Control	Experiment 1 (*SGM*)	Experiment 2 (*CLM*)	Experiment 3 (*LLM)*
Laying rate	%	$62.67^{a} \pm 2.52$	$65.00^{ab} \pm 2.28$	$68.67^{b} \pm 1.02$	$69.17^{b} \pm 0.97$
Egg productivity/hen/10 weeks	egg	$43.87^{a} \pm 0.19$	$45.50^{b} \pm 0.16$	$48.07^{c} \pm 0.15$	$48.42^{c} \pm 0.13$
Compared to control group	%	100.00	103.72	109.57	110.37
Hatching eggs/hen/10 weeks	egg	$42.82^{a} \pm 0.09$	$44.80^{b} \pm 0.09$	$47.48^{c} \pm 0.09$	$47.60^{c} \pm 0.08$
Compared to control group	%	100.00	104.62	110.88	111.16
Rate of hatching eggs	%	$97.64^{a} \pm 0.45$	$98.34^{a} \pm 0.74$	$98.78^{a} \pm 0.41$	$98.33^{a} \pm 0.50$

Horizontally, the data with different an alphabetical are significantly different (P<0.05)

Table 2. **Chemical composition of eggs**

Indicators	Unit	Control	Experiment 1 (SGM)	Experiment 2 (CLM)	Experiment 3 (LLM)
Yolk's dry matter	%	43.42 ± 0.47	44.76 ± 0.35	45.10 ± 0.63	44.51 ± 0.58
White's dry matter	%	14.04 ± 0.26	13.26 ± 0.48	13.37 ± 0.18	13.40 ± 0.51
Yolk's protein	% DM	14.30 ± 0.62	14.65 ± 0.41	14.76 ± 0.29	14.72 ± 0.17
White's protein	% DM	12.05 ± 1.21	11.93 ± 0.93	11.70 ± 0.75	11.75 ± 0.83
Yolk's lipid	% DM	20.87 ± 0.66	22.74 ± 1.32	22.46 ± 1.22	22.31 ± 0.73
White's lipid	% DM	0.053 ± 0.00	0.054 ± 0.00	0.052 ± 0.00	0.055 ± 0.00

Table 3. **Carotenoids content (mg % DM) and fan score of fresh egg yolk**

Day	Control	Experiment 1 (SGM)	Experiment 2 (CLM)	Experiment 3 (LLM)
1	16.16 ± 0.69	15.75 ± 1.02	16.18 ± 0.75	16.04 ± 0.88
3	16.31 ± 1.07	23.07 ± 0.69	22.98 ± 1.31	23.41 ± 0.77
5	15.89 ± 0.58	28.05 ± 1.13	28.78 ± 1.25	30.58 ± 1.14
7	16.30 ± 0.72	31.45 ± 1.30	33.55 ± 1.51	35.38 ± 1.75
9	16.24 ± 1.15	32.45 ± 0.83	34.26 ± 0.96	36.78 ± 1.28
10	15.98 ± 1.04	32.66 ± 1.22	34.15 ± 1.36	36.90 ± 1.70
20	16.19 ± 1.11	32.10 ± 1.68	34.28 ± 1.56	36.80 ± 1.62
Average	16.15^{a}	27.93^{b}	29.17^{b}	30.84^{b}
Average fan score	$7.24^{a} \pm 0.86$	$11.21^{b} \pm 0.75$	$11.87^{b} \pm 0.54$	$12.30^{b} \pm 0,69$

Horizontally, the data with different an alphabetical are significantly different (P<0.05

After 10 weeks of the experiment, the survival rate of chickens in the four groups was 100%. This absolute percentage proved that Stylo grass meal, cassava leaf and *Leuacena* leaf meal did not adversely affect the health of the chickens. However, the chickens of experiment groups 1, 2 and 3 (whose feed contained leaf meal) had shinier feathers and brighter red crests than the control group.

The average laying rate in 10 weeks of laying is still rather high, from 62.67% (CG) to 69.17% (experiment 3). Average laying rate of experiment 1 (Stylo grass meal) showed no significant differences with the control and experiment 2, and 3 ($P>0.05$), while experiment 2 and 3 are showed significant differences with control ($P<0.05$), but between the two groups (experiment 2 and 3), no significant differences ($P>0.05$). The results of our study match previous studies (**Duong Thanh Liem,** 1998; **Nguyen Duc Hung,** 2004; **Tran Thi Hoan,** 2012; **Ho Thi Bich Ngoc,** 2012).

Egg productivity/hen/10 weeks of experiment 1 (SGM), experiment 2 (CLM) and experiment 3 (LLM) was higher than the control at 1.63, 4.20 and 4.55 eggs, respectively. Hatching eggs/hen/10 weeks also show a similar trend: control < experiment 1 < experiment 2 < experiment 3. Egg production and hatching eggs of experiments 1, 2, 3 showed significant differences compared with the control ($P<0.05$). Experiment 1 showed significant differences compared with experiments 2 and 3 ($P<0.05$), but compared to experiments 2 with 3, there is no significant difference ($P>0.05$). The rate of hatching eggs of the four group is the same, from 97.64 % to 98.78 % with no significant differences ($P>0.05$).

Thus, all three types of leaf meal have a good impact on laying rate, egg production and hatching eggs. However, based on the best effects, the three leaf meals can be ranked as follows: LLM, CLM, SLM.

Some physical and chemical indicators of eggs. The physical indicators of eggs such as egg weight, white rate, yolk rate, shell, yolk and white index of eggs were surveyed (120 eggs were weighted/group and the other index were 40 eggs/group). The results showed that the indicator of the 4 groups are approximately equivalent and there are no significant differences ($P>0.05$). This proves that SGM, CLM, LLM didn't significantly influence the above indicators of eggs.

The chemical indicators of eggs such as dry matter, protein, lipid of the yolk and white were analyzed at days 1, 10, and 20 during the experiment (analysis of 5 samples/1 time/1 group). The average results of the analysis carried out for 3 days are presented in Table 2.

The data in table 2 show that: the DM, protein, lipid egg yolk DM of experiments 1, 2, 3 are higher than the control, but the whites of the egg are more likely to be lower. However, these indicators show no significant differences between these groups. It shows that the effect of all three types of leaf meal to dry matter, proteins, lipids of the yolk and the egg white is slight.

Carotenoids content and dark colour of egg yolk.

Carotenoids content and dark colour of the egg yolk were measured with a colorimetric fan of Roche (1988) on days 1, 3, 5, 7, 9, and 20 of the experiment. (In each aforementioned time, carotenoids content of 5 samples were analyzed and the dark colour 10 eggs was measured). Results are presented in Table 3.

The carotenoids content in the yolk's dry matter (see table 3) of the experiment groups 1, 2, and 3 increased over time in the hens which were fed a diet with leaf meal, and stablized from day 9 onward (above 32 mg% DM for experiment 1, over 34 mg% DM for experiment 2 and over 36 mg% for experiment 3). Average carotenoids content of experiment 1, 2, and 3 show significant differences compared with the control ($P<0.05$), and between the 3 experiment groups, there are no significant differences ($P>0.05$). The results of previous studies indicate: approximately 20-60% of carotenoids derived from feed are transferred to the egg yolks. Leaf meal supplementation to the diet of the experimental groups increased the carotenoids content from 59-190% higher compared to the control group, thus leading to increased levels of carotenoids in egg yolks.

Fan score of egg yolks is a mirror to reflect the carotenoids content in egg yolk. So it has the same trend as carotenoids, and increasing stability from day 9 onward. Fan score of egg yolks in experimental groups 1, 2 and 3 also show significant differences compared with the control group, and between them there are no other significant differences ($P>0.05$).

The results showed that: SGM, CLM, LLM significantly affect the levels of carotenoids and fan score of the egg yolk. The impact can be arranged as follow: LLM, CLM, SLM.

Percentage of embryonated eggs, eggs hatched and class 1 chicks. For this experiment, 1800 eggs were used in each group, divided into 6 times of hatching, each time having 300 eggs. The average results of 6 times of hatching are presented in Table 4.

The rate of embryonated eggs of the 4 groups was rather high, from 87.83 to 93.17%. The rate of Luong Phuong embryonated eggs reported by **Tran Thi Hoan** (2012) was from 88.70 to 92.88%, while **Ho Thi Bich Ngoc** (2012) was from 89.71 to 90.74%. The percentage of embryonated eggs was ranked in order from high to low as follows: experiment 2 (CLM), experiment 3 (LLM), experiment 1 (SGM), control, this percentage between 3 experimental groups have significant differences compared to the control ($P<0.05$).

Percentage of hatched eggs/ embryonated eggs was from 91.08 to 93.74%. This rate as reported by **Tran Thi Hoan** (2012) was 87.69 to 91.16%, while **Ho Thi Bich Ngoc** (2012) was 88.31 to 89.64%. The rate of hatched eggs in experiment 1 (SGM) was roughly equivalent with no significant difference as compared with the control, but lower and with significant differences compared with experiment 2 (CLM) and experiment 3 (LLM). This percentage of experiment 2 (CLM) and experiment 3 (LLM) showed no significant differences ($P>0.05$).

Table 4. **The rate of embryonated eggs, eggs hatched and class 1 chicks**

Indicator	Unit	Control	Experiment 1 (SGM)	Experiment 2 (CLM)	Experiment 3 (LLM)
Total hatching egg	egg	1800	1800	1800	1800
Embryonated egg/ hatching egg	%	87.83^{a}	90.22^{b}	93.17^{c}	91.44^{bc}
Hatched egg/ embryonated egg	%	91.08^{a}	91.69^{a}	93.20^{b}	93.74^{b}
Class 1chicks/hatched egg	%	95.28^{a}	96.03^{a}	95.96^{a}	95.52^{a}
Class 1chicks/hatching egg	%	76.22^{a}	79.44^{b}	83.33^{c}	81.89^{bc}

Horizontally, the data with different an alphabetical are significantly different (P<0.05)

Table 5. **FCR and feed cost for eggs produced and class 1 chicks**

Indicators	Unit	Control	Experiment 1 (SGM)	Experiment 2 (CLM)	Experiment 3 (LLM)
FCR/10 eggs	kg	$2.63^{a} \pm 0.06$	$2.54^{b} \pm 0.07$	$2.40^{c} \pm 0.03$	$2.39^{c} \pm 0.08$
FCR/10 hatching egg	kg	$2.70^{a} \pm 0.11$	$2.58^{b} \pm 0.05$	$2.43^{c} \pm 0.07$	$2.42^{c} \pm 0.03$
Feed cost/10 egg	%	100.00^{a}	98.67^{b}	90.54^{c}	88.54^{c}
Feed cost /10 hatching egg	%	100.00^{a}	97.81^{b}	89.46^{c}	88.12^{c}
Feed cost /1 chick class 1	%	100.00^{a}	98.19^{b}	90.74^{c}	90.97^{c}

Horizontally, the data with different an alphabetical are significantly different (P<0.05)

The rate of class 1 chicks/hatched eggs in the 4 groups was nearly equal (from 95.28 to 96.03%) and there were no significant differences seen ($P>0.05$).

The rate of class 1 chicks/hatching eggs is calculated from the three above criteria. This rate is ranked in order from high to low as follows: experiment 2 (CLM), experiment 3 (LLM), experiment 1 (SGM), control. The rate of class 1 chicks/hatching egg of the three experimental groups were greater than the control with significant differences ($P<0.05$). The rate of class 1 chicks/hatching eggs was lower in experiment 1 and had significant differences compared with experiment 2, but no significant differences compared with experiment 3.

Thus, for every 100 hatching eggs, experiment 2 (CLM), experiment 3 (LLM) and experiment 1 (SGM) had class 1 chicks more than the control as shown by 7.11, 5.67 and 3.22 chicks, respectively. The reason may be the following: the levels of carotenoids in egg yolks of the experimental groups were from 1.7 to 1.9 times higher than the control. Carotenoids have been effective in increasing the percentage of embryonated eggs of poultry and number of eggs hatched.

FCR and feed costs for eggs produced. Base on the feed consumption, egg production, hatching eggs and the rate of class 1 chicks / eggs hatched of the 4 groups, we calculated the FCR and feed cost for 10 eggs, 10 hatching eggs and one class 1 chick. Results are presented in table 5.

FCR/10 eggs and 10 hatching eggs of the experimental groups were lower than the control with significant differences ($P<0.05$). Leaf meal was proven to be effective in feed efficiency for egg production of laying hens. In the three kinds of leaf meal, the CLM and LLM have similar effects and are higher than SGM.

Feed cost/1 class 1 chick of these experimental groups were lower than the control with significant differences ($P<0.05$). This indicator of experiment 2 (CLM) and experiment 3 (LLM) was different by nearly 91% compared with the control, and experiment 1 (SGM) by 98 % compared with the control.

The feed cost/1 class 1 chick of the experimental groups is lower than the control due to the effects of leaf meal that improved the efficiency of feed utilization for egg production of laying hens, and increased the rate of embryonated eggs and eggs hatched.

CONCLUSION

The diet of Luong Phuong laying hens containing 6% SGM or CLM, LLM, which have the same level of metabolic energy and protein as the control, had a positive impact on performance and egg quality of Luong Phuong laying hens. The influence of these 3 kinds of leaf meal ranked in order from high to low is as follows: cassava leaf meal, leucaena leaf meal, Stylo grass meal.

REFERENCES

1. Duong Thanh Liem, Nguyen Phuc Loc, Nguyen Van Hao, Ngo Van Man, Bui Huy Nhu Phuc and Bui Xuan An, 1998. "The use of cassava dried leaf powder as animal feed". In: Hoang Kim and Nguyen Dang Mai (Eds). Progress in Cassava Research and Extension in Vietnam. Proc. 7th Vietnamese Cassava Workshop, held at IAS, Ho Chi Minh city, Vietnam. March 4-6, 1997, pp. 256-265.

2. Ho Thi Bich Ngoc, 2012. Research cultivating, processing, storage, and used of Stylosanthes guianensis CIAT 184 for broiler chickens and Luongphuong laying hens. PhD thesis of Agricultural Sciences, Thainguyen University.

3. Nguyen Duc Hung, 2004. Determine the chemical composition, nutrition value and affect of leucaena leaf meal were treated to the productivity of broiler chicken and laying hens. PhD thesis of Agricultural Sciences. Thai Nguyen University.

4. Roche, 1988. Vitamin and Fine chemicals, egg yolk pigmentation with carophyll. 3rd. Hoffmann - La Roche Ltd., Basel, Switzerland, pp.1218.

5. Tran Thi Hoan, 2012. Research cassava cultivating for leaves collection and used cassava leaf meal in diet of broiler chickens and Luongphuong laying hens. PhD thesis of Agricultural Sciences, Thainguyen University.

6. Tu Quang Hien, 2013. Animal nutrition and feed. Agricultural Publishing House, Hanoi.

EFFECT OF CASSAVA LEAF, *LEUCAENA* LEAF AND *STYLO* GRASS MEAL IN THE DIET CONTAINING THE SAME LEVEL OF ENERGY AND PROTEIN ON EGG PERFORMANCE AND QUALITY OF LUONG PHUONG LAYING HENS

Tu Quang Hien, Tran Thi Hoan, Tu Trung Kien**
Thai Nguyen University - Vietnam
**College of Agriculture and Forestry – TNU, Vietnam*

SUMMARY

Experiments were conducted on 360 Luong Phuong laying hens in 2013, in order to determine the effect of cassava leaf, *leucaena* leaf, and stylo grass meal on their egg performance and quality. The experiments were carried out with four experimental groups including a control group (CG) whose feed did not contain leaf meal; experimental groups 1, 2 and 3 (EG 1, 2 and 3) whose feed contained 6% *stylo* grass meal (EG1), 6% cassava leaf meal (EG2) and 6% *Leucaena* leaf meal (EG3) respectively. The diet for the four groups had the same metabolic energy and protein percentage as 2700 kcal/kg and 15% respectively. The results showed that the diets containing 6% of stylo grass meal, cassava leaf meal or *leucaena* leaf meal, all increased laying rate, egg performance, concentration of carotenoids, fan scores of egg yolks, rate of embryonation, hatching rate, and percentage of class 1 chicks / hatched eggs and reduced feed cost for production of eggs and class 1 chicks, compared to the control group (feed without leaf meal). The effects of the three kinds of leaf meal were ranked in the following order: cassava leaf meal, *Leucaena* leaf meal and stylo grass meal.

Key words: *grass meal, leaf meal, the same level (energy, protein), Roche Yolk colourimetric fan (RYCF)*