Effect of Sorghum Tannin on Egg Quality and Quantity of Laying Hen

Ebadi, M. R.,[2] J. Pourreza[3], S. Esmaeilkhanian[1] , A. A. Gharadaghi[4]*
[1]Department of Animal Science, Isfahan Research Center of Agriculture and Natural Resources, Isfahan, IRAN, P.O.BOX 81785-199 , E-mail: ebadi@icrasn.com
[2] Department of Animal Science, Faculty of Agriculture, Isfahan University of Technology, Isfahan, IRAN
[3] Animal Science Research Institute, Karaj, Tehran, IRAN

Abstract
In order to assessment of three grain sorghum varieties (GSV) containing low, medium and high tannin (LTS, MTS and HTS, respectively) on egg quantity and quality in laying hens 375 Single Comb White Leghorn hens were divided to 75 triple groups. Three GSVs were substituted for corn in a control diet in levels of 0, 25.50,75 and 100 percent. Effects of experimental diets were studied for 12 weeks. Results showed that substitution of GSV for corn increased egg production ($P > 0.05$) and egg weight ($P < 0.05$). Variety and level of substitution had no significant effect on albumen quality. Also, when tannin intake increased albumen weight\egg weight ratio decreased significantly ($P < 0.05$). Effect of variety was significant on yolk weight and shell quality ($P < 0.05$). Tannin intake had a positive correlation with yolk mottling ($r = 0.14$, $P < 0.05$) and a negative correlation with shell thickness ($r = - 0.14$, $P < 0.05$). Linear and quadratic effects of tannin intake were significant on most of the traits. Regression coefficient showed that if tannin intake was less than 1.7% had no any negative effect on laying hen performance. .

Key Words: Grain Sorghum, Tannin, Laying hen, Egg quality

Introduction
Increasing production costs and narrowing profit margins encourage attempts to formulate least-cost diets. The lower price has made Grain Sorghum (GS) preferable to corn as a source of grain for poultry diets in Iran.
The toxicity of dietary tannins and tannic acid for chicks was demonstrated by investigators(Gualtieri & Rappaccni 1990, Elkin et al, 1996, and Nyachoti,1997).The toxicity of tannic acid in laying hens was demonstrated by Potter et al.(1967). Tannic acid at the level of 2% in the diet of laying hens caused a marked decrease in the incidence of egg yolk mottling and yolk discoloration. Fry et al. (1972) observed yolk mottling in eggs from hens fed tannic acid as 2% and 4% of the diet, but feeding HTS as 40% of the diet didn't influence yolk mottling.
Initial study on Iranian GSs (Ebadi et al., 1998) has shown that the range of metabolizable energy (AMEn) varied from 2750 to 3540 Kcal\Kg for low tannin sorghum (LTS) and high tannin sorghum (HTS). Also the protein content was reported to vary from 9.5 to 14, ADF from 3 to 18, ether extract from 1.5 to 4.5, and tannin from 0.02 to 1 percent.
Since the tannin content in Iranian GSs is not too high, the objective of this study was to test the influence of corn substitution with GS on egg production and egg quality in laying hens.

Materials and Methods

Three varieties of GSs with different tannin content (LTS 0.14%, MTS 0.24% and HTS 0.37% tannin) at five levels (0, 25, 50, 75 and 100 percent) was substituted for corn in the control diet. The diets were iso-caloric and iso-nitrogenous (NRC, 1994).Three hundred-seventy five Single Comb White Leghorn hens in their fifth week of production were placed in wire cages with 3 birds for each cages. Experimental diets fed for twelve weeks. Feed consumption, egg production, egg weight and feed conversion ratio were determined weekly. For egg quality assessment, eggs were collected on three days of 4th, 8th and 12th weeks, and 3 eggs close to average of each replication selected for quality analyzing. Measurements were made on egg shell, albumen and yolk quality. Tannin in GSs was determined by Folin –Denis method (AOAC, 1990).

All data were analyzed by analysis of variance (SAS Institute, 1993) and the multiple range test of Duncan (Snedecore, and Cochran, 1980) was used to evaluate treatment means.

Results and Discussion

The results showed that diets containing GS were higher in egg production and egg weight than control diet (Corn as a main grain), although the differences were not significant for HTS (table 1). Previous studies (Sell et al. 1983, 1984) have shown that energy intake is one of the most important factors on egg production, while protein intake has significant effect on egg production when energy intake is limited. So higher egg production for diets containing GS maybe for more energy intake, because of higher feed consumption (Ebadi et al., 2000). This result was disagree with the previous studies (Sell et al. 1983 and Gualtirir & Rappaccini, 1990 Gualtieri & Rappaccini, 1990) that showed replacement of corn with GS decrease egg production. It can be related to variability found in the chemical composition of the various cultivars and diverse methods used to evaluate their tannin and metabolizable energy contents (Gualtieri & Rappaccini, 1990 and Ebadi et al., 1999). Sorghum cultivar had no significant effect on Haugh unit but albumen weight and albumen weight\egg weight ratio were different significantly ($P < 0.05$) for different GS varieties and different levels of substitution. Variety had significant effect ($P < 0.05$) on yolk weight. The highest and the lowest yolk weight belonged to HTS and MTS respectively. Correlation between yolk mottling and tannin intake was positive and significant ($r = 0.14$, $P < 0.05$). All egg shell quality traits were affected by GS varieties.The highest and the lowest egg shell weight belonged to MTS and corn, respectively. Sell et al.,(1983,1984) showed that tannin reduce egg shell thickness and specific gravity. They demonstrated that level of protein and methionine can affect on egg shell quality. Since tannin decrease protein, amino acids and some minerals availability, so cation-anion balance of blood will change and HCo3 availability and shell thickness will reduce. These results showed that substation of corn with different GS had no any negative effect on laying performance, except reduction for egg shell quality when inclusion rate of sorghum is high. For overcome to this problem supplementation of diet containing sorghum with synthetic amino acids, fats and some minerals suggest.

Particularly in areas where maize yield are unsatisfactory, it can be concluded that the widespread cultivation of low tannin sorghum would be desirable.

References

AOAC. (1990) 0fficial Methods of Analysis. Association of Analytical Chemists. Washington, D.C.

Ebadi, M. R., (2000). Substitution of three varieties of grian sorghum for corn in laying hens nutrition. Final report of research plant. Ministry of agriculture

Ebadi, M. R., Pourreza, J., Khorvash, M. Nazeradl, K., Almodarres, A.(1998) Nutrient composition and metabolizable energy of 36 grain sorghum varieties and two types of corn. Journal of Agricultural Science and Natural Resources 1: 67-76

Elkin, R. G., Freed, M. B., Hammarer, B. R., Zhang, Y., and Parsons, C. M. (1996) Condenced tannins are only partially responsible for the variation in nutrient digestibility of sorghum grain cultivars. Journal of Agriculture and Food Chemistry, 44: 848-853

Gualtieri, M., and Rapaccini, S. (1990). Sorghum grain in poultry feeding. World's Poultry Science Journal 46: 246-254

Fry, J. L., Herric, G. M., Pine, G. M. and Harms, R. H. (1972) Effect of bird resistant sorghums and tannic acid on yolk mottling. Poultry Science 51: 1540-1543

Nyachoti, C. M., Atkinson, J. L., and Leeson, S. (1997) Sorghum tannins: a review. World's Poultry Science Journal 53: 5-21

Potter, D. K., Fuller, H. L., and Blackshear, C. D. (1967) Effcet of tannic acid on egg production and egg egg yolk mottling. Poultry Science 46: 1508-1512

SAS, Institute. 1993. SAS User's Guide : Statistics, SAS institute, Inc., Cary, NC

Sell, D. R. and Rogler, J. C. (1984) The effect of sorghum tannin and methionine level on the performance of laying hens maintained in two temperature environment. Poultry Science 63: 109-116 Sell, D. R., Rogler, J. C. and Featherston, W. R. (1983) The effect of sorghum tannin and protein level on the performance of laying hens maintained in two temperature environment. . Poultry Science 62: 2420-2428

Snedecore, G. W., and. Cochran, P. W. L.(1980) Statistical Methods. 7th ed. Iowa State Uni. Press. Iowa, USA.

Table 1 Effects of grain sorghum varieties and level of substitution on egg quantity and quality traits of laying hens

	Level of substitution					Grain					
	Corn	LTS	MTS	HTS	SEM	0	25	50	75	100	SEM
Feed Intake (g)	99.2a	105.8b	102.4a	110.7c	0.8	99.2a	102.9a	105.1b	105.8b	111.5c	0.9
Egg production (%)	82.5	84.7	82.7	85.9	0.8	82.5 *a*	82.3*c*	85.9*ab*	82.8 *bc*	86.6a	0.9
Egg weight (g)	54.3*b*	54.9*a*	54.3*b*	55.1*a*	0.2	54.3*a*	55.1*ab*	54.5*b*	55.3*a*	54.4*b*	0.2
Albumen weight (g)	36.5*ab*	36.4*ab*	35.8*b*	36.8*a*	0.2	36.5	36.6	36.0	36.6	36.1	0.3
Albumen weight \ Egg weight (%)	65.8*a*	64.9*bc*	64.9*c*	65.0*b*	0.1	65.8*b*	65.0*ab*	64.7*a*	65.1*b*	64.9*ab*	0.1
Haugh unit	95.9	96.2	96.9	95.7	0.6	95.9	96.6	95.4	97.1	96.0	0.8
Yolk weight (g)	14.3*ab*	14.3*ab*	13.9*b*	14.4*a*	0.1	14.3*a*	14.3*a*	14.1*b*	14.2*b*	14.2*b*	0.1
Yolk weight\ Egg weight (%)	25.6*a*	25.4*a*	25.2*b*	25.4*a*	0.1	25.6*a*	25.5*ab*	25.4*ab*	25.2*b*	25.5*a*	0.2
Yolk index	0.44*ab*	0.44*ab*	0.44*b*	0.45*a*	0.26	0.44*ab*	0.45*a*	0.43*b*	0.44a*b*	0.44*ab*	0.3
Shell weight (g)	5.28*d*	5.39*c*	5.41*a*	5.40*b*	0.04	5.28*b*	5.44*ab*	5.43*ab*	5.45*a*	5.30*b*	0.05
Shell weight\ Egg weight (%)	9.5*b*	9.6*b*	9.8*a*	9.5*b*	0.09	9.5*b*	9.7*ab*	9.8*a*	9.7*a*	9.5*b*	0.1
Shell strength (Kg\Cm2)	2.60*a*	2.57*ab*	2.58*a*	2.46*b*	0.06	2.6	2.52	2.58	2.54	2.50	0.07
Shell thickness (mm)	0.403*a*	0.387*a*	0.386*ab*	0.384*b*	0.003	0.403*a*	0.388*ab*	0.388*ab*	0.385*b*	0.382*b*	0.003

a-d Mean in a row without common superscript are significantly different ($P<0.05$).