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ORIGINAL ARTICLE

Effects of Adding Mixed Powder of Garlic and Thyme to Diets Included Graded Levels of Rice Bran on Productive Performance of Laying Hens and Egg Quality Characteristics

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Mohebbifar, A. and M. Torki; Effects of adding mixed powder of garlic and thyme to diets included graded levels of rice bran on productive performance of laying hens and egg quality characteristics

ABSTRACT

To investigate the effects of adding dried powder of medicinal plants (MP) including garlic (*Allium sativum*) and thyme (*Thymus vulgaris*) to rice bran-included diets on performance of laying hens, egg quality traits and blood differential count of white blood cells, 144 Lohmann LSL-Lite hens after production peak were randomly divided in 24 cages (n=6). Six iso-caloric and iso-nitrogenous experimental diets (ME = 2720 Kcal/ Kg and CP=154.2 g/Kg) including three levels (0, 100 and 200 g/kg) of rice bran (RB) with MP (0 and 2.5 g/kg) were fed hens with 4 replicates per diet during 8-week trial period. In weeks 4 and 8, all produced eggs per each dietary group during three frequent days were collected to measure egg quality traits. To determine blood biochemical parameters and differential count of white blood cells, one randomly selected hen per replicate was bled via wing vein on day 35 of trial. Collected data of feed intake (FI), egg production (EP), egg mass (EM); calculated feed conversion ratio (FCR), egg quality traits and blood parameters in a 3×2 factorial arrangement was analyzed based on completely randomized design using GLM procedure of SAS. Dietary treatment did not have significant effect on EP, EM, FI and FCR of laying hens (P>0.05). Egg weight, egg index, Haugh unit, egg gravity and egg shell weight were not significantly affected by dietary treatment (P>0.05). Yolk color in the first measurement (wk 4) was higher in the control compared to the RB-included dietary group (P=0.02); but, in second egg sampling (wk 8) yolk color was higher in the 200 g RB-included dietary group (P= 0.01) compared the other dietary groups. In second measurement (wk 8) egg shell thickness was higher in the control compared to RB-included dietary groups (P=0.03). Dietary treatment did not have significant effect on feces pH (P> 0.05). From the results of the present study it can be concluded that RB can be included in diets of laying hens up to 20% with no adverse effect on productive performance. In terms of egg quality characteristics, egg shell quality might be improperly affected by dietary RB inclusion. Adding ground mixture of dried garlic and thyme did not have beneficial effects on hens' performance and egg quality.

Key words: rice bran, garlic, *Allium sativum*, thyme, *Thymus vulgaris*, laying hens, performance, egg quality

Introduction

Rice bran, a low-price agricultural by-product which tremendously produces in North part of Iran, can be partly replaced in expensive ingredients of poultry diets to reduce production cost. It is a powdery fine, fluffy material that consists seeds or kernels, in addition to particles of pericarp, seed coat, aleurone, germ and fine starchy endosperm and rich in B-vitamins and its nutrient density and profiles of

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amino acids, including 74% of unsaturated fatty acids, are superior to cereal grains [3].

Improving poultry performance by dietary manipulation has been the goal of nutritionists. In our previous works, effects of feed additives like enzymes [15], organic acids [7] or medicinal plants[4,10] on poultry performance was investigated. Phytogenic feed additives are plant-derived products used in animal feeding to improve the performance of livestock. This class of feed additives has recently gained increasing interest, especially for use in poultry, as can be derived from a significant increase in the number of scientific publications since 2000; however, our knowledge is still rather limited regarding to the aspects of their application. Further complications arise because phytogenic feed additives may vary widely with respect to botanical origin, processing, and composition. Most studies investigate blends of various active compounds and report the effects on production performance [4,14]. Thyme (*Thymus vulgaris* L.) is an herbaceous perennial plant belonging to the Lamiaceae family. The Plant is native to the western Mediterranean region and southern Italy [8]. Garlic (*Allium sativum* L.) the spices of life is unique among the members of plant kingdom. Several clinical reports, including meta-analyses, have revealed a cholesterol lowering effect of garlic in humans [13]. Allicin (the active compound produced by garlic) may reduce the levels of serum cholesterol, triglyceride and LDL [1]. Mottaghitalab and Taraz [9] concluded that diets containing garlic powder has potential as feed additives, which may be beneficial in reducing serum and egg cholesterol in hens. Khan *et al.* [6] also reported that feed consumption, feed efficiency, EW and EM were not affected over 6 weeks when 0, 2, 6 and 8% dietary garlic powder was fed to the laying hens. Serum and egg yolk cholesterol concentrations decreased with increasing levels of dietary garlic.

The objectives of this study was to evaluate effects of including RB to laying hens' diets with or without dietary supplementation by MP (ground mixture of garlic and thyme with 1:1 ratio) on productive performance, egg quality traits and blood differentiable count of white blood cells

Materials and methods

A total number of 144 Lohmann LSL-Lite hens after production peak were distributed in 24 cages (n=6) with almost the same body weight and EP throughout the cages. As it is presented in table 1, six iso-caloric and iso-nitrogenous experimental diets (ME = 2720 Kcal/ Kg and CP=154.2 g/Kg) including three levels (0, 100 and 200 g/kg) of RB with medicinal plant (MP: 0 and 2.5 g/kg) fed to hens with 4 replicates per diet during 8-week trial period. In weeks 4 and 8, all produced eggs per each dietary group during three frequent days were collected to measure egg quality traits. To determine blood biochemical parameters and differential count of white blood cells, one randomly selected hen per replicate was bled via wing vein on day 35 of trial. Collected data of FI, EP, EM, calculated FCR, egg quality traits and blood differential counts of white blood cells in a 3×2 factorial arrangement was analyzed based on completely randomized design using GLM procedure of SAS. All statements of significance are based a probability of less than 0.05. The mean values were compared by Duncan's Multiple Range Test. In the following statistical model: $Yijk = \mu + Aj + Bj + (A.B)ij + eijk$, Yijk = tested parameter of laying hens fed diets containing graded levels of RB (0, 100 and 200 g/kg) and MP (0 and 2.5 g/kg), Ai = dietary inclusion of RB, Bj = dietary inclusion of MP, (A.B)ij = interaction between RB and MP, and eijkl = error term.

Results

Effects of dietary RB inclusion and MP supplementation on FI (g/ hen/ day), FCR (g feed: g egg), EP (%), EW (g) and EM (g/ hen/ day) are presented in tables 2 to 6, respectively. Dietary treatment did not have significant effects on the productive performance parameters. Effects of dietary RB inclusion and MP supplementation on egg quality characteristics in first and second egg sampling (week 4 and week 8 of trial period) are presented in tables 7 to 10, respectively. Egg quality characteristics were not significantly affected by dietary treatment, except for yolk color (first and second egg sampling) and egg shell thickness (second egg sampling). In the first egg sampling (week 4) yolk color in hens fed the RB-included diets was decreased compared to the hens fed control diet; however, in the second egg sampling (week 8), the highest yolk color was seen in hens fed the diets with 20% RB inclusion. In the second egg sampling, egg shell thickness was decreased in hens fed the RB-included diets compared to hens fed the control diet. Effects of dietary RB inclusion and MP supplementation on white blood cell counts, serum biochemical parameters and feces pH are presented in tables 11 to 13, respectively. White blood cell counts, serum biochemical parameters and feces pH were not significantly affected by dietary treatment, except for lymphocytes. The interaction between dietary RB inclusion and MP supplementation on lymphocytes count was significant ($p<0.05$). The highest and the lowest count for lymphocytes were seen in hens fed the control diets with and without MP, respectively.

Table 1: Ingredients and composition of the experimental diets

	Rice bran (g/100 g iet)					
	0.00		10.00		20.00	
Medicinal plant (g/100g diet)	0.00	0.25	0.00	0.25	0.00	0.25
Feed ingredients	g / 100 g diet					
Corn	51.13	51.22	48.32	48.41	45.51	45.59
Fish meal	4.00	4.00	4.00	4.00	4.00	4.00
Soybean meal	12.91	13.07	14.27	14.43	15.64	15.80
Wheat bran	17.63	17.13	9.07	8.57	0.51	0.01
Rice bran	-	-	10.00	10.00	20.00	20.00
Soybean oil	4.47	4.47	4.47	4.47	4.47	4.47
Dicalcium phosphate	1.28	1.28	1.30	1.30	1.32	1.32
Lime stone	7.68	7.67	7.66	7.66	7.65	7.65
Common salt	0.22	0.22	0.22	0.22	0.22	0.22
Medicinal Plant	-	0.25	-	0.25	-	0.25
Vit. & Min. Premix[2]	0.25	0.25	0.25	0.25	0.25	0.25
Lysine-HCL	0.19	0.19	0.19	0.19	0.19	0.19
Calculated analyses						
ME (Kcal/kg)	2720	2720	2720	2720	2720	2720
Crude protein (%)	15.42	15.42	15.42	15.42	15.42	15.42
Ether extract (%)	6.80	6.79	6.89	6.88	6.99	6.98
Crude fiber (%)	4.01	3.97	4.91	4.87	5.81	5.77
Calcium (%)	3.42	3.42	3.42	3.42	3.42	3.42
Available P (%)	0.35	0.35	0.35	0.35	0.35	0.35
Lys (%)	0.79	0.79	0.82	0.82	0.85	0.86
Met (%)	0.47	0.47	0.47	0.47	0.47	0.47[1]

The vitamin and mineral premix provide the following quantities per kilogram of diet: vitamin A, 10,000 IU (*all-trans*-retinal); cholecalciferol, 2,000 IU; vitamin E, 20 IU (*α*-tocopheryl); vitamin K3, 3.0 mg; riboflavin, 18.0 mg; niacin, 50 mg; D-calcium pantothenic acid, 24 mg; choline chloride, 450 mg; vitamin B12, 0.02 mg; folic acid, 3.0 mg; manganese, 110 mg; zinc, 100 mg; iron, 60 mg; copper, 10 mg; iodine, 100 mg; selenium, 0.2 mg; and antioxidant, 250 mg

Table 2: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on feed intake (FI) of laying hens (weeks 41-48 of age)

	Feed intake (g/ hen/ day)[1]				
Week	1-2	3-4	5-6	7-8	1-8
Treatments					
Rice bran					
0.0 (g/kg diet)	115.17±3.98	114.56±3.92	113.74±5.10	112.40±4.42	113.97±3.94
100 (g/kg diet)	116.05±6.23	115.59±5.08	111.87±7.42	110.40±7.21	113.48±5.92
200 (g/kg diet)	119.10±1.22	116.19±3.35	114.90±6.10	112.21±4.80	115.60±3.58
Medicinal plant					
0.00 (g/kg diet)	116.64±5.00	115.74±3.83	113.66±6.38	111.93±6.27	114.49±4.91
2.50 (g/kg diet)	116.91±4.10	115.15±4.41	113.35±6.15	111.41±4.73	114.21±4.24
SEM[2]	0.913	0.827	1.252	1.111	0.916
CV	3.86	3.77	5.89	5.21	4.22
P values					
Rice bran (RB)	0.24	0.71	0.77	0.79	0.76
Medicinal plant (MP)	0.88	0.80	0.77	0.65	0.79
RB × MP	0.33	0.37	0.65	0.51	0.42

[1]Means ± SD, [2]SEM= Standard error of means.

Table 3: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on feed conversion ratio (FCR) of laying hens (weeks 41-48 of age)

	Feed conversion ratio (g feed : g egg)[1]				
Week	1-2	3-4	5-6	7-8	1-8
Treatments					
Rice bran					
0.0 (g/kg diet)	2.04±0.12	1.96±0.10	1.98±0.14	2.01±0.11	1.20±0.10
100 (g/kg diet)	2.00±0.09	1.97±0.11	1.92±0.10	1.98±0.13	1.97±0.07
200 (g/kg diet)	2.01±0.11	1.92±0.12	1.91±0.10	1.99±0.14	1.96±0.09
Medicinal plant					
0.00 (g/kg diet)	1.99±0.07	1.96±0.13	1.93±0.08	2.04±0.12	1.98±0.07
2.50 (g/kg diet)	2.04±0.13	1.95±0.09	1.93±0.14	1.95±0.12	1.97±0.11
SEM[2]	0.021	0.023	0.023	0.025	0.018
CV	5.20	6.14	6.11	6.03	4.64
P values					
Rice bran (RB)	0.65	0.57	0.48	0.87	0.61
Medicinal plant (MP)	0.37	0.67	0.95	0.10	0.62
RB × MP	0.48	0.59	0.31	0.19	0.22

[1]Means ± SD, [2]SEM= Standard error of means.

Table 4: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on hen-day egg production (%) in laying hens (weeks 41-48 of age)

	Hen-day egg production (%)[1]				
Week	1-2	3-4	5-6	7-8	1-8
Treatments					
Rice bran					
0.0 (g/kg diet)	93.01±5.15	95.83±3.97	93.30±5.58	92.50±3.86	93.66±4.28
100 (g/kg diet)	94.94±6.64	94.94±5.39	93.45±5.69	91.92±5.43	93.81±5.28
200 (g/kg diet)	96.55±2.86	98.06±4.58	95.83±5.44	93.27±5.15	95.93±3.62
Medicinal plant					
0.00 (g/kg diet)	95.73±5.16	95.93±5.68	93.95±6.12	91.31±4.54	94.23±4.80
2.50 (g/kg diet)	93.93±5.12	96.63±3.62	94.44±4.96	93.81±4.66	94.70±4.11
SEM[2]	1.044	0.954	1.113	0.955	0.894
CV	5.34	4.83	5.73	5.12	4.62
P values					
Rice bran (RB)	0.29	0.50	0.75	0.94	0.60
Medicinal plant (MP)	0.52	0.78	0.96	0.27	0.84
RB × MP	0.26	0.16	0.12	0.23	0.12

[1]Means ± SD, [2]SEM= Standard error of means.

Table 5: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on egg weight (g) in laying hens (weeks 41-48 of age)

	Egg Weight (g/egg)[1]				
Week	1-2	3-4	5-6	7-8	1-8
Treatments					
Rice bran					
0.0 (g/kg diet)	61.00±0.89	61.04±0.89	61.76±0.84	60.47±1.09	61.07±0.80
100 (g/kg diet)	61.18±1.29	61.87±1.27	62.57±1.18	60.95±1.90	61.64±1.15
200 (g/kg diet)	61.73±1.94	62.55±2.04	63.00±2.09	60.78±1.85	62.02±1.86
Medicinal plant					
0.00 (g/kg diet)	61.37±1.62	61.84±1.70	62.59±1.62	60.40±1.23	61.55±1.34
2.50 (g/kg diet)	61.23±1.24	61.81±1.45	62.31±1.43	61.06±1.89	61.60±1.41
SEM[2]	0.29	0.31	0.31	0.32	0.27
CV	2.43	2.53	2.45	2.57	2.27
P values					
Rice bran (RB)	0.60	0.19	0.28	0.82	0.41
Medicinal plant (MP)	0.82	0.96	0.66	0.31	0.93
RB × MP	0.47	0.67	0.59	0.12	0.49

[1]Means ± SD, [2]SEM= Standard error of means.

Table 6: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on egg mass (g/hen/day) in laying hens (weeks 41-48 age)

	Egg mass (g/hen/day)[1]				
Week	1-2	3-4	5-6	7-8	1-8
Treatments					
Rice bran					
0.0 (g/kg diet)	56.77±3.85	58.54±3.07	57.70±3.10	55.96±2.54	57.24±3.20
100 (g/kg diet)	58.04±3.75	58.73±3.42	58.46±3.20	56.00±4.43	57.81±3.32
200 (g/kg diet)	59.64±3.32	61.39±4.39	60.44±5.08	56.78±4.61	59.56±3.82
Medicinal plant					
0.00 (g/kg diet)	58.76±3.44	59.35±4.32	58.83±4.45	55.19±3.34	58.03±3.47
2.50 (g/kg diet)	57.54±3.97	59.75±3.26	58.90±4.02	57.30±4.09	58.37±3.54
SEM[2]	0.752	0.766	0.847	0.778	0.700
CV	6.08	6.30	6.97	6.62	5.80
P values					
Rice bran (RB)	0.20	0.34	0.57	0.98	0.45
Medicinal plant (MP)	0.56	0.85	0.88	0.23	0.85
RB × MP	0.21	0.25	0.17	0.12	0.13

[1]Means ± SD, [2]SEM= Standard error of means.

Table 7: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on egg characteristics (first sampling on week 4).

	Egg characteristics (wk4)[1]		
Egg Characteristics	Egg index	Yolk index	Haugh unit
Treatments			
Rice bran			
0.0 (g/kg diet)	74.86±1.39	39.73±1.51	67.30±2.35
100 (g/kg diet)	75.78±1.51	40.07±1.08	67.88±2.66
200 (g/kg diet)	75.94±1.90	40.55±0.97	67.80±2.96
Medicinal plant			
0.00 (g/kg diet)	75.79±1.65	39.95±1.40	66.96±2.21
2.50 (g/kg diet)	75.26±1.61	40.28±1.01	68.36±2.80
SEM[2]	0.331	0.246	0.524
CV	2.12	2.96	4.06
P values			
Rice bran (RB)	0.36	0.40	0.90
Medicinal plant (MP)	0.42	0.51	0.22
RB × MP	0.26	0.22	0.86

[1]Means ± SD, [2]SEM= Standard error of means.

Table 8: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on egg characteristics (first sampling on week 4)

	Egg characteristics (wk 4)[1]			
Egg Characteristics	Yolk color (Roch)	Specific gravity	Shell weight (gr)	Shell thickness (mm×10^{-2})
Treatments				
Rice bran				
0.0 (g/kg diet)	7.25±0.23[a]	1.10±0.01	7.54±0.50	26.41±1.83
100 (g/kg diet)	6.92±0.43[b]	1.09±0.00	7.46±0.41	25.78±1.72
200 (g/kg diet)	6.79±0.25[b]	1.09±0.00	7.35±0.31	25.28±1.22
Medicinal plant				
0.00 (g/kg diet)	6.97±0.44	1.10±0.01	7.49±0.38	26.11±1.84
2.50 (g/kg diet)	7.00±0.28	1.09±0.00	7.42±0.43	25.53±1.36
SEM[2]	0.074	0.001	0.082	0.329
CV	4.32	0.42	5.90	5.74
P values				
Rice bran (RB)	0.02	0.19	0.70	0.34
Medicinal plant (MP)	0.82	0.20	0.71	0.35
RB × MP	0.11	0.19	0.89	0.08

[1]Means ± SD, [2]SEM= Standard error of means.

Table 9: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on egg characteristics (second sampling on week 8)

	Egg characteristics (wk 8)[1]		
Egg Characteristics	Egg index	Yolk index	Haugh unit
Treatments			
Rice bran			
0.0 (g/kg diet)	74.18±1.70	38.80±1.00	63.69±6.03
100 (g/kg diet)	74.45±1.41	38.41±0.94	66.37±2.70
200 (g/kg diet)	75.27±1.41	39.42±1.27	64.58±2.97
Medicinal plant			
0.00 (g/kg diet)	74.86±1.69	39.03±1.22	65.45±4.99
2.50 (g/kg diet)	74.41±1.38	38.72±1.03	64.31±3.24
SEM[2]	0.311	0.228	0.848
CV	2.11	2.77	6.65
P values			
Rice bran (RB)	0.29	0.32	0.47
Medicinal plant (MP)	0.59	0.36	0.55
RB × MP	0.50	0.31	0.35

[1]Means ± SD, [2]SEM= Standard error of means.

Table 10: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on egg characteristics (second sampling on week 8)

	Egg characteristics (wk 8)[1]			
Egg Characteristics	Yolk color (Roch)	Specific gravity	Shell weight(gr)	Shell thickness (mm×10^{-2})
Treatments				
Rice bran				
0.0 (g/kg diet)	6.42±0.34^{b}	1.09±0.00	7.16±0.31	40.46±3.05^{a}
100 (g/kg diet)	6.25±0.23^{b}	1.09±0.00	7.41±0.43	37.79±1.34^{b}
200 (g/kg diet)	6.87±0.30^{a}	1.10±0.00	7.42±0.47	37.83±1.32^{b}
Medicinal plant				
0.00 (g/kg diet)	6.47±0.44	1.10±0.00	7.25±0.40	39.22±2.65
2.50 (g/kg diet)	6.55±0.36	1.09±0.00	7.42±0.41	38.17±1.99
SEM[2]	0.080	0.001	0.084	0.481
CV	5.01	0.44	5.81	5.30
P values				
Rice bran (RB)	0.01	0.26	0.49	0.03
Medicinal plant (MP)	0.58	0.58	0.49	0.18
RB × MP	0.88	0.20	0.90	0.34

[1]Means ± SD, [2]SEM= Standard error of means. a-b Means within a column (within main effects) with no common superscript differ significantly ($p < 0.05$).

Table 11: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on white blood cell counts (heterophil, lymphocyte, monocyte, eosinophil, basophil and heterophil to lymphocyte ratio) in laying hens (on day 56 of the experiment)

	White blood cell counts[1]					
Labels	H[2]	L	M	E	B	H:L
Treatments						
Rice bran						
0.0 (g/kg diet)	26.25±8.60	69.88±9.57	1.50±1.77	1.13±1.81	1.25±2.37	0.39± 0.17
100 (g/kg diet)	25.25±7.02	72.13±7.40	1.25±1.39	0.45±1.39	1.75±1.91	0.36± 0.12
200 (g/kg diet)	26.63±5.78	69.88±5.89	1.38±1.60	0.88±1.36	1.25±2.05	0.39± 0.11
Medicinal plant						
0.00 (g/kg diet)	25.67±6.97	70.50±8.13	1.25±1.44	1.25±1.86	2.08±2.31	0.38± 0.13
2.50 (g/kg diet)	26.42±7.18	70.75±7.17	1.50±1.68	0.58±0.90	0.75±0.54	0.38± 0.13
SEM[3]	1.415	1.531	0.312	0.300	0.417	0.026
CV	25.08	8.87	124.50	167.63	146.47	30.87
P values						
Rice bran (RB)	0.91	0.71	0.96	0.88	0.86	0.82
Medicinal plant (MP)	0.78	0.92	0.72	0.30	0.13	0.90
RB × MP	0.06	0.00	0.96	0.44	0.49	0.02

RB	MP		
0.00	0.00	63.00±3.91^{b}	0.49±0.10
0.00	2.50	76.75±8.50^{a}	0.29±0.16
100	0.00	76.25±8.99^{a}	0.29±0.13
100	2.50	68.00±1.15^{ab}	0.42±0.07
200	0.00	72.25±4.79^{ab}	0.34±0.09
200	2.50	67.50±6.55^{ab}	0.43±0.12
CV		8.87	30.87
P values		0.04	0.14

[1]Means ± SD, [2]Heterophil, Lymphocyte, Monocyte, Eosinophil, Basophil, Heterophil to Lymphocyte ratio
[3]SEM= Standard error of means, a-b Means within a column (within main effects) with no common superscript differ significantly ($p < 0.05$).

Table 12: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on serum biochemical parameters (cholesterol, triglycerides, high density lipoprotein, low density lipoprotein) in laying hens (on day 56 of the experiment).

	Serum biochemical parameters[1]			
Labels	CHOL[2]	TG	HDL	LDL
Treatments				
Rice bran				
0.0 (g/kg diet)	316.00±450.84	1739.38±395.46	53.25±9.90	89.88±16.08
100 (g/kg diet)	170.63±39.01	2291.88±726.79	53.63±12.76	96.50±21.40
200 (g/kg diet)	158.50±97.91	1921.75±1838.47	47.63±20.37	83.75±37.75
Medicinal plants				
0.00 (g/kg diet)	163.00±44.57	2153.33±806.77	54.83±14.11	93.58±25.04
2.50 (g/kg diet)	267.08±373.75	1815.33±1410.19	48.17±14.93	86.50±27.71
SEM[3]	54.231	232.036	2.982	5.324
CV	123.79	61.28	29.03	30.64

Table 12: Continue

P values				
Rice bran (RB)	0.44	0.66	0.67	0.66
Medicinal plant (MP)	0.35	0.50	0.29	0.54
RB × MP	0.34	0.68	0.39	0.53

[1]Means ± SD, [2] Cholesterol, Triglycerides, High density lipoprotein, Low density lipoprotein, [3]SEM= Standard error of means

Table 13: Effect of dietary inclusion of rice bran (0, 100 and 200 g/kg) and medicinal plant (0 and 2.5 g/kg) on feces pH in laying hens (on day 56 of the experiment).

Label	Feces pH[1]
Treatments	
Rice bran	
0.0 (g/kg diet)	7.87±0.72
100 (g/kg diet)	7.62±0.80
200 (g/kg diet)	8.01±0.58
Medicinal plant	
0.00 (g/kg diet)	7.67±0.69
2.50 (g/kg diet)	7.99±0.69
SEM[2]	0.142
CV	9.38
P values	
Rice bran (RB)	0.56
Medicinal plant (MP)	0.31
RB × MP	0.88

[1]Means ± SD, [2]SEM= Standard error of means

Discussion

Ersin Samli *et al.* [3] reported that inclusion RB more than 10% in laying hens diets has adverse effects on productive performance and egg quality. Nobakht [11] shown that dietary RB inclusion (10%) increased FCR in layers; however, no significant difference was seen between hens fed the RB 5 and 7.5% inclusion and hens fed the control diet in terms of FCR and EP. In this experiment, EM increased and decreased in hens fed diets included 7.5 and 10 % RB, respectively. In addition, no significant effect of dietary RB inclusion was found on plasma cholesterol and egg quality traits [11]. Rezaei [12] who included 0, 5, 10, 15, 20 and 25% RB in the laying hen diets observed no significant effect of dietary treatment on birds' performance in terms of FI and FCR.

Chowdhury *et al.,* [2] who evaluated effects of dietary inclusion of rice polish (14, 15, 16 and 20%) and garlic paste (0, 2, 4, 6, 8 and 10%) on laying hens performance, reported no significant effects of dietary treatment on EP, FI and FCR; however, average concentrations of serum cholesterol were reduced by 15, 28, 33, and 43% in hens fed diets included 2, 4, 6, or 8% garlic paste, respectively. Ersin Samli *et al.* [3] reported that inclusion 15% of RB in laying hens' diets reduce EM and improve Haugh unit. Dietary supplementation of garlic powder (2%) provided from fresh garlic in broilers significantly decreased serum content of total cholesterol and total triglyceride [5].

In conclusion, RB can be included in diets of laying hens up to 20% with no adverse effect on productive performance. In terms of egg quality characteristics, egg shell quality might be improperly affected by dietary RB inclusion. In the present study, adding ground mixture of dried garlic and thyme did not have beneficial effects on hens' performance and egg quality.

References

1. Alder, A.J. and B.J. Holub, 1997. Effect of garlic and fish-oil supplementation on serum lipid and lipoprotein concentrations in hypercholesterolemic men. Am. J. Clin. Nutr., 65: 445-450. http://www.ajcn.org/cgi/content/abstract/65/2/445.
2. Chowdhury, S.R., S.D. Chowdhury and T.K. Smith, 2002. Effects of dietary garlic on cholesterol metabolism in laying hens. Poult. Sci., 81: 1856-1862. PMID 12512577.
3. Ersin Samli, H., N. Senkoylu, H. Akyurek, A. Agma, 2006. Using rice bran in laying hen diets Journal of Central European Agriculture, 7(1): 137-140. http://www.agr.hr/jcea/issues/jcea7-1/pdf/jcea71-18.pdf.
4. Ghasemi, R., M. Zarei and M. Torki, 2010. Adding dedicinal herbs including garlic (*Allium sativum*) and thyme (*Thymus vulgaris*) to diet of laying hens and evaluating productive performance and egg quality characteristics, Am. J. Anim. Vet. Sci., 5(2): 151-154.
5. Habibian Dehkordi., S.A. Zamani Moghadam, N. Maghsoudi, E. Aali, R. Gerami and E. Dehsadeghi, 2010. The effects of fresh garlic on the serum concentration of total cholesterol, total triglyceride and adipose tissues of broilers. Comp. Clin. Pathol., 19: 363-365. DOI 10.1007/s00580-009-0879-7.
6. Khan, S.H., S. Hasan, R. Sardar and M.A. Anjum, 2008. Effects of dietary garlic powder on cholesterol concentration in Native Desi laying hens. Am. J. Food Tech., 3: 207-213. http://scialert.net/qredirect.php?doi=ajft.2008.207.213&linkid=pdf.

7. Mahdavi, R. and M. Torki, 2009. Study on usage period of dietary protected butyric acid on performance, carcass characteristics, serum metabolite levels and humoral immune response of broiler chickens. J. Anim. Vet. Adv., 8(9): 1702-1709. DOI:10.3923/javaa.2009.1702.1709.
8. Matiljan, J., 2008. Foundation, the World's Healthiest Foods. http://www.whfoods.com/genpage.php?tname=foodspice&dbid=77.
9. Mottaghitalab, M. and Z. Taraz, 2002. Effects of garlic (Allium sativum) on egg yolk and blood serum cholesterol in Aryan breed laying hens. Br. Poult. Sci., 43: 42-43. DOI: 10.1080/000716602762388608.
10. Najafi, P. and M. Torki, 2010. Performance, blood metabolite and immunocompetence of broiler chicks fed diets included essential oils of medicinal plants. J. Anim. Vet. Adv., 9: 1164-1168. DOI: 10.3923/javaa.2010.1164.1168.
11. Nobakht, A., 2007. The effects of inclusion dfferent levels of rice bran in laying hens diets on performance and plasma and egg yolk cholesterol contents. J. Anim. Vet. Adv., 6: 1120-1124. DOI 10.3923javaa.2007.1120.1124.
12. Rezaei, M., 2006. Utilization of mixed rice bran in laying hen diets. Pak. J. Biol. Sic., 9: 1420 -1423. DOI 10.3923pjbs.2006.1420.1423.
13. Warshafsky, S., R.S. Kamer and L. Sivak, 1993. Effects of garlic on total serum cholesterol. A metaanalysis. Ann. Intern. Med., 119: 599-605. http://www.annals.org/content/119/7_Part_1/599.full.
14. Windisch, W., K. Schedle, C. Plitzner and A. Kroismayr, 2008. Use of phytogenic products as feed additives for swine and poultry. J. Anim. Sci. 2008. 86(E. Suppl.): E140–E148. DOI:10.2527/jas.2007-0459.
15. Zangiabadi, H.R. and M. Torki, 2010. The effect of a β-mannanase-based enzyme on growth performance and humoral immune response of broiler chickens fed diets containing graded levels of whole dates. Trop. Anim. Health Prod. 42: 1209-1217. DOI: 10.1007/s11250-010-9550-1.