http://www.trakya.edu.tr/Enstituler/FenBilimleri/fenbilder/index.php
Trakya Univ J Sci, 6(1): 29-33, 2005
ISSN 1302 647X
DIC: 141MANS610406040704

Research Article/Araştırma Makalesi

EFFECT OF ENZYME ADDITION TO WHEAT BASED DIETS IN BROILERS

Mária ANGELOVIČOVÁ, Ján MENDEL, Marek ANGELOVIČ, Miroslava KAČÁNIOVÁ
Slovak University of Agriculture, Tr. A. Hlinku 2, 949 01 Nitra, Slovak Republic (SLOVAKIA) Tel.: ++42137 6508331, e-mail.: maria.angelovicova@uniag.sk

Received : 18.03.2004
Accepted : 01.09.2004

Abstract: Two group trials were run with the ISA Vedette broilers. Each trial lasted 42 days. The intent of each trial was to observe the quality of wheat as the base component of diets (40.23 % in starter, 52.68 % in growth and 54.73 % in finisher). The wheat extract viscosity was determined as 13.70 cPs. Both trials were carried out with reference and trial groups and they differed in the fact that a trial diet was fortified with enzymatic premix with 1.4-endo-β-xylanase and protease (0.1 % in 100 kg). At the end of the feeding period the body weight gain of broilers fed an enzymatic premix-fortified diet was tend to higher and their feed conversion had improved.

Key words: wheat, quality, enzymes, broilers, productibility

Piliçlerin buğday kökenli yiyeceklerine enzim eklenmesinin etkileri Makale'nin Türkçe adı

Özet: ISA Vedette piliçleri ile iki farklı deney gerçekleştirilmiştir..Her bir deney 42 gün sürmüştür. Her bir denemede yiyeceklerin temel bileşeni olarak buğdayın kalitesinin gözlenmesi amaçlanmıştır (40.23 % başlangıçta, 52.68 % gelişim durumundakilerde ve 54.73 % sonuçta). Buğday ekstraktı viskozitesi 13.70 cPs olarak belirlenmiştir. Her bir denemede bir referans ve deneme grupları kullanılmıştır. Denem grubu, enzimatik olarak 1.4-endo-β-xylanaz ve proteaz (0.1 % in 100 kg) ile muamele edilmiş olmasıyla diğer gruptan ayrılmaktadır. Besleme periyodunun sonunda enzim eklenmiş diyet ile beslenen piliçlerin ağırlık kazançlarının daha fazla olduğu gözlenmiştir.

Anahtar kelimeler: buğday, kalite, enzim, piliç, verimlilik.

Introduction

Standard wheat quality parameters, e.g. starch content, nitrogen compound contents, specific gravity or grain mass are not sufficient to thoroughly characterize the wheat nutritive value. 54 analysed wheat grain samples (9 varieties of wheat grown in two locations within three years) showed just a weak correlation of the grain mass with energy value ($r^2 = 0.38$) and its statistically inconclusive correlation with other indicators (Barrier-Guillot et al., 1995).

The trial provides the evidence of the high correlation between differences in the nutritive value of different wheat varieties used for broiler feeding and viscosity of intestinal chyme (in vivo). The increase of the viscosity of intestinal chyme due to the increase in the soluble arabinoxylans or β-glucans contents results in the reduced content of metabolisable energy and worsened feed conversion (Classen et al., 1995; Jeroch et al., 1999 and Pack, 1996).

The data regarding the wheat extract viscosity vary among particular wheat varieties. The more viscous wheat varieties are of the worst quality irrespective of their location and the differences among the wheat grain samples taken from the same wheat variety are more significant compared to lower viscous wheat varieties (Classen et al., 1995).

Generally, facts regarding the quality of wheat used as a basis of diets for broilers have been gradually collected. Also, these findings indicate the importance of fast and reliable method of determination of starch-free polysaccharides in viscous cereals.

This report is intended to present information regarding quality of wheat used as the main component of feed mixtures for broilers from the point of view of their productibility and feed conversion.

Material and Methods

Two group trials were run with the ISA Vedette broilers. Each trial lasted 42 days. Broilers fed wheat-rich diets. A feed mixture contained 40.23 % of wheat in starter, 52.68 % in growth and 54.73 % in finisher. Both trials were carried out with reference and trial groups differed due to the addition of the enzymatic premix, 0.1 % in 100 kg. The enzymatic premix consisted of 1.4-endo-β-xylanase produced by *Trichoderma longibrachiatum* and protease produced by *Bacillus subtilis*. One gram of enzymatic contains 2500 U of active xylanase and 800 U of active protease (subtilisin).

Individual parameters were determined this way:

Metabolisable energy:

ME_N (MJ/kg) = 0.3431∗fat + 0.1551* protein + 0.1669*starch + 0.1301*sugar

Crude protein: Kjeldahl method.

Lysine, methionine and cystine, treonine: automatic analysator, type AAA 339.

Calcium and phosphorus: burning of the sample feedstuffs by 550 ^{0}C (calcium – manganesemetric measurement; phosphorus – Lang´s colorimeter and nonphytate phosphorus by calculation from all phosphorus).

Linolic acid – gas chromatograph, type Chrom 5.

Body weight – commercial scale VEB.

Feed conversion – total feed intake/weight gain.

Results and Discussion

Table 1. The composition of experimental diets (g/kg)

		Diets		
		Starter	Growth	Finisher
Corn		402.3	526.8	547.3
Wheat		215.0	156.0	139.0
Soybean meal		236.0	181.0	198.0
Meat-bone meal		50.0	50.0	50.0
Fish meal		50.0	50.0	-
Rapeseed oil		22.0	18.5	35.0
Premix vitamine and mineral substances		10.0	10.0	10.0
Fodder limestone		8.0	5.0	7.5
Dicalciumphosphate		4.0	-	4.0
DL-methionine		1.7	1.7	2.2
Fodder salt		1.0	1.0	2.5
L - lysine		-	-	4.5
Enzymatic premix		1.0	1.0	1.0
Metabilisable energy	(MJ/kg)	12.35	12.39	12.59
Crude protein	(g/kg)	224.70	209.30	188.50
Lysine	(g/kg)	12.10	11.10	10.20
Methionine	(g/kg)	5.69	5.42	5.13
Methionine+cystine	(g/kg)	9.25	8.91	8.31
Calcium	(g/kg)	9.15	7.80	8.10
Nonphytate phosphorus	(g/kg)	4.80	4.30	3.80
Linolic acid	(g/kg)	14.10	13.30	14.20

In cereal-rich diets, i.e. in diets based on wheat, barley, rye or tritical, viscous cereals, a significant amount of fibers consists of soluble and insoluble starch-free polysaccharides and arabinoxylans and betaglukans (Bedford and Classen, 1992). They declared that soluble starch-free polysaccharide fibres increase the viscosity (adhesiveness) of the contents of small intestine. This fact is known due to earlier publications. The higher viscosity of intestine chyme decreases the availability of nutrients for the digestion stimulating effect of endogenous enzymes, therefore it reduces their digestibility. Such conditions decelerate the growth of broilers and de-

teriorate the utilization of nutrients contained in diets. Considering this fact, our selection of enzymatic activities was closely related to the composition of diets. We purposefully chose the enzymatic activities of 1.4-endo-beta-xylanase and protease for the trial cereal-rich feed mixtures, based predominantly on wheat representing from 43.23 % (starter) to 54.75 % (finisher), maize from 21.5 % (starter) to 13.9 % (finisher) and extracted soya groats from 23.6 % (starter) to 18,1 % (growth) of the mixture and we expected it to increase the productive efficiency of diets for broilers and the effectiveness of their feeding.

Table 2. The composition of premix vitamine and mineral substances

		Starter	Growth	Finisher
Lysine	g/kg	40	40	-
Manganese	mg/kg	11200	11200	9600
Zinc	mg/kg	7000	7000	6000
Iron	mg/kg	8400	8400	7300
Copper	mg/kg	1100	1100	1000
Iodine	mg/kg	110	110	100
Selenium	mg/kg	28	28	24
Vitamins:				
A	thousand I.U./kg	1200	1000	1000
D_3	thousand I.U./kg	300	300	200
E	mg/kg	3600	1820	1820
K_3	mg/kg	400	300	300
B_1	mg/kg	250	100	50
B_2	mg/kg	1000	500	500
B_6	mg/kg	300	300	100
B_{12}	mg/kg	2	2	2
Biotin	mg/kg	20	15	5
Folic acid	mg/kg	160	100	60
Nicotinic acid	mg/kg	4000	3000	2500
Pantothenic acid	mg/kg	1000	1000	800
Choline	mg/kg	30000	20000	-
Wheat meal	kg	1	1	1

The addition of the xylanase enzyme to the wheat-rich diets for broilers has been accepted as the most effective approach to the problem of viscosity.

The insufficiently developed digestive tract of younger broilers may not be able to absorb the high content of nitrogen compounds in extracted soya grouts, which is also an important feed base for broiler diets. The addition of protease help to neutralize the negative impact of anti-nutritive factors on the exploitation of nitrogen compounds and it also facilitates the decomposition of a huge amount of nitrogen compound molecules into their smaller forms which can be easier absorbed (Sheppy, 2001). This is why we chose the xylanase and protease based enzymatic premix. Generally, the enzyme is required to have a side synergic effect (Zyla et al., 1999a; 1999b).

Based on the findings of many authors our trials dealt with purposeful manipulation of diets composition and reached results, which are comparable with the findings of other authors and even economically more efficient if compared with diets with no addition of enzymatic premix.

Table 3: Determined nutrient composition on viscosity of wheat (n=8)

Viscosity of wheat extract	(cPs)	13.70 ± 0.38
Crude protein	(g/kg)	118.00
Fibre	(g/kg)	22.40
Gluten	(% in dry matter)	32.70
Albumin and globulin	(% from crude protein)	23.72
Glutenins	(% from crude protein)	27.78

Classen et al. (1995), Jeroch et al. (1999), Barier-Guillot et al. (1995) and Pack (1996) consider the increasing viscosity of intestinal chime, resulting from the increased content of soluble starch-free polysaccharides, as the reason of the reduction of the metabolisable energy content and deterioration of feed conversion as the increase in viscosity by each 0.1 cPs results in the equivalent deterioration of feed conversion. The content of wheat in diets for broilers significantly affects the total effectiveness of their diet. There is a close correlation between the differences in nutritive values of particular wheat varieties and the viscosity of broiler intestinal chyme. These authors measured the wheat extract viscosity in the wheat varieties grown in western Canada. The factors influencing the viscosity of wheat have been already determined. It is significantly influenced by genetics (Classen et al. 1995; Saastamoinen et al., 1989).

Table 4: Effect of enzyme supplementation of wheat – based diets on the body weight

Experiment	n	Group	Beginning	End
I.	12500	control	39.0	1860.0[a]
	12500	experimental	39.0	2030.0[a]
II.	12500	control	40.0	1970.0
	12500	experimental	39.0	2000.0

t - test: a : a = $^{+}P<0.05$

Weighing broilers at the end of the feeding period we found higher body weight of broilers fed diets enriched with the enzymatic premix. Pursuant to the feed act the use or enzymatic premixes in feed mixtures should result in preserving or improving the productibility of fed animals. Following a large number of trials focused on nutrient digestibility and performance of broilers it is recommended (Bedford and Morgan, 1996; Schutte, 1995) to use the effect of xylanase and protease enzymatic premixes in order to improve wheat-rich diets and increase the productibility of poultry. We applied this alternative in our trials and reached the results comparable with findings of the mentioned above authors.

Table 5: Effects of enzyme supplementation of wheat - based diets on the feed conversion

Experiment	n	Group	Feed conversion (Feed intake/weight gain)	Index
I.	12500	control	2.14	100.0
	12500	experimental	1.96	91.59
II.	12500	control	1.99	100.0
	12500	experimental	1.94	97.49

The important indicator of the effective use of feed is the feed consumption per 1 kg of the body weight gain. The evaluation of the effect of diets enriched with the enzymatic premix on performance of broilers showed the improvement of the feed utilization by 8.41 % in average in trial 1 and by 2.51 % in trial 2 in comparison with the reference group. Similar evaluation of feeding costs per 1 kg of the body weight gain of broilers and the feeding effectiveness index indicate the improved effect of the diet enriched with enzymatic premixe. These results were determined using the method which represents a part of the complex broiler nutrition and feeding indicators. Bedford and Morgan (1996) and Schutte (1995) recommend a different method with comparable results. The mentioned above authors recommend utilizing the effect of the xylanase and protease enzymatic premix in the wheat-rich diets in connection with the decrease of feeding costs via the wheat modification aimed at increasing the content of metabolisable energy by 6 % and the content of nitrogen compounds and particular amino acids by 10 % with no negative impact on the productibility of poultry.

Conclusion

The results of our trials have proved the opinions and results of many authors and widened and deepened the knowledge regarding purposeful manipulation of diets for broilers focused on the assessment of the quality of the diet, based on a wheat. A positive correction of feed mixtures can be reached due to their fortification with enzymes purposefully chosen according to their effect in the wheat substrate.

References

1 BARRIER-GUILLOT B, BEDFORD M, METAYER JP, GATEL, F. Effect of xylanase on the feeding value of wheat-based diets from different wheat varietes for broilers. *Proceedings of the WPSA 10th European Symposium on Poultry Nutrition*. Antalya, Turkey. 324-325,1995.

2 BEDFORD MR, CLASSEN HL. Reduction of intestinal viscosity through manipulation of dietary rey and pentosanase concentracion is effected through changes in the carbohydrate composition of the intestinal aqueous phase and results in improved growth rate and food conversion efficiency of broiler chicks. *Journal of Nutrition*. 560-569, 1992.

3 BEDFORD MR, MORGAN A. The use of enzymes in poultry diets. *World's Poultry Science Journal.* 52: 61-68, 1996.

4 CLASSEN HL, SCOTT TA IRISH, GG, HUCK P, SWIFT M, BEDFORD MR. The relationship of chemical and physical measurements to the apparent metabolizable energy (AME) of wheat when fed to broiler chickens with and without enzyme source. *Proceeding of the second European Symposium on Feed Enzymes*. 65-77, 1995, Noordwij-kerhout, Netherlands.

5 JEROCH H., DUSEL G., KLUGE H., NONN, H. The effectiveness of microbial xylanase in piglet rations based on wheat or wheat, rye and barley. *Landbauforschung Volkenrode.* 193: 1999, 223-228.

6 PACK M. Turning grain into gain. *Feed Milling International*. 9: 33-39, 1996.

7 SAASTAMOINEN M, PLAAMI S, KUMPULAINEN J. Response of poultry to enzyme supplement. *J Cereal Sci* 10: 199-207, 1989.

8 SHEPPY C. The Current Feed Enzymes Market and Likely Trends. pp. 1-10, 2001. [Eds: BEDFORD M R, PAR-TRIDGE, GG. Enzymes in farm animal nutrition. CAB International, Oxon.]

9 SCHUTTE JB, DE JONG J, LANGHOUT DJ. Effect of a xylanase enzyme supplementation to wheat based diets in broiler chicks in relation to dietary factors. *Proceeding of the second European Symposium on Feed Enzymes*. 95-102, 1995, Noordwijkerhout, Netherlands.

10 ZYLA K, GOGAL D, KORELESI J, SWIATKIEWICZ S, LEDOUX DR. Simultaneous application of phytase and xylanase to broiler feed based on wheat in vitro measurments of phosphorus and pentose release from wheat-based feeds. *J Sci Food Agriculture* 79: 1832-1840, 1999a.

11 ZYLA K, GOGAL D, KORELESI J, SWIATKIEWICZ S, LEDOUX DR. Simultaneous application of phytase and xylanase to broiler feed based on wheat: feeding experiment with growing broilers. *J Sci Food Agriculture* 79: 1841-1848, 1999b.