ID: 467

Effect of Using Enzyme-Added Wheat Instead of Corn in the Diet on the Performance and Slaughtering Characteristics of Broilers

Seyit Ahmet Gökmen[1], Yusuf Cufadar[2], Esra Tuğçe Gül[2], Osman Olgun[2], Behlül Sevim[3]

[1]Program of Poultry Breeding, Department of Plant and Animal Production, Ladik Vocational School, Ondokuz Mayıs University, 55500, Samsun, Türkiye
[2]Department of Animal Science, Agriculture Faculty, Selcuk University, 42130, Konya, Türkiye
[3]Department of Food Processing, Aksaray Technical Sciences Vocational School, Aksaray University, 68100, Aksaray, Türkiye

Abstract

Current research has been conducted to evaluate the effects of diets containing 50 and 100% wheat supplemented with 300 g/ton enzymes (phytase, xylanase, glucanase, amylase and protease) instead of maize on the performance and carcass characteristics of male broilers. A total of 120 male Ross 308 chicks of day-old age have been distributed into three treatment groups with four subgroups of ten birds each. Experimental groups have been composed of diets containing maize as the grain source (Wheat0), wheat with 300 g/ton enzyme added as 50% of maize (Wheat50) and wheat with 300 g/ton enzyme added as 100% of maize (Wheat100). Performance parameters have been determined on the 10th, 25th and 42nd days, and carcass and visceral weights have been determined at the end of the study (42nd day). The effect of using enzyme-added wheat in the diet on feed intake is statistically insignificant except for the 0-10th days period ($P>0.05$). Compared to the control group (Wheat0), body weight and feed conversion ratio have been improved with the use of enzyme-added wheat in the diet ($P<0.05$). The use of enzyme-added wheat instead of maize in the diet reduced the relative abdominal fat weight, and the relative liver weight increased in the Wheat100 group ($P<0.05$), but other slaughtering parameters have not been affected by the treatment groups ($P>0.05$). According to the results of this study, it has been determined that the use of wheat instead of all maize (100%) with the addition of enzymes in male broiler diets improved performance and reduced fatness.

Key Words: *Broiler, Carcass, Enzyme, Performance, Wheat*

Rasyonda Mısır Yerine Enzim İlaveli Buğday Kullanımının Broilerlerin Performansı ve Kesim Özellikleri Üzerine Etkisi

Özet

Bu çalışma mısır yerine 300 g/ton seviyesinde enzim (fitaz, xylanase, glucanase, amylase ve protease) katkılı %50 ve 100 seviyelerinde buğday kullanılan rasyonların erkek etlik piliçlerin performansına, karkas özelliklerine ve iç organ ağırlıklarına etkisini tespit etmek amacıyla yürütülmüştür. Çalışmada günlük yaşta 120 adet erkek Ross 308 piliçleri 3 muamele grubuna her birinde 10 civcivin bulunduğu 4 tekerrür olarak dağıtılmıştır. Muamele grupları tahıl kaynağı olarak mısır (Buğday0), mısırın %50'si oranında 300 g/ton enzim ilaveli (Buğday50) ile mısırın %100'ü oranında 300 g/ton enzim ilaveli (Buğday100) rasyonlardan oluşturulmuştur. Performans parametreleri 10., 25. ve 42. günde belirlenmiş, karkas ve iç organ ağırlıkları ise çalışma sonunda (42. gün) tespit edilmiştir. Rasyonda enzim ilaveli buğday kullanımının erkek etlik piliçlerin yem tüketimine etkisi ilk on günlük periyot hariç istatistiki olarak önemsiz olmuştur ($P>0.05$). Kontrol grubu (Buğday0) ile karşılaştırıldığında canlı ağırlık ve yem değerlendirme katsayısı rasyonda enzim ilaveli buğday kullanımı ile iyileşmiştir ($P<0.05$). Rasyonda mısır yerine enzim ilaveli buğday kullanımı abdominal yağ oranını azaltmış, Buğday100 grubunda ise karaciğer oranı artmış ($P<0.05$), ancak diğer kesim parametreleri muamele gruplarından etkilenmemiştir ($P>0.05$). Bu çalışma sonuçlarına göre erkek piliç rasyonlarında enzim ilavesi ile mısırın tamamı (%100) yerine buğdayın kullanımının performansı iyileştirdiği ve yağlanmayı azalttığı tespit edilmiştir.

Anahtar Kelimeler: *Buğday, Enzim , Etlik piliç, Karkas, Performans*

Introduction

Improvements in genetics and breeding conditions have significantly increased the growth rate of broilers todays. However, enhancing the genetic and environmental criteria alone will not provide optimal output; diets centered around highly digestible and antinutritional factor-free products like soybean meal and maize meal are required. Concerns about sustainability are raised by this situation for both our nation and a few other nations where environmental demands make maize farming insufficient. The use of other energy sources such as wheat instead

of maize is still popular. Unfortunately, the usage of these products has been restricted due to the anti-nutritional components and biased advice present in them.

Because of its high starch and low cellulose content, wheat has the second-highest energy content of any grain, only surpassed by maize. But since it includes non-starch polysaccharides (beta glucan, arabinoxylan), wet litter and other issues are noticed, which causes loss of production. About 90% more energy is present in wheat than in maize. But wheat has nearly double the protein content of maize. In broiler diets, up to 25% of the feed can be wheat; with the addition of enzymes, this can be raised to 50%, or all of the maize.

Enzymes reduce feed costs by increasing the use of nutrients in feed materials. Grain-based feeds (wheat, barley, rye, oats) used in broiler production contain non-starch polysaccharides and anti-nutritional factors (Çiftçi, 2001). Since non-starch polysaccharides has a high water binding capacity, it increases intestinal viscosity. The increase in viscosity reduces the digestion of nutrients in the small intestine. In addition, high viscosity increases the amount of sticky stool, and as a result, health problems caused by wet litter problems arise. Enzyme addition reduces the water retention capacity of polysaccharides and viscosity decreases. Enzymes such as xylanase, β-glucanase, pectinases, cellulases, proteases, amylases, lipase, phytase, galactosidase, and β-mannanase can be used in feeds to increase feed efficiency and eliminate negative effects (Sevgili et al., 1999; Çiftçi, 2001). For this purpose, enzyme preparates used as feed additives are commercially produced to contain one or more enzyme activities (Sevgili et al., 1999). With the use of these enzymes, there is a decrease in small intestine viscosity, an increase in utilization of nutrients, an improvement in litter quality, a decrease in dirty egg problems, increase of endogenous enzymes activities and utilization of energy, protein and mineral substances as a result of more effective disintegration (Sevgili et al., 1999; Çiftçi, 2001). In this study, it has been aimed to determine the effect of using enzyme-added wheat instead of maize (instead of 50% and 100% of maize) on the performance and slaughtering characteristics of broilers.

Material and Method

Male broiler chicks (Ross 308) and feed materials have been purchased from commercial companies and the diets have been prepared in the Feed Unit located in Selçuk University, Faculty of Agriculture, Prof. Dr. Orhan Düzgüneş Animal Husbandry Research and Application Facility. In the study, 120 male broiler chicks have randomly been distributed into 3 treatment groups with 4 subgroups. A mixture of phytase, xylanase, glucanase, amylase and protease enzymes have been used as enzyme supplement in the study. These additives used in the studies have also been supplied by commercial companies. Treatment groups have been composed of diets containing maize as the grain source (Wheat0), wheat with 300 g/ton enzyme added as 50% of maize (Wheat50) and wheat with 300 g/ton enzyme added as 100% of maize (Wheat100) (Table 1).

Table 1. Treatment diets using different levels of barley and nutrient contents

Ingredients	Treatment diets								
	Wheat0			Wheat50			Wheat100		
	Starter (0-10. days	Grower (11-25. days)	Finisher (26-42. days)	Starter (0-10. days	Grower (11-25. days)	Finisher (26-42. days)	Starter (0-10. days	Grower (11-25. days)	Finisher (26-42. days)
Maize	48.14	51.28	56.40	26.69	26.65	28.90	---	---	---
Barley	---	---	--	25.00	26.10	28.90	53.00	54.04	59.38
Soybean meal	42.70	39.00	33.80	35.40	37.00	31.80	33.44	35.00	29.50
Corn gluten	---	---	---	4.00	---	---	4.00	---	---
Soybean oil	5.40	6.30	6.80	5.00	6.80	7.40	5.65	7.50	8.10
Limestone	0.70	0.60	0.60	0.85	0.65	0.60	0.85	0.73	0.65
Dicalcium phosphate	2.20	2.00	1.75	2.08	1.95	1.75	2.05	1.85	1.68
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
L-lysine	0.17	0.26	0.12	0.30	0.28	0.12	0.33	0.31	0.16
DL-methionine	0.34	0.21	0.18	0.33	0.22	0.18	0.33	0.22	0.18
Calculated nutrient contents									
ME, kcal/kg	3003	3105	3203	3007	3101	3200	3008	3105	3203
Crude protein, %	23.012	21.530	19.496	23.052	21.496	19.541	23.082	21.504	19.508
Calcium, %	0.973	0.872	0.794	0.976	0.873	0.789	0.964	0.873	0.785
Available phosphorus, %	0.489	0.445	0.396	0.480	0.448	0.409	0.486	0.441	0.409
Lysine, %	1.288	1.291	1.063	1.288	1.283	1.042	1.291	1.284	1.046
Methionine, %	0.675	0.521	0.467	0.679	0.528	0.466	0.678	0.526	0.463
Methionine+cystine	0.974	0.899	0.815	1.057	0.915	0.823	1.065	0.922	0.829

[1] The premix provided the following per kg of diet: retinyl acetate, 4.0 mg; cholecalciferol, 0.055 mg; DL-α-tocopheryl acetate, 11 mg; nicotinic acid, 44 mg; calcium-D-pantothenate, 8.8 mg; riboflavin sodium phosphate, 5.8 mg; thiamine hydrochloride, 2.8 mg; cyanocobalamin, 0.66 mg; folic acid, 1 mg; biotin, 0.11 mg; choline, 220 mg; Zn, 60 mg; Mn, 60 mg; Fe, 30 mg; Cu, 5 mg; Iodine, 1.1 mg; Se, 0.1 mg.

During the experiment body weight and feed intake have been determined as g/chick by group weighings at the hatching, 10th day, 24th day, and final (42nd day) of the trial. Body weight gain and feed conversion ratio have been calculated according to the Gül and Yıldız (2024).
At the end of the experiment, two broilers at six weeks of age from each subgroup have been euthanized by cervical dislocation. Slaughtering traits have been determined according to the Gül and Yıldız (2024).
Data have been analysed in the SPSS 18.0 software package (SPSS Inc., Chicago, IL, USA) with a model of one-way ANOVA, using the group mean as an experimental unit. Differences among the group means have been determined by Duncan's range tests. A probability value of $P < 0.05$ has been considered statistically significant.

Results and Discussion

The effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of maize in broiler diets on performance is shown in Table 2.

Table 2. Effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of corn in the diet on the performance

Parameters	Treatments			Standard error	*P-value*
	Wheat0	Wheat50	Wheat100		
Body weight, g/bird					
Hatching	41.95	41.60	41.00	0.232	0.258
10th days	251.2^{b}	252.7^{b}	265.9^{a}	2.55	0.015
25th days	1176.3^{b}	1273.0^{a}	1308.5^{a}	20.57	0.007
42nd days	3185.5^{b}	3447.8^{a}	3496.3^{a}	53.52	0.016
Body weight gain, g/bird					
0-10th days	209.3^{b}	211.1^{b}	224.9^{a}	2.59	0.008
11-25th days	925.0^{b}	1020.3^{a}	1042.6^{a}	19.08	0.009
26-42nd days	2006.3^{b}	2174.8^{a}	2187.8^{a}	34.72	0.038
0-42nd days	3140.6^{b}	3406.2^{a}	3455.3^{a}	53.51	0.015
Feed intake, g/bird					
0-10th days	269.7^{b}	270.7^{b}	278.3^{a}	1.59	0.034
11-25th days	1264.4	1285.1	1273.3	12.93	0.836
26-42nd days	3349.6	3489.9	3434.4	35.53	0.291
0-42nd days	4883.7	5045.8	4986.0	47.25	0.404
Feed conversion ratio					
0-10th days	1.289	1.284	1.238	0.0109	0.097
11-25th days	1.367^{a}	1.260^{b}	1.222^{c}	0.0194	<0.001
26-42nd days	1.671^{a}	1.605^{b}	1.570^{b}	0.0148	0.003
0-42nd days	1.556^{a}	1.482^{b}	1.443^{c}	0.0148	<0.001

Wheat0: Group without wheat and enzyme addition, **Wheat50**: Group containing 50% wheat with enzyme instead of corn, **Wheat100**: Group containing 100% wheat with enzyme instead of corn. $^{a,b:}$ The difference between the means shown with different letters in the same row is statistically significant ($P<0.05$).

Hatching weights of chicks are statistically similar and vary between 41.00-41.95 g ($P>0.05$). Body weights on the 10th, 25th, and 42nd days have been statistically affected by the treatment diets ($P<0.05$). On the 10th day, the body weight of the Wheat100 group (265.9 g) is significantly higher than the Wheat0 and Wheat50 groups (251.2 g and 252.7 g, respectively). The 25th and 42nd days body weights of broilers are significantly higher in the Wheat50 (1273.0 g and 3447.8 g) and Wheat100 (1308.5 g and 3496.3 g) groups than in the Wheat0 group (1176.3 g and 3185.5 g). In the 0-10th days period of the study, the body weight gain of the Wheat100 group (224.9 g) has been found to be significantly higher than the Wheat0 and Wheat50 groups (209.3 g and 211.1 g, respectively). On the 11-25th, 26-42nd, and 0-42nd days body weight gain is significantly higher in Wheat50 (1020.3, 2174.8 and 3406.2 g) and Wheat100 (1042.6, 2187.8 and 3455.3 g) groups than in Wheat0 group (925.0, 2006.3 and 3140.6 g). Feed intake has been significantly affected by the treatment diets in the 0-10th days period of the study ($P<0.05$) but has not been affected in the other periods ($P>0.05$). Feed intake increased with wheat levels in the first period (0-10th days). This increase is significant in the Wheat100 (278.3 g) compared to the control (Wheat0 (269.7 g) and similar in the Wheat50 group (270.7 g). Feed intake of broilers is 1264.4-1285.1 g in the 11-25th days, 3434.4-3489.9 g in the 25-42nd days, and 4883.7-5045.8 g in total (0-42nd days). The feed conversion ratio of chicks in the first period (0-10th days) varies between 1.238-1.289 and there is no statistical difference ($P>0.05$). However, in other periods, the feed conversion ratio has been statistically affected by the treatments ($P<0.05$). In the 11-25th and 0-42nd days of the study, feed conversion ratio improved with the use of enzyme-added wheat instead of maize and this improvement is significant in each treatment group. In these periods (11-25th and 0-42nd days), feed conversion ratio has been determined as 1.367 and 1.556 in Wheat0, 1.260-1.482 in Wheat50, and 1.222-1.443 in Wheat100 groups. In the 26-42nd days period, the feed conversion ratio of broilers has been found to be significantly lower in the Wheat50 and Wheat100 groups (1.605 and 1.570) compared to the control (Wheat0) group (1.671). Similar to this study, earlier research has shown that broiler performance may be enhanced by

enzyme supplementation (Annison, 1992; Kırkpınar et al., 1996). In comparison to the control group, broilers given diets treated with enzymes showed improved feed efficiency, according to studies by Olukosi et al. (2007) and Woyengo et al. (2010). Once more, Thorat et al. (2015) reported that broiler body weight and feed efficiency were enhanced by enzyme supplementation. Furthermore, it has been clarified that the usage of enzymes tends to enhance body weight (Omojola and Adesehinwa, 2007; Kırkpınar et al., 2018). Using a variety of enzymes is advised to receive the most benefit from them, since they can each target a particular anti-nutritional element in diets (Adeola and Cowieson, 2011). It should be remembered, nevertheless, that the nature of the feed may affect how helpful the enzyme combination (Meng et al., 2005). Thorat et al. (2015) and Islam et al. (2010) have explained similar results, namely that broiler feed intake remains unchanged when enzymes are added to the diet. Chiang et al. (2005) reported that enzyme addition to wheat-containing broiler diets improved body weight but had no effect on other performance parameters. Tang et al. (2017) and Kırkpınar et al. (2018) stated that enzyme use in wheat-containing diets did not affect performance parameters.
The effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of maize in broiler diets on slaughtering characteristics is demonstrated in Table 3.

Table 3. Effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of corn in the diet on the slaughtering characteristics

Parameters	Treatments			Standard error	*P* value
	Wheat0	Wheat50	Wheat100		
Carcass*	76.80	75.67	74.76	0.512	0.290
Thigh+drumstick**	27.33	27.01	28.08	0.486	0.695
Breast**	37.14	37.43	38.79	0.534	0.442
Abdominal fat*	1.41[a]	0.52[b]	0.57[b]	0.148	0.005

Wheat0: Group without wheat and enzyme addition, **Wheat50**: Group containing 50% wheat with enzyme instead of corn, **Wheat100**: Group containing 100% wheat with enzyme instead of corn. *Given as a percentage of body weight. ** Given as a percentage of carcass [a,b:] The difference between the means shown with different letters in the same row is statistically significant (P<0.05).

The use of 50% and 100% wheat with enzyme supplementation instead of maize in the diet did not affect the carcass (74.76-76.80%), thigh+drumstick (27.01-28.08%), and breast (37.14-38.79%) ratios of broilers statistically (P>0.05). The use of enzyme supplemented wheat instead of maize in the diet affected the relative abdominal weight significantly (P<0.05) and the abdominal fat ratio of Wheat50 (0.50%) and Wheat100 (0.57%) groups has been found to be significantly lower than the control (Wheat0) group (1.41%).
The effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of maize in broiler diets on visceral weights is given in Table 4.

Table 4. Effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of corn in the diet on the visceral weights

Parameters*	Treatments			Standard error	*P* value
	Wheat0	Wheat50	Wheat100		
Liver	1.49[b]	1.63[ab]	1.84[a]	0.059	0.033
Gizzard	1.25	1.54	1.31	0.076	0.278
Pancreas	0.214	0.213	0.191	0.0069	0.329

Wheat0: Group without wheat and enzyme addition, **Wheat50**: Group containing 50% wheat with enzyme instead of corn, **Wheat100**: Group containing 100% wheat with enzyme instead of corn. *Given as a percentage of body weight. [a,b:] The difference between the means shown with different letters in the same row is statistically significant (P<0.05).

The use of 50% and 100% wheat with enzyme instead of maize in the diet did not affect the gizzard (1.25-1.54%) and pancreas (0.191-0.214%) ratios of broilers statistically (P>0.05). The use of wheat with enzyme instead of maize in the diet affected the relative liver weights significantly (P<0.05) and the liver ratio of the Wheat100 group (1.84%) has been found to be significantly higher than the Wheat0 (control) group (1.49%). Kırkpınar et al. (2018) reported that the use of wheat in broiler diets did not affect internal organ weights. Omojola and Adesehinwa (2007) stated that the use of enzymes increased carcass yield but did not affect other slaughtering parameters. These studies are not consistent with the current study.

Kaynaklar

Adeola, O., & Cowieson, A. J. (2011). Board-invited review: opportunities and challenges in using exogenous enzymes to improve nonruminant animal production. *Journal of Animal Science*, 89(10), 3189-3218. https://doi.org/10.2527/jas.2010-3715

Annison, G. (1992). Commercial enzyme supplementation of wheatbased diets raises ileal glycanase activities and improves apparent metabolisable energy, starch and pentosan digestibilities in broiler chickens. *Animal Feed Science and Technology*, 38(2-3), 105-121. https://doi.org/10.1016/0377-8401(92)90096-O

Chiang, C. C., Yu, B., & Chiou, P. W. S. (2005). Effects of xylanase supplementation to wheat-based diet on the performance and nutrient availability of broiler chickens. *Asian-Australasian Journal of Animal Sciences*, 18(8), 1141-1146. https://doi.org/10.5713/ajas.2005.1141

Çiftçi, İ. (2001). Yem katkı maddesi olarak enzimler, çiftlik hayvanlarının beslenmesinde temel prensipler ve karma yem üretiminde bazı bilimsel yaklaşımlar. Farmavet ilaç sanayi ve ticaret AŞ İstanbul, 543-583.

Islam, S. S., Akter, P., Pal, J. R., Gain, P., & Khan, M. K. A. (2010). Effect of different levels of exogenous enzyme supplementation to the diet on broiler performances. *Indian Journal of Animal Sciences*, 80(5), 479.

Kırkpınar, F., Açıkgöz, Z., Mert, S., & Işık, Ö. (2018). Effects of dietary probiotic, prebiotic and enzyme mixture supplementation on performance, carcase, organs, ileal ph and viscosity of broilers. *Hayvansal Üretim*, 59(2), 1-9. https://doi.org/10.29185/hayuretim.469862

Kırkpınar F, Taluğ AM, Erkek R, Sevgican F. 1996. The effect of added enzyme in broiler chicks diets based on barley on utilization of nutrients. First National Animal Science Congress Proceedings, February 5-7, Antalya-Turkey, pp. 84-89 (in Turkish, with English abstract).

Meng, X., Slominski, B. A., Nyachoti, C. M., Campbell, L. D., & Guenter, W. (2005). Degradation of cell wall polysaccharides by combinations of carbohydrase enzymes and their effect on nutrient utilization and broiler chicken performance. *Poultry Science*, 84(1), 37-47. https://doi.org/10.1093/ps/84.1.37

Olukosi, O. A., Cowieson, A. J., & Adeola, O. (2008). Energy utilization and growth performance of broilers receiving diets supplemented with enzymes containing carbohydrase or phytase activity individually or in combination. *British Journal of Nutrition*, 99(3), 682-690. https://doi.org/10.1017/S0007114507815807

Omojola, A. B., & Adesehinwa, A. O. K. (2007). Performance and carcass characteristics of broiler chickens fed diets supplemented with graded levels of Roxazyme G. *International Journal of Poultry Science*, 6(5), 335-339.

Sevgili, H., Özen, N., & Ertürk, M. M. (1999). Arpa-buğday ağırlıklı bıldırcın karma yemlerinde enzim kullanımının performansa etkileri. *VİV. Poultry Yutav*, 99, 3-6.

Tang, D. F., Liu, X. X., Shi, X. G., & Aftab, U. (2017). Effect of cereal type and xylanase supplementation on nutrient retention and growth performance of broilers. *Journal of Applied Poultry Research*, 26, 529–535. https://doi.org/10.3382/japr/pfx026

Thorat, S. G., Panwar, V. S., Dahiya, D. S., & Tewatia, B. S. (2015). Efficacy of probiotics, prebiotics and enzymes as growth promoters on the performance of broiler chicken. *Haryana Veterinarian Journal June*, 54 (1), 75-78.

Woyengo, T. A., Slominski, B. A., & Jones, R. O. (2010). Growth performance and nutrient utilization of broiler chickens fed diets supplemented with phytase alone or in combination with citric acid and multicarbohydrase. *Poultry Science*, 89(10), 2221-2229. https://doi.org/10.3382/ps.2010-00832