Effects of bacterial xylanase on egg production and quality and on diet digestibility in laying quail (*Coturnix coturnix japonica*) fed on diets based on Corn and Soybean meal.

I. BAYRAM[1]*, I.S. CETINGUL[1], A.B. AKKAYA[1] and C. UYARLAR[1]

[1]Faculty of Veterinary / Dep. of Animal Nutrition, University of Afyon Kocatepe, ANS Campus, Afyonkarahisar-Turkey.

*Corresponding author: ibayram@aku.edu.tr

Abstract: Corn and soybean meal (SBM) are high-quality feed ingredients for poultry diets. Despite the fact that such diets are low in indigestible carbohydrates, it has been suggested that the inclusion of exogenous feed enzymes to such diets could improve nutrient availability and, subsequently, improve energy digestibility. This study was carried out to determine the effects of bacterial xylanase (Nutrase® Xyla) on egg production, feed consumption, feed conversion ratio, egg weight and egg quality of laying quail (*Coturnix coturnix japonica*). A total of 120 8 week old laying quail (Coturnix coturnix japonica) were divided into six groups of 20 birds each (which were, subdivided into 10 subgroups of 2 each for experimental replicates). One basal diet with a content of 22% crude protein, 2900 kcal/kg of metabolisable energy was used in the experiment. The energy levels of experimental groups were reduced as follows: *Group I*; 1,5 %(43,5 kcal/kg), *Group II;* 2% (58 kcal/kg), *Group III*; 2,5% (72,5 kcal/kg), *Group IV;* 3% (87 kcal/kg), *Group V;* 3,5%(101,5 kcal/kg), respectively. Moreover, 100 ppm of bacterial xylanase was supplemented to all the experimental groups. The control group received no enzymes. The experiment lasted 12 weeks. Feed and water were supplied ad libitum and artificial light was provided for 16 h per day. Significant differences among the groups were examined by one-way ANOVA followed by Tukey test. There were no statistical differences in egg production. Results of this study indicate that enzyme addition to corn-SBM-based basal diets can significantly improve energy utilisation (P<0.01).This result was supported with the findings in group IV which had a 3% decrease in energy. There were no statistical differences in terms of egg quality parameters between the groups.

Keywords:bacterial xylanase; egg production; laying quail

Introduction

Corn is a feedstuff which is the most commonly used poultry feed followed by soybean. For this reason we have to optimize the exploitation of the corn's nutrients. The digestibility of corn and soybean nutrients is very high, however a protein matrix which closes the circumference of the corn, reduces corn utilization in poultry (Graham,1996). Cell wall polysaccharides of the plant feeds have a more complex structure. They include cellulose, hemicellulose, pectins, oligosaccharides and are known as non-starch polysaccharides (NSP) (Hygheabert and Groote, 1995). There are no enzymes to destroy these NSP in poultry. So NSP are antinutritious and reduce the performance of poultry. NSP content of feed rations are more important than the NSP content of single feed and we have to determine required enzyme amount of total diets. Nnenna et al (2006) showed that Roxazyme G, which is a combination of xylanase and glucanase and achieved from *Trichoderma viridae,* saves 20 percent of corn while using corn residue and corn hulls rather than corn itself. Adding β-glucanase and xylanase to rye based rations of broiler chicks, reduces performance losses by decreasing bile acid congestion and promoting villus length. Yoruk and Bolat (2003) showed that adding xylanase including enzyme mixtures to barley based rations of hens did not incur a significant effect on weight , feed conversion, feed consumption, egg weight, egg shell thickness and haugh unit. Yalcin et al (2002) determined that adding enzyme, probiotics and antibiotics to the ration of hens didn't effect body weight, feed conversion, egg white index, yellow index and haugh unit.

This study was carried out to determine the effects of bacterial xylanase on egg production, feed consumption, feed conversion ratio, egg weight, body weight and egg quality of laying quail.

Materials and methods

A total of 120 laying quails (Coturnix coturnix japonica) were used in the experiment. They were 8 weeks of age at the start of the experiment and were divided into six groups of 20 birds each. One basal diet with a content of 22 % crude protein, 2900 kcal/kg metabolisable energy and 2,5 % calcium were used in the study. Composition of experimental diets are shown in table 1. The energy levels of experimental groups were reduced as follows: Group I, 1,5% (43,5 kcal/kg), Group II; 2% (58 kcal/kg), Group III; 2,5% (72,5 kcal/kg), Group IV; 3% (87 kcal/kg), Group V; 3,5% (101,5 kcal/kg), respectively. Moreover, 100 ppm of bacterial xylanase ,which was provided from Bacillus subtilis was supplemented to all experimental groups. The control group received no enzymes. Feed and water were provided as ad libitum. Artificial light was supplied for 16 hours per day. Egg production was recorded daily, feed consumption and egg weight collected weekly. Egg quality parameters (yolk index, index, haugh unit, shape index and egg shell thickness) were also evaluated in the experiment. The experiment continued for 12 weeks. Nutrient requirements of the rations were determined according to NRC (1994).

Table 1. Composition of experimental diets,%

Feedstuffs	Control	Group 1	Group 2	Group 3	Group 4	Group 5
Corn	49,062	47,937	48,370	48,833	49,267	49,729
Soybean meal	16,522	15,893	16,631	17,421	18,159	18,950
Full fat soya	9,685	8,073	6,647	5,119	3,692	2,164
Limestone	5,764	5,795	5,799	5,805	5,809	5,815
Sunflower meal	3,570	7,521	7,769	8,034	8,282	8,548
Wheat	10,000	10,000	10,000	10,000	10,000	10,000
Corn gluten meal	2,000	2,000	2,000	2,000	2,000	2,000
DCP	0,719	0,763	0,760	0,758	0,755	0,752
Fismeal	1,948	1,161	1,160	1,159	1,158	1,157
Vitamin premix	0,250	0,250	0,250	0,250	0,250	0,250
$NaHCO_3$	0,200	0,200	0,200	0,200	0,200	0,200
Salt	0,180	0,180	0,180	0,180	0,180	0,180
Mineral premix	0,100	0,100	0,100	0,100	0,100	0,100
L –Lysine	0,000	0,027	0,034	0,041	0,048	0,055
Enzyme*	-	0,100	0,100	0,100	0,100	0,100
Calculated values%						
Crude fiber	20,000	20,000	20,000	20,000	20,000	20,000
ME kcal/kg	2900,000	2856,000	2842,000	2827,000	2813,000	2798,000
Calcium	2,500	2,500	2,500	2,500	2,500	2,500
A. Phosphorus	0,350	0,350	0,350	0,350	0,350	0,350

* Enzyme (Nutrase ® Xyla: Bacterial (*Bacillus Subtilis*) endo-1,4-beta-xylanase)

Variance analyses and Tukey test were implemented as a statistical method in the experiment (SPSS inc. 2001).

Results and discussion

Performance results of the experiment (egg production, feed consumption, feed conversion ratio, egg weight) and egg quality parameters are shown in Table 2. There is no statistical significance between the groups in all parameters except feed consumption and feed conversion ratio ($P<0,01$).

Hence we can say that while xylanase promoted energy efficiency of the ration there are no statistical differences in egg production between the experiment groups. We can decrease energy content of the ration because birds utilize ration energy more effectively by adding enzymes. Xylanase compensated reduced energy content of the ration at the level of 3%, but couldn't compensate reduced energy content of the ration at the level of 3,5%. Pan et al (1998) demonstrated that commercial enzyme mixtures could promote metabolizable energy particularly utilized in wheat based rations.

Table 2 Mean performance and egg quality values of the experimental groups.

	Control	Group 1	Group 2	Group 3	Group 4	Group 5	P
Egg production,%	92,57	92,20	91,61	90,54	91,43	93,19	NS
Feed consumption, gr	$24{,}25^{b}$	$24{,}62^{ab}$	$23{,}65^{b}$	$23{,}91^{b}$	$24{,}43^{ab}$	$25{,}40^{a}$	**
Feed convertion ratio+	$1{,}85^{ab}$	$1{,}92^{ab}$	$1{,}82^{b}$	$1{,}84^{ab}$	$1{,}93^{ab}$	$1{,}95^{a}$	**
Egg weight, gr	12,13	12,11	11,93	11,70	12,08	11,76	NS
Egg Yolk index	45,32	45,99	45,33	45,81	45,62	46,71	NS
Egg Albumen index	9,10	10,66	10,68	9,87	9,78	10,26	NS
Haugh units	88,76	90,82	91,30	92,20	92,07	91,78	NS
Egg shape index	78,61	77,47	77,96	79,22	78,52	77,59	NS
Egg shell tickness, mmx 10^{-2}	20,85	21,10	21,02	20,22	20,92	20,32	NS

** P<0.01, Mean values with different superscripts within a row differ significantly.
NS:non significant
+FCR, (kg feed / kg egg)

There were no differences between groups in feed consumption and feed conversion ratio except group five (energy level of the ration reduced as 3,5%) in this study. Birds in group five, consumed much more feed than the other groups. Enzymes could not compensate all energy deprivation in group five. Choct (2002) indicated that adding enzymes to the rations promotes feed conversion ratio depending on reduced viscosity of the intestine. Moreover Ergun et al (1993) demonstrated that Kemzyme dry enzyme supplement to the rations that include barley, wheat and corn did not effect body weight, feed consumption, egg production, feed conversion ratio and egg quality parameters. However, Ciftci et al (2005) indicated that microbial phytase supplement to the corn and soybean based rations improved egg production, egg weight and feed conversion ratio in laying hens. There is no difference in egg weight and egg quality parameters between groups in this experiment. Hamilton and Proudfoot (1993) reported that Avizyme (cellulase, β-glucanase, xylanase) supplement to the barley based rations did not effect egg production, egg weight and Haugh unit in laying hens. Silversides et al (2006) illustrated that xylanase supplement to the wheat based rations did not effect egg production, although it improved egg weight, albumen height and weight. In addition some researchers reported that enzyme supplement to the rations had a negative effect on egg quality (Richards,1998), while other researchers reported that enzyme supplement to the rations had a positive effect on egg quality (Van Der klis et al. 1997) and yet again other researchers reported that enzyme supplement to the rations had no effect on egg quality (Ciftci et al. 2003).

Consequently, by supplementing bacterial xylanase to the corn – soybean based rations in laying quails, it is possible to economize in the energy content (at the level 3%) of the ration.

References

ÇIFTCI, I. , YENICE, E.and ELEROGLU, H. (2003) Use of triticale alone and in combination with wheat or maize: effects of diet type and enzyme supplementation on hen performance, egg quality, organ weights, intestinal viscosity and digestive system characteristics. *Anim. Feed Sci. and Technol,* **105** : 149–161.

CIFTÇI,M., DALKILIÇ,B. and AZMAN,M.A. (2005) Effects of microbial phytase supplementation on feed consumption and egg production of laying hens. *Int.J. Poult.Sci.* **4**(10): 758-760.

ERGÜN, A., ÇOLPAN,I., YALÇIN,S. and MUGLALI,Ö.H. (1993) Yumurta tavuğu rasyonlarına kat›lan kemyzme dry'›n yumurta verimi ve kalitesine etkisi. *Ankara Univ. Vet. Fak. Derg* **40**:371-378.

GRAHAM, H.(1996) Enzymes for maize-soybroiler diets. *Feed International.* **17** (12) : 14-23

HAMILTON,R.M.G. and PROUDFOOT, F.G.(1993) Effects of dietary barley level on the performance of leghorn hens. *Can. J. Anim. Sci*. **73**: 625-634.
HYGHEABERT, G. and GROOTE, D. (1995) The effect of specifik enzymes on the ME_n-value and nutrietnt utilization of target feedstuff in broiler and layer diets. WPSA Proceedings, 10th European Symposium on Poultry Nutriton, October 15-19, Antalya Turkey
NATIONAL RESEARCH COUNCIL (1994) Nutrient requirements of poultry. 9.th ed. Natl. Acad. Pres, Washington, DC.
NNENNA, O. P., EMEKA, N. P. and OKPOKO, C. L. (2006) Performance of Broiler Chicks (Gallus domesticus) Fed Maize Offal-Based Diets Supplemented With Roxazyme G Enzyme. *International Journal Of Poultry Sci.* **5** (7) : 607-610
PAN,D.F., IGBASAN,F.A., GUENTER,W. and MARQUARDT,R.R. (1998) The effects of enzyme and inorganic phosphorus supplements in wheat and rye based diets on laying hen performance, energy and phosphorus availability. *Poult. Sci*. **77**:83-89.
RICHARDS,G.(1998) Designer diets and management for optimum egshell quailty. Alltech's 12th Annual Asia Pasific Lecture Tour, pp. 35-40.
SILVERSIDES, F.G, SCOTT, T.A. and KORVER, D.R. (2006) Afsharmanesh M, Hruby M.: A study on the interaction of xylanase and phytase enzymes in wheat-based diets fed to commercial white and brown egg laying hens *Poult Sci.* Feb;**85**(2):297-305.
SPSS Inc. (2001) SPSS for Windows 10.0 Base system user's guide, release 10.0 SPSS Inc. Printed in the USA.
VAN DER KLIS, J.D., VERSTEECH, H.A.J., SIMONS, P.C.M. and KIES,A.K. (1997) The efficacy of phytase in corn-soybean meal based diets for laying hens. *Poult. Sci*. **76**: 1535-1542.
YALÇIN,SAKİNE., GÜÇLÜ,B.K., OĞUZ,F.K. and YALÇIN,SUZAN (2002) Yumurta tavuğu rasyonlar›nda enzim probiyotik ve antibiyotik kullan›lmas›. *Ankara Univ. Vet. Fak. Derg.* 2002; 49: 79-83.
YORUK,M.A. and BOLAT,D.(2003) Arpaya dayalı yumurta tavuğu rasyonlarına farklı enzim katkılarının çeşitli verim özelliklerine etkisi.*Türk J.Vet.Anim. Sci*. **27:**797-804.