Zagazig Journal of Animal and Poultry Production 463-480

Zagazig J. Agric. Res., Vol. 43 No. (2) 2016

http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

EFFECT OF FIBER SOURCE AND LEVEL WITH / OR WITHOUT ENZYME SUPPLEMENTATION ON GROWTH PERFOPMANCE OF BROILER CHICKS

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ABSTRACT

A 2×3×2 factorial design experiment was performed including two sources of fiber (corn cobs and wheat straw), three levels of fiber (3, 6 and 9 %) and two levels of enzyme (without or 250 g/kg diet) through the experimental period (1-5 weeks of age). A total number of 360 unsexed one week old Cobb broiler chicks were randomly distributed into 12 treatment groups of 30 chicks each with 3 replicates (10 chicks each). Growth performance (live body weight, body weight gain, feed intake and feed conversion ratio) were studied through out the period from 1- 5 weeks of age. Results obtained indicated, significant (P<0.01) improvement in most traits of growth performance (live body weight, body weight gain and feed conversion ratio) in groups fed corn cobs diet through all the experimental periods studied comparatively with those received wheat straw diets, except, feed intake, in which increased (P<0.01) in groups fed wheat straw diets. However, significant (P<0.01) improvement in all traits of growth performance was observed for chicks fed diets containing 3% crude fiber level when compared with those fed diets containing 6 or 9% crude fiber levels. Addition of enzyme to the diets of broiler chicks significantly (P<0.01) improved live body weight, body weight gain and feed conversion ratio, while feed intake was decreased through out the experimental periods studied due to enzyme supplementation to broiler chicks diet. Chicks fed corn cobs diet at 3% crude fiber level with enzyme supplementation recorded the highest values of growth performance of broiler chicks while the lowest values were obtained by chicks fed wheat straw diets at 9% crude fiber level and without enzyme supplementation. It could be concluded that, supplementation of enzyme to diet contained corn cobs at 3% crude fiber would be suitable of broiler chicks through 1- 5 weeks of age for obtaining high growth performance.

Key words: Growth performance, corn cobs, wheat straw, enzyme, crude fiber.

INTRODUCTION

Fiber source of natural plants could be used as a possible nutritional and economical alternative source to supplement scavenging intake of free-range chickens, however there are only a few reports in the literature which evaluate utilization of natural plants fiber source for improving poultry health and production. McDonald and Whitesides (2002) defined fiber as a term that refers to cell walls of plant tissue that mostly consist of lignin, cellulose as well as hemicelluloses. Further, it as the composition of plant cell that is resistant against enzymes in the small intestine. Moreover, from the chemical point of view, fiber is illustrated as non-starch polysaccharides. According to McNab and Boormann (2002), non-starch polysaccharides (NSP) could be divided into two types of (soluble and insoluble). Based on a research conducted by Branton *et al.*(1997) a non-contagious disease takes place in poultry every time that diet enriches of insoluble NSP results in more risk of necrotic enteritis. This is because of an increasing microbial fermentation in the intestine. The two terms of “crude fiber” and

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"roughage" are mostly applied synonymously in animal nutrition. Crude fiber refers to the structural carbohydrates made of cellulose, hemicelluloses and lignin in the plant cell wall while the composition of crude fiber in each single plant is different between plants.

The latest researches precisely recognize the percentage of crude fiber for poultry; crude fiber could be in a range from 3 to 4% for a greater period while it could be applied by 5% for layers. Generally, poultry-feed manufacturers and poultry producers believe that fiber content must be kept below 7% in poultry feed. Fiber is viewed negative as it declines production as well as chicken growth, it looks to decrease the effectiveness of feed utilization.

The effects of dietary fiber in chickens are not well understood but it is known to contribute little to the nutrition (Larrea and Garcia, 1963). However, fiber influences the utilization of other nutrients in the food through changes in gut transit time, digestion, absorption and therefore, food intake.

The best level of dietary fiber, which achieves acceptable performance, varied from study to another (Hill and Dansky, 1954 ; Abdelsamie and Yadiwilo, 1981).

Abbas (1992) reported that chick, feed mixtures must contains a sufficient concertation of required nutrients of good digestibility to achieve the best feed efficiency. The same author added that the dietary fiber up to 7% has no effect on performance of chick, while some adverse effects were observed at the level of 9% although in some cases especially with feed energy no differences were found between all treatments. The increment of fiber in the diet up to 7% was accompanied by increases in feed conversion with the advancement of age. This demonstrated the capacity of chick to accommodate large volumes of feed in an attempt to maintain a static level of nutrient intake in order to satisfy their requirements.

Traditionally, fiber represents the indigestible component in poultry diets because birds do not digest cellulose (Tasaki and Kibe, 1959). Janssen and Carre (1985) showed that a strong negative correlation between crude fiber content of the diet and protein and fat digestibility in broilers and concluded that low-crude fiber diets improve poultry performance. However, the inclusion of moderate amounts of fiber might benefit digestive physiology in poultry (Hedemann *et al*., 2006; Mateos *et al*., 2006). In fact, Hetland *et al*. (2003) reported that moderate levels of insoluble fiber in the diet increased the ilea digestibility of starch. Recently, Gonzalez-Alvarado *et al*. (2007) demonstrated that the inclusion of 3% oat hulls or soy hulls improved performance of broilers from 1 to 21 days of age and nutrient digestibility at 18 days of age.

Addition of enzymes such as amylase and xylanase are useful in the utilization of the non-starch polysaccharide component of the diet ingredients. Others, such as proteases supplementation may enhance the utilization of dietary protein. Therefore, enzymes supplementation increase the effectiveness of nutrient utilization resulting in improved performance (Acamovic, 2001).

Many enzymes have been found to be beneficial when added to poultry diets containing carbohydrate or protein source. This Avizyme product which contains amylase (improves corn starch utilization), xylanase (reduces viscosity and breaks down cereal cell walls), and protease (targets soybean meal antinutritional factors and storage proteins). Avizyme may also be effective in improving energy utilization in corn-soy diets (Michael, 2002). These data suggested a slight improvement in protein and amino acid utilization. In addition the Avizyme destroys anti-nutritional factors and increases the digestibility of indigestible nutrients. Thus the utilization of enzyme systems saves energy and improves amino acid digestibility (Lyons, 1995; Silversides and Bedford, 1999).

However the present study was conducted to evaluate the source and level of dietary fiber at which the chicks could tolerate without adverse effect on its performance using corn cobs and wheat straw as source of fiber with or without enzyme supplementation.

MATERIALS AND METHODS

The experimental work was carried out at a private farm, near to Zagazig city, Sharkiya Governorate, Egypt, during the period from 15 April, 2014 to 1 June, 2014.

This work was designed to investigate the effect of source and level of dietary fiber with or without enzyme supplementation on growth performance of Cobb broiler chicks. A 2×3×2 factorial design experiment was performed including two sources of fiber (corn cobs and wheat straw), three levels of fiber (3, 6 and 9%) and two levels of enzyme (without or 250 g/kg diet) through the experimental period (1-5 week of age). A total number of 360 unsexed one week old Cobb broiler chicks were randomly distributed into 12 treatment groups of 30 chicks each with 3 replicates, (10 chicks each). Chicks of all experimental groups had nearly the same initial average live body weight and were not statistically different. Six iso coloric-iso nitrogenous diets were formulated to cover the nutrient requirements of broiler chicks during strater (1-3 weeks of age) and grower/finisher (3-5 weeks of age) periods. Diets contained three levels of crude fiber (3, 6 and 9%) from corn cobs and the same levels from wheat straw, the composition and chemical analysis of the starter and grower/ finisher experimental diets are presented in Tables 2 and 3.

Diets were supplemented or not with kemzyme (250 g/kg diet). Kemzyme used in this study is a natural multi-enzyme fed supplement containing : Alpha-amylase, Beta-gluconases, proteases and cellulose. Enzyme was purchased from Multivita Company, six th of October, Egypt.

Birds were allocated on floor and kept under similar conditions of management. Artificial light source was used, giving a total of 23 hours of light per day throughout the experimental period. Gas heaters were used to provide chicks with needed heat for brooding. Room temperature was about 32˚C for the first three days and then decreased 0.3˚C daily until 24˚C, reaching thereafter to the normal temperature. Electric fans were used to achieve a regular circulation of air up to 35 days of chick's age in all treatment groups. Chicks were provided with feed and water for *ad-libitum* consumption. The experimental period was extended 5 weeks.

Chicks were individually weighed at 1, 3 and 5 weeks of age. Also, body weight gain was calculated. Feed intake data were weekly recorded on a replicate basis during the experimental period, consequently, feed conversion was estimated (g feed/g gain).

Data were statistically analyzed on a 2×3×2 factorial design basis according to Snedecor and Cochran (1982) using SPSS® software statistical analysis program (SPSS, 1999), by adopting the following model:

$$Y_{ijkl} = \mu + S_i + L_j + E_k + SL_{ij} + SE_{ik} + LE_{jk} + SLE_{ijk} + e_{ijkl}$$

Where:

Y_{ijkl} = an observation,

μ = the overall mean,

S_i = effect of fiber source,

L_j = effect of fiber level,

E_k = effect of enzyme supplementation

SL_{ij} = effect of interaction between fiber source and level,

SE_{ik} = effect of interaction between fiber source and enzyme,

LE_{jk} =effect of interaction between fiber level and enzyme,

SLE_{ijk} = effect of interaction among fiber source, fiber level and enzyme,

e_{ijkl} = experimental random error.

Duncan's new multiple range test (Duncan, 1955) was used for comparison among significant means.

RESULTS AND DISCUSSION

Growth Performance

Effect of fiber source

Results in Tables 4 and 5 reveale that, live body weight at 3 and 5 weeks of age and body weight gain during starter (1 - 3 weeks of age),

Table 1. Chemical composition of feed stuffs

Feed stuff / Ingredient	Corn cobs	Wheat straw
Dry matter (%)	90.0	90.0
Crude protein (%)	4.0	3.2
Ether extract (%)	1.0	1.5
Fiber		
Crude fiber (%)	29.2	42.1
Acid detergent fiber (%)	33.0	55.0
Neutral detergent fiber (%)	57.0	80.0
Legnin (%)	9.4	9.0
Cellulose (%)	21.3	36.0
Ash (%)	6.1	8.0
Macroelements		
Calcium	0.52	0.16
Total phosphorous	0.20	0.05
Available phosphorous	-	-
Amino Acids		
Lysine (%)	-	-
Methionine (%)	-	-
Methionine + Cystine (%)	-	-
Threonine (%)	-	-
Tryptophane (%)	-	-
Energy Values		
Gross Energy K cal/kg	4000	3800
Metabolizable energy poultry (K cal/kg)	-	-
Digestible energy for rabbits (K cal/kg)	-	-

Total digestable nutrients (%)	45	44

Table 2. Composition and chemical analysis of the experimental starter diets (1-3 weeks of age).

Ingredient	**Corn cobs**			**Wheat straw**		
	3	**6**	**9**	**3**	**6**	**9**
Yellow corn	50.1	46.1	37.5	50.5	44.3	41.4
Soybean meal 44%	30	29.5	27.2	30.3	29.7	29.1
Corn gluten 62%	7	8	9.5	7	7.6	8.7
Corn cobs	3	6	9	0	0	0
Wheat straw	0	0	0	3	6	9
Cotton seed oil	4.2	6	6.5	4.8	5.3	7.4
Salt	0.3	0.3	0.3	0.3	0.3	0.3
Premix[1]	0.4	0.4	0.4	0.4	0.4	0.4
Wheat bran	1.3	0	6	0	2.8	0
Anti-toxins	0.1	0.1	0.1	0.1	0.1	0.1
Limestone	1.5	1.4	1.4	1.5	1.4	1.4
Di-calcium phosphate	1.5	1.6	1.5	1.5	1.5	1.6
L-lysine	0.4	0.4	0.4	0.4	0.4	0.4
Dl-Methionine	0.2	0.2	0.2	0.2	0.2	0.2
Total	100	100	100	100	100	100
Chemical analysis						
a- Calculated[2]						
ME, Kcal /Kg	3075	3073	3086	3077	3081	3072
Crude protein (%)	22.70	22.74	22.75	22.72	22.78	22.74
Calcium (%)	1.03	1.01	1.03	1.04	1.01	1.02
Phosphorous (%)	0.42	0.43	0.43	0.42	0.42	0.43
M+C (%)	0.98	0.98	1.00	0.98	0.98	0.98
Linoleic (%)	1.24	1.13	1.04	1.23	1.14	1.03
Crude fiber (%)	3	6	9	3	6	9
b- Determined[3]						
Crude protein (%)	21.89	22.01	22.76	21.98	22.87	22.56
Crude fat (%)	3.50	2.95	2.87	3.00	2.86	2.67
Crude fiber (%)	3.21	6.13	9.22	3. 14	6.34	9.20
Ash (%)	4.82	5.43	5.01	5.27	5.12	4.72

[1]The vitamin premix supplied the following per kilogram of complete feed: vitamin A, 4,500 IU (retinyl acetate); cholecalciferol, 1,000 IU; vitamin E, 25IU (dl-a-tocopheryl acetate); vitamin B12,0.02 mg; menadione, 1.5 mg; riboflavin, 3 mg; thiamine, 1.5 mg; pantothenic acid, 5 mg; niacin, 20 mg; choline, 150 mg; folic acid, 0.5 mg; biotin, 0.5 mg; pyridoxine, 2.5 mg.The mineral premix supplied the following per kilogram of complete feed: manganese ($MnSO_4 \cdot H_2O$), 60 g; zinc (ZnO), 40 mg; iron ($FeSO_4 \cdot 7H_2O$), 80 mg; copper ($CuSO_4 \cdot 5H_2O$), 8 mg; selenium (Na_2SeO_3), 0.2 mg; iodine (Iodized NaCl), 0.8 mg; cobalt ($CoCl_2$), 0.4 mg.

[2]Calculated according to NRC (1994).

[3]Determined according to AOAC (2003).

Table 3. Composition and chemical analysis of the experimental grower/finisher diets (3-5 weeks of age).

Ingredient	Corn cobs			Wheat straw		
	3	6	9	3	6	9
Yellow corn	55.4	50.5	45.6	57.3	52.3	49
Soybean meal 44%	26.3	25.5	23.5	26	25.8	23.2
Corn gluten 62%	4.8	5.6	7.2	5	5.6	7.7
Corn cobs	3	6	9	0	0	0
Wheat straw	0	0	0	3	6	9
Cotton seed oil	5	5.3	6.5	4.6	6.2	7
Salt	0.3	0.3	0.3	0.3	0.3	0.3
Premix[1]	0.4	0.4	0.4	0.4	0.4	0.4
Wheat bran	1.4	3	4.1	0	0	0
Anti-toxins	0.1	0.1	0.1	0.1	0.1	0.1
Limestone	1.3	1.3	1.3	1.3	1.3	1.3
Di-calcium phosphate	1.4	1.4	1.4	1.4	1.4	1.4
L-lysine	0.4	0.4	0.4	0.4	0.4	0.4
Dl-Methionine	0.2	0.2	0.2	0.2	0.2	0.2
Total	**100**	**100**	**100**	**100**	**100**	**100**
Chemical analysis						
a- Calculated [2]						
ME, Kcal /Kg	3157	3124.5	2164.6	3119	3126.1	3152.2
Crude protein (%)	20.10	20.15	20.07	20.07	20.08	20.07
Calcium (%)	0.93	0.94	0.93	0.91	0.92	0.91
Phosphorous (%)	0.39	0.39	0.38	0.39	0.39	0.38
M+C (%)	0.89	0.89	0.90	0.89	0.88	0.90
Linoleic (%)	1.35	1.26	1.17	0.0	1.25	1.17
Crude fiber (%)	3	6	9	3	6	9
b- Determined[3]						
Crude protein (%)	19.47	19.85	20.05	19.87	20.12	20.07
Crude fat (%)	3.85	3.25	3.16	3.30	3.15	2.94
Crude fiber (%)	3.16	6.18	9.52	3.32	6.26	9.17
Ash (%)	5.30	5.97	5.51	5.80	5.63	5.19

[1]The vitamin premix supplied the following per kilogram of complete feed: vitamin A, 4,500 IU (retinyl acetate); cholecalciferol, 1,000 IU; vitamin E, 25IU (dl-a-tocopheryl acetate); vitamin B12,0.02 mg; menadione, 1.5 mg; riboflavin, 3 mg; thiamine, 1.5 mg; pantothenic acid, 5 mg; niacin, 20 mg; choline, 150 mg; folic acid, 0.5 mg; biotin, 0.5 mg; pyridoxine, 2.5 mg.The mineral premix supplied the following per kilogram of complete feed: manganese ($MnSO_4 \cdot H_2O$), 60 g; zinc (ZnO), 40 mg; iron ($FeSO_4 \cdot 7H_2O$), 80 mg; copper ($CuSO_4 \cdot 5H_2O$), 8 mg; selenium (Na_2SeO_3), 0.2 mg; iodine (Iodized NaCl), 0.8 mg; cobalt ($CoCl_2$), 0.4 mg.

[2]Calculated according to NRC (1994).

[3]Determined according to AOAC (2003).

Table 4. Live body weight ($\overline{X}$±SE), g of broiler chickens as affected by fiber source, levels, enzyme supplementation and their interactions

Item			Age in weeks 1	3	5
Fiber source effect			**NS**	**	**
Corn cobs (C c)			125.21±0.16	577.94 [a]±15.16	1184.28[a]±30.74
Wheat straw (W s)			125.48±0.15	521.06 [b]±16.26	1001.89[b]±29.12
Fiber levels effect			**NS**	**	**
3%			125.43±0.16	607.00 [a]±13.06	1213.33[a]±36.71
6%			125.34±0.19	543.08 [b]±17.57	1093.33[b]±32.73
9%			125.26±0.23	498.42 [c]±18.60	972.58 [c] ±37.03
Enzyme supplementation effect (mg/kg diet)			**NS**	**	**
Without (0)			125.39±0.10	503.89 [b]±14.56	1020.94[b]±31.27
250			125.29±0.20	595.11[a] ±11.52	1165.22[a]±34.37
Interactions					
Fiber Source × Level			**NS**	**NS**	**NS**
	3		125.48±0.18	632.67±15.25	1304.67±40.99
(C c)	6		125.17±0.31	569.00±22.71	1180.33±37.10
	9		124.97±0.30	532.17±23.68	1067.83±31.16
	3		125.37±0.29	581.33±15.94	1122.00±30.21
(W s)	6		125.52±0.21	517.17±23.94	1006.33±17.63
	9		125.55±0.33	464.67±22.47	877.33±37.87
Fiber Source × Enzyme			**NS**	**NS**	**
	0		125.44±0.15	532.78±17.91	1103.33[b]±31.24
(C c)	250		124.97±0.25	623.11±12.06	1265.22[a]±37.47
	0		125.34±0.15	475.00±19.27	938.56 [c] ±38.52
(W s)	250		125.61±0.27	567.11±14.92	1065.22[b]±33.44
Fiber Level × Enzyme			**NS**	**	**
	0		125.52±0.19	573.00[bc]±12.37	1134.17[b]±35.74
3	250		125.33±0.28	641.00[a]±11.60	1292.50[a]±46.32
	0		125.37±0.20	491.33[d]±12.44	1033.00[b]±29.13
6	250		125.32±0.33	594.83[b]±11.48	1153.67[b]±49.10
	0		125.30±0.16	447.33[e]±15.11	895.67 [c] ±46.01
9	250		125.22±0.45	549.50[c]±15.80	1049.50[b]±39.38
Fiber Source × Level ×Enzyme			**NS**	**NS**	**
	3	0	125.50±0.29	600.00±5.77	1213.67 [c] ±7.80
(C c)	3	250	125.47±0.29	665.33±7.86	1395.67 [a] ±7.80
	6	0	125.33±0.33	518.33±1.67	1098.00 [f] ±3.46
(C c)	6	250	125.00±0.58	619.67±2.91	1262.67 [b] ±9.53
	9	0	125.50±0.29	480.00±7.64	998.33 [h] ±4.67
(C c)	9	250	124.43±0.30	584.33±4.98	1137.33 [e] ±1.86
	3	0	125.53±0.32	546.00±1.73	1054.67 [g] ±2.60
(W s)	3	250	125.20±0.53	616.67±4.41	1189.33 [d] ±4.91
	6	0	125.40±0.31	464.33±6.44	968.00 [i] ±2.31
(W s)	6	250	125.63±0.34	570.00±5.77	1044.67 [g] ±8.95
	9	0	125.10±0.10	414.67±3.93	793.00 [j] ±4.62
(W s)	9	250	126.00±0.58	514.67±3.18	961.67 [i] ±6.06

Means with the same letter are not significantly different (P ≤ 0.05). ** = (P ≤ 0.01) and NS = Not significant.

Table 5. Daily body weight gain ($\bar{X}$ ±SE), g of broiler chickens as affected by fiber source, levels, enzyme supplementation and their interactions

Item			Period in weeks		
			1 – 3	3 – 5	1 – 5
Fiber source effect			**	**	**
Corn cobs (C c)			32.34^{a} ±1.08	43.31^{a} ±1.20	37.82^{a} ±1.10
Wheat straw (W s)			28.26^{b} ±1.16	34.35^{b} ±1.04	31.30^{b} ±1.04
Fiber levels effect			**	**	**
3%			34.40^{a} ±0.93	43.31^{a} ±1.76	38.85^{a} ±1.31
6%			29.84^{b} ±1.26	39.30^{b} ±1.43	34.57^{b} ±1.17
9%			26.65^{c} ±1.33	33.87^{c} ±1.46	30.26^{c} ±1.32
Enzyme supplementation effect (mg/kg diet)			**	**	**
Without (0)			27.04^{b} ±1.04	36.93^{b} ±1.28	31.98^{b} ±1.12
250			33.56^{a} ±0.83	40.72^{a} ±1.68	37.14^{a} ±1.23
Interactions					
Fiber Source × Level			*	NS	NS
	3		36.23^{a} ±1.09	48.00±1.92	42.11±1.46
(C c)	6		31.70^{ab} ±1.63	43.67±1.05	37.69±1.33
	9		29.09^{b} ±1.71	38.26±0.60	33.67±1.12
	3		32.57^{ab} ±1.15	38.62±1.06	35.59±1.08
(W s)	6		27.98^{bc} ±1.71	34.94±0.55	31.46±0.63
	9		24.22^{c} ±1.59	29.48±1.11	26.85±1.35
Fiber Source × Enzyme			NS	**	**
	0		29.10±1.28	40.75^{b} ±1.01	34.93^{b} ±1.12
(C c)	250		35.58±0.85	45.87^{a} ±1.86	40.72^{a} ±1.33
	0		24.98±1.37	33.11^{c} ±1.53	29.04^{c} ±1.37
(W s)	250		31.54±1.07	35.58^{c} ±1.38	33.56^{b} ±1.20
Fiber Level × Enzyme			**	**	**
	0		31.96^{bc} ±0.88	40.08^{b} ±1.69	36.02^{b} ±1.28
3	250		36.83^{a} ±0.83	46.54^{a} ±2.56	41.69^{a} ±1.65
	0		26.14^{d} ±0.89	38.69^{b} ±1.23	32.42^{b} ±1.04
6	250		33.54^{b} ±0.83	39.92^{b} ±2.71	36.73^{b} ±1.76
	0		23.00^{e} ±1.07	32.02^{e} ±2.25	27.51^{c} ±1.64
9	250		30.31^{c} ±1.15	35.71^{bc} ±1.70	33.01^{b} ±1.42
Fiber Source × Level ×Enzyme			NS	**	**
	3	0	33.89±0.40	43.83^{c} ±0.49	38.86^{c} ±0.27
(C c)	3	250	38.56±0.55	52.17^{a} ±0.88	45.36^{a} ±0.29
	6	0	28.07±0.14	41.41^{d} ±0.27	34.74^{f} ±0.12
(C c)	6	250	35.33±0.17	45.93^{b} ±0.58	40.63^{b} ±0.33
	9	0	25.32±0.54	37.02^{f} ±0.32	31.17^{h} ±0.17
(C c)	9	250	32.85±0.36	39.50^{e} ±0.38	36.18^{e} ±0.06
	3	0	30.03±0.10	36.33^{f} ±0.06	33.18^{g} ±0.08
(W s)	3	250	35.11±0.35	40.91^{d} ±0.60	38.01^{c} ±0.16
	6	0	24.21±0.46	35.98^{f} ±0.31	30.09^{i} ±0.08
(W s)	6	250	31.74±0.43	33.91^{g} ±0.57	32.82^{g} ±0.32
	9	0	20.68±0.28	27.02^{i} ±0.38	23.85^{j} ±0.17
(W s)	9	250	27.76±0.21	31.93^{h} ±0.21	29.85^{i} ±0.21

Means with the same letter are not significantly different ($P \leq 0.05$). **= ($P \leq 0.01$) and NS = Not significant.

grower finisher (3 - 5 weeks of age) or overall the experimental period (1- 5 weeks of age) were significantly ($P \leq 0.05$) increased for corn cobs diets compared with wheat straw diets. It is worthy to note that, live body weight in chicks fed diets contained corn cobs as fiber source increased by 9.84 and 15.4% at 3 and 5 weeks of age respectively, when compared with those fed wheat straw diets. The corresponding figures of body weight gain were 12.61, 20.68 and 17.24% during 1 - 3, 3 - 5 and 1 - 5 weeks of age, respectively.

The reduction in growth rate (live body weight and body weight gain) as affected by wheat straw may be due to its effect on feed intake (Table 6) which resulted in a decrease in feed intake associated with increase of dietary wheat straw. Jimenez-Moreno *et al*. (2010) found that, body weight gain was higher ($P \leq 0.01$) for broilers fed oat hulls than for broilers fed sugar beet pulp, with those fed cellulose being intermediate.

Results of live body weight and body weight gain in the present study were in agreement with those obtained by Abou-Khashaba (1999) who, showed that the response of live body weight was directly proportional to the amount of corn cobs added, whereas broiler chicks fed the diet containing 2.5, 5 and 7.5% corn cobs had live body weight higher than that of control group .

Hetland and Svihus (2001) pointed that birds were able to maintain adequate body weight gain when fed diet containing high levels of insoluble fiber (10% oat hulls), probably because fiber increase the rate of passage of the digestive system as well as the physical capacity of the gastrointestinal tract.

Results in Tables 6 and 7 revealed that, Feed intake and feed conversion were significantly ($P \leq 0.01$) affected by fiber source during the experimental periods. Using corn cobs as fiber source in broiler chick's diet significantly ($P \leq 0.01$) decreased feed intake and improved feed conversion ratio of birds during the starter, finisher and the whole experimental periods compared to wheat straw as fiber source. During the starter, finisher and the whole experimental periods, broiler fed corn cobs had lower ($P \leq 0.01$) feed intake than broiler fed wheat straw by 2.4, 1.78 and 2.00 %, respectively.

Also, it is clear that groups fed corn cobs were significantly ($P \leq 0.01$) better in feed conversion ratio by 15.32, 22.61 and 19.22% than those fed wheat straw diet during the starter, finisher and the whole experimental periods, respectively.

Jimenez-Moreno *et al*. (2010) stated that broilers fed sugar beet pulp had lower ($P \leq 0.05$) average daily feed intake than broilers fed oat hulls, and broilers fed oat hulls, had better feed conversion ratio ($P \leq 0.01$) than broiler fed control, with those fed sugar beet pulp and cellulose being intermediate. Amerah *et al*. (2015) observed that, a 10% increase in AME_n intake in 21-d-old broilers fed a diet diluted with 6% cellulose with respect to those fed the control diet.

Gonzalez-Alvarado *et al*. (2010) reported that the inclusion in the diet of 3% SBP as a source of soluble dietary fiber reduced the average daily feed intake from 25 to 42 day of age as compared with a diet containing 3% oat hulls. However, no negative effects of sugar beet pulp inclusion were observed during the first 10 days of age.

Pettersson and Razdan (1993) reported that the inclusion of 2.3% SBP in the diet increased average daily feed intake in broilers at 14 and 21 days of age.

Muhammed *et al.* (2013) concluded that feed intake was not altered in broiler chick by the inclusion of two high fiber feed ingredients (DDGS or wheat bran) into the dietary formulation.

Effect of fiber level

Dietary fiber level had significant effect on live body weight at 3 and 5 weeks of age and body weight gain during all the experimental periods studied (1 – 3 , 3 – 5 and 1 – 5 weeks of age) Tables 4 and 5. It could be noticed that, live body weight and body weight gain decreased significantly due to increase dietary fiber level in the diet from 3 to 6 or 9%. The reduction in live body weight and body weight gain increased

Table 6. Daily feed intake ($\bar{x}$ ±SE), g of broiler chickens as affected by fiber source, levels, enzyme supplementation and their interactions

Item			Period of weeks		
			1 – 3	**3 – 5**	**1 – 5**
Fiber source effect			**	**	**
Corn cobs (C c)			63.04 [b] ±0.79	121.95 [b] ±0.85	92.50 [b] ±0.82
Wheat straw (W s)			64.58 [a] ±0.67	124.17 [a] ±0.70	94.38 [a] ±0.68
Fiber levels effect			**	**	**
3%			66.87 [a] ±0.30	126.40 [a] ±0.43	96.63 [a] ±0.36
6%			64.30 [b] ±0.49	123.63 [b] ±0.46	93.96 [b] ±0.47
9%			60.26 [c] ±0.55	119.16 [c] ±0.59	89.71 [c] ±0.55
Enzyme supplementation effect (mg/kg diet)			**	**	**
Without (0**)**			65.02 [a] ±0.65	124.14 [a] ±0.79	94.58 [a] ±0.71
250			62.61 [b] ±0.74	121.98 [b] ±0.78	92.29 [b] ±0.76
Interactions					
Fiber Source × Level			**	**	**
	3		66.41[ab]±0.38	125.54 [b] ±0.48	95.97 [ab] ±0.40
(C c)	6		63.58 [c] ±0.67	122.77 [c] ±0.59	93.18 [c] ±0.62
	9		59.14 [e] ±0.66	117.54 [e] ±0.50	88.34 [e] ±0.55
	3		67.33 [a] ±0.41	127.26 [a] ±0.53	97.30 [a] ±0.46
(W s)	6		65.02[bc]±0.64	124.48 [b] ±0.55	94.75 [b] ±0.58
	9		61.38 [d] ±0.62	120.77 [d] ±0.48	91.08 [d] ±0.54
Fiber Source × Enzyme			NS	NS	NS
	0		64.26±0.99	123.01±1.18	93.64±1.08
(C c)	250		61.83±1.14	120.89±1.20	91.36±1.16
	0		65.77±0.82	125.27±0.97	95.52±0.89
(W s)	250		63.39±0.94	123.07±0.93	93.23±0.93
Fiber Level × Enzyme			**	NS	*
	0		67.69 [a] ±0.27	127.43±0.46	97.56 [a] ±0.36
3	250		66.05 [b] ±0.23	125.37±0.42	95.71 [b] ±0.29
	0		65.75 [b] ±0.33	124.81±0.41	95.28 [b] ±0.35
6	250		62.86 [c] ±0.36	122.44±0.46	92.65 [c] ±0.39
	0		61.61 [d] ±0.52	120.18±0.75	90.89 [d] ±0.61
9	250		58.92 [e] ±0.57	118.13±0.75	88.52 [e] ±0.64
Fiber Source × Level ×Enzyme			NS	NS	NS
	3	0	67.19±0.27	126.48±0.25	96.83±0.23
(C c)	3	250	65.62±0.19	124.60±0.46	95.11±0.14
	6	0	65.07±0.19	123.98±0.25	94.52±0.09
(C c)	6	250	62.10±0.17	121.57±0.48	91.83±0.27
	9	0	60.52±0.37	118.57±0.41	89.55±0.19
(C c)	9	250	57.76±0.33	116.50±0.15	87.13±0.09
	3	0	68.19±0.23	128.38±0.31	98.29±0.23
(W s)	3	250	66.48±0.21	126.14±0.27	96.31±0.21
	6	0	66.43±0.21	125.64±0.27	96.04±0.20
(W s)	6	250	63.62±0.19	123.31±0.25	93.46±0.11
	9	0	62.69±0.25	121.79±0.21	92.24±0.02
(W s)	9	250	60.07±0.42	119.76±0.31	89.92±0.32

Means with the same letter are not significantly different ($P \leq 0.05$). ** = ($P \leq 0.01$) and NS = Not significant.

Table 7. Feed conversion ($\bar{X}$±SE), g of broiler chickens as affected by fiber source, levels, enzyme supplementation and their interactions

Item			Period in weeks		
			1 – 3	**3 – 5**	**1 – 5**
Fiber source effect			**	**	**
Corn cobs (C c)			1.99^{b} ±0.07	2.84^{b} ±0.06	2.48^{b} ±0.06
Wheat straw (W s)			2.35^{a} ±0.10	3.67^{a} ±0.10	3.07^{a} ±0.10
Fiber levels effect			**	**	**
3%			1.96^{c} ±0.06	2.97^{c} ±0.12	2.52^{c} ±0.09
6%			2.21^{b} ±0.11	3.19^{b} ±0.12	2.76^{b} ±0.10
9%			2.34^{a} ±0.14	3.60^{a} ±0.18	3.04^{a} ±0.16
Enzyme supplementation effect (mg/kg diet)			**	**	**
Without (0**)**			2.46^{a} ±0.08	3.44^{a} ±0.13	3.02^{a} ±0.11
250			1.88^{b} ±0.04	3.08^{b} ±0.12	2.53^{b} ±0.08
Interactions					
Fiber Source × Level			**	**	**
	3		1.85^{c} ±0.07	2.64^{e} ±0.11	2.29^{d} ±0.09
(C c)	6		2.04^{bc} ±0.13	2.82^{de} ±0.08	2.49^{cd} ±0.10
	9		2.08^{bc} ±0.14	3.08^{cd} ±0.06	2.64^{cd} ±0.10
	3		2.09^{bc} ±0.08	3.31^{bc} ±0.10	2.75^{bc} ±0.10
(W s)	6		2.38^{ab} ±0.17	3.57^{b} ±0.05	3.02^{b} ±0.08
	9		2.60^{a} ±0.20	4.13^{a} ±0.17	3.44^{a} ±0.19
Fiber Source × Enzyme			**	**NS**	**
	0		2.23^{b} ±0.07	3.03±0.05	2.70^{b} ±0.06
(C c)	250		1.74^{d} ±0.01	2.66±0.08	2.26^{c} ±0.05
	0		2.68^{a} ±0.11	3.84±0.17	3.34^{a} ±0.14
(W s)	250		2.02^{c} ±0.04	3.49±0.11	2.80^{b} ±0.07
Fiber Level × Enzyme			**	**	**
	0		2.13^{b} ±0.07	3.21^{b} ±0.15	2.73^{bc} ±0.11
3	250		1.80^{c} ±0.05	2.74^{b} ±0.16	2.32^{c} ±0.10
	0		2.53^{a} ±0.10	3.24^{b} ±0.11	2.96^{b} ±0.11
6	250		1.88^{bc} ±0.06	3.14^{b} ±0.22	2.55^{bc} ±0.13
	0		2.71^{a} ±0.15	3.86^{a} ±0.29	3.37^{a} ±0.22
9	250		1.96^{bc} ±0.09	3.35^{ab} ±0.18	2.71^{bc} ±0.14
Fiber Source × Level ×Enzyme			**NS**	**	**
	3	0	1.99±0.03	2.88^{j} ±0.04	2.49^{f} ±0.02
(C c)	3	250	1.70±0.02	2.39^{i} ±0.03	2.10^{i} ±0.01
	6	0	2.32±0.01	2.99^{fj} ±0.02	2.72^{e} ±0.01
(C c)	6	250	1.76±0.01	2.65^{h} ±0.04	2.26^{h} ±0.03
	9	0	2.39±0.06	3.20^{e} ±0.03	2.88^{d} ±0.01
(C c)	9	250	1.76±0.03	2.95^{j} ±0.03	2.41^{j} ±0.01
	3	0	2.27±0.02	3.53^{cd} ±0.01	2.96^{c} ±0.01
(W s)	3	250	1.90±0.02	3.09^{f} ±0.04	2.53^{f} ±0.01
	6	0	2.75±0.06	3.49^{d} ±0.03	3.19^{b} ±0.01
(W s)	6	250	2.00±0.02	3.64^{bc} ±0.07	2.85^{d} ±0.03
	9	0	3.03±0.03	4.51^{a} ±0.06	3.87^{a} ±0.03
(W s)	9	250	2.16±0.03	3.75^{b} ±0.03	3.01^{c} ±0.03

Means with the same letter are not significantly different ($P \leq 0.05$). ** = ($P \leq 0.01$) and NS= Not significant.

with increasing dietary crude fiber level from 3 to 6 or 9%. At 5 weeks of age, live body weight decreased by 17.88 and 19.85%, when crude fiber increased from 3 to 6 or 9% in the diet, respectively.

It is worthy mentioned that, growth performance (live body weight and body weight gain) of broiler chicks fed diet containing 3% crude fiber were better than those fed diet contained 6% or 9% during the all experimental periods, indicating that, the chicks could not tolerate such level. This might be due to reduction in the utilization of the basal portion in such higher fiber diet. Davorak and Bray (1978) reported that, the lowered utilization of high fiber diet may be due partly to an increase rate of passage of the feed through the digestive tract, thereby reducing the time of ingesta exposure to enzymatic degradation and the time of nutrient contact with the absorptive membranes. The inert material (fiber) may have sufficiently distended the digestive tract, thereby limiting the mixing of ingesta with digestive secretions and reducing the proportion of the total ingesta making contact with the absorptive surfaces to the extent that digestion and absorption were reduced. In addition, greater abrasive action of the added fiber may have contributed to maintenance costs for gut epithelial replacement.

Adverse effect was observed when crude fiber was increased from 3 to 6 or 9%. In this concern Abbas (1992) and Aboul-Ela *et al.* (2005) stated that chicks fed the diet containing 7% crude fiber showed no significant in live body weight and body weight gain . Increasing crude fiber may decrease the availability of amino acid (Nwokolo *et al.*, 1976) and almost decreased feed intake (Soliman *et al*., 1996; Aboul-Ela *et al.*, 2005).

The results revealed that dietary crude fiber level had a significant (P≤0.01) effect on feed intake and feed conversion during the all studied experimental periods (1- 3, 3- 5 and 1- 5 weeks of age). It was observed that, a decrease in daily feed intake and poorest of feed conversion increased with increasing the level of dietary crude fiber from 3 to 6 or 9% with significant difference between them.

Increasing dietary crude fiber from 3 to 6 and 9%, feed intake decreased from 9.88 to 5.73 and 7.16% during the whole experimental period, the corresponding values for feed conversion values were 16.24, 17.5 and 17.10%, respectively.

Sklan *et al.* (2003) found that feed efficiency decreased when diets contained 80 to 90 g crude fiber /kg.

Mateos *et al*. (2012) stated that, an increase in the crude fiber content of the diet from 3 to 9%, increased average daily feed intake from 1 to 4 weeks and from 11 to 14 weeks of age. An increase in dietary crude fiber hindered feed conversion ratio from 1 to 4 weeks of age.

Effect of Kemzyme supplementation

In the present study, enzyme supplementation of the experimental diets significantly (P ≤ 0.01) improved live body weight at 3 and 5 weeks of age and body weight gain through all the experimental periods. compared with those fed unsupplemented one. This improvement was to the extent 15.33 and 12.38% for live body weight at 3 and 5 weeks of age, respectively and 19.43, 9.31 and 13.89% for body weight gain during 1 – 3, 3 – 5 and 1 – 5 weeks of age, respectively. The improvement in live body weight and body weight gain due to enzyme supplementation may be attributed to feed intake (Table 6). Also, increased in digestion and absorption of all nutrients and not simply to the starch alone (Bedford and Morgan, 1996). Moreover, Non starch polysaccharides may coat the nutrients contained in the feed. The addition of cell wall degrading enzymes may release nutrients coated by non strach polysaccharides (NSP) contained in the feed and favor their digestion (Classen, 1996 and Cowan *et al.*, 1996). It is well known that also, enzymes decrease the viscosity of the digestive contents (Bedford, 1995), which may allow a better contact of nutrients with endogenous and absorptive mucosae cells and there for a better use of the diet. Marquardt *et al.* (1996) observed the enzymes caused a decrease in the water content of excreta, which will benefit a management productivity and quality of the end product.

Our results disagree with those obtained by Mohamed and Hamza, 1991; Ghazalah *et al*., 1994) who indicated that enzyme preporation failed to obtain a significant increase in live body weight and body weight gain of broiler chicks.

However, other investigate found an improvement in broilers and quail chicks growth performance (live body weight and body weight gain) with enzyme supplementation of diet including high level of fiber (Zeweil, 1996; Attia and Abd El-Rahmane, 2001; Aboul Ela *et al*., 2005; Khan *et al*., 2006; Yu *et al*., 2007; Yang *et al*., 2008; Abudabos and Aljumaah, 2010; Ahsan *et al.*, 2012; Ali *et al.*, 2014; Amerah *et al.*, 2015).

Results in Tables 6 and 7 revealed that, enzyme supplementation of the experimental diets rightly increased feed intake ($P \leq 0.01$) and improved feed conversion values through all the experimental periods (1-3, 3- 5 and 1- 5 weeks of age). It is worth to note that, addition of kemzyme to the diets of broiler chicks significantly ($P \leq 0.01$) enhanced the increase in feed intake by 3.70, 1.74 and 2.42% during 1- 3 , 3- 5 and 1-5 weeks of age, respectively. The corresponding improvements in feed conversion were 23.6, 10.46 and 16.22%, respectively. Enzyme supplementation increases the rate of passage which may improve feed intake (Brenes *et al*., 1996) and decreases multiplication of anacrobes of genus clostridium (Ward, 1995). Pettersson and Aman (1989) has established that, supplementation with appropriate enzyme can partially degrade feed indosperm cell wall, giving a more rapid and extensive digestion of starch, protein and other nutrients in the small intestine, and consequently a higher feed intake and better feed conversion efficiency.

The present results are in agreement with those obtained by Zeweil (1996) who indicated that kemzyme supplementation in growing Japanese quail diets significantly improved feed consumption and feed conversion. Brenes *et al*. (1993) found that, addition of Roxazyme and Avizyme to diets containing bed ford barley improved feed to gain ratio by about 5 % over a 6 weeks period for both male and female broilers.

Khan *et al*. (2006) found that birds fed the enzymes supplemented diets ate more and had better feed conversion ($P<0.05$) than those fed the control diet .

Mushtaq *et al* (2008) observed that enzyme supplementation during 1- 42 days decreased the feed intake and improved gain feed ratio.

Ahsan *et al.* (2012) revealed that broiler fed different enzymes significantly consumed 5.9 – 9.9% more feed and improved 3.5 – 7.5% feed conversion ratio as compared with control one.

Amerah *et al*. (2015) observed that enzyme supplementation improved ($P<0.05$) feed conversion ratio compared with the unsupplemented diets.

Ali *et al*. (2014) found significant improvement on feed intake due to enzymes supplementation on broiler chick's diet.

However, other investigators indicated that, enzyme preporation failed to obtain significant improvement in feed intake or feed conversion ratio (Mohamed and Hamza, 1991; Ghazalah *et al.*, 1994, Arce *et al*., 2009 ; Ali *et al*. 2014).

Effect of interaction on fiber source × level

There were no interaction effects between crude fiber source and level on live body weight at 3 and 5 weeks of age and body weight gain during 3- 5 and 1- 5 weeks of age (Tables 4 and 5) while, the interaction effect between fiber source and level was significant ($P \leq 0.05$) on body weight gain during 1- 3 weeks of age (starter period). It is clear that the highest live body weight and body weight gain were recorded for chicks fed diet containing 3 % crude fiber from corn cobs. On the other hand, the lowest values for live body weight and body weight gain were observed for chicks fed diet containing 9% crude fiber from wheat straw.

Within each dietary fiber source increased fiber level from 3 to 6 and 9% significantly ($P \leq 0.01$) decreased feed intake and poorer feed conversion through the forementioned period studied. Treatment groups fed diets containing 3% crude fiber from corn cobs had significantly higher fed intake and better feed conversion during the different intervals period when compared with other treatment groups. On the other hand, chicks fed diets containing 9% crude fiber from wheat straw had lower feed intake and poorest feed conversion.

Effect of interaction on fiber source × enzyme supplementation

Results in Tables 4 and 5 showed that, the interaction between crude fiber source and enzyme supplementation were significant (P≤0.01) on live body weight at 5 weeks of age and body weight gain through the finisher and the whole experimental periods. It is worthy to mentioned that, at any source of crude fiber, enzyme supplementation improved live body weight and body weight gain when compared to groups fed diets without enzyme supplementation.

The highest values of (live body weight and body weight gain) were recorded for chicks fed diet containing corn cobs with enzyme supplementation. While, the lowest values of (live body weight and body weight gain) were recorded by chicks fed diets containing wheat straw without enzyme supplementation.

Abou-Khashaba (1999) observed that the response of chicken's to the enzyme in live body weight was greater during the first 3 weeks of the starter period. While the beneficial effect of adding enzyme to corn cobs diet decreased by increasing the experimental corn cobs levels.

Results in Table 6 did not show any significant effects due to the interaction between fiber source and enzyme supplementation on feed intake during all the experimental periods (1-5 weeks of age) while, Results in Table 7 Show significant effect (P≤0.01) on feed conversion during 1- 3 and 1- 5 weeks of age. Within each dietary fiber source, enzyme supplementation improved feed conversion, in which the best overall mean values of feed conversion was detected for chicks fed diet containing corn cobs supplemented with kemzyme through 1- 3 and 1- 5 weeks of age . In the same respect chicks fed diet containing wheat straw without enzyme supplementation had the poorest feed conversion values.

Our results disagree with those obtained by Abou-Khashaba (1999) who showed that feed intake was significantly increased during the starter period for chicks fed on corn cobs diet supplemented with enzyme compared with control group.

Effect of interaction on fiber level × enzyme supplementation

The interaction between fiber level and enzyme supplementation was significant on live body weight at 3 and 5 weeks of age and body weight gain during all the experimental periods studied (Tables 4 and 5). It could be noticed that, within each dietary fiber level, enzyme supplementation improved live body weight and body weight gain when compared with unsupplemented one. Chicks fed diet contained 3% crude fiber supplemented with enzyme recorded the highest values of live body weight at 3 and 5 weeks of age and body weight gain during all the experimental periods. While, chicks fed diet contained 9 % crude fiber without enzyme supplementation recorded the lowest live body weight and body weight gain during the forementioned periods.

The interaction effect between crude fiber level and enzyme supplementation were highly significant (P≤0.01) for feed intake and feed conversion through the interval period except feed intake at 3- 5 weeks of age which, the interaction effect was not significant. The highest amount of feed intake and better feed conversion were recorded for chicks fed diet containing 3% crude fiber without enzyme supplementation. In the same respect diet containing 9% crude fiber without enzyme supplementation had the lowest feed intake and poorest feed conversion.

Effect of interaction on fiber source × level × enzyme supplementation

Results in Tables 4 and 5 showed that, live body weight at 5 weeks of age and body weight gain during 3- 5 and 1- 5 weeks of age .were significantly affected (P≤0.01) due to the interaction between fiber source × level × enzyme supplementation. Taking live body weight and body weight gain into consideration, it could be concluded that, corn cobs diets at 3% crude fiber level with enzyme supplementation would be suitable of broiler chicks through 1- 5 weeks of age for obtained high growth rate (live body weight and body weight gain).

The interaction among fiber source × level × enzyme supplementation Tables 6 and 7 was not significant for feed intake and highly significant (P≤0.01) for feed conversion through 3- 5 and 1-5 weeks of age. Remarkably, the best overall mean values of feed conversion were recorded for chicks fed diet containing 3% crude fiber from corn cobs and supplemented with kemzyme, while the poorest values were recorded by chicks fed corn cobs diets containing 9% crude fiber without enzyme supplementation.

It could be concluded that, corn cobs diet at 3% crude fiber level with enzyme supplementation would be suitable for broiler chicks through out 1- 5 weks of age for obtained highe growth performance.

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تأثير مصـــدر ومســـتوى الأليـــاف مـــع أو بـــدون إضـــافة الأنزيـم على أداء النمـو لبداري التسمين

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تم إجراء تجربه عامليه ٢×٣×٢ أشتملت علي مصدرين للألياف (قوالح الذرة – وتبن القمح) وثلاثه مستويات من الألياف (٣ ، ٦ ، ٩%) ومستويين للإنزيمات (بدون أو ٢٥٠ ملجم/ كجم عليقة)، تم إستخدام عدد ٣٦٠ من كتاكيت الكب غير المجنسة على عمر أسبوع وقسمت عشوائياً إلى ١٢ مجموعه تجريبيه بكل منها ٣٠ كتكوت، تم دراسه أداء النمو (وزن الجسم الحي ، معدل الزياده في وزن الجسم ، إستهلاك الغذاء، معامل التحويل الغذائي) وذلك خلال الفتره التجريبيه التي امتدت من ١-٥ اسابيع من العمر، أوضحت النتائج المتحصل عليها وجود تحسن معنوي (P<0.01) في معظم صفات أداء النمو (وزن الجسم الحي، معدل الزياده في وزن الجسم، إستهلاك الغذاء، معامل التحويل الغذائي) في المجموعات التي غذيت علي علائق قوالح الذره بالمقارنه بتلك التي غذيت علي علائق تبن القمح فيما عدا إستهلاك الغذاء والذي زاد معنوياً (P<0.01) في المجموعات التي غذيت على علائق تبن القمح، لوحظ وجود تحسن معنوي (P<0.01) في المجموعات التي غذيت على ٣% ألياف مقارنه بتلك التي غذيت علي ٦ أو ٩% ألياف في كل صفات النمو المدروسة، أدت إضافه الإنزيمات إلى علائق كتاكيت التسمين إلى تحسن معنوي في وزن الجسم (P<0.01) ووزن الجسم المكتسب ومعدل التحويل الغذائي خلال الفترات التجريبيه المدروسة، بينما إنخفض الغذاء المأكول نتيجه إضافه الإنزيم لعلائق كتاكيت التسمين، سجلت الكتاكيت التي غذيت على علائق تحتوى على قوالح الذره بمستوي ٣% من الألياف الخام مع إضافه الإنزيم أعلي معدل نمو بينما أقل معدل نمو تم الحصول عليه للكتاكيت التي غذيت علي علائق تبن القمح بمستوي ٩% من الألياف الخام بدون إضافه إنزيم، ومن ذلك يمكن إستنتاج أن إضافه قوالح الذره بمستوي ٣% من الألياف الخام مع إضافه الإنزيم يمكن أن يكون مناسباً لكتاكيت التسمين خلال الفتره العمريه من ١- ٥ أسابيع.

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