RESEARCH ARTICLE

Effect of Dietary Incorporation of Chili (*Capsicum annuum*) Leaf Powder on Production Performance and Egg Quality Parameters of Rhode Island Red Laying Hens

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Abstract

This experiment was planned to ascertain the effect of dietary incorporation of chili **(***Capsicum annuum)* leaf powder on production performance and egg quality parameters of Rhode Island Red laying hens of 28 weeks of age for a period of 12 weeks. Hens were individually weighed and then randomly assigned into four treatment groups with three replicates of 6 birds each viz., T_1: (control, containing basal diet); T_2: Incorporation of 0.5% chili leaf powder in basal diet; T_3: Incorporation of 1.5% chili leaf powder in basal diet; T_4: Incorporation of 2.5% chili leaf powder in basal diet. The results indicated that egg production and feed conversion ratio were not significantly affected. However, overall average feed intake significantly ($p<0.05$) reduced in hens supplemented with 2.5% chili leaf powder. Egg quality parameters *viz*., egg weight, shape index, shell weight percentage and shell thickness of eggs, egg albumen quality such as albumen height, albumen weight and Haugh unit were statistically similar among all the groups. The egg yolk quality parameters including yolk weight, yolk percentage, yolk index, yolk cholesterol and yolk triglycerides did not differ significantly among different treatment groups, however, egg yolk colour was significantly ($p<0.05$) improved in T_4 group, compared to T_1 group. While, egg yolk colour in treatment groups T_1, T_2 and T_3 showed no significant difference. To conclude, supplementation of chilli leaf powder @ 2.5% can be used to improve egg yolk colour.

Keywords: Chili leaf powder, Egg quality parameters, Production performance, Rhode Island Red laying hens.

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Introduction

Poultry sector has developed high yielding layer (310-340 eggs/ annum) and broiler (2.4-2.6 kg at 6 weeks) varieties together with standardized package of practices on nutrition, housing, management and disease control over past 40 years (Chatterjee and Rajkumar, 2015). To maintain optimal production, many natural substances such as probiotics, prebiotics, organic acids, plant extracts and essential oils have been used (Fulton *et al*., 2002). Chili peppers (*Capsicum annuum*) are widely grown and used for food and traditional medicine all over the world. Chili is a good source of vitamins and minerals, carotenoids, and phenolic compounds such as capsaicinoids, luteolin and quercetin. Capsaicin (8-methyl-N-vanillyl-6-nonenamide), a bioactive chemical found in chili, has been shown to enhance antioxidant capacity and anti-inflammatory effect, as well as pain alleviation and modification of lipid metabolism and the gut microbial population. (Lee *et al*., 2005; Prakash and Srinivasan, 2010).

Chili leaves are one of the potent agro industrial wastes of chili farming after harvesting the chili which are not used for human consumption, do not adversely alter the laying hen performance and additionally the use of red chili as a potential natural colour pigment can improve egg-yolk colour (Gurbuz *et al*., 2003) as egg yolk color is an important

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purchasing criteria for consumers (Esfahani-Mashhour *et al*., 2009).

There have been a meager studies on the effects of diets incorporated with chili leaf powder on egg quality parameters in poultry. Thus, a study was planned to assess the effect of dietary supplementation of chili leaf powder on egg quality parameters in Rhode Island Red laying hens.

Materials and Methods

Ethical Statement

The experiment was conducted at Instructional Poultry Farm of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar with the permission of Institutional Animal Ethical Committee of GBPUAT, Pantnagar, Uttarakhand.

Birds and Experimental Diets

Feeding experiment of 12 weeks duration was performed on Rhode Island Red laying hens. 72 birds of 28 weeks old with uniform body weight were divided into four treatment groups at random, with each treatment group comprising three replicates of six birds. Four dietary treatment groups were T_1: (control, containing basal diet); T_2: supplementation of 0.5% chili leaf powder in basal diet; T_3: supplementation of 1.5% chili leaf powder in basal diet; T_4: supplementation of 2.5% chili leaf powder in basal diet. Feed consumption and the impact of dietary interventions on egg production and egg quality were monitored. Standard laying hen basal diets were prepared by combining ingredients to meet the birds' nutritional requirements, as recommended by BIS (2007) were :. Yellow Maize (57%), Deoiled Rice bran (6.5%), Rice polish (4.5%), Groundnut cake- Solvent extracted (09.0%), Soyabean meal (18.0%), Marble powder (03%) , Dicalcium Phosphate (01.0%), DL- methionine (0.15%), Choline Chloride (0.10%), Mineral mixture (0.10 %), Common salt (0.40%), Hepatocare 0.10 %), Vitamin Premix (010%) and Toxin binder (0.05%)

Preparation of Chili Leaf Powder

Chili (*Capsicun annuum*) leaves were obtained from plants in the local area of Jaspur, Udham Singh Nagar, Uttarakhand. The leaves were first shade dried for 3-4 days after being picked up, followed by sun drying on a clean concrete floor followed by drying in a hot air oven set to 70°C until they attained consistent weight. Dried chili leaves were then finely ground into powder and kept in sealed plastic bags. The proximate analysis of chili (*Capsicum annuum*) leaf powder and basal diet was determined as per the method of AOAC (2003) and presented in Table 1.

Production Parameters and Egg Quality Traits

Feed intake and Feed conversion ratio were calculated following routine procedure.

In the last week of experiment, six eggs from each treatment group were collected to determine the egg quality parameters. To measure the impact of dietary treatments on egg quality, external egg quality parameters such as egg weight, shape index, shell weight, shell thickness and internal egg quality parameters such as albumen height, Haugh unit, yolk weight, yolk index analyzed at the end of the feeding study as per the standard procedure in practice .Yolk colour was compared with DSM yolk colour fan strips (Galobart *et al*., 2004). To estimate the egg yolk cholesterol, the egg yolk was separated from the albumen and then the yolk lipids were isolated. Cholesterol content of extracted yolk was determined using a commercial kit (Erba diagnostic kit) and egg triglycerides was determined using an Erba diagnostic kit and the GPO Trinder,

The experimental data generated were analyzed statistically (Snedecor and Cochran, 1994) by ANOVA generated from the general linear model procedure. Duncan›s Multiple Range Test was used to assess the variations between treatment means.

Results and Discussions

Production Performance

Overall average production performance of Rhode Island Red laying hens during 28-40 weeks feeding trial in terms of egg production, feed intake and feed conversion ratio (kg/dozen eggs and kg/kg eggs) of different groups is presented in Table 2. Average feed intake was found to be significantly decreased in T_4 as compared to T_1 group. However, overall egg production and feed conversion ratio during the entire experiment was not affected significantly by the supplementation of chili leaf powder in laying hens diet. The present findings were corroborated with Lokaewmanee (2019) who observed that supplementing laying hens with dietary chili leaf powder at a concentration of 3% reduced feed intake ($p<0.05$) while egg production of laying hens was not significantly affected by supplementation of chili leaf powder. Siddiqui *et al*. (2022) noted a non-significant effect on egg production, feed intake and feed conversion ratio in White Leghorn laying hens fed diet supplemented with mulberry leaf powder. In contrast, Saleh *et al.* (2021) reported that egg production of laying hens supplemented with paprika powder was significantly improved. Ashour *et al.* (2020) observed a significant increase in egg production; however, feed intake and feed conversion ratio were not affected after incorporation of *Moringa oleifera* leaf powder in diet of laying quails. Filik *et al*. (2020) found significant increase in egg production of Japanese quail among all the hot pepper (*Capsicum annuum*) waste supplemented groups.

Egg Quality Parameters

Average values of external egg quality parameters including weight, shape index (%), shell weight (%), shell thickness (mm) and egg albumen quality and Haugh unit were found to be non-significant among various treatment groups (Table 3 and 4). The average values of egg yolk weight, yolk weight percentage, yolk index, egg yolk cholesterol and egg yolk

Table 1: Chemical composition of chili (*Capsicum annuum*) leaf powder and diet (% dry matter basis) provided to different treatment groups

		Treatments/Groups			
		T_1	T_2	T_3	T_4
Nutrients	Chili Leaf	Basal diet (control)	Basal diet+0.5% chili leaf powder	Basal diet+1.5% chili leaf powder	Basal diet+2.5% chili leaf powder
Crude protein	6.78	17.56	17.50	17.40	17.29
Ether extract	14.52	3.8	3.79	3.81	3.72
Crude Fibre	7.89	4.19	4.28	4.45	4.35
Total Ash	5.15	9.72	9.13	8.89	8.62
Nitrogen Free Extract	65.66	64.73	65.30	65.45	66.02

Table 2: Average production performance of Rhode Island Red laying hens from 28-40 weeks period fed diet supplemented with chili (*Capsicum annuum*) leaf powder

	Treatments/Groups				
	T_1	T_2	T_3	T_4	
Period (28-40 weeks)	Basal diet (control)	Basal diet+0.5% chili leaf powder	Basal diet+1.5% chili leaf powder	Basal diet+2.5% chili leaf powder	P- value
Feed intake (g/day)*	$120.40^{b}\pm0.31$	$120.15^{ab}\pm0.11$	$119.97^{ab}\pm0.11$	$119.45^{a}\pm0.33$	0.03
Egg production (%)	62.50±2.34	63.16±2.38	63.62±2.49	64.62±2.45	0.95
FCR (kg feed/ dozen egg)	2.32±0.08	2.29±0.08	2.26±0.08	2.23±0.09	0.95
FCR (kg feed/kg egg mass)	3.48±0.12	3.45±0.12	3.36±0.12	3.31±0.13	0.86

$^{a, b}$ Mean values bearing different superscripts in a row differ significantly, *P≤0.05

Table 3: Average values of external egg parameters of Rhode Island Red laying hens fed diet supplemented with chili (*Capsicum annuum*) leaf powder

	Treatments/Groups				
	T_1	T_2	T_3	T_4	
Parameters	Basal diet (control)	Basal diet+0.5% chili leaf powder	Basal diet+1.5% chili leaf powder	Basal diet+2.5% chili leaf powder	P- value
Egg wt. (g)	55.33±0.15	55.33±0.29	56.02±0.63	56.19±0.85	0.59
Shape index (%)	77.52±0.21	77.55±0.33	77.59±0.09	77.81±0.48	0.92
Shell wt. (%)	9.49±0.12	9.61±0.13	9.54±0.31	9.53±0.21	0.98
Shell thickness (mm)	0.40±0.04	0.39±0.06	0.38±0.06	0.37±0.00	0.85

Table 4: Average values of albumen quality and Haugh unit of Rhode Island Red laying hens fed diet supplemented with chili (*Capsicum annuum*) leaf powder

	Treatments/Groups				
	T_1	T_2	T_3	T_4	
Parameters	Basal diet (control)	Basal diet+0.5% chili leaf powder	Basal diet+1.5% chili leaf powder	Basal diet+2.5% chili leaf powder	P- value
Albumen height (mm)	6.60±0.10	6.57±0.06	6.58±0.15	6.65±0.10	0.95
Albumen weight (g)	32.85±0.19	32.78±0.37	33.25±0.65	33.38±0.88	0.85
Albumen weight (%)	59.37±0.33	59.25±0.41	59.34±0.51	59.39±0.73	0.99
Haugh unit	83.13±0.07	82.81±0.26	83.01±0.35	83.07±0.31	0.84

Table 5: Average values of egg yolk quality of Rhode Island Red laying hens fed diet supplemented with chili (*Capsicum annuum*) leaf powder

Parameters	Treatments/Groups				P- value
	T_1	T_2	T_3	T_4	
	Basal diet (control)	Basal diet+0.5% chili leaf powder	Basal diet+1.5% chili leaf powder	Basal diet+2.5% chili leaf powder	
Yolk weight (g)	17.23±0.17	17.28±0.13	17.43±0.10	17.46±0.32	0.81
Yolk weight (%)	31.13±0.26	31.23±0.28	30.83±0.95	30.55±0.35	0.81
Yolk index (%)	43.82±0.30	43.89±0.83	43.91±0.10	43.92±0.75	0.99
Yolk colour*	6.35^{b}±0.66	6.20^{b}±0.15	6.60^{b}± 0.14	8.43^{a}±0.13	0.01
Yolk cholesterol (mg/g)	14.49±0.22	14.41±0.23	13.94±0.35	13.23±0.81	0.43
Yolk triglyceride (mg/g)	203.61±0.05	202.12±0.29	201.95±0.30	201.16±0.28	0.33

[a, b] Mean values bearing different superscripts in a row differ significantly, *p≤0.05

triglycerides were statistically similar among all the treatment groups. Lokaewmanee (2019) also reported similar trend on laying hens after chili leaf powder. However, the egg yolk colour was significantly increased in T_4 as compared to T_1 group. Though, no significant difference was found in egg yolk color among T_1, T_2 and T_3 treatment groups due to incorporation of chili leaf powder in the diet of laying hens (Table 5). Numerous studies have been done to investigate the effect of feeding of chili on egg yolk colour. Zeaxanthin, lutein, alpha-carotene, beta-carotene and carotenoids present in chilies have been proven to enhance egg yolk colour in laying hens. Chili leaves are good source of beta-carotene which may reflect the increased egg yolk colour of laying hens. Siddiqui *et al*. (2022) noted a significant increase in egg yolk colour score and found no adverse effect on shell quality, albumen and egg yolk quality parameters of White Leghorn laying hens fed diet supplemented with mulberry leaf powder. Ashour *et al.* (2020) observed no significant effect on egg weight and shell percent after incorporation of *Moringa oleifera* leaf powder in diet of laying quails. Filik *et al*. (2020) found no significant effect on egg weight of Japanese quail supplemented with hot pepper *(Capsicum annuum)* waste powder at 1 and 4 g/kg diet. However, egg weight was increased when hot pepper *(Capsicum annuum)* waste powder was added into quail's diet at 2 g/kg diet. Cayan and Erener (2015) found no significance effect on egg weight, shell weight, shell ratio, shell thickness, albumen quality and egg yolk quality**;** however egg yolk colour was enhanced after feeding of olive leaf powder in laying hens. Vicente *et al*. (2007) noted that addition of dietary capsaicin from paprika significantly increased the deposition of red pigmentation in the egg yolk.

Conclusion

From the above observations , it can be concluded that chili (*Capsicum annuum*) leaf powder can be supplemented @ 2.5 % in laying hens' diet to improve egg yolk pigmentation without imposing any negative impact on performance of Rhode Island Red laying hens.

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References

Abou-Elezz, F.M.K., Sarmiento-Franco, L., Santos-Ricalde, R., & Solorio-Sanchez, F. (2011). Nutritional effects of dietary inclusion of *Leucaena leucocephala* and *Moringa oleifera* leaf meal on Rhode Island Red hens' performance. *Cuban Journal of Agricultural Science*, *45*(2), 163-169.

AOAC. (2003). *Official methods of analysis,* 16th Ed. Association of official analytical chemists, Washington D.C, USA.

Ashour, E.A., El-Kholy, M.S., Alagawany, M., Abd El-Hack, M.E., Mohamed, L.A., Taha, A.E., El Sheikh, A.I.,Laudadio, V., & Tufarelli, V. (2020). Effect of dietary supplementation with *Moringa oleifera* leaves and/or seeds powder on production, egg characteristics, hatchability and blood chemistry of laying Japanese quails. *Sustainability*, *12*(6), 2463.

BIS. (2007). *Indian Standard: Poultry Feeds- Specification, IS-1374*. Bureau of Indian Standards, 9, Bahadur Sah Zafar Marg, ManakBhawan, New Delhi, India.

Cayan, H., & Erener, G. (2015). Effect of Olive leaf (*Oleaeuropaea*) powder on laying hens performance, egg quality and egg yolk cholesterol levels. *Asian-Australasian Journal of Animal Sciences*, *28*(4), 538-543.

Chatterjee, R. N., & Rajkumar, U. (2015).An overview of poultry production in India. *The Indian Journal of Animal Sciences, 54*(2), 89-108.

Esfahani-Mashhour, M., Morave,j H., Mehrabani-Yeganeh, H., & Razavi, S. H. (2009**)**. Evaluation of coloring potential *of Dietzianatonolinaea* biomass as source of canthaxanthin for egg yolk pigmentation.*Asian-Australasian Journal of Animal Sciences, 22*(2), 254- 259.

Filik, G., Filik, A. G., & Altop, A. (2020). The effects of dietary hot pepper *Capsicum annuum* waste powder supplementation on egg production traits of Japanese quail layers. *Ciencia Rural, 50*(9), 1-8.

Fulton R. M., Nersessian B. N., &Reed W. M. (2002).Prevention of *Salmonella enteritidis* infection in commercial ducklings by oral chicken egg derived antibody alone or in combination with probiotics. *Poultry Science, 81*(1), 34-40.

Galobart, J., Sala, R., Rincón-Carruyo, X., Manzanilla, E.G., Vil, B., & Gasa, J., (2004). Egg yolk color as affected by saponified oleoresin of red pepper (*Capsicum annuum*) fed to laying hens. *Journal of Applied Poultry Research*, *13*(2), 328-334.

Gurbuz, Y., Yasar, S., & Karaman, M. (2003). Effects of addition of the red pepper from 4th harvest to corn or wheat based diets on egg-yolk colour and egg production in laying hens. *International Journal of Poultry Science*, *2*(2), 107-111.

Lee, J. J., Crosby, K. M., Pike, L. M., Yoo, K. S., & Lescobar, D. I. (2005). Impact of genetic and environmental variation of development of flavonoids and carotenoids in pepper (*Capsicum* spp.). *Scientia Horticulturae*, *106*(3), 341-352.

Lokaewmanee, K. (2019). Effect of Chili leaf powder on laying hen performance, egg quality and egg yolk cholesterol levels. *International Journal of Poultry Science*, *18*(4), 168-173.

Prakash, U. N., & Srinivasan, K., (2010). Gastrointestinal protective effect of dietary spices during ethanol-induced oxidant stress in experimental rats.*Applied Physiology, Nutrition, and Metabolism, 35*(2), 134-141.

Saleh, A. A., Gawish, E., Mahmoud, S. F., Amber, K., Awad, W., Alzawqari, M. H., Shukry, M., & Abdel-Moneim, A. M. E. (2021). Effect of natural and chemical colorant supplementation on performance, egg-quality characteristics, yolk fatty acid profile, and blood constituents in laying hens. *Sustainability*, *13*(8), 45-53.

Siddiqui, R., Mondal, B.C., Kumar, R., Kaur, M., Kumar, A., Palod, J., & Lata, M. (2022). Effect of replacing rice polish with mulberry (*Morus alba*) leaf powder in diet containing phytase enzyme on performance and haemato-biochemical parameters of commercial laying hens. *The Indian Journal of Veterinary Sciences and Biotechnology*, *18*(1), 17-22.

Snedecor, G. W., & Cochran, W. G. (1994). *Statistical Methods*. 8th Ed. Iowa State University Press, Iowa.

Vicente, J. L., Lopez, C., Avila, E., Morales, E., Hargis, B. M., & Tellez, G. (2007). Effect of dietary natural capsaicin on experimental *Salmonella enteritidis* infection and yolk pigmentation in laying hens. *International Journal of Poultry Science*, *6*(6), 393-396.