Egyptian J. Nutrition and Feeds (2011) 14 (2) : 251-265

EFFECT OF SUBSTITUTING YELLOW CORN BY TRITICALE GRAINS ON PRODUCTIVE PERFORMANCE OF TWO BROILER STRAINS.

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(Received 18/12/2010, Accepted 29/4/2011)

SUMMARY

The objective of this experiment was to evaluate the efficiency of substituting (0, 25, 50, 75 and 100%) yellow corn by triticale grains with or without a commercial enzyme supplementation (Avizyme 1500) on productive performance, mortality rate and economical efficiency of broiler chickens. A total number of 700 one-day old unsexed broiler chickens from two strains Ross and Cobb (350 each) were divided into ten treatments for each cross (35 birds each), each treatment contained 5 replicates of 7 birds.

Results indicated that substitution of yellow corn by triticale grains at different levels caused significant increase in live body weight at 42 days of age and live body weight gain during the period from 5-42 days for the Ross strain, while the differences were insignificant for Cobb strain. Feed intake was significantly increased by substitution of yellow corn by triticale in the Ross broiler diet from 0% to 100%. Cobb broiler fed diet containing 100% triticale had the lowest feed intake while, those fed diets containing 50% triticale had higher FI. Enzyme supplementation significantly affected feed intake for the two strains. Inclusion of triticale in the Ross and Cobb broiler diets at different levels had insignificant effects on feed conversion, crude protein conversion, caloric conversion ratio and performance index. Enzyme supplementation insignificantly affected feed conversion, crude protein conversion caloric conversion ratio and performance index for both strains. Substitution of triticale in the Ross broiler diets at different levels improved performance index compared with those fed the control diet. Mortality was 2.86% in Ross chicks fed diet containing 25 and 100% triticale supplemented with enzyme and zero% in chicks fed the other experimental diets. Mortality was 2.86% in Cobb chicks fed control diet and those containing 25% triticale supplemented with enzyme however, mortality was zero% in chicks fed the other experimental diets. Ross broiler chicks fed 100% triticale un-supplemented with enzyme had the best economical and relative efficiency followed by Ross broiler chicks fed 75% triticale un-supplemented with enzyme then Ross broiler chicks fed 25% triticale un-supplemented with enzyme. Cobb broiler chicks fed 100% triticale supplemented with enzyme had the best economical and relative efficiency followed by Cobb broiler chicks fed 25% triticale un-supplemented with enzyme then Cobb broiler chicks fed 75% triticale un-supplemented with enzyme.

It can be concluded that triticale can be used in broiler chick (Ross and Cobb) diets without adverse effect to get the best performance and highest income, taking in consideration the strain response to the level of substitution.

Keywords: *Triticale, broiler, strain, performance.*

INTRODUCTION

The increasing cost of imported feed ingredients has prompted animal nutritionists and feed processors to focus their attention on non-conventional feed sources. The feed cost for poultry production is about 60-70% of the total cost production, and energy alone contributes about 70% of the feed cost (Wilson and Bayer, 2000 and Saleh *et al.*, 2004). This suggests that in order to minimize the feed cost and maximize profit, the producer must use the cheapest form of energy as a substitute for corn (the main component of broiler diet) to obtain a greater growth rate with lower cost. Nontraditional feed grains, particularly from local production may offset some of the cost of feeding poultry. In Egypt, the traditional feed grains, particularly corn, is not produced in available quantities to be used in poultry diets. Once identified, some nontraditional feed grains prove to be useful. Triticale is a relatively new feed grains in poultry feed (Hermes and Johnson, 2004). Triticale is an alternative cereal grains that is a hybrid of wheat and rye. These species were crossed with the intention of producing a grain with the feeding characteristics of wheat and the winter hardiness, drought and disease resistance of rye (Boros, 1999 and Attia and Abd El-Rahman, 1996, 2001). Triticale was developed to combine the high crude protein (CP) and digestible energy of wheat with the high yields and protein quality of rye. Triticale has the ability to grow in acidic soils and extreme climates, coupled with larger yields than rye, making it a practical and economical feedstuff, in addition to its ability to produce higher biomass and high regrowth after grazing, and its usefulness as a feed grain for monogastric animals (Attia and Abd El-Rahman, 1996, 2001).

A number of studies have reported no negative impact on growth associated with triticale consumption. Vieira *et al.* (1995) found that the graded inclusion of triticale up to 40% (substituted for corn) had no negative effect on final weight of broilers. Similarly, Al-Athari and Al-Bustany (1997) reported that inclusion of triticale up to 20% with 40% corn did not cause any significant effect on body weight when compared with the control (60% corn), but inclusion of triticale over 40% caused a significant reduction in body weight. Abd El-Rahman *et al.* (2008) demonstrated that the feed intakes were significantly increased with inclusion of triticale in the broiler diet (50% of corn) during the finishing and overall periods when compared with the other treatments. Janushonis *et al.* (2004) indicated that feed consumption in the experimental groups was lower when maize had been replaced by triticale with dietary enzymes in turkey broilers at the rate of 25 to 35%. Al-Athari and Al-Bustany (1997) obtained a significant improve in FCR when chicks were fed a diet containing 40.6% triticale with 19.2% corn, compared with the control group (57.5% corn). Abd El-Rahman *et al.* (2008) observed that FCR were significantly improved by inclusion of triticale in the diet during the finishing and overall period when compared with the control, however, no significant differences were observed between the groups fed triticale at 25 and 50%. Other researchers have observed poorer FCR with triticale-based diets in broilers (Proudfoot and Hulan, 1988 and Vieira *et al.*, 1995 and Smith *et al.* 1989).

The higher concentrations of limiting essential amino acids, in particular lysine and threonine, permit less use of a supplemental protein source, such as soybean meal, when using triticale as opposed to maize in formulating poultry diets. Triticale became economically feasible as a straight maize replacement in broiler diets when the price was less than or equal to 95% of maize. This information is important to broiler producers where triticale is produced and is available for poultry diets. In economic studies of broiler diets, Belaid (1994) showed that the inclusion of triticale leads to cost savings resulting from the complete replacement of maize and from a considerable reduction of soybean meal in the diets. The cost reductions from using triticale ranged from 1.3 to 2.3% when triticale was priced equal to corn. When triticale was priced at 95% of corn, these cost reductions were 4.5 to 7.2%.

Nowadays, there are numerous commercial broiler strains in the market. These strains differ in their response to dietary composition. It is important to evaluate these strains in Egypt under different dietary compositions.

Therefore, the objective of this experiment was to study the effect of substituting yellow corn by triticale grains with or without enzyme supplementation on productive performance, mortality rate and economical efficiency of Ross and Cobb strains.

MATERIALS AND METHODS

The experimental work of the present study was carried out at the Poultry Research Station, Poultry Production Department, Faculty of Agriculture, Fayoum University during the period from November 2008 to January 2009. Chemical analyses were performed in the laboratories of the same department according to the procedures outlined by AOAC (1990).

Experimental birds and diets:

A total number of 700 one-day old unsexed broiler chickens from two strains Ross and Cobb (350 of each) were initially fed a control diet for five days. Chicks were individually weighed to the nearest gram at the start of experiment, wing-banded and randomly allotted to the dietary treatments. Chicks were raised in electrically heated batteries with raised wire mesh floors and had a free access to the mach feed and fresh water throughout the experiment. Light was provided for 23 h/d. Room temperature on day 0 was 33°C and decreased approximately 3°C per week until 20°C was reached, according to standard poultry rearing practices. The chicks were fed broiler starter diets between day five to 11, broiler grower diets between day 12 to 23, and broiler finisher diets between days 24 to 42. The experimental birds at five days of age of each strain were divided into ten treatments (35 birds each). Each treatment contained five replicates of seven birds. The experimental treatments were as follows for each strain:

1- The control diet, 100% yellow corn (YC) (D1).

2- The control diet, 100% YC + 0.1% Avizyme 1500 (D2).

3- 25% YC in D1 was replaced by triticale grains.

4- 25% YC in D2 was replaced by triticale grains.

5- 50% YC in D1 was replaced by triticale grains.

6- 50% YC in D2 was replaced by triticale grains.

7- 75% YC in D1 was replaced by triticale grains.

8- 75% YC in D2 was replaced by triticale grains.

9- 100% YC in D1 was replaced by triticale grains.

10- 100% YC in D2 was replaced by triticale grains.

The experimental diets were formulated to be iso-nitrogenous and iso-caloric and supplemented with minerals and vitamins mixture, DL-methionine and L-Lysine HCl to cover the recommended requirements according to standard commercial guidelines for each strain. The composition and chemical analyses of the experimental diets are shown in Tables (1-6).

Table (1). Composition and determined analyses of the starter diet for Ross strain.

Item	Level of yellow corn substitution%				
	0	25	50	75	100
Yellow corn, ground	54.00	40.50	27.00	13.50	0.00
Triticale, ground	0.00	13.50	27.00	40.50	54.00
Soybean meal (44%CP)	31.55	30.95	32.50	32.62	34.00
Broiler concentrate (48%CP[1])	10.00	10.00	7.20	6.00	3.32
Calcium carbonate	0.56	0.56	0.45	0.80	0.70
Sodium chloride	0.05	0.05	0.12	0.14	0.22
Vit. and Min. premix[2]	0.30	0.30	0.30	0.30	0.30
Dicalcium phosphate	0.50	0.50	1.00	1.10	1.70
Vegetable oil[3]	2.80	3.40	4.20	4.80	5.50
DL–Methionine	0.10	0.09	0.09	0.10	0.11
L-Lysine HCl	0.14	0.15	0.14	0.14	0.15
Total	100.0	100.0	100.0	100.0	100.0
Determined analysis (%):					
Moisture	12.61	11.90	11.48	11.42	10.69
Crude protein	23.50	23.69	23.62	23.59	23.54
Ether extract	5.50	5.85	6.35	6.62	7.00
Crude fiber	3.39	3.70	3.98	4.02	4.65
Ash	6.06	6.62	6.29	7.95	7.25
Nitrogen free extract	48.94	48.24	48.28	46.40	46.87
ME, kcal./Kg	3015	3018	3018	3009	3001
Cost (L.E./ton)[4]	2200.0	2202.1	2181.5	2166.8	2157.6
Relative cost[5]	100.0	100.09	99.16	98.49	98.07

[1]Broiler concentrate manufactured by Alpha Feed For Premix Production Company and contains: 48% Crude protein; 1.5% crude fiber; 4.75% ether extract; 6.85% calcium; 3% available phosphorus; 1.2% methionine; 1.8% methionine + cystine; 2.4% lysine; 0.96% Sodium; 2415 K cal ME/kg.
[2]Each 3.0 Kg of the Vit. and Min. premix manufactured by Vetgreen Company contains: Vit. A 10000000 IU; Vit. D_3 2000000 IU; Vit. E 1000 mg; Vit. K_3 1000 mg; Vit. B1 1000 mg; Vit. B2 500 mg; Vit. B6 1500 mg; Vit. B12 10 mg; biotin 50 mg; folic acid 1 g; niacin 3000 mg; Ca pantothenate 1000 mg; Zn 50 g; Cu 4 g; Fe 30 g; Co 0.1 g; Se 0.1 g; I 0.3 g; Mn 60 g and anti-oxidant 10 g, and complete to 3.0 Kg by calcium carbonate.
[3]Mixture from 75% soybean oil and 25% sunflower oil.
[4]According to the local market price at the experimental time.
[5]Assuming the price of the control group equal 100.

A commercial arabinoxylanase preparation (Avizyme 1500) was included in enzyme treatments, as arabinoxylans are the major water-soluble nonstarch polysaccharides of wheat, rye, and the wheat-rye hybrid triticale (Bonnin *et al.*, 1998 and Mathlouthi *et al.*, 2002).

Measured and/or calculated criteria include: Live body weight (LBW), Live body weight gain (LBWG), daily feed intake (FI), feed conversion (FC) as g feed/g gain, crude protein conversion (CPC) as g protein consumed/g gain, caloric conversion ratio (CCR) as Kcal. ME consumed/g gain, performance index (PI) according to the equation described by North (1981) PI = (LBW, Kg/FC) x100, mortality % and economical efficiency.

Table (2). Composition and determine analyses of the grower diet for Ross strain.

Item	Level of yellow corn substitution%				
	0	25	50	75	100
Yellow corn, ground	58.00	43.50	29.00	14.50	0.00
Triticale, ground	0.00	14.50	29.00	43.50	58.00
Soybean meal (44%CP)	27.00	26.00	26.93	27.03	26.00
Broiler concentrate(48%CP[1])	10.00	10.00	7.66	7.00	7.00
Calcium carbonate	0.16	0.20	0.20	0.40	0.73
Sodium chloride	0.05	0.05	0.11	0.13	0.12
Vit. and Min. premix[2]	0.30	0.30	0.30	0.30	0.30
Dicalcium phosphate	0.22	0.35	0.90	0.70	0.80
Vegetable oil[3]	4.07	4.90	5.70	6.30	6.90
DL–Methionine	0.10	0.10	0.10	0.06	0.06
L-Lysine HCl	0.10	0.10	0.10	0.08	0.09
Total	100.0	100.0	100.0	100.0	100.0
Determined analysis (%):					
Moisture	12.58	11.48	10.70	10.60	10.53
Crude protein	21.82	21.99	21.85	21.98	22.01
Ether extract	6.95	7.50	7.95	8.20	8.50
Crude fiber	3.25	3.60	3.92	4.23	4.32
Ash	5.28	6.69	6.40	6.80	7.05
Nitrogen free extract	50.12	48.74	49.18	48.19	47.59
ME, kcal./Kg	3160	3172	3168	3165	3156
Cost (L.E./ton)[4]	2157.9	2168.5	2155.5	2116.9	2118.7
Relative cost[5]	100.0	100.49	99.89	98.10	98.18

[1]Broiler concentrate manufactured by Alpha Feed For Premix Production Company and contains: 48% Crude protein; 1.5% crude fiber; 4.75% ether extract; 6.85% calcium; 3% available phosphorus; 1.2% methionine; 1.8% methionine + cystine; 2.4% lysine; 0.96% Sodium; 2415 K cal ME/kg.
[2]Each 3.0 Kg of the Vit. and Min. premix manufactured by Vetgreen Company contains: Vit. A 10000000 IU; Vit. D_3 2000000 IU; Vit. E 1000 mg; Vit. K_3 1000 mg; Vit. B1 1000 mg; Vit. B2 500 mg; Vit. B6 1500 mg; Vit. B12 10 mg; biotin 50 mg; folic acid 1 g; niacin 3000 mg; Ca pantothenate 1000 mg; Zn 50 g; Cu 4 g; Fe 30 g; Co 0.1 g; Se 0.1 g; I 0.3 g; Mn 60 g and anti-oxidant 10 g, and complete to 3.0 Kg by calcium carbonate.
[3]Mixture from 75% soybean oil and 25% sunflower oil.
[4]According to the local market price at the experimental time.
[5]Assuming the price of the control group equal 100.

Data were analyzed for each strain separately (because they have different nutrients requirements) using General Linear Models procedure of SPSS software (SPSS, 1999). Two way analyses of variance model was applied with treatment and enzyme supplementation effects according to the follows Model:

$$Y_{ijk}= \mu+T_i+E_j+TE_{ij} +e_{ijk}$$

Where: Y_{ijk}: an observed value in the i^{th} treatment in the j^{th} enzyme supplementation of the k^{th} individual; μ: overall mean; T_i: treatment effect (i: 1 to 10); E_j: enzyme supplementation effect (j: 0.0 and 0.1%); TE_{ij}: interaction of treatment and enzyme supplementation and e_{ijk}: random error term. Means indicating significant differences (P≤0.01 and P≤0.05) were tested using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Live body weight (LBW):

Results presented in Table (7) showed the effect of feeding different levels of triticale grains with or without enzyme supplementation on LBW of Ross and Cobb strains. Substitution of yellow corn by

Table (3). Composition and determine analyses of the finisher diet for Ross strain.

Item	Level of yellow corn substitution%				
	0	25	50	75	100
Yellow corn, ground	62.00	46.50	31.00	15.50	0.00
Triticale, ground	0.00	15.50	31.00	46.50	62.00
Soybean meal (44%CP)	22.72	21.93	23.24	24.20	25.72
Broiler concentrate (48%CP[1])	10.00	10.00	7.00	5.21	2.00
Calcium carbonate	0.10	0.10	0.70	0.50	0.70
Sodium chloride	0.05	0.05	0.13	0.15	0.25
Vit. and Min. premix[2]	0.30	0.30	0.30	0.30	0.30
Dicalcium phosphate	0.30	0.30	0.60	0.90	1.40
Vegetable oil[3]	4.50	5.30	6.00	6.72	7.60
DL – Methionine	0.03	0.02	0.03	0.02	0.03
L-Lysine HCl	0.06	0.06	0.10	0.10	0.10
Total	100.0	100.0	100.0	100.0	100.0
Determined analysis (%):					
Moisture	11.22	10.81	10.29	10.12	9.13
Crude protein	20.10	20.32	20.15	20.25	20.11
Ether extract	7.50	8.00	8.23	8.51	8.97
Crude fiber	3.21	3.35	3.66	3.98	4.58
Ash	8.24	7.86	8.55	8.09	8.56
Nitrogen free extract	49.73	49.66	49.12	49.05	48.65
ME, kcal./Kg	3231	3242	3219	3218	3210
Cost (L.E./ton)[4]	2069.2	2071.7	2028.6	2016.8	1988.1
Relative cost[5]	100.0	100.12	98.04	97.47	96.08

[1]*Broiler concentrate manufactured by Alpha Feed For Premix Production Company and contains: 48% Crude protein; 1.5% crude fiber; 4.75% ether extract; 6.85% calcium; 3% available phosphorus; 1.2% methionine; 1.8% methionine + cystine; 2.4% lysine; 0.96% Sodium; 2415 K cal ME/kg.*

[2]*Each 3.0 Kg of the Vit. and Min. premix manufactured by Vetgreen Company contains: Vit. A 10000000 IU; Vit. D_3 2000000 IU; Vit. E 1000 mg; Vit. K_3 1000 mg; Vit. B1 1000 mg; Vit. B2 500 mg; Vit. B6 1500 mg; Vit. B12 10 mg; biotin 50 mg; folic acid 1 g; niacin 3000 mg; Ca pantothenate 1000 mg; Zn 50 g; Cu 4 g; Fe 30 g; Co 0.1 g; Se 0.1 g; I 0.3 g; Mn 60 g and anti-oxidant 10 g, and complete to 3.0 Kg by calcium carbonate.*

[3]*Mixture from 75% soybean oil and 25% sunflower oil.*

[4]*According to the local market price at the experimental time.*

[5]*Assuming the price of the control group equal 100.*

triticale grains in the diets at different levels caused significant increase in LBW of Ross strain at 42 days of age; chicks fed diet with 75% of YC substitution had the highest LBW while those fed the control diet had the lowest value (Table 7). Substitution of yellow corn by triticale grains in the Cobb chick's diets at different levels caused insignificant differences in LBW. Chicks fed diet with 50% of YC substitution had the highest LBW while those fed the 100% of YC substitution diet had the lowest value. These results agree with the findings of Janushonis *et al.* (2004) who indicated that average body weight was higher when maize was replaced with triticale and enzymes in the diets of turkey broilers at the rate of 25 to 35%. Similarly, Vieira *et al.* (1995) found that the graded inclusion of triticale up to 40% (substituted for corn) had no negative effect on final weight of broilers. Attia and Abd El-Rahman, (1996, 2001) found similar results. However, negative effects regarding the decrease in chicks LBW by feeding triticale were observed by Smith *et al.* (1989). Enzyme supplementation insignificantly affected LBW of both strains, chicks fed enzyme supplemented diet had higher LBW than those fed the unsupplemented diet as shown in Table (7). Similar to the present results, Petersen *et al.* (1999) indicated that older chicks are better able to cope with increases in digesta viscosity related to the dietary level of non-starch polysaccharides. On the other hand, the poor absorptive ability of broilers is due to an immature (Croom *et al.*, 1999) and shorter gastro-intestinal tract (Cherry *et al.*, 1987) with a limited digestive capacity, as the levels of pancreatic amylase and chymotrypsin have been shown to be lower in heavy breed birds (Nir *et al.* 1978). For this reason, it can be concluded that exogenous feed enzyme can be added to broiler chicken diets at an early ages to overcome perceived dietary problems or to help the birds' poorly developed digestive system. The interaction between triticale levels x enzyme supplementation had an insignificant effect on LBW for the two strains. The group of Ross strain fed diet containing 75% triticale supplemented with 1%enzyme had the highest LBW, while those fed 0% triticale supplemented with 0%enzyme had the lowest. Regarding the Cobb strain, the group fed diet containing 50% triticale unsupplemented with enzyme had the highest LBW, while those fed 100% triticale supplemented with 0% enzyme had the lowest (Table 7). These results indicated that triticale can be substituted in Ross and

Cobb diets up to 100% YC without any adverse effect on chicks taking in consideration the strain response to the level of substitution.

Table (4). Composition and determine analyses of the starter diet for Cobb strain.

Item	Level of yellow corn substitution%				
	0	25	50	75	100
Yellow corn, ground	62.00	46.50	31.00	15.50	0.00
Triticale, ground	0.00	15.50	31.00	46.50	62.00
Soybean meal (44%CP)	25.00	27.10	26.65	27.70	28.80
Broiler concentrate (48%CP[1])	10.00	6.70	5.80	3.40	1.00
Calcium carbonate	0.40	0.40	0.70	0.85	1.00
Sodium chloride	0.05	0.14	0.15	0.16	0.28
Vit. and Min. premix[2]	0.30	0.30	0.30	0.30	0.30
Dicalcium phosphate	0.80	1.20	1.20	1.77	2.00
Vegetable oil[3]	1.29	2.00	3.00	3.60	4.40
DL–Methionine	0.10	0.10	0.10	0.12	0.12
L-Lysine HCl	0.06	0.06	0.10	0.10	0.10
Total	100.0	100.0	100.0	100.0	100.0
Determined analysis (%):					
Moisture	12.91	12.25	12.43	11.19	10.63
Crude protein	21.09	21.15	21.20	21.08	21.10
Ether extract	4.20	4.55	5.21	5.48	5.83
Crude fiber	3.71	3.75	3.56	4.02	4.56
Ash	6.08	6.26	8.15	8.68	7.65
Nitrogen free extract	52.01	52.04	49.45	49.55	50.23
ME, kcal./Kg	2998	2986	3002	2979	2974
Cost (L.E./ton)[4]	2090.5	2056.4	2049.3	2041.1	2011.7
Relative cost[5]	100.0	98.37	98.03	97.64	96.23

[1]*Broiler concentrate manufactured by Alpha Feed For Premix Production Company and contains: 48% Crude protein; 1.5% crude fiber; 4.75% ether extract; 6.85% calcium; 3% available phosphorus; 1.2% methionine; 1.8% methionine + cystine; 2.4% lysine; 0.96% Sodium; 2415 K cal ME/kg.*

[2]*Each 3.0 Kg of the Vit. and Min. premix manufactured by Vetgreen Company contains: Vit. A 10000000 IU; Vit. D_3 2000000 IU; Vit. E 1000 mg; Vit. K_3 1000 mg; Vit. B1 1000 mg; Vit. B2 500 mg; Vit. B6 1500 mg; Vit. B12 10 mg; biotin 50 mg; folic acid 1 g; niacin 3000 mg; Ca pantothenate 1000 mg; Zn 50 g; Cu 4 g; Fe 30 g; Co 0.1 g; Se 0.1 g; I 0.3 g; Mn 60 g and anti-oxidant 10 g, and complete to 3.0 Kg by calcium carbonate.*

[3]*Mixture from 75% soybean oil and 25% sunflower oil.*

[4]*According to the local market price at the experimental time.*

[5]*Assuming the price of the control group equal 100.*

Live body weight gain (LBWG):

Inclusion of triticale in the Ross diets at different levels caused significant (P≤0.01) increase in LBWG. Live body weigh gain of Ross chicks fed 75% triticale grains were significantly higher when compared with those fed the control diet, but did not differ when compared with the other triticale groups. Substitution of yellow corn by triticale grains in the Cobb chick's diets at different levels caused insignificant differences in LBWG. Chicks fed diet with 50% of YC substitution had the highest LBW while those fed the 100% of YC substitution diet had the lowest values (Table 7). In this connection, Abd El-Rahman, *et al.* (2008) reported that inclusion of triticale in the broiler diets at different levels caused a significant reduction in LBWG during the starter period, but not during the finishing and overall periods which is in harmony with findings obtained herein. Similar results were previously observed by Yaqoob and Netke (1975) who found that substituting triticale from maize, weight for weight, but not on an iso-nitrogenous basis, in a soybean oil meal diet improved weight gain at 50% or more. Further more, Al-Athari and Guenter (1988) observed that diets containing 50 to 100% triticale resulted in higher LBWG which is in harmony with our findings with Ross strain. Also, Chapman *et al.* (2005) indicated that the daily LBWG for the diets using triticale was five percent higher than for the corn-based diet. Enzyme supplementation improves LBWG compared with those fed enzyme un-supplemented diet but the differences were not significant for the two strains as shown in Table (7). Also, Jakic *et al.* (1998) examined the influence of multienzyme on broiler performance and indicated that LBWG of group fed diets supplemented with multienzyme was higher at 42 days of age as compared with the control group. Interaction due to triticale levels x enzyme addition had insignificant effect on LBWG for the two strains. Ross chicks fed diet containing 75% triticale supplemented with 1% enzyme had heavier LBWG, while those fed 0% triticale diet unsupplemented with enzyme had the lowest value. While, the Cobb group fed diet containing 50% triticale unsupplemented with enzyme had the highest LBWG and those fed 100% triticale supplemented with 0%enzyme had the lowest. In conclusion, the experimental results indicated that triticale can be substituted in Ross and Cobb diets up to 100% YC without any adverse effect on chicks LBWG (Table7).

Table (5). Composition and determine analyses of the grower diet for Cobb strain.

Item	Level of yellow corn substitution%				
	0	25	50	75	100
Yellow corn, ground	64.00	48.00	32.00	16.00	0.00
Triticale, ground	0.00	16.00	32.00	48.00	64.00
Soybean meal (44%CP)	25.60	26.26	27.00	25.91	25.64
Broiler concentrate (48%CP[1])	5.00	3.00	1.00	1.00	0.00
Calcium carbonate	0.60	0.70	0.90	0.90	1.20
Sodium chloride	0.18	0.25	0.27	0.28	0.30
Vit. And Min. premix[2]	0.30	0.30	0.30	0.30	0.30
Dicalcium phosphate	1.30	1.70	1.90	2.10	2.30
Vegetable oil[3]	2.80	3.60	4.40	5.32	6.10
DL–Methionine	0.12	0.12	0.13	0.10	0.10
L-Lysine HCl	0.10	0.07	0.10	0.09	0.06
Total	100.0	100.0	100.0	100.0	100.0
Determined analysis (%):					
Moisture	12.99	12.16	11.37	11.66	10.90
Crude protein	19.25	19.22	19.30	19.35	19.33
Ether extract	5.70	6.04	6.50	7.01	7.49
Crude fiber	3.10	3.20	3.50	4.23	4.60
Ash	5.95	5.78	6.46	6.83	7.36
Nitrogen free extract	53.01	53.60	52.87	50.92	50.32
ME, kcal./Kg	3096	3088	3085	3097	3091
Cost (L.E./ton)[4]	2025.1	2005.5	1991.6	1990.3	1975.8
Relative cost[5]	100.0	99.03	98.35	98.28	97.57

[1]*Broiler concentrate manufactured by Alpha Feed For Premix Production Company and contains: 48% Crude protein; 1.5% crude fiber; 4.75% ether extract; 6.85% calcium; 3% available phosphorus; 1.2% methionine; 1.8% methionine + cystine; 2.4% lysine; 0.96% Sodium; 2415 K cal ME/kg.*
[2]*Each 3.0 Kg of the Vit. and Min. premix manufactured by Vetgreen Company contains: Vit. A 10000000 IU; Vit. D_3 2000000 IU; Vit. E 1000 mg; Vit. K_3 1000 mg; Vit. B1 1000 mg; Vit. B2 500 mg; Vit. B6 1500 mg; Vit. B12 10 mg; biotin 50 mg; folic acid 1 g; niacin 3000 mg; Ca pantothenate 1000 mg; Zn 50 g; Cu 4 g; Fe 30 g; Co 0.1 g; Se 0.1 g; I 0.3 g; Mn 60 g and anti-oxidant 10 g, and complete to 3.0 Kg by calcium carbonate.*
[3]*Mixture from 75% soybean oil and 25% sunflower oil.*
[4]*According to the local market price at the experimental time.*
[5]*Assuming the price of the control group equal 100.*

Feed intake (FI):

The effects of feeding different levels of triticale grains with or without enzyme supplementation on FI of Ross and Cobb strains are given in Table (8). Inclusion of triticale in the Ross and Cobb diets at different levels caused significant increase in FI compared with those fed the control diet. Birds of Ross strain fed diet containing 75% triticale grains had the highest FI while those fed the control diet had the lowest values. In the Cobb strain, birds fed diet containing 50% triticale grains had the highest FI while those fed the 50% triticale grains had the lowest values (Table 8). These results are in harmony with those obtained by Abd El-Rahman *et al.* (2008) who reported that the FI values were significantly increased with inclusion of triticale in the broiler diet (50% of corn) during the finishing and overall periods when compared with the other treatments. Also, Al-Athari and Guenter (1988) reported that FI of chickens given 100% triticale diets was greater ($P \leq 0.05$) than chickens given the wheat control or 25% triticale diets. However, with broiler chickens, FI did not differ significantly among the corn/triticale based diets (Attia and Abd El-Rahman, 1996, 2001). However, results obtained herein disagree with those of Janushonis *et al.* (2004) who indicated that feed consumption in the experimental groups was lowest when maize was replaced by triticale and enzymes in the diets of turkey broilers at the rate of 25 to 35%. Enzyme supplementation significantly ($P \leq 0.01$) affected FI, in which Ross chicks fed diet supplemented

Table (6). Composition and determine analyses of the finisher diet for Cobb strain.

Item	Level of yellow corn substitution%				
	0	25	50	75	100
Yellow corn, ground	68.00	51.00	34.00	17.00	0.00
Triticale, ground	0.00	17.00	34.00	51.00	68.00
Soybean meal (44%CP)	19.92	20.00	21.10	21.10	21.43
Broiler concentrate (48%CP[1])	7.00	5.70	3.00	1.80	0.00
Calcium carbonate	0.40	0.60	0.60	0.88	1.10
Sodium chloride	0.13	0.16	0.23	0.25	0.30
Vit. And Min. premix[2]	0.30	0.30	0.30	0.30	0.30
Dicalcium phosphate	0.83	1.00	1.61	1.70	2.00
Vegetable oil[3]	3.20	4.00	4.90	5.70	6.60
DL–Methionine	0.10	0.10	0.12	0.12	0.12
L-Lysine HCl	0.12	0.14	0.14	0.15	0.15
Total	100.0	100.0	100.0	100.0	100.0
Determined analysis (%):					
Moisture	10.96	10.67	11.82	10.34	9.34
Crude protein	18.10	18.15	18.11	18.20	18.21
Ether extract	6.25	6.60	7.05	7.60	7.98
Crude fiber	3.20	3.25	3.82	3.95	4.38
Ash	8.52	8.57	8.43	8.15	8.62
Nitrogen free extract	52.97	52.76	50.77	51.76	51.47
ME, kcal./Kg	3187	3183	3176	3172	3169
Cost (L.E./ton)[4]	1995.4	1984.9	1974.8	1963.7	1946.7
Relative cost[5]	100.0	99.47	98.97	98.41	97.56

[1]*Broiler concentrate manufactured by Alpha Feed For Premix Production Company and contains: 48% Crude protein; 1.5% crude fiber; 4.75% ether extract; 6.85% calcium; 3% available phosphorus; 1.2% methionine; 1.8% methionine + cystine; 2.4% lysine; 0.96% Sodium; 2415 K cal ME/kg.*
[2]*Each 3.0 Kg of the Vit. and Min. premix manufactured by Vetgreen Company contains: Vit. A 10000000 IU; Vit. D_3 2000000 IU; Vit. E 1000 mg; Vit. K_3 1000 mg; Vit. B1 1000 mg; Vit. B2 500 mg; Vit. B6 1500 mg; Vit. B12 10 mg; biotin 50 mg; folic acid 1 g; niacin 3000 mg; Ca pantothenate 1000 mg; Zn 50 g; Cu 4 g; Fe 30 g; Co 0.1 g; Se 0.1 g; I 0.3 g; Mn 60 g and anti-oxidant 10 g, and complete to 3.0 Kg by calcium carbonate.*
[3]*Mixture from 75% soybean oil and 25% sunflower oil.*
[4]*According to the local market price at the experimental time.*
[5]*Assuming the price of the control group equal 100.*

Table (7). Effects of different levels of yellow corn (YC) substitution by triticale grains with or without enzyme supplementation on live body weight (LBW) at 42 days of age and live body weight gain (LBWG) during the period from 5-42 days of age in Ross and Cobb strains, Mean ± SE.

Item		LBW, g		LBWG, g	
		Ross	Cobb	Ross	Cobb
Level of YC substitution (L)%:					
0		2025.3^B ±35.4	2104.5±32.5	1882.7^B ±35.2	1958.0±32.1
25		2212.0^A ±35.0	2114.0±31.9	2068.3^A ±34.8	1965.8±31.5
50		2199.8^A ±35.7	2150.0±31.9	2053.6^A ±35.5	2004.3±31.5
75		2266.5^A ±35.7	2086.5±32.2	2121.4^A ±35.5	1939.1±31.8
100		2189.1^A ±35.4	2071.5±32.5	2044.0^A ±35.2	1924.0±32.1
Enzyme (En)%:					
0.0		2153.5±22.6	2095.4±20.3	2008.8±22.5	1947.8±20.0
0.1		2203.6±22.2	2115.2±20.4	2059.2±22.1	1968.7±20.2
L% x En%:					
0	0.0	2008.9±50.5	2139.5±45.5	1864.4±50.2	1993.6±45.0
	0.1	2041.7±49.5	2069.5±46.4	1901.1±49.2	1922.5±45.9
25	0.0	2268.8±49.5	2134.0±44.6	2124.9±49.2	1985.0±44.1
	0.1	2155.3±49.5	2093.9±45.5	2011.6±49.2	1946.5±45.0
50	0.0	2113.2±51.5	2158.8±45.5	1965.4±51.2	2009.7±45.0
	0.1	2286.4±49.5	2141.2±44.6	2141.9±49.2	1998.8±44.1
75	0.0	2225.7±50.5	2027.8±45.5	2083.3±50.2	1881.4±45.0
	0.1	2307.4±50.5	2145.2±45.5	2159.5±50.2	1996.7±45.0
100	0.0	2151.2±50.5	2016.6±45.5	2006.2±50.2	1869.3±45.0
	0.1	2227.0±49.5	2126.4±46.4	2081.9±49.2	1978.7±45.9
Overall mean		2178.6±15.9	2105.3±14.4	2034.0±15.8	1958.2±14.2

[A, B] *Means in the same column within the same item followed by different superscripts are significantly different (P ≤0.01).*

Table (8). Effects of different levels of yellow corn (YC) substitution by triticale grains with or without enzyme supplementation on feed intake (FI) and feed conversion (FC) during the period from 5-42 days of age in Ross and Cobb strains, Mean ± SE.

Item		FI, g		FC(g feed/g gain)	
		Ross	Cobb	Ross	Cobb
Level of YC substitution (L)%:					
0		3836.7^{C} ±18.1	4064.3^{BC} ±14.1	2.08±0.04	2.09±0.04
25		4163.8^{B} ±17.9	4083.3^{B} ±14.1	2.04±0.03	2.10±0.03
50		4167.4^{B} ±17.9	4156.0^{A} ±14.2	2.05±0.04	2.10±0.03
75		4254.4^{A} ±17.9	4032.1^{C} ±14.1	2.03±0.04	2.12±0.04
100		4135.5^{B} ±18.2	3979.9^{D} ±14.3	2.05±0.04	2.11±0.04
Enzyme (En)%:					
0.0		4032.3^{B} ±11.4	4063.7±9.0	2.03±0.02	2.11±0.02
0.1		4190.8^{A} ±11.4	4062.6±8.9	2.07±0.02	2.10±0.02
L% x En%:					
0	0.0	3727.8^{G} ±25.7	4119.9^{BC} ±19.9	2.02±0.05	2.08±0.05
	0.1	3945.5^{F} ±25.4	4008.7^{D} ±19.9	2.13±0.05	2.11±0.05
25	0.0	4170.5^{CD} ±25.4	4101.0^{BC} ±19.9	1.98±0.05	2.08±0.05
	0.1	4157.1^{D} ±25.4	4065.7^{C} ±19.9	2.09±0.05	2.11±0.05
50	0.0	4048.6^{E} ±25.4	4194.8^{A} ±19.9	2.09±0.05	2.11±0.05
	0.1	4286.2^{AB} ±25.4	4117.2^{BC} ±20.2	2.02±0.05	2.08±0.05
75	0.0	4185.8^{CD} ±25.4	3926.4^{E} ±19.9	2.04±0.05	2.11±0.05
	0.1	4323.0^{A} ±25.4	4137.8^{B} ±19.9	2.03±0.05	2.13±0.05
100	0.0	4028.7^{E} ±25.4	3976.3^{DE} ±20.5	2.02±0.05	2.16±0.05
	0.1	4242.3^{BC} ±26.1	3983.5^{DE} ±19.9	2.08±0.05	2.06±0.05
Overall mean		4111.6±8.1	4063.1±6.3	2.05±0.02	2.10±0.02

A, G: Means in the same column within the same item followed by different superscripts are significantly different (P ≤0.01).

Table (9). Effects of different levels of yellow corn (YC) substitution by triticale grains with or without enzyme supplementation on crude protein conversion (CPC) and caloric conversion ratio (CCR) during the period from 5-42 days of age in Ross and Cobb strains, Mean ± SE.

Item		CPC		CCR	
		Ross	Cobb	Ross	Cobb
Level of YC substitution (L)%:					
0		0.403±0.01	0.363±0.01	5.92±0.09	5.86±0.09
25		0.398±0.01	0.371±0.01	5.79±0.09	5.96±0.09
50		0.398±0.01	0.369±0.01	5.83±0.09	5.94±0.09
75		0.393±0.01	0.377±0.01	5.72±0.09	6.06±0.09
100		0.393±0.01	0.384±0.01	5.74±0.09	6.15±0.09
Enzyme (En)%:					
0.0		0.395±0.004	0.376±0.003	5.77±0.06	6.03±0.05
0.1		0.399±0.004	0.370±0.003	5.83±0.06	5.95±0.05
L% x En%:					
0	0.0	0.400±0.01	0.360±0.01	5.85±0.13	5.80±0.12
	0.1	0.406±0.01	0.367±0.01	5.98±0.13	5.92±0.12
25	0.0	0.386±0.01	0.370±0.01	5.61±0.13	5.94±0.12
	0.1	0.411±0.01	0.372±0.01	5.97±0.13	5.98±0.12
50	0.0	0.406±0.01	0.371±0.01	5.95±0.13	5.98±0.12
	0.1	0.389±0.01	0.367±0.01	5.71±0.13	5.90±0.12
75	0.0	0.396±0.01	0.380±0.01	5.76±0.13	6.09±0.12
	0.1	0.390±0.01	0.374±0.01	5.68±0.13	6.03±0.12
100	0.0	0.388±0.01	0.398±0.01	5.67±0.13	6.38±0.12
	0.1	0.397±0.01	0.369±0.01	5.82±0.13	5.92±0.12
Overall mean		0.397±0.003	0.373±0.002	5.80±0.04	5.99±0.04

CPC = g protein consumed/g gain, CCR = Kcal. ME consumed/g gain.

Table (10). Effects of different levels of yellow corn (YC) substitution by triticale grains with or without enzyme supplementation on performance index (PI) and mortality% during the period from 5-42 days of age in Ross and Cobb strains, Mean ± SE.

Item		PI		Mortality%	
		Ross	Cobb	Ross	Cobb
Level of YC substitution (L)%:					
0		56.57±1.57	55.68±1.35	0	2.85
25		59.94±1.56	55.31±1.33	2.857	2.85
50		59.58±1.59	56.28±1.33	0	0
75		61.69±1.59	54.79±1.34	0	0
100		59.91±1.57	54.70±1.35	2.857	0
Enzyme (En)%:					
0.0		59.32±1.00	54.62±0.84	2.857	2.857
0.1		59.76±0.99	56.08±0.85	2.857	2.857
L% x En%:					
0	0.0	56.43±2.24	56.25±1.89	0	2.857
	0.1	56.71±2.20	55.11±1.93	0	0
25	0.0	63.08±2.20	55.85±1.86	2.857	0
	0.1	56.79±2.20	54.77±1.89	0	2.857
50	0.0	57.08±2.29	56.31±1.89	0	0
	0.1	62.08±2.20	56.25±1.86	0	0
75	0.0	60.45±2.24	52.80±1.89	0	0
	0.1	62.93±2.24	56.77±1.89	0	0
100	0.0	59.54±2.24	51.90±1.89	0	0
	0.1	60.27±2.20	57.51±1.93	2.857	0
Overall mean		59.54±0.70	55.35±0.60		

PI = Kg live body weight x100 /Feed conversion.

Table (11). Effects of different levels of yellow corn (YC) substitution by triticale grains with or without enzyme supplementation on economical efficiency (EEf) of Ross strain (using average local market price).

Item	Level of YC substitution%									
	0		25		50		75		100	
	0.0En	0.1En	0.0En	0.1 En	0.0En	0.1En	0.0En	0.1En	0.0En	0.1 En
	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7	Diet 8	Diet 9	Diet 10
FI_1	0.2044	0.2159	0.2072	0.2095	0.2064	0.2083	0.2077	0.2092	0.2062	0.2210
P_1	220.00	223.00	220.21	223.21	218.15	221.15	216.68	219.68	215.76	218.76
$FI_1 \times P_1 = c_1$	44.968	48.146	45.628	46.762	45.026	46.066	45.004	45.957	44.490	48.346
FI_2	1.0008	1.0156	1.0329	1.0682	1.0643	1.1167	1.0656	1.0763	1.0017	1.1180
P_2	215.79	218.79	216.85	219.85	215.55	218.55	211.69	214.69	211.87	214.87
$FI_2 \times P_2 = c_2$	215.96	222.20	223.98	234.84	229.41	244.05	225.58	231.07	212.23	240.22
FI_3	2.5195	2.7140	2.9304	2.8793	2.7780	2.9612	2.9125	3.0376	2.8209	2.9033
P_3	206.92	209.92	207.17	210.17	202.86	205.86	201.68	204.68	198.81	201.81
$FI_3 \times P_3 = c_3$	521.33	569.72	607.09	605.14	563.55	609.59	587.39	621.74	560.82	585.91
TFC	782.27	840.07	876.70	886.75	837.98	899.71	857.97	898.76	817.54	874.49
LBWG	1.8644	1.9011	2.1249	2.0116	1.9654	2.1419	2.0833	2.1595	2.0062	2.0819
P	825.00	825.00	825.00	825.00	825.00	825.00	825.00	825.00	825.00	825.00
TR	1538.1	1568.4	1753.0	1659.6	1621.5	1767.1	1718.7	1781.6	1655.1	1717.6
NR	755.86	728.34	876.34	772.82	783.47	867.35	860.75	882.82	837.57	843.08
EEf	0.9663	0.8670	0.9996	0.8715	0.9350	0.9640	1.0032	0.9823	1.0245	0.9641
RE	100.00	89.728	103.450	90.196	96.761	99.771	103.83	101.66	106.03	99.776

En: enzyme %. FI_1, FI_2 and FI_3: average feed intake (Kg/bird) during the starter, grower and finisher periods respectively. P_1, P_2 and P_3: price/Kg feed during the starter, grower and finisher periods, respectively. c_1, c_2 and c_3: feed cost during the starter, grower and finisher periods, respectively. TFC: total feed cost = ($c_1+c_2+c_3$). LBWG: live body weight gain (Kg/ bird). P: price/Kg live weight (according to the local market price at the experimental time). TR: Total revenue = LBWG x price. NR: Net revenue (net revenue per unit feed cost) = TR – TFC. EEf: Economical efficiency= TR -TFC/ TFC. RE: Relative efficiency (assuming that economical efficiency of the control group equal 100).

with enzyme had higher FI (Table 8). Enzyme supplementation in Cobb diets did not significantly affect FI. The present results for Ross strain are in harmony with those obtained by Jakic *et al.* (1998) who examined the influence of multienzyme on broiler performance and indicated that FI of group fed diets supplemented with multienzyme was higher at 42 days of age as compared with the control group. Interaction due to triticale levels x enzyme supplementation significantly ($P \leq 0.01$) affected FI in Ross diets. Chicks fed diet containing 0% triticale without enzyme supplementation had lower FI. On the other hand, the FI was significantly increased with inclusion of triticale in the diets from 0 to 100% triticale grains with or without enzyme supplementation when compared with those fed the control diet. This may give an indication that inclusion of triticale in the broiler diet did not have a negative effect on diet palatability. Also, the interaction between triticale levels x enzyme supplementation significantly ($P \leq 0.01$) affected FI of Cobb strain as birds fed diet containing 50% + 0.0% enzyme had higher FI (Table 8).

Feed conversion (FC):

Inclusion of triticale in the Ross diets at different levels had insignificant effects on FC for both strains as shown in Table (8). These results are in harmony with those obtained by Abd El-Rahman *et al.* (2008) who reported that the FI values were significantly increased with inclusion of triticale in the broiler diet (50% of corn) during the overall periods when compared with the other treatments. However, with broiler chickens, FI did not differ significantly among the corn/triticale based diets (Attia and Abd El-Rahman, 1996, 2001). These results disagree with those of Janushonis *et al.* (2004) who indicated that feed consumption in the experimental groups was lowest when maize was replaced by triticale and enzymes in the diets of turkey broilers at the rate of 25 to 35%. In some reports, triticale feeding resulted in similar or improved feed efficiency relative to other grains. Enzyme supplementation insignificantly affected FC for both strains as shown in Table (8). In this respect, addition of enzyme (avizyme 0.1%) and enzyme with probiotic to the diet significantly improved FC ratio as reported by Mudullu and Tuncer (2001). Interaction between triticale levels x enzyme supplementation had no significant effect on FC.

Crude protein conversion (CPC):

Effects of feeding different levels of triticale grains on CPC of the two strains are given in Table (9). Inclusion of triticale in the diets at different levels had insignificant differences in CPC for the two strains. The results showed that triticale level at 100% of YC significantly improved CPC of Ross chicks compared to the other triticale levels. While, improve in CPC was observed for Cobb chicks with increasing triticale level. Enzyme supplementation for Ross and Cobb strains insignificantly affected CPC. The interaction between triticale levels x enzyme supplementation had no significant effect on CPC as shown in Table (9).

Caloric conversion ratio (CCR):

Addition of triticale in Ross and Cobb diets at different levels had insignificant differences in CCR. This finding agreed with other researchers who reported non-detrimental effect of triticale in poultry feeding. Yaqoob and Netke (1975) found that substituting triticale for maize, weight for weight, but not on an iso-nitrogenous basis, in a groundnut oil cake starter diet did not affect the protein efficiency ratio when the substitution exceeded 75%. Enzyme supplementation had insignificant effect on CCR. The interaction between triticale levels x enzyme supplementation had an insignificant effect on CCR (Table 9).

Performance index (PI):

Inclusion of triticale in the diets at different levels caused insignificant improvement in PI compared with those fed the control diet for Ross and Cobb strains. Enzyme supplementation for Ross and Cobb diets insignificantly affected PI. Interaction due to triticale levels x enzyme supplementation insignificantly affected PI. Numerically, the PI was higher for chicks fed enzyme supplemented diet compared with those fed the diet without enzyme supplementation (Table 10). Similar results were observed by Hermes and Johnson (2004) who found that broiler feeding triticale up to 15% with corn did not affect performance of broilers. Also, recent study by Abd El-Rahman *et al.* (2008) demonstrated that triticale can be substituted for corn in broiler diets up to 50% of the corn grain (27% starter and 30% for finisher diets) without any adverse effect on chicks performance. In several studies using different varieties of triticale with different levels in the diet, the feed value was adequate for broilers (Proudfoot and Hulan, 1988 and Maurice *et al.*, 1989). Diets containing up to 30% triticale had no negative effect on performance and result in savings of feed costs (Belaid, 1994). Vieira *et al.* (1995) reported that triticale inclusion at the level tested (40%) did not negatively affect the performance of the broilers. However, other studies with broilers and laying hens show no differences in productivity, even when diets consist of 100% triticale (Yaqoob and Netke, 1975; Leeson and Summer, 1987; Maurice *et al,* 1989; Fayez *et al,* 1996 and Boros, 1999).

Table (12). Effects of different levels of yellow corn (YC) substitution by triticale grains with or without enzyme supplementation on economical efficiency (EEf) of Cobb strain (using average local market price).

Item	Level of YC substitution %									
	0		25		50		75		100	
	0.0En	0.1En	0.0En	0.1 En	0.0En	0.1En	0.0En	0.1En	0.0En	0.1 En
	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7	Diet 8	Diet 9	Diet 10
FI_1	0.1982	0.1982	0.1974	0.1974	0.1975	0.2167	0.2002	0.2056	0.2009	0.2045
P_1	209.05	212.05	205.64	208.64	204.93	207.93	204.10	207.10	201.17	204.17
$FI_1 \times P_1 = c_1$	41.425	42.024	40.593	41.186	40.463	45.058	40.863	42.588	40.411	41.743
FI_2	1.0949	1.0663	1.0600	1.1026	1.0667	1.0717	1.0314	1.0538	0.9950	1.0150
P_2	202.51	205.51	200.55	203.55	199.16	202.16	199.03	202.03	197.58	200.58
$FI_2 \times P_2 = c_2$	221.73	219.14	212.58	224.43	212.44	216.65	205.28	212.90	196.59	203.59
FI_3	2.8269	2.7442	2.8436	2.7658	2.9307	2.8288	2.6948	2.8783	2.7734	2.7641
P_3	199.54	202.54	198.49	201.49	197.48	200.48	196.37	199.37	194.67	197.67
$FI_3 \times P_3 = c_3$	564.08	555.81	564.43	557.28	578.75	567.12	529.18	573.85	539.90	546.38
TFC	827.23	816.97	817.60	822.90	831.66	828.83	775.32	829.33	776.90	791.71
LBWG	1.9936	1.9225	1.9850	1.9465	2.0097	1.9988	1.8814	1.9967	1.8693	1.9787
P	825.00	825.00	825.00	825.00	825.00	825.00	825.00	825.00	825.00	825.00
TR	1644.7	1586.1	1637.6	1605.9	1658.0	1649.0	1552.2	1647.3	1542.2	1632.4
NR	817.49	769.09	820.02	782.96	826.34	820.18	776.83	817.94	765.27	840.72
EEf	0.9882	0.9414	1.0030	0.9515	0.9936	0.9896	1.0020	0.9863	0.9850	1.0619
RE	100.00	95.262	101.49	96.281	100.54	100.14	101.39	99.802	99.678	107.46

En: enzyme %. FI_1, FI_2 and FI_3: average feed intake (Kg/bird) during the starter, grower and finisher periods respectively. P_1, P_2 and P_3: price/Kg feed during the starter, grower and finisher periods, respectively. c_1, c_2 and c_3: feed cost during the starter, grower and finisher periods, respectively. TFC: total feed cost = ($c_1+c_2+c_3$). LBWG: live body weight gain (Kg/ bird). P: price/Kg live weight (according to the local market price at the experimental time). TR: Total revenue = LBWG x price. NR: Net revenue (net revenue per unit feed cost) = TR – TFC. EEf: Economical efficiency= TR -TFC/ TFC. RE: Relative efficiency (assuming that economical efficiency of the control group equal 100).

Mortality rate%:

The calculated cumulative mortality% of chicks during the period from 5 to 42 days of age for Ross and Cobb strains indicated that the percentage of mortality was 2.86% in Ross chicks fed diet containing 25 and 100% triticale supplemented with enzyme and 2.86% in Cobb chicks fed control diet containing 25% triticale supplemented with enzyme. However, the percentage of mortality was zero% in chicks fed the other experimental diets for Ross and Cobb strains (Table 10). It appears that mortality% was not related to treatments studied. Similar results were observed by Azmal *et al.* (2001), who found that in broiler chickens, mortality did not differ significantly among the wheat/triticale based diets. Further, Hermes and Johnson (2004) reported that, there were no differences in mortality from zero to six weeks among the dietary groups.

Economical efficiency (EEf):

Economical efficiency values during the period from 5 to 42 days of age for Ross strains are presented in Table (11). Economical efficiency values during the period from 5 to 42 days of age were improved for chicks fed diets 3, 7, 8 and 9 as compared with those fed the control diet and other treatments. Chicks fed diet 9 (100% triticale) had the best economical and relative efficiency values being 1.024 and 106.03%, respectively followed by chicks fed diet 7 (75% triticale) being, 1.003 and 103.83%, respectively, then chicks fed diet 3 (25% triticale) being, 0.999 and 103.45%, respectively, when compared with the other treatments or the control. Whereas, chicks fed diet 2 (control + enzyme) had the lowest corresponding values, being 0.867 and 89.728%, respectively. The relative economical efficiency values varied between 89.728 (diet 2) to 106.03 % (diet 9) as shown in Table (11).

Effects of different levels of yellow corn (YC) substitution by triticale grains with or without enzyme supplementation on economical efficiency of Cobb strain are given in Table (12). Economical efficiency values during the period from 5 to 42 days of age were better in chicks fed diets 3, 5, 6, 7 and 10 as compared with those fed the control diet and other treatments. Chicks fed diet 10 (100% triticale + enzyme) had the best economical and relative efficiency values being 1.062 and 107.46%, respectively followed by chicks fed diet 3 contained 75% triticale (1.003 and 101.49%, respectively) then chicks fed diet 7 (75% triticale) being, 1.002 and 101.39%, respectively, when compared with the other treatments or the control. Whereas, chicks fed diet 2 (control + enzyme) had the worst corresponding values, being 0.941 and 95.262%, respectively. The relative economical efficiency varied between 95.262 (diet 2) to 107.46% (diet 10) which is of minor importance relative to other factors of production. This again favors the use of triticale without enzyme than use of the triticale with enzyme supplementation in feeding broiler chicks. On the other hand, data also indicate that using enzymes are worthless in triticale containing diets as it increase cost of feeding since it added to the expenses not to the income.

In general, it can be concluded that triticale can be used in broiler chick diets without adverse effect to get the best performance and highest income, taking in consideration the strain response to the level of substitution.

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تأثير استبدال الذرة الصفراء بحبوب التريتيكال علي الأداء الإنتاجي لسلالتين من بداري التسمين

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تم إجراء هذه التجربة بهدف تقييم كفاءة إحلال مستويات مختلفة (صفر، 25، 50، 75 و 100%) من حبوب التريتيكال (المنزرع محليا) في علائق بداري التسمين (روس ،كب) مع أو بدون إضافة الإنزيمات (أفيزيم 1500) علي النمو والأداء الإنتاجي ونسبة النفوق والكفاءة الاقتصادية. تم استعمال عدد 700 كتكوت غير مجنس من كلا السلالتين من بداري التسمين عمر 5 أيام (350 من كل سلالة) وتم تغذيتها علي عليقة الكنترول لمدة 5 أيام. ثم قسمت الكتاكيت إلي 10 معاملات لكل سلالة (35 طائر /معاملة) كل معاملة تشتمل علي 5 مكررات بكل مكرر 7 طيور.

أظهرت النتائج المتحصل عليها أن هناك زيادة معنوية في وزن الجسم الحي ومعدل الزيادة في وزن الجسم عند عمر 42 يوم نتيجة لاحتواء العليقة علي مستويات مختلفة من حبوب التريتيكال لسلالة روس وغير معنوية بالنسبة لسلالة كب. لم يكن لإضافة الإنزيم أي تأثير معنوي علي وزن الجسم الحي ومعدل الزيادة فى وزن الجسم للسلالتين. كانت هناك زيادة في كمية الغذاء المأكول كلما زادت نسبة الإحلال من صفر-100% تريتيكال في علائق الروس. أظهرت كتاكيت سلالة كب المغذاة علي عليقة تحتوي علي 100% تريتيكال اقل كمية غذاء مأكول، بينما أظهرت كتاكيت سلالة كب المغذاة علي عليقة تحتوي علي 50% حبوب تريتيكال اعلي كمية غذاء مأكول. لم يكن هناك أي فرق معنوي في كفاءة تحويل الغذاء و كفاءة تحويل البروتين و كفاءة تحويل الطاقة و دليل الأداء الإنتاجي نتيجة لاحتواء العليقة علي مستويات مختلفة من حبوب التريتيكال بالنسبة للسلالتين. أيضا لم يكن لإضافة الإنزيم تأثير معنوي على كفاءة تحويل الغذاء و كفاءة تحويل البروتين و كفاءة تحويل الطاقة ودليل الأداء الإنتاجي بالنسبة للسلالتين بينما تحسن دليل الأداء الإنتاجي لسلالة روس نتيجة لاحتواء العليقة علي مستويات مختلفة من حبوب التريتيكال عند مقارنتها بعليقه الكنترول. كانت نسبة النفوق 2.86% لكتاكيت روس المغذاة علي عليقة تحتوي علي 25 و 100% تريتيكال مضاف إليها 0.1% إنزيم و صفر% للكتاكيت المغذاة علي باقي المعاملات المدروسة. كانت نسبة النفوق 2.86% لكتاكيت كب المغذاة علي عليقة الكنترول و 25% تريتيكال مضاف إليها0.1% إنزيم و صفر% للكتاكيت المغذاة علي باقي المعاملات المدروسة. كان لبداري روس المغذاة علي عليقة 100% تريتيكال بدون أنزيم أعلي كفاءة اقتصادية ونسبية ثم تلاها بداري روس المغذاة علي عليقة 75% تريتيكال بدون أنزيم ثم المغذاة علي عليقة 25% تريتيكال بدون أنزيم عند مقارنتها بالمعاملات الأخرى أو مجموعة الكنترول بينما كان لدجاج روس المغذي علي عليقة 0% تريتيكال مضاف إليها 0.1% إنزيم أقل كفاءة اقتصادية ونسبية بينما كان لبداري كب المغذاة علي عليقة 100% تريتيكال مضاف إليها0.1% إنزيم أعلي كفاءة اقتصادية ونسبية ثم تلاها بداري كب المغذاة علي عليقة 25% تريتيكال بدون أنزيم ثم المغذاة علي عليقة 75% تريتيكال بدون أنزيم عند مقارنتها بالمعاملات الأخرى أو مجموعة الكنترول بينما كان لدجاج كب المغذي علي عليقة 0% تريتيكال مضاف إليها0.1% إنزيم أقل كفاءة اقتصادية ونسبية.

يمكن استخلاص انه يمكن استخدام التريتيكال في علائق بداري التسمين (روس ، كب) بدون اى تأثير ضار للحصول علي أحسن أداء و أعلي كفاءة اقتصادية ونسبية. ويجب أن تؤخذ السلالة في الاعتبار عند اختيار نسبة الإحلال نظرا لاختلاف السلالتين في استجابتهما لنسب الإحلال والكفاءة الاقتصادية.