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Replacing Corn with Wheat Screening and Triticale by Xylanase Enzyme Supplementation in Layers Pullets Diet

Research Article

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ABSTRACT

The present study was conducted to evaluate the effects of corn replacement with triticale and wheat screening and supplemented with Xylanase enzymes in 144 W-36 Hay lines. Treatments were arranged from 15 to 25 weeks of age. With 6 treatments 4 replicates and 6 pullets in each. Results of the experiment have shown the highest body weight gain by treatment 5 (wheat screening without enzymes) (P=0.99), Significant decreased were observed in feed intake by treatments 5 during 6 weeks of growth period. In terms of egg quality, the results have showed the significant effect on yolk color by replacing treatments (P<0.05). In other hand result have indicated that there were no significant differences in body mass index between treatments. At the end of the study, blood samples were collected in the test tubes to determine cholesterol. A higher concentration of low density lipoprotein (LDL) was observed by experimental treatments in comparison to control. As well as treatments 3 and 4 were shown the highest concentration of low density serum lipoprotein (LDL) (P<0.05). No significant differences were found in serum triglyceride concentration by experimental and control treatments. At the end of the experiment, no significant differences were indicated in egg cholesterol and intestinal viscosity (P>0.05). The results of this study have shown no adverse effect on performance and health status by up to 30% wheat screening and triticale in pullet diet.

KEY WORDS enzyme, pullet, triticale, wheat screening.

INTRODUCTION

Feeding cost is the major part of the poultry industry which is more priority than other factors and this could affect the poultry production status. Corn in high metabolism energy and digestion facility are known as the suitable and the best source of energy in poultry industry. In contrast corn with high price is known as a major problem in poultry industry need to be consideration. In concerned to these reason feed sources are necessary as a solution in reducing price of production. In the other hand, there are many problems by using various nutritional content such as non-starch polysaccharides (NSP). In such a situation, with the availability and cheaper of other grain such as barley, wheat and their by-products like wheat screening could be replace with some part of the corn in the poultry diet. As well as other grain such as triticale, residual rice grain and rye are also may be partially alternative in poultry nutrition (Lázaro *et al*. 2003; Ebrahimi *et al*. 2017; Zhang *et al*. 2021). Due to the lower performance of poultry fed by wheat and triticale based diets, with their anti-nutritional compounds such as non-starch polysaccharides (NSP). The oral enzymes have been suggested to reduce the anti-nutritional effects and improve the nutritional value in the diet (Dumitrescu *et al*. 2011).

Carbohydrates enzymes are used to eliminate the anti-nutritional effects on feed such as barley, wheat, oat and triticale in the poultry diet. It has been reported that the addition of xylanase-containing enzyme supplements in the diet of broiler chickens could decomposition the arabinoxylans into low-molecular-weight compounds. This may reduce the viscosity of the intestinal contents and improve digestion and absorption. Also, Annison (1993) has noted that ideal digestibility of starch and apparent metabolizable energy in wheat-based diets containing high NSP has increased with the addition of enzymatic xylanase and beta-glucoses enzyme. Also, Ciftci *et al.* (2003) and McGoverin *et al.* (2011) have investigated the effect of different grain on egg production and liver fat content of laying hens. The wheat and triticale varieties in terms of egg production, egg weight and body weight of layer had a value equal to corn. Improved egg yolk color and reduced the viscosity of the small intestine were found by supplementation of the xylanase enzyme in the laying hens diet. Performance, physiological status, apparent digestibility of nutrients, blood parameters, laying hens yield, eggs quality have restrict condition by triticale as well as in viscosity status. Therefore, the aim of this study was to investigate the effect of corn replacement with wheat screening and triticale by xylanase enzyme- supplemented, in plasma and egg cholesterol as well as layer pullet performance (Ciftci *et al.* 2003; McGoverin *et al.* 2011).

MATERIALS AND METHODS

In this experiment, 144 W-36 Hay lines from 15 to 25 weeks old for 10 weeks were arranged into 6 treatments, 4 replicates and 6 pullets in each. Treatments includes control (corn and soy bean meal) with and without enzyme as 1 and 2 treatments. Treatments 3 and 4 includes control plus 30% wheat screening with and without enzyme. Treatments 5 and 6 includes 30% triticale with and without enzyme. The 40 cages, by 40 × 40 × 40 cm characters (length, width and height) and the light programmer was modulated in 16 hours at the peak of production.

Experimental treatments

The experiment treatments were arranged in growing, pre-laying and laying stages. In formulate the diet, first, the amount of dry matter, crude protein, crude fiber, crude fat and ash in the dietary were analysis in laboratory by formal association methods (1990). The experimental diets were formulated based on the recommendations W-36 Hay-line laying hens (2015). In this experiment, the pure xylanase enzyme (WX Ribozyme) was used. Experimental diets were provided in laying hens for 8 weeks from 17 to 25 weeks. Experimental diets composition of the laying period and the chemical analysis are presented in Table 1.

Layers performance

In this study, performance of laying hens such as body weight gain, feed intake, feed conversion ratio, growth uniformity, body mass index, leg length and metatarsus bone length were measured.

During the experiment period, birds were access to water and feed. The first two weeks of the experiment (from 15 to 17 weeks) were considered as an adaptation period (Harms *et al.* 2000).

Every two weeks, all information related to feed intake, body weight gain, and feed conversion ratio were recorded. Weight loss was performed in two weeks to obtain uniformity of growth and growth curve. The egg production and egg weight (at the end of the period) were measured for each laying period. Leg length and metatarsus bone length, were measured at the beginning and the end of the period, by random selected and using a digital caliper.

Viscosity was measured by acetyl viscometer at the 25 weeks of age. To calculate the body mass index (BMI), the body length and body weight in the early and late periods by following formula (Mendes *et al.* 2007).

$$\text{BMI}= (\text{Body weight (g)}/\text{Body length (cm)}^2) \times 100$$

Egg characteristics

In onset of lay (25 weeks), three eggs were randomly selected in each replicate. In the first stage, egg weight, length and width also the white high, diameter, yolk color, and egg shell weight after drying in the oven were determined by Narushin and Romanov (2002) methods. In the second stage, characteristics such as shape index, yolk index, shell ratio and Haugh unit (Hu) were calculated by following formulas:

Egg shape index= egg width / length
Yolk index= yolk height / yolk diameter
Shell ratio= shell weight / egg weight
$\text{Hu}= 100\text{Log} (\text{white height} + 7.75 -1.7\ \text{egg weight})^{0.37}$

Blood parameters

In the serum biochemical parameters, blood samples were collected from the chicken's vein at the end of the period in each replicate.

Samples were separated by a centrifuge in 3500 rpm for 20 minutes and kept at -20 °C until the test was carried out. Then, four parameters of serum, including cholesterol, triglyceride, high density lipoprotein (HDL) and low density lipoprotein (LDL) were measured by Pars Tests Manufacturing Kit. Experimental treatments were arranged by SAS produce version 9.4 (SAS, 2013).

Table 1 Ingredient, experimental treatments and chemical analysis of diets (%)

Food ingredient	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Corn	57.74	57.59	39.36	39.21	35.42	35.27
Soybean meal	27.41	27.41	27.61	27.61	28.69	28.69
Triticale	-	-	17.5	17.5	-	-
Wheat screening	-	-	-	-	17.5	17.5
Soybean oil	1.88	1.88	2.57	2.57	5.72	5.72
Di-calcium phosphate	2.16	2.16	2.15	2.15	1.93	1.93
Oyster powder	9.75	9.75	9.75	9.75	9.72	9.72
Salt	0.38	0.38	0.4	0.4	0.34	0.34
Mineral supplement[1]	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin supplement[2]	0.25	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.18	0.18	0.16	0.16	0.18	0.18
Lysine	-	-	-	-	-	-
Xylanase enzyme	-	0.015	-	0.015	-	0.015
Total	100	100	100	100	100	100
Price (Rails)	14000	14000	13350.1	13350.1	13800.3	13800.3
Chemical analysis						
Metabolizable energy (kcal/kg)	2955	2955	2955	2955	2955	2955
Crude protein	16.20	16.20	16.33	16.33	16.50	16.50
Crude fiber	3.15	3.15	3.34	3.34	4.21	4.21
calcium	4.15	4.15	4.15	4.15	4.15	4.15
Available phosphorus	0.49	0.49	0.49	0.49	0.49	0.49
Sodium	0.18	0.18	0.18	0.18	0.18	0.18
Chlorine	0.26	0.26	0.26	0.26	0.23	0.23
Lysine	0.87	0.87	0.83	0.83	0.85	0.85
Methionine	0.42	0.42	0.42	0.42	0.42	0.42
Methionine + cysteine	0.76	0.76	0.76	0.76	0.76	0.76
Threonine	0.66	0.66	0.66	0.66	0.66	0.66
Tryptophan	0.20	0.20	0.20	0.20	0.20	0.20
Isoleucine	0.68	0.68	0.68	0.68	0.68	0.68
Valine	0.78	0.78	0.78	0.78	0.78	0.78

[1, 2] Each kilogram of mineral supplement containing: Manganese (oxide): 64 g; Zinc (oxide): 44 g; Iron (sulfate): 100 g; Copper (sulfate): 16 g; iPod (Calcium iodate): 64%; Cobalt: 0.2 g and Selenium (1%): 8 g. Each kilogram of vitamin supplemented contains: vitamin A: 7.2 g; vitamin D: 7 g; vitamin E: 14.4 g; vitamin K3: 1.6 g; Thiamine: 72.0 g; Riboflavin: 3.2 g; Pantothenic acid: 12 g; Niacin: 12.160 g; Pyridoxine: 6.2 mL; Coalmine: 0.6 g; Biotin: 0.2 g; Choline chloride: 440 mL.

RESULTS AND DISCUSSION

The results of this study have shown that wheat screening replacement by corn had the highest weight gain in comparison to control during the period of 17 to 21 weeks (Table 2). In contrast the replacement of other cereals with corn did not have a significant effect on feed intake, feed conversion ratio and growth uniformity in this respect (P>0.05). Also, in the period of 21-25 weeks no significant effect was observed on average egg weight, feed intake and feed conversion ratio by the replacement of corn with wheat screening and triticale supplemented with xylanase enzymes (P>0.05). A significant decreased has found on feed intake by enzyme supplementation (P<0.05), but other characteristics were not affected by enzyme from 17 to 21 weeks of age (P>0.05). The results of the performance traits during the growth period (17 to 21 weeks) have shown that treatment 5 (wheat screening without enzymes) was the highest in weight gain in comparison to other treatments (P=0.9999). In contrast the lowest feed intake was observed in treatment 6 (wheat screening with enzyme) compared with other treatments (P<0.05). However, no significant differences were observed in feed conversion and growth uniformity in this case (P>0.05). Feed intake decreased significantly by wheat screening (without enzymes) compared with other treatments in 17-21 weeks of age (P<0.05). The highest egg production and egg mass showed by treatment 5 (wheat screening without enzyme) in the 21 to 25 weeks of age compared with control (P<0.05). No significant differences were found on body mass index

(BMI), leg length and length of metatarsus bone by replacement of cereals with corn in this respect as well as by enzyme reaction (P>0.05) (Table 3). Egg production decreased by triticale but increased by others treatments in compared to control (P<0.05).

There were no significant differences on Haugh unit, yolk index, shape index, shell thickness and shell ratio by treatments (P>0.05). In contrast yolk color significantly decreased by replacement 30% triticale and wheat screening by corn (Table 5).

The results have indicated that the level of blood cholesterol was not significantly affected by the substitution of grains (Table 6). But replacement of corn with wheat screening and triticale significantly decreased HDL concentration in compared with control (P<0.05).

Low-density lipoprotein (LDL) and triglyceride were not significantly different between various levels of replacement diet (P>0.05). Blood parameters no affected by diet supplemented with enzyme (P>0.05). Otherwise, there was no significant differences between serum cholesterol levels in treatments (P>0.05).

Triticale and, wheat screening (without and with enzyme) caused a significantly decreased high serum lipoprotein (HDL) concentrations compared with control treatment (P<0.05). Increased the serum concentration of low density lipoprotein (LDL) was observed by experimental treatments in comparison to control treatment. In other hand the highest serum concentration of low density lipoprotein (LDL) was observed by triticale treatment with the enzyme (P<0.05). In contrast a significant decreased in serum triglyceride concentration was shown by experimental treatments in comparison to control treatment (P<0.005).

No significant effected were found in egg yolk cholesterol by replacement corn with wheat screening and triticale with enzyme supplemented table (6). In addition, no response was indicated in intestinal status by treatments (Table 7).

The results have shown that weight gain in treatment 30% of wheat screening was highest in comparison to control at the growth period (15 to 21 weeks). Various results in this respect could be due to different levels and types of wheat or wheat grain yield, grain quality, base diet type, age of bird, different environmental conditions and varieties of wheat grain (Wu and Ravindran, 2004).

No significant differences were found in body weight gain, feed intake and feed conversion ratio at 28, 35, 42 and 46 days of age in broiler chickens by different levels (0, 10, 20 and 30%) of wheat screening (Saki and Alipana, 2005). Contrary to the results of the present study, Ciftci *et al.* (2003) have reported that the addition of triticale to diets of laying hens decreased feed consumption compared with wheat, which may be related to raw fiber in triticale and better bluked diet. Martín *et al.* (1996) have noted that less feed intake in the diet based on triticale is due to the pentose in the triticale. Lack of enzymes production in poultry is the limitations agent for fiber digestion in gastrointestinal tract Classen (1996). Anti-nutritional effects of soluble non-starch polysaccharides are applied through several mechanisms, which include increasing the viscosity of the small intestine. Therefore, reducing the digestibility of nutrients and ultimately leads to reeducation poultry production (Choc and Anniston, 1993).

A higher feed intake, and no response were observed in, body weight and laying status in White Leghorn hens, by fed corn-based diets in comparison to wheat based diets (Kim *et al.* 1976).

In contrast, no discriminated were found between the production of Hay-line and brown Lehman by replacing 50% wheat with corn. No similarly affected, was shown on performance by high levels of wheat in the Lehman diet from 22 to 61 weeks of age (Lázaro *et al.* 2003; Liebert *et al.* 2005; Safaa *et al.* 2009).

Contrary to the results of this study, increased egg formation, egg mass and improved feed conversion ratio were noted by xylanase enzyme in diet (Mirzaee *et al.* 2014). It has also need to be highlighted that increasing feed intake and improving nutrients digestibility by using enzymes could lead to improve the poultry performance (Lázaro *et al.* 2003).

In fact, supplementation of the diet containing polysaccharide with xylanase enzyme may lead to reducing ileum viscosity, improves of feed intake and nutrients digestibility. Mature birds may be able to reduce the negative effects of viscosity on feed intake, but digestibility of nutrients is influenced by viscosity, which is consistent with the results of Mathlouthi *et al.* (2002) and Gracia *et al.* (2003); Lázaro *et al.* (2003); Mateos *et al.* (2012).

In contrast Mirzaee *et al.* (2014) have monitored that increased egg mass at the peak of production by addition of Xylanase enzymes in the diet. Scott *et al.* (2001) have suggested that the beneficial effects of the enzyme are often observed at the peak of production, because the nutrients requirement for laying hens at this stage is high to maintain a higher laying rate. Stapleton *et al.* (1980) have highlighted that wheat screening can be used without adverse effects on the growth or yield, the results of this study are not consistent with the results of Choct and Aniston (1992); Hetland *et al.* (2002); Gao *et al.* (2008) and Lavinia *et al.* (2010) where they have shown significantly reduced feed intake by increase wheat in the diet.

Sarica *et al.* (2009) no found any significant differences between experimental treatments by adding enzymes in wheat-based diet of quails from 0 to 35 days.

Table 2 Effect of corn replacement with triticale and wheat screening supplemented by xylanase enzymes on performance in growth period (17 to 21 weeks)

Treatment	WG (g/period)	FI (g/day)	FCR (g /g)	GU
Control	7.19[b]	53.74[ab]	9.382[ab]	92.18
Triticale (30%)	8.49[ab]	55.25[a]	9.807[a]	90.99
Wheat screening (30%)	8.65[a]	52.28[b]	7. 470[b]	91.57
SEM	0.46	0.54	0.78	0.52
Enzyme				
No enzymes	8.54	54.54[a]	8.149	91.50
With enzyme	7.68	52.98[b]	9.623	91.66
SEM	0.37	0.44	0.64	0.43
Treatments				
1 (Control without enzyme)	7.36[ab]	53.96[a]	8.606	91.40
2 (Control with enzyme)	7.03[b]	53.53[a]	10.158	92.96
3 (Triticale without enzyme)	8.99[ab]	55.28[a]	8.368	91.24
4 (Triticale with Enzyme)	7.98a[b]	55.23[a]	11.245	90.74
5 (Wheat screening without enzyme)	9.26[a]	54.37[a]	7.473	91.87
6 (Wheat screening with enzyme)	8.04[ab]	50.18[b]	7.468	91.28
SEM	0.64	0.76	1.11	0.73
P-value				
Replacement	0.058	0.001	0.087	0.273
Enzyme	0.116	0.015	0.107	0.794
Replacement × enzyme	0.777	0.014	0.432	0.260
Treatment	0.099	0.0001	0.100	0.373

WG: weight gain; FI: feed intake; FCR: feed conversion ratio and GU: growth uniformity.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 3 Effect of corn replacement with triticale and wheat screening supplemented with xylanase enzymes on performance of layers from 21 to 25 weeks of age

Treatment	EW (g)	PR (%)	EM (g/day)	FCR (g/g)	FI (g/day)
Control	54.97	33.33[ab]	18.46	3.708	63.38
Triticale (30%)	54.92	27.06[b]	14.88	3.945	60.43
Wheat screening (30%)	54.14	43.49[a]	21.10	3.715	63.33
SEM	0.936	3.82	2.102	0.502	1.85
Enzyme					
No enzymes	54.69	31.49	17.37	4.072	63.15
With enzyme	54.22	34.33	18.92	3.45	61.6
SEM	0.77	3.12	1.721	0.467	1.508
Treatment					
1 (Control without enzyme)	54.36	28.28[b]	15.465[b]	4.496	60.75
2 (Control with enzyme)	55.56	38.40[a]	21.46[ab]	3.086	65.99
3 (Triticale without enzyme)	55.38	31.79[ab]	15.05[b]	4.134	61.35
4 (Triticale with Enzyme)	54.45	26.79[b]	14.71[b]	3.894	59.31
5 (Wheat screening without enzyme)	54.36	39.29[a]	21.6[a]	3.509	67.16
6 (Wheat screening with enzyme)	53.87	42.8[a]	20.6[ab]	3.621	59.69
SEM	1.338	4.4	2.978	0.811	2.61
P-value					
Replacement	0.96	0.045	0.125	0.674	0.442
Enzyme	0.632	0.613	0.138	0.13	0364
Replacement × enzyme	0.394	0.18	0.468	0.45	0.096
Treatment	0.659	0.274	0.27	0.432	0.214

EW: egg weight; PR: production rate; EM: egg mass; FCR: feed conversion ratio and FI: feed intake.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 4 The Effect of corn replacement with triticale and wheat screening supplemented by xylanase enzymes on body mass index, leg length, and metatarsal bone status

Treatment	BMI (g/cm²)	LL (mm)	M (mm)
Control	0.386	129.52	82.60
Triticale (30%)	0.389	133.65	86.46
Wheat screening (30%)	0.400	130.81	85.04
SEM	0.006	0.48	0.39
Enzyme			
No enzymes	0.399	130.16	83.62
With enzyme	0.385	132.50	85.78
SEM	0.005	0.39	0.32
Treatment			
1 (Control without enzyme)	0.384	128.01	81.74
2 (Control with enzyme)	0.389	131.03	83.45
3 (Triticale without enzyme)	0.389	133.35	85.75
4 (Triticale with enzyme)	0.389	133.96	87.17
5 (Wheat screening without enzyme)	0.424	129.12	83.38
6 (Wheat screening with enzyme)	0.376	132.50	86.71
SEM	0.008	0.68	0.55
P-value			
Replacement	0.543	0.124	0.258
Enzyme	0.197	0.161	0.254
Replacement × enzyme	0.0008	0.798	0.179
Treatment	0.204	0.246	0.499

BMI: body mass index; LL: leg length and M: metatarsus.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 5 Effect of corn replacement with triticale and wheat screening supplemented by xylanase enzymes on egg quality traits at 25 weeks' old

Treatment	EYC (Mg/dL)	HU	YI (%)	YC	SI (%)	ST (mm)	SR (%)
Control	180.51	86.19	43.94	5.25[a]	76.36	0.432	9.91
Triticale (30%)	180.03	85.74	43.5	3.92[b]	75.72	0.454	10.01
Wheat screening (30%)	180.51	87.84	44.09	4.13[b]	75.43	0.44	9.49
SEM	0.59	2.35	4.08	0.13	1.1	0.009	0.19
Enzyme							
No enzymes	179.58	85.51	42.37	4.36	75.1	0.446	9.9
With enzyme	180.18	87.66	45.37	4.5	76.57	0.436	9.7
SEM	0.48	1.25	1.65	0.11	0.9	0.009	0.16
Treatment							
1 (Control without enzyme)	178.67	84.75	42.37	5.00[b]	76.59	0.438	9.84
2 (Control with enzyme)	179.54	87.63	45.51	5.50[a]	76.12	0.44	9.98
3 (Triticale without enzyme)	180.72	84.16	40.68	4.08c[d]	75.19	0.445	10.17
4 (Triticale with Enzyme)	179.33	87.33	46.32	3.75[d]	76.25	0.454	9.85
5 (Wheat screening without enzyme)	179.35	87.63	44.06	4.00c[d]	73.53	0.456	9.7
6 (Wheat screening with enzyme)	181.66	88.04	44.11	4.25[c]	77.34	0.414	9.27
SEM	0.84	2.17	2.86	0.19	1.56	0.04	0.27
P-value							
Replacement	0.518	0.258	0.95	<0.0001	0.862	0.419	0.089
Enzyme	0.557	0.254	0.092	0.213	0.312	0.277	0.321
Replacement × enzyme	0.112	0.179	0.428	0.089	0.393	0.032	0.545
Treatment	0.555	0.499	0.397	<0.0001	0.706	0.277	0.198

EYC: egg yolk cholesterol; HU: Haugh unit; YI: yolk index; YC: yolk color; SI: shape index; ST: shell thickness and SR: shell ratio.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 6 Effect of corn replacement with xylanase-enriched triticale and wheat screening on blood parameters in layers at 25 weeks

Treatment	Chol (mg/dL)	HDL (mg/dL)	LDL (mg/dL)	Tg (mg/dL)
Control	128.20	36.41[a]	67.70	194.77
Triticale (30%)	131.01	22.06[b]	79.61	151.91
Wheat screening (30%)	130.93	24.13[b]	76.98	185.62
SEM	0.93	1.69	1.69	8.33
Enzyme				
No enzymes	129.87	27.13	70.83	188.55
With enzyme	130.23	27.94	70.78	166.33
SEM	0.76	0.90	1.38	6.80
Treatment				
1 (Control without enzyme)	128.36	36.61[a]	48.38[c]	208.91[a]
2 (Control with enzyme)	128.04	36.22[a]	54.30[bc]	180.63[ab]
3 (Triticale without enzyme)	129.55	21.43[b]	71.70[a]	174.21[ab]
4 (Triticale with Enzyme)	132.48	22.70[b]	82.13[a]	129.66[b]
5 (Wheat screening without enzyme)	131.70	23.34[b]	70.53[ab]	182.53[ab]
6 (Wheat screening with enzyme)	130.17	24.91[b]	65.97[ab]	188.71[ab]
SEM	1.31	1.57	2.45	11.77
P-value				
Replacement	0.346	0.0005	0.109	0.125
Enzyme	0.840	0.755	0.089	0.209
Replacement × enzyme	0.636	0.798	0.0009	0.111
Treatment	0.636	0.005	<0.0001	0.003

Chol: cholesterol; HDL: high density lipoprotein; LDL: lipoprotein with low density and Tg: triglycerides.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 7 Effect of corn replacement with triticale and wheat screening supplemented by xylanase enzymes on intestinal viscosity

Treatment	Viscosity (centipoise, cap)
Control	0.86
Triticale(30%)	0.87
Wheat screening (30%)	0.87
SEM	0.01
Enzyme	
No enzymes	0.8
With enzyme	0.88
SEM	0.09
Treatment	
1 (Control without enzyme)	0.84
2 (Control with enzyme)	0.90
3 (Triticale without enzyme)	0.91
4 (Triticale with Enzyme)	0.84
5 (Wheat screening without enzyme)	0.82
6 (Wheat screening with enzyme)	0.92
SEM	0.014
P-Value	
Replacement	0.988
Enzyme	0.327
Replacement × enzyme	<0.0001
Treatment	0.194

SEM: standard error of the means.

Mathlouthi *et al.* (2002) have indicated that the content of arabinoxylan in wheat screening is lower than wheat and this could lead to a reduction in the intestinal contents viscosity compared with wheat. In numerous studies on the replacement of corn with wheat and wheat screening, no negative effects were shown in bird's performance in addition no differences were found between the feeding of birds with corn and wheat screening diets. While the negative effect was observed on yield by wheat diet. It could be mentioned that wheat screening has less arabinoxylan than wheat. This type of anti-nutritional material increases intestinal viscosity and decreases the rate of material movement in the ileum and consequently reduce digestibility aspects (Mathlouthi *et al.* 2002).

The evaluation of egg quality in this experiment at the 25 weeks of age are presented in Table 5. Reduced the egg yolk color by wheat screening and triticale in diet in comparison to corn, but no response were found in other egg characteristics in this respect. The results of Zarghi and Golian (2009) are consistent with this finding which no effect were observed on eggs quality by wheat and triticale in the chicken.

Ciftci *et al.* (2003) have no observed effect on the thickness egg shells by replaced 30% of wheat with corn in the Lehman White hens' diet from 27 to 43 weeks of age. None of the egg quality characteristics were affected in laying hen diet supplemented by xylanase enzyme, this could be related to the type of wheat or triticale grain and their composition in this case. Mirzaee *et al.* (2012) have pointed out that increased the thickness and strength of egg shell by supplementation Xylanase enzyme in chicken diet at 47 weeks of age, which was contradicted with the results of this study.

Regarding the results of this study the measurement of blood parameters was presented in Table 6. It was observed that high density lipoprotein levels (HDL) by wheat screening and triticale treatments, which was significantly lower than the control treatment. Insoluble crude fiber increases the passage of nutrients and increased bile excretion; this could be due to a significant amount of dietary fat to restore bile production in the liver. As a result, good cholesterol levels (HDL) and bad cholesterol (LDL) are increased in this particular case. Different high increase in this stage may be related to changes in blood parameters in birds, but most of the effects are related to the NSP content, which is high in the wheat diet. Fiber-rich diets, could reduce blood cholesterol levels by 20% or more.

Short chain fatty acids, have shown by produce bacterial fermentation of fiber in the colon. This probably inhibit cholesterol synthesis changes in bile acid excretion and secretion of natural steroids, since there were shown by dietary fibers which lead to decrease cholesterol and triglycerides. This could be agreement by triticale and wheat secreting results in current study (Marshall *et al.* 2006).

In a study conducted by Mazhari *et al.* (2011) the replacement of different levels of corn by wheat screening and Xylanase enzymes in broiler chickens leads to a significant decrease in serum cholesterol level, which was not match with this study. The increased bile acid secretion and fecal excretion and ultimately could lead to lower cholesterol levels in soluble fiber binds directly to bile acid (Pettersson *et al.* 1987). Hojjat and Agheli (2009) have indicated that adding the enzyme to the diet resulted an increase in serum cholesterol, HDL, and triglyceride concentrations, which is not consistent with the results of this study. This could be related to experiment condition and different treatments in both study.

The results of this study have noted that no significant in egg cholesterol was shown by different treatments. On the other hand, the fiber content of the feed is very effective on egg cholesterol. Non-starch polysaccharides form the major part of cerebellum cell carbohydrates in wheat and triticale seeds mainly contain argininoylans, which increases the viscosity of the gastrointestinal tract. Conesquently it needs to supplement by xylanase enzyme through the hydrolysis of arabinoxylanase reduces the viscosity of the intestinal contents and increases the digestibility of nutrients (Anniston and Choc, 1991). Contrary to the present result a significant increase was indicated in viscosity due triticale diet content of laying hens Ciftci *et al.* (2003). Also, Silva *et al.* (2006) have stated that increased viscosity by wheat in poultry diet, which no corresponding to the results of this study. This could be related to different levels of wheat. The intestinal viscosity of the small intestine was not affected by the enzyme, which is in contradiction with the findings of Bedford and Classen (1992). The researchers have found that reduce viscosity in intestinal content by Xylanase enzyme in laying hen diet could be related to break down in the arabinoxylanse in triticale (Pettersson *et al.* 1987; Mathlouthi *et al.* 2003). Mirzaee *et al.* (2012) have pointed out that reduced viscosity by addition of enzymes in laying hens diets. Mathlouthi *et al.* (2002) have stated that viscosity depends on the type of grains (cultivar) and the amount of arabinoxylan and water soluble beta-gleans. There reasons could be related to the current result.

CONCLUSION

The present experiment has shown that replacing 30% of corn by wheat screening and triticale in the pullet and laying hens diets could have achieved a good benefited as an alternatives of corn and can reduce the cost of egg production. In contrast no significant differences were found in plasma and egg yolk cholesterol by corn, triticale and wheat screening.

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