EFFECT OF DIFFERENT LEVELS OF CASSAVA LEAF MEAL IN THE DIET ON PRODUCTIVITY AND QUALITY OF LUONGPHUONG HEN EGGS

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

Cassava is a plant widely cultivated in Southeast Asia and Latin America. Cassava leaves are rich in protein and carotenoids; protein content from 23 to 26 % in dry matter (DM), carotenoids from 476 - 625 mg/kg DM (**Tran Thi Hoan,** 2012). Additional cassava leaf meal (CLM) for laying hens increased the colour of egg yolk, the rate of embryonated eggs and eggs hatched. But CLM has a high proportion of fiber, about 11 - 15% of DM and contains cyanogenic glucosides which causes HCN poisoning in animals. Therefore, there is a need to identify a suitable rate of CLM in the diet for laying hens. Our research was carried out to solve this problem.

CONTENT AND RESEARCH METHODS

Experiments were conducted with 450 hens and 45 Luong Phuong cocks, divided into 5 groups: a control group (CG), and experimental groups (EG) 1 , 2 , 3 and 4. Each group had 90 hens and 9 cocks (3 sets of 30 hens and 3 cocks). The research started when the hens were 20 weeks of age and ended at 55 weeks of age (corresponding to 3 weeks before laying and finishing at 32 weeks of laying) in 2013.

The diet of the control group without CLM, and experimental groups 1, 2, 3, 4 are 4, 6, 8 and 10 % respectively of the CLM. Diets of all five groups were a mixture of materials, such as: corn, wheat bran, soybean by product, fish meal, cassava leaf meal and other supplement feed. The diets of the control group and 4 experimental groups had the same level of metabolic energy (2700 kcal/kg) and protein content (16%). Soybean oil was used to balance the energy in the diet of the experimental groups to control group.

The monitoring indicators were: live rate, laying rate, egg productivity, physical and chemical indicators of the egg, embryonated egg and hatched eggs, feed cost for 10 eggs, the cost of feed for hatching eggs and one class 1 chick.

Methods of monitoring indicators was the method commonly used in animal studies.

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

RESULTS AND DISCUSSION

Survival rate, laying rate, egg productivity. Survival rate, laying rate and egg productivity were mornitored for 32 weeks. The results are showed in table 1.

Data in Table 1 shows the survival rate of these group are almost similar, from 86.67% to 90.00%; the diets having 10% CLM did not affect the survival rate of the chickens. Laying rate of the experimental group 1 (4% CLM), experimental group 2 (6% CLM) and experimental group 3 (8% CLM) was significantly higher compared with the control group ($P<0.05$), and experimental group 4 (10% CLM) is equivalent to the control group. Laying rate directly affects egg production, and therefore egg productivity and hatching egg of the experimental groups 1, 2 , and 3 were higher than the control group with significant differences ($P<0.05$), while the experimental group 4 had no significant difference compared with the control group ($P>0.05$). The rate of hatching eggs of the 5 groups was nearly equal, from 80.65 to 82.50% with no significant differences. Thus, the diet having cassava leaf meal from 4-8% significantly increased the rate of laying and egg productivity. With 10% of CLM in the diet the indicators decreased close to the control group. This result is similar to the results of **Nguyen Duc Hung** (2005) and **Ho Thi Bich Ngoc** (2013) when studying addition of *Leuceana* leaf meal and *stylo* grass meal in the diet of laying hens.

Table 1. **Survival rate, egg productivity, the rate of hatching eggs**

Indicators	Unit	Control group	Experimental group 1 4 % CLM	Experimental group 2 6 % CLM	Experimental group 3 8 % CLM	Experimental group 4 10 % CLM
Survival rate	%	67 ± 1.36	87.78 ±1.36	86.67±3.60	90.00 ±2.35	87.78±3.60
Laying rate	%	57.44a ±1.24	61.23b ± 1.08	62.04b±1.09	61.01b±1.36	58.64a±0.79
Egg productivity	egg/ hen	132.70a ±1.15	140.84b±2.15	143.30b±1.99	141.11b±1.10	135.46a±0.79
Hatching eggs productivity	egg/ hen	107.94a±1.63	116.19b ±1.57	117.08b±1.45	114.09b±1.23	109.25a±1.27
Rate of hatching eggs	%	81.34 ±0.72	82.50 ±1.20	81.70±1.16	80.85 ±1.34	80.65±1.03

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

Table 2. **Physical indicators of egg**

Indicators	Unit	Control group	Experimental group 1 4 % CLM	Experimental group 2 6 % CLM	Experimental group 3 8 % CLM	Experimental group 4 10 % CLM
Egg weight	g	55.12 ± 0.58	55.21 ±0.71	55.08±0.75	55.75±0.71	55.09±0.05
Morphological index	%	1.31	1.32	1.33	1.32	1.32
Yolk's weight	g	15.87 ± 0.46	15.93±0.46	15.33±0.56	15.38±0.41	15.60±0.42
White's weight	g	31.91 ± 0.32	31.68 ±0.38	31.28±0.32	31.24±0.40	31.25±0.31
Yolk/white	%	49.73	50.28	49.00	49.23	49.92

Table 3.**Chemical indicators of egg**

Indicator	Unit	Control group	Experimental group 1 4 % CLM	Experimental group 2 6 % CLM	Experimental group 3 8 % CLM	Experimental group 4 10 % CLM
Eggs yolk DM	%	44.08 ± 0.68	45.39 ± 1.00	45.58 ± 0.77	45.77 ± 1.99	45.32 ± 0.79
Yolk's protein	% DM	14.56 ± 0.60	14.95 ± 0.51	14.91 ± 0.56	15.31 ± 0.65	15.17 ± 0.60
White dry matter	%	14.76 ±0.48	14.17 ±0.36	14.48 ±0.32	14.37 ±0.80	13.89 ±0.38
White's protein	% DM	13.16 ± 1.04	12.81 ± 1.83	12.96 ± 1.71	12.64 ± 1.32	12.56 ± 1.69
Yolk's cartenoids	mg % DM	15.05^{a} ± 0.93	31.39^{b} ± 1.83	37.52^{c} ± 1.50	46.42^{d} ± 1.88	55.03^{e} ± 1.60
Yolk's colour	score	9.25^{a} ± 0.44	11.57^{b} ± 0.22	12.71^{bc}±0.20	13.29^{c} ± 0.20	13.57^{c} ± 0.22

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

Some physical and chemical indicators of eggs

** Physical indicators of eggs.*

In each group, 200 eggs were weighed and 30 eggs were used to determine the remaining indicators. The results are showed in Table 2.

The data in table 2 shows that: weight, morphology index, yolk weight, white weight and the rate of yolk/ white of the 5 groups are the same, with no significant

differences (P> 0.05). This demonstrates that the different rates of CLM in the diet didn't affect these indicators mentioned above.

** Chemical indicators of egg*

Twenty eggs of each group were analyzed with the indicators: dry matter, protein of yolks and whites, and carotenoids of yolk. Results are shown in Table 3.

Data in Table 3 show that: the rate of yolk dry matter tended to increase in the four experimental groups compared with the control group, and DM percentage of white, by contrast, the rate of yolk protein and whites also similar developments. However, in the 5 groups the indicators show no significant differences (P>0.05). This proves that the rate of 4 - 10% CLM in the diet did not significantly affect the indicator above.

The content of carotenoids in dry matter of egg yolks increased in proportion to the level of CLM in the diets. When the rate of cassava leaf meal increased from 4 to 10%, the concentration of carotenoids increased from 31.39 to 55.03 mg % dry matter. This is explained as follows: increased rate of CLM in diet from 4-10% increased levels of carotenoids in the diet from 34.56 to 65.04 mg % dry matter, according to **Bornstein and Bartov** (1966), and about 20-60% of feed carotenoids will be transferred into the yolk. Thus, when increasing the rate of CLM in diet it causes increased levels of carotenoids in egg yolks. Carotenoids content of the 4 experimental groups have significant differences compared with control group, and among them also several significant differences in the level from P<0.05 to 0.001.

The colour of the egg yolk was measured by a colorimetric fan of **Roche** (1988) on a scale of 1-15. Fan score of egg yolks is a mirror to refect carotenoid content in egg yolk. So the fan's point of the experimental groups was higher than control group with significant differences (P<0.05 to 0.001). In the 4 experimental groups, the fan's point of experimental group 3 (8% CLM) and experimental group 4 (10% CLM) had significant differences with experimental group 1 (4% CLM) but no significant differences compared with experimental group 2 (6% CLM).

Thus, increasing the rate of CLM in the diet increased the levels of carotenoids and fan scores of egg yolks.

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

Indicator	Unit	Control group	Experimental group 1 4 % CLM	Experimental group 2 6 % CLM	Experimental group 3 8 % CLM	Experimental group 4 10 % CLM
The number of hatching eggs	Egg	2079	2079	2079	2079	2079
Embryonated eggs/ hatching eggs	%	88.70^{a}	91.48^{b}	92.45^{b}	92.88^{b}	91.25^{b}
Hatched eggs/embryonated eggs	%	87.69^{a}	89.65^{ab}	90.48^{b}	91.16^{b}	87.98^{a}
Class 1 chicks /hatched	%	92.36^{a}	93.16^{ab}	94.79^{bc}	95.90^{c}	92.15^{a}
Class 1 chicks / hatching eggs	%	71.84^{a}	76.40^{b}	79.29^{c}	81.19^{c}	73.78^{a}

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

Table 5. **FCR and feed cost for 10 eggs, 10 hatching eggs and one class 1 chick.**

Indicator	Unit	Control group	Experimental group 1 4 % CLM	Experimental group 2 6 % CLM	Experimental group 3 8 % CLM	Experimental group 4 10 % CLM
FCR/10 eggs	kg	2.58^{a} ±0.02	2.47^{bc} ±0.03	2.46^{bc}±0.02	2.45^{c} ±0.03	2.56^{ab}±0.07
FCR /10 hatching eggs	kg	3.17^{a} ±0.05	3.00^{b} ± 0.08	3.02^{b}±0.11	3.04^{b}±0.12	3.17^{a}±0.04
Feed cost/10 eggs	%	100.0^{a}	90.56^{b}	91.25^{b}	92.20^{b}	99.22^{a}
Feed cost /10 hatching eggs	%	100.0^{a}	90.55^{b}	91.17^{b}	92.94^{b}	100.34^{a}
Feed cost /1 class 1 chick	%	100.0^{a}	87.97^{b}	85.32^{c}	84.90^{c}	97.70^{d}

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

The rate of embryonated eggs, hatching eggs, class 1 chicks. The number of eggs per group for hatching is 2079 eggs. Results of monitoring of hatching eggs are shown in Table 4.

Data in Table 4 shows the percentage of embryonated eggs of the four experimental groups are higher than the control group with significant differences ($P<0.05$), but between them there are no other significant differences. For hatchability and the rate of class 1 chick/ chicks hatched, only experimental group 2 (6% CLM) and experimental group 3 (8% CLM) show significant differences compared with control group ($P<0.05$), while the rate of 4 % and 10% CLM in the diet (experimental group 1 and 4) had no significant impact in these indicators. It can be explained as follows: the impact of carotenoids effect depends on its concentration in the feed. The research on astaxanthin supplementation in the diet of salmon finfish showed the increased levels of astaxanthin in feed (0.4, 1.0, 13.7 ppm), the survival rate of salmon finfish also increased from 17 to 70 and 90% (quoting from **Tu Quang Hien**, 2013). The rate of 10% CLM in the diet may have made high levels of toxic HCN adversely affect hatchability and class 1 chick/chick hatched.

The rate of class 1 chicks/hatching eggs is an indicator reflecting the total of three indicators mentioned above, the rate of experimental group 1, 2, 3 was higher with significant differences compared with control group and experimental group 4. In the three experimental groups (1, 2, 3), the experimental group 2 and 3 were higher and significant showed differences compared to experimental group 1. Thus, the rate of 6% and 8% CLM in the diet had a better impact on the quality of eggs than the rate of 4 % and 10%.

FCR and feed costs for producing eggs and class 1 chicks. FCR for 10 eggs and one class 1 chick is shown in Table 5.

Data in Table 5 shows the FCR and feed cost for 10 eggs and 10 hatching eggs of experimental group 1 (4% CLM), experimental group 2 (6% CLM), and experimental group 3 (8% CLM) are lower than the control group with a significant difference ($P<0.05$), and experimental group 4 (10% CLM) is equivalent to the control group.

The cost of feed for one class 1 chick is an indicator of the general evaluation of the effectiveness of the feed. This indicator of the 4 experimental groups were lower compared with the control group with significant differences ($P<0.05$ to 0.001), in which the experimental group 2 and 3 are lowest, with only 85 % compared with the control group, experimental group 1 is 87.97% and experimental group 4 is 97.70% as compared with control group.

CONCLUSION

After researching the 4 rates of cassava leaf meal (4 , 6 , 8 and 10%) in the diet, the rate of 6 and 8 % increased the following indicators: laying rate, egg productivity, percentage of embryonated eggs, hatched, class 1 chicks, and reduced the following indicators: FCR, feed cost for egg production, hatching eggs and one class 1 chick compared with 4 and 10%. Therefore, the combination of cassava leaf meal in the diet of laying hens with the rate 6-8% is appropriate.

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

SUMMARY

The experiment was conducted with 4 different percentages of cassava leaf meal (4%, 6%, 8% and 10%) in the diet of Luongphuong laying hens. The results showed that: the diet containing 4, 6 and 8% of cassava leaf meal increased laying rate and egg productivity compared with the control diet (without cassava leaf meal) with significant differences ($P<0.05$). When the percentage of cassava leaf meal in diet was increased from 4 % to 10 % , the carotenoids content in the egg yolk increased from 31.39 to 55.03 mg % of dry matter and the score of yolk by Roche yolk colourimetric fan (RYCF) increased from 11.57 to 13.57 points. The diets having 4, 6 and 8% cassava leaf meal increased the rate of embryonated eggs, hatched eggs and class 1 chicks, reduced FCR, the cost of feed for 10 hatching eggs and one class 1 chick, with significant differences in comparison with the control ($P<0.05$). These above indicators of laying hens fed a diet containing 10% cassava leaf meal was equivalent to the control group. These indicators of hen groups fed diets with 6 to 8% cassava leaf meal were higher with significant differences compared with the diet having 0%, 4% and 10% cassava leaf meal. Thus, adding cassava leaf meal in diet for laying hens from 6 to 8 % is a suitable rate.

Key words: *cassava leaf meal, Roche yolk colourimetric fan (RYCF).*