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The Effects of Inclusion Different Levels of Rice Bran in Laying Hens Diets on Performance and Plasma and Egg Yolk Cholesterol Contents

A. Nobakht
Department of Animal Science, Islamic Azad University Branch, Maragheh, Iran

Abstract: This study was designed to evaluate the effects of inclusion different levels of rice bran in laying hens diets on performance and serum and egg yolk cholesterol contents. Two hundred and fifty six Hy-Line strain laying hens, 65-73 weeks of age, were randomly assigned to 4 dietary treatments. The levels of rice bran Inclusion were 0, 5, 7.5 and 10% and fed to laying hens for 8 week. Egg production, feed efficiency and egg mass were significantly affected by inclusion of rice bran in treatments. Whereas egg quality and plasma and egg yolk cholesterol content were not significantly affected ($p<0.05$). It was concluded that rice bran can be used as an alternative feedstuff in laying hens diets, at inclusion levels up to 7.5% without negative effects on performance and egg quality.

Key words: Rice bran, performance, laying hens, egg yolk cholesterol, blood plasma cholesterol

INTRODUCTION

Rice bran is an agricultural by product, Which is produce, in large quantities in northern provinces of Iran (Haghnazar and Rezaei, 2004). Rice bran 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. Rice bran is rich in B-vitamins and its nutrient density and profiles of amino acids, including 74% of unsaturated fatty acids, are superior to cereal grains (Ersin Samli *et al*., 2006). Both rice bran protein and fat are a relatively high biological value (Khan, 2004). The price of rice bran is lower than other energy sources in the diet, thus its use in layer diet decreases the cost of egg production. In most paddy grinding works in Iran, outer layer (rice hull) and inner rice bran are mined, thus the levels of crude fiber of the rice bran is increased. Adding hulls back to bran significantly change its nutrient composition particularly for poultry (Haghnazar and Rezaei, 2004). It was reported that hulls adulteration appears to be the most important constraint to the utilization of rice bran particularly when the hull content is greater than 10% of the rice bran (Tangendjaja and Lowry, 1985).

Yet rice bran's full nutrient potential can not be utilized due to the presence of anti-nutritional factors, particularly endogenous lipase and peroxidase enzymes that rapidly oxidase fats and oils released during milling process (Warren and Farrell, 1990). It was reported that further deterioration through hydrolytic and oxidative rancidity may result in poor livestock acceptability and growth depression particularly in chicks (Gunawan and Tangendjaja, 1988). Among factors limiting the maximum utilization of rice bran in poultry diets is the phytin content (Warren and Farrel, 1991). Phytin not only reduce P availability, but also impairs the utilization of other minerals such as Zn, Fe, Ca and Man (Farrell, 1994; Ravindran *et al*., 1995) and has a negative impaction protein digestibility and energy utilization, probably partly due to inhibition of digestive enzymes, including pepsin and triypsin (Kies *et al*., 2001). It was reported that 50-60% of the oil was affected within 4-6 weeks depending upon storage temperature and humidity demonstrated that 250 ppm of ethoxyquin was effective in reducing rancidity for up to 4 week even when the temperature and humidity were high (Randall *et al*., 1985). Today's, however, knowledge and technological advances have made it possible to tackle these toxicity problems in a better way. A significant development was achieved by application of heat treatment in the alleviation of adverse effects of the toxicities caused by raw rice bran. This method includes acetic acid (1%) treatment plus wet extrusion cooking at 135°C for 10 sec (Khan, 2004).

Gallinger *et al*. (2004) showed that inclusion rice bran more than 20% has adverse effect on broiler performance. Ersin Samli *et al*. (2006) reported that inclusion rice bran more than 10% in laying hens diets has adverse effects on laying performance and egg quality. In contrast Haghnazar and Rezaei (2004) reported that rice bran can be inclusion in laying hens diets up to 25% without any adverse effects on laying performance and egg quality.

In the recent years, people are becoming more and more health conscious and are preferring meat and egg with low cholesterol content. Efforts are being made to reduce the cholesterol content of egg and meat by feeding poultry with fiber rich diets and never feed ingredients with hypocholesterolemic activity. Rice bran is fiber rich feed resource and thought can be act as cholesterol reducing feedstuff in poultry product (McNaughton, 1978).

Talwinder *et al*. (1992) reported that inclusion 43.7% full fat rice bran in hamster diets reduced blood cholesterol diets significantly. Plasma cholesterol reduction were significantly correlated to the level of rice bran in the diet.

Regardless of the source, feeding fiber to laying hens also dilutes the available energy content of a diet and, as a result, may limit energy intake and potentially reduce hepatic cholesterol production, especially if prior energy intake had been excessive (Naber, 1990). This may partially explain the observations of Weiss and Scott (1979) who fed laying hens diets containing 50% wheat bran, oat hulls or alfalfa meal substituted isonitrogenously for part of the corn and soybean meal in the control diet and reported that yolk cholesterol contents were decreased by 19.8% (wheat bran), 16.2% (oat hulls) and 7.8% (alfalfa). Hen-day egg production rates were also greatly reduced in each of the fiber- supplemented groups (by 44.34 and 23%, respectively, from a control value of 84%, suggesting that the hens were severely energy deficient.

The objective of this study was to examine the effects of different levels of unprocessed rice bran on productive performance and blood plasma and egg yolk cholesterol contents.

MATERIALS AND METHODS

Hens and dietary treatments: Two hundred and fifty six, 65 weeks old Hy-Line W36 laying hens obtained from a Company, were used in this study. These 256 hens were divided into 16 groups (each group containing 16 laying hens) in completely random design. Treatments were in a completely randomized design. The rations (Table 1) prepared for different experimental groups (n = 64) are summarized:

Group1: Control diet without inclusion of rice bran
Group2: Basal diet containing 5% of rice bran
Group3: Basal diet containing 7.5% of rice bran
Group4: Basal diet containing 10% of rice bran

Table 1: Composition of laying hen diets (as fed basis[1])

	Rice bran%			
	0	5	7.5	10
Ingredient composition(kg/t)				
Corn grain	300	300	301.3	480.7
Rice bran	0	50	75	100
Soybean meal	195.6	188.2	184.6	201.4
Wheat grain	323.4	294.9	279.1	58.2
Oil Vegetable	40	40	40	40
Oyster shell	91.9	92.3	92.5	92.6
Bone meal	17.7	17.3	17.1	16.9
Salt	3.4	3.4	3.4	3.6
Vitamin premix[2]	2.5	2.5	2.5	2.5
Mineral premix[2]	2.5	2.5	2.5	2.5
DL- Methionine	1.4	1.6	1.7	1.6
Lysine	0.5	0.5	0.5	0
Chemical composition (g kg^{-1})				
Metabolizable energy (kcal kg^{-1})	2817	2817	2817	2817
Crude protein	150	150	150	150
Calcium	41	41	41	41
Avail. Phosphorus	3.4	3.4	3.4	3.4
Sodium	1.8	1.8	1.8	1.8
Lysine	7.4	7.4	7.4	7.4
Methionine	3.5	3.5	3.5	3.5
Tryptophan	2	2	2	2

[1]Dry matter content 900 g kg^{-1}. [3]Premix supplied per kg of diet: 9000 IU vitamin A, 1.78 mg vitamin B_1, 6.6 mg vitamin B_2, 30 mg niacin, 10 mg pantothenic acid, 3 mg vitamin B_6, 0.15 mg biotin, 1500 mg choline, 0.015 mg vitamin B_{12}, 2000 IU vitamin D, 18 IU vitamin E, 2 mg vitamin K_3. [4]Premix supplied per kg of diet: 10 mg Cu, 0.99 mg I, 50 mg Fe, 100 mg Mn. 0.08 mg Se, 100 mg Zn

All diets were in the meal form and based on corn and soybean meal. The diets were formulated to be isonitrogenous (15%) and isocaloric (2817 Kcal kg^{-1}) According the Hy-Line commercial management guide (2006- 2008) as fed basis. All diets have the same level of the amino acids lysine, methionine and tryptophan. During the experimental period, conventional management procedures were employed, natural and artificial light was provided for 16 h per day, ambient temperature was controlled and brides were fed and watered ad *libitum.* The birds were weighted at the commencement (65 week of age) and the end (73 week of age) of the trial.

Egg production (%hen-day) and egg weight (g) were recorded daily. Daily production was determined on a shelled egg weight basis. Feed intake (g/hen/day) was recorded weekly. Feed Conversion Ratio (FCR) was calculated as gram feed consumption per day per hen divided by gram egg mass per day per hen.

At the end of experiment 4 eggs per replicate (16 eggs per treatment) were individually weighted and the egg specific gravity (g mL^{-1}) was also evaluated. Eggshell weight and shell thickness were determined by randomly collecting 4 eggs from each replicate. After the eggs were broken the shells were washed and dried in room temperature for the determination of shell weight. The shell thickness was measured with a micrometer gauge (Measure, 24 21/1 type) on three part of shell from the eqator of each egg. These measurements were pooled.

The shell weigh/area also recorded and shell ash was determined after drying at room temperature for 3 days.

Yolk and blood plasma cholesterol were determined during the last week of the trial. Yolk cholesterol was extracted by the method of Folch *et al*. (1956) as modified by Washburn and Nix (1974) from 2 eggs of each replicate.

Blood samples from the brachial vein of two hens in each replicate, were drawn and centrifuged (3000×g for 15 min) immediately and plasma collected. Plasma and yolk cholesterol was estimated by the colorimetric Libermann-Burchard methods.

Statistical analysis: Data were analyzed by the General Linear models procedure of SAS Institute (1994). Means for treatments showing significant differences in the analysis of variance were compared using Duncan's multiple range tests. All statements of significance are based on the probability level of 0.05.

RESULTS AND DISCUSSION

The results for performance of laying hens are presented in (Table 2 and Fig 1-3). At the end of experiment, final daily feed intake were similar among all treatments. However, egg production, egg mass and feed conversion were higher ($p<0.05$) in treatments continent rice bran. Egg production was reduced from 75.98-71.43% as the rice bran level increased from 0-10%. The groups fed with 5 and 7.5% rice bran did not differ from the control group with egg production respectively at 72.92 and 75%. Egg mass and feed conversion were also significantly ($p>0.05$) affected by inclusion of rice bran in diets. Egg mass increased with inclusion of rice bran up to 7.5% in diets but decreased with inclusion of 10% of rice bran. Egg mass in control group from 47.53 g increased to 48.72 g in group that received 7.5% rice bran but decreased in group with 10% of rice bran. Feed conversion increased with inclusion of rice bran in layer diets from 2.39 in control group to 2.6 in group with inclusion of 10% of rice bran. But there were not any significant difference between groups fed with 5 and 7.5% rice bran with control group. Inclusion 10% of rice bran in layer diets had adverse effect on feed conversion.

The results for egg quality of laying hens are presented in (Table 3). There were not any significant differences ($p<0.05$) in egg quality traits between treatments. Inclusion rice bran up to 10% in diets didn't have any adverse effects on egg quality laying hens diets. The results of blood plasma and egg yolk cholesterol contents are presented in (Table 4). Inclusion of rice bran in laying hens diets did not significantly ($p>0.05$) affected egg Yolk and blood plasma cholesterol.

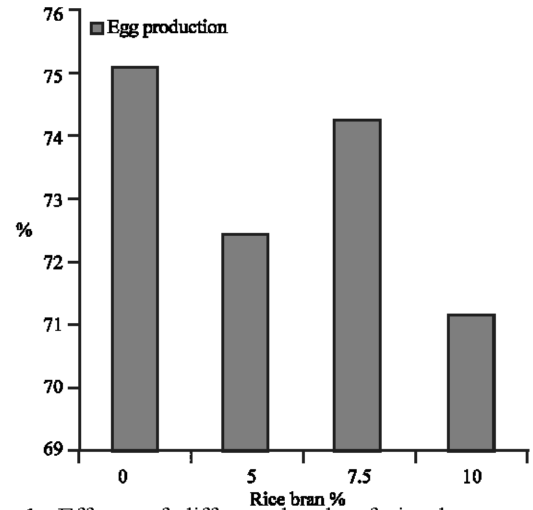

Fig. 1: Effects of different levels of rice bran on Egg production rate

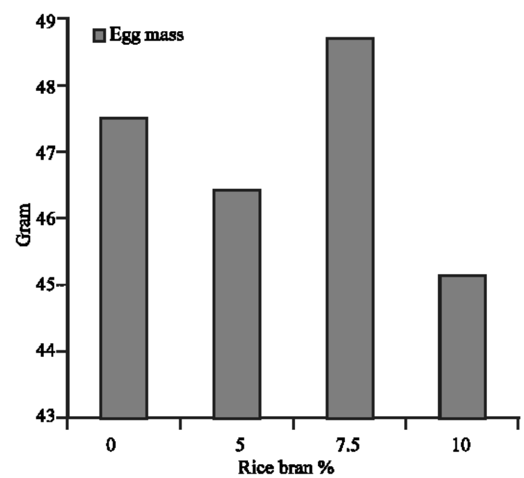

Fig. 2: Effects of different levels of rice bran on egg mass

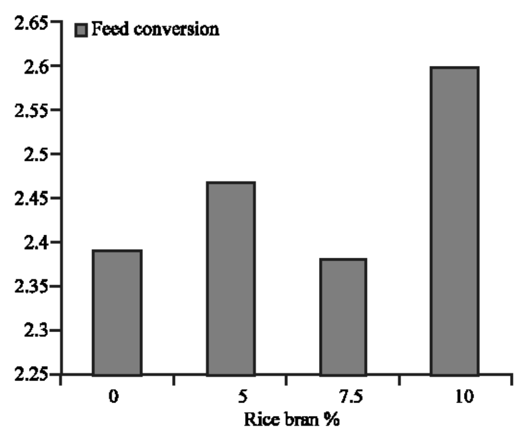

Fig. 3: Effects of different levels of rice bran on feed conversion

Table 2: Effects of different levels of rice bran on laying hens performance

Treatments	Egg production (%)	Feed intake (g/hen/day)	Egg weight (g egg^{-1})	Egg mass (g/hen/day)	FCR (g feed g^{-1} egg)
Rice bran (%)					
0	75.98[a]	113.73[a]	62.62[a]	47.53[ab]	2.39[b]
5	72.92[ab]	113.48[a]	63.67[a]	46.44[ab]	2.47[ab]
7.5	75[ab]	114.19[a]	63.95[a]	48.72[a]	2.38[b]
10	71.43[b]	115.21[a]	63.46[a]	45.14[b]	2.60[a]
Pooled SEM	±1.31	±1.72	±0.43	±0.94	±0.06

[a]Means within each column with different superscripts are significantly different ($p<0.05$)

Table 3: Effects of different levels of rice bran on eggshell quality

Treatments	Specific gravity (mg cm^{-2})	Eggshell weight (g)	Eggshell thickness (mm)	Haugh unit	Shell weight/surface area (mg cm^{-2})
Rice bran (%)					
0	1.075[a]	6.34[a]	0.316[a]	79.16[a]	83.5[a]
5	1.080[a]	6.1[a]	0.308[a]	77.80[a]	80.13[a]
7.5	1.074[a]	6.36[a]	0.317[a]	78.78[a]	83.25[a]
10	1.083[a]	6.43[a]	0.321[a]	79.68[a]	85.50[a]
Pooled SEM	±0.0038	±0.129	±0.0043	±2.033	±1.63

Means within each column with same superscripts are significantly different ($p<0.05$)

Table 4: Effects of different levels of rice bran on blood plasma and egg yolk cholesterol

Treatments	Egg yolk cholesterol (mg gr^{-1} yolk)	Plasma cholesterol (mg dl^{-1})
Rice bran (%)		
0	12.81[a]	106[a]
5	12.60[a]	122[a]
7.5	9.80[a]	127[a]
10	9.28	100[a]
Pooled SEM	±1.68	±15

Means within each column with same superscripts are not significantly different ($p>0.05$)

There were not any significant difference in Egg production rate with inclusion the rice bran levels up to 7.5 % in laying hens diets but inclusion more than 7.5% of rice bran significantly reduced the egg production. Decrease in egg production rate with inclusion 10% of rice bran in laying diets can be explained by increased fiber levels in diets. Ersin Samli *et al.* (2006) reported that the fiber level in laying hens diets increased to 4.29% by inclusion 15% of rice bran. Also Haghnazar and Rezaei (2004) reported that in most paddy grinding works in Iran, outer layer (rice hull) and inner rice bran are mined, thus the levels of crude fiber of the rice bran is increased and adding hulls back to rice bran can significantly change its nutrient composition particularly for poultry. Egg mass increased significantly with inclusion rice bran in laying hens diets up to 7.5% but decreased when the level of rice bran in diets increased to 10%. With increasing rice bran in the diet, the amount of Linoleic acid in diets increased and this may have caused the elevation in egg weight. There is strong correlation between egg production rate, egg weight and egg mass. High level of fiber that obtained with inclusion of 10% rice bran in diets affected egg mass in this experiment. Whereas Ersin Samli *et al.* (2006), reported that inclusion 15% of rice bran in laying hens diets can reduce significantly egg mass. Adding 10% of rice bran in laying hens diets had adverse effect on feed conversion and increased it. Whereas Ersin Samli *et al.* (2006), with inclusion 15% and Haghnazar and Rezaei (2004) with inclusion 25% of rice bran did not observe any adverse effect in feed conversion. Feed conversion can be affected by egg production rate and amount of feed intake. By inclusion 10% of rice bran in laying hens diets egg production rate decreased whereas feed intake amount increased. In this experiment Egg quality did not affected significantly by inclusion different levels of rice bran in laying hens diets. Our finding agreement with and Hagnazar and Rezaei (2004) research results that there were not observed any significant difference in egg quality with inclusion up to 25% of rice bran in laying hens diets. In contrast Ersin Samli *et al.* (2006), reported that inclusion rice bran up to 15% in laying hens diets can improve Haugh unit.

In this experiment plasma total cholesterol and yolk cholesterol contents not affected significantly by inclusion different levels of rice bran in layer diets. However plasma cholesterol and yolk cholesterol decreased. Meng *et al.* (1974) found that increasing the dietary fiber level from 4.1-17.7% with cellulose caused a reduction in serum cholesterol and an increase in egg yolk cholesterol. Rice bran contained high fiber this might have affected the absorption of cholesterol. Mouundras *et al.* (1997) reported that the plasma cholesterol lowering effect of crude fiber may be due to its ability to enhance fecal excretion of cholesterol and bile acids. Burr *et al.* (1985) reported a negative correlation between dietary fiber content and serum cholesterol. In this experiment yolk and plasma cholesterol decreased 27.56 and 5.66% by inclusion 10% of rice bran in laying hens diets. For significantly decreasing of plasma and yolk cholesterol contents may be needed inclusions high levels of rice bran for enhancing fiber level in laying hens diets and

More researches should be done in this respect with consideration that high levels of fiber have adverse effects on laying hens performance.

CONCLUSION

Overall results of the present experiment indicated that rice bran could be included in diets of laying hens from 65-73 weeks of age up to 7.5% without any adverse affect on laying performance and egg quality. Also inclusion rice bran in laying hens diets has beneficial effects in lowering blood plasma and egg yolk cholesterol but there are not affected significantly by inclusion of rice bran up to 10% in this experiment.

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