Effect of *Curcuma domestica* Stock Solution on Layer Performance, Egg Quality, and Antioxidant Activity

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ABSTRACT

The aim of this research was to evaluate the effect of *Curcuma domestica* stock solution on layer performances, egg quality, and antioxidant activity of egg yolk. A total number of 32 *Lohman LSL-lite* white laying hens were divided into 4 treatments; there were 8 replication birds in individual cages. Laying hens were fed with 4 experimental diets, basal diet and diets with 1%, 2%, and 3% of *Curcuma domestica* 10% stock solution. Eggs were collected daily and analyzed of the eggs which were divided into three age stages, namely stage 1 (week 22 - 25), stage 2 (26 - 29), and stage 3 (30 - 33), respectively. The respective layer performances and egg quality were determined every week at every age stage. Antioxidant activity and color stability were determined every week at second age stage. The data was analysed using GLM in a windows-based software package, SAS version 9.1. Data was obtained from a different level, age stage, and interaction among level and age stage. The differences were tested by LSM. Significant level used in the group comparisons was set at $p<5\%$. The addition of *Curcuma domestica* 10% stock solution did significantly improve laying performances, egg quality, and antioxidant activity. Addition of 3% *Curcuma domestica* stock solution increased layer performances including water consumption, hen day egg production, and egg weight as well as antioxidant activity including FRAP, iron chelating, and DPPH on egg yolk. Moreover, the addition of 2% *Curcuma domestica* 10% stock solution increased egg shell thickness and egg shell strength. In summary, the use of 3% addition of *Curcuma domestica* 10% stock solution had ability to improve layer performances and antioxidant activity of egg yolk on laying hens.

Keywords: Antioxidant activity, *Curcuma domestica*, Egg quality, Laying hen, Performance

INTRODUCTION

Recently, chemicals substance is commonly used as a feed additive in livestock. However, the addition of chemicals substance in feed would bring a high risk to health (Dibner and Buttin, 2002). The addition of chemical substances will not only have a negative effect in animals, however will also have a negative impact on livestock production. The use of plant herbs as a natural supplement in livestock feeds has a beneficial effect on the health animals (Radwan, 2003). Natural herbs have no risk on accumulated residues of chemical substances in livestock product and it has no harmful effect on animal health. *Curcuma domestica* contains a bioactive compound of curcumin. It was commonly used as flavoring, coloring, and preservative agents. The important natural substance of *Curcuma domestica* can be used as food colorant and spice with the high antioxidant and antimicrobial properties (Pruthi, 1980).

MATERIALS AND METHODS

The experimental was carried out at the Poultry Research Farm and Dairy Laboratory, Department of Animal Science, National Pingtung University of Science and Technology (NPUST). Thirty-two (32) *Lohman LSL-Lite* white laying hens were divided into 4 treatments in which each treatment had 8 replications with 1 laying hen per replication. Individual battery cages (40 x 30 x 40) cm was used and equipped with feeder and bottle drinker. In this experimental were used 4 treatments, consist of control (basal diet + drinking water), T1 (basal diet + 1% of *Curcuma domestica* 10% stock solution), T2 (basal diet + 2% of *Curcuma domestica* 10% stock solution), T3 (basal diet + 3% of *Curcuma domestica* 10% stock solution). All treatments were measured into analysis layer performance, egg qualities, and antioxidant activity.

Layer performances were recorded daily in every treatment at the first stage, second stage, and third stage. The layer performances include feed intake, water consumption, hen day egg production (HDP), egg weight and egg mass, and feed conversion ratio (FCR).
Egg qualities were recorded weekly by two eggs in each treatment at the first age stage, second age stage, and third age stage. Two eggs in each treatment were broke up to analyzed egg quality. The egg quality includes Haugh unit (HU), eggshell thickness, eggshell strength, eggshell percentage, and egg shape index. Antioxidant activity of egg yolk was measured by DPPH (1,1-Diphenyl-2-picrylhydrazyl), FRAP (Ferric Reducing Antioxidant Power), and iron chelating. Two eggs yolk per treatment were collected weekly at second age stage.

The data was analyzed by GLM (General Linear Model) in a windows-based software package, SAS version 9.1. Data was obtained from different level, age stage, and interaction among level and age stage. The differences between level and age stage were tested by least squares mean. Significant level used among treatment comparisons was set at $p<5\%$.

RESULTS AND DISCUSSION

Different level of *Curcuma domestica* 10% stock solution improved water consumption, HDP, and egg weight ($p<0.01$) compared to control group. Results showed that the addition of 3% *Curcuma domestica* 10% stock solution improved 8.15 mL of water consumption, 6.4% of HDP, and 3.77 g of egg compared to control group. Agreed with statement El-Sheikh (2006) that herbal plants influenced appetite and water-consumption. *Curcuma domestica* have bioactive compounds increased enzymatic activity in the digestive tract resulting in improving nutrient utilization. Therefore, *Curcuma domestica* improved HDP and egg weight.

The effect of different levels of layer fed *Curcuma domestica* 10% stock solution on egg quality has significantly ($p<0.05$) improved 0.05 mm of egg shell thickness and 0.84% of egg shell percentage. Herbal plants were found as improve ovarian function and quality of eggs. Egg quality could be measured by increasing the number fertilized of eggs as well as improved quality of the embryos examined by microscopic examination. The organic material from herbal plants has calcium binding properties and its organization during shell formation influences the strength of the shell.

Curcuma domestica 10% stock solution increased FRAP of egg yolk. The addition of 3% *Curcuma domestica* 10% stock solution improved 18% FRAP compared to control group. The increasing of FRAP has the ability as antioxidant, anti-inflamantory, and anti-tumor (Radwan, 2008). In this case, *Curcuma domestica* has curcumin as a bioactive compound on antioxidant activity in human and animals. The increase of curcumin has a positive impact on the antioxidant activity of animal production, i.e. egg yolk of layer hens.

Curcuma domestica 10% stock solution significantly ($p<0.05$) affected the iron chelating. The addition of 3% *Curcuma domestica* 10% stock solution improved 16% of the stability of iron chelating compared with those observed in control group. Antioxidant properties of the yolk were evaluated based on iron ions chelation effect. Egg yolk has been recognized have strong antioxidant (Sakanaka, 2006). Free radical scavenging assay of iron chelating confirmed that the higher hydrolysates showed the higher of antioxidant properties on egg yolk. Addition of *Curcuma domestica* 10% stock solution significantly ($p<0.05$) improved in DPPH. The addition of 3% Curcuma domestica 10% stock solution increased 24% DPPH compared with control group. DPPH measured indicated the ability of antioxidants to inhibit free radicals by donating a hydrogen atom. Antioxidant activity contributes to free radical scavenging nature to prevent atom hydrogenate (Sathisa et al., 2011). Addition of *Curcuma domestica* 10% stock solution has ability to increase DPPH of egg yolk.

Table 1. Different level and age stage of addition *Curcuma domestica* 10% stock solution on layer performances

Variable	Feed intake (g/bird/day)	Water consumption (mL/bird/day)	HDP (%)	Egg weight (g)	Egg mass	FCR
Control	100.90	305.81[b]	91.96[c]	49.23[b]	48.42	2.15
T1 (1%)	101.09	312.32[a]	94.56[b]	52.65[a]	49.87	2.04
T2 (2%)	101.18	313.88[a]	95.93[b]	52.88[a]	50.70	2.01
T3 (3%)	101.20	313.96[a]	98.36[a]	53.00[a]	49.20	2.05
SEM	0.97	8.03	3.87	3.59	4.18	0.19

SEM: Standard error of mean.
[a-c] Means within a row with different superscripts were significantly different ($p<0.05$).

Table 2. Effect of different level and age stage of Curcuma domestica 10% stock solution on egg quality

Items	Egg shape index (%)	Egg shell thickness (mm)	Egg shell percentage (%)	Egg shell strength (kgf)	Haugh unit
Control	75.89	0.37[c]	13.33[b]	3.28	85.70
T1 (1%)	75.78	0.38[bc]	14.10[a]	3.33	86.81
T2 (2%)	75.84	0.41[ab]	14.23[a]	3.41	86.71
T3 (3%)	76.01	0.42[a]	14.17[a]	3.38	85.65
SEM	2.65	0.06	1.16	0.43	4.09

SEM: Standard error of mean.
[a-c] Means within a row with different superscripts were significantly different ($p<0.05$).

Table 3. Effect of addition level of *Curcuma domestica* 10% stock solution on antioxidant activity of egg yolk

Variable	Treatment				SEM
	Control	T1 (1%)	T2 (2%)	T3 (3%)	
FRAP (%)	0.866[c]	0.879[c]	0.924[b]	1.020[a]	0.014
Iron chelating (%)	94.371[b]	103.612[a]	104.338[a]	109.603[a]	2.269
DPPH (%)	32.003[b]	34.809[ab]	37.216[ab]	39.602[a]	2.087

SEM: Standard error of mean.
[a-c] Means within a row with different superscripts were significantly different ($p<0.05$).

CONCLUSIONS

The addition of *Curcuma domestica* 10% stock solution did significantly improve laying performances, egg quality, and antioxidant activity. Addition of 3% *Curcuma domestica* stock solution increased layer performances including water consumption, hen day egg production, and egg weight as well as antioxidant activity including FRAP, iron chelating, and DPPH on egg yolk. Moreover, the addition of 2% *Curcuma domestica* 10% stock solution increased egg shell thickness and egg shell strength. In summary, the use of 3% addition of *Curcuma domestica* 10% stock solution had ability to improve layer performances and antioxidant activity of egg yolk on laying hens.

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