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EFFECTS OF FEEDING DRIED DISTILLERS GRAINS BY SOLUBLES WITH OR WITHOUT ENZYME SUPPLEMENTATION ON GROWTH PERFORMANCE OF BROILER CHICKS

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ABSTRACT: A5×2 factorial design experiment, included five levels of dried distillers grains by soluble, DDGS, (0, 7.5, 15, 22.5 and 30% in the diet) and two levels of enzyme supplementation (without and 0.5 g enzyme/kg diet) through 1-9 weeks of the age. A total number of 300 Saso broiler chicks one week old were randomly divided into 10 treatment groups each of 30 chicks, with three replicates each of 10 chicks. Each experiment group was allotted on one of the experimental diets to study the effect of DDGS in the diet with or without Avizyme supplementation on growth performance (live body weight, body weight gain, feed consumption and feed conversion) of Saso broiler. The results indicated that no significant effects of DDGS levels were detected on body weight (BW) at all studied ages (1, 5 and 9 weeks of age). Body weight gain (BWG) was significantly ($P<0.05$) affected due to DDGS levels only at the period of 5-9 weeks of age. It is worth noting that, the best BWG was found in 22.5% DDGS group (29.20 g/day), followed by that of 30% DDGS (27.67 g/day) compared with the control and the other DDGS levels. Chicks fed the 30% DDGS diet consumed more feed compared with the control and other DDGS levels. During the period of 1-5 weeks of age, the best feed conservation ratio (FCR) (1.75) was found in 7.5% DDGS group. While, the group of 22.5% DDGS gave the best FCR value (3.15) during 5-9 weeks of age. Results noticed that chicks fed diets supplemented with Avizyme gained more weight compared to those fed unsupplemented diet. Results showed that, feed intake was insignificantly effected during all experimental periods studied, while feed conversion was significantly ($P<0.05$) improved due to Avizyme supplementation during 5-9 and 1-9 weeks of age compared to the control. The interaction between DDGS levels and enzyme supplementation was significant ($P<0.05$) on BW at 5 weeks of age, BWG and FC at the first period (1-5 weeks of age). Chicks fed diet contained 22.5% DDGS supplemented with enzyme improved values of live body weight at 9 weeks of age, body weight gain and FC during all the experimental periods. In conclusion it could be concluded that, DDGS could be used in Saso broiler diets up to 22.5% with enzyme supplementation (0.5 g/kg diet) without adverse effect on their growth performance.

Key words: DDGS, broiler, enzyme, growth performance.

INTRODUCTION

Poultry industry in Egypt was and still facing severe challenges due to the high prices of corn and soybean meal which mainly used in poultry feed diets. The price of these ingredients hit an all-time record high. Thus, there is an urgent need for affordable and nutritious feed. The best strategy to reduce costs is developing diets formulation using alternative, locally available ingredients, thereby decreasing feed cost. Distiller's dried grains with soluble (DDGS) is a by-product of the ethanol industry created in the fermentation process of cereal grains, mainly maize, and can be defined as the product obtained after the removal of ethyl alcohol by distillation from the yeast fermentation of grains by condensing and drying at least 75% of the resultant whole stillage by methods employed in the grain distilling industry (**AAFCO, 2002; Świątkiewicz *et al*., 2013**).

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Because of the rapid increase of ethanol production from yellow corn in recent years, huge amounts of DDGS have been generated. The United States of America is the first place in the world in producing ethanol from corn and consequently DDGS. Total distiller grains production in the United States reached approximately 22 million metric tons in the year of 2008 and 30.5 million metric tons in 2009/2010 as reported by the Renewable Fuel Association. The DDGS produced has been used in livestock and poultry feeding and about 20 % of total amount has been exported to other countries over the world **(Cortes-Cuevas *et al.*, 2015).** With the increase in DDGS production and based on its nutritional value, DDGS could be an attractive low cost ingredient to replace soybean meal and corn in poultry rations **(Świątkiewicz *et al.*, 2014)**.

Several studies have shown beneficial effects of supplemental enzymes on feed intake, and feed utilization of different poultry species (**Pan *et al*., 1998; Jaroni *et al*., 1999**). Enzymes are now being manufactured specifically for feed use, and can be broadly categorized as carbohydrates, proteinases and lipases. Increasing the digestibility of various carbohydrate fractions of cereals and plant proteins has received most attention, although there is growing interest in potential for improving digestibility of both plant and animal proteins, and saturated fatty acids for young birds. Examples of enzymes used in poultry diets include: amylase, protease, xylanase. Beta-glucanase, mixtures of enzyme activities (**Cowieson and Ravindran, 2008**). The results of **Liu *et al.* (2008)** indicated that the broiler diets supplemented with Phytase improved body weight, feed intake and feed conversion values than those fed control diet. Therefore, supplementing monogastric diets with exogenous enzymes may improve the available energy of DDGS by degrading the fiber content and increasing the digestibility of other components. Also, amylase improves starch digestion, xylanase reduces gut viscosity and breaks down cereal cell walls and protease affects soybean meal anti-nutritional factors and storage proteins (**Graham and Aman, 1991**).The present study was designed to evaluate DDGS inclusion rates in Saso broiler chickens diets with or without enzyme supplementation on their growth performance.

MATERIALS AND METHODS

The present experiment was carried out at a private farm, Mit Ghamr city, Dakahlia Governorate, Egypt.

A total number of 300 one week old Saso broiler chicks, nearly similar in live body weigh were randomly distributed into ten treatment groups each of 30 chicks, with three replicates of 10 chicks. A 5×2 factorial design experiment was performed including five levels of DDGS (0, 7.5, 15, 22.5 and 30% in the diet) and two levels of enzyme(without or 0.5 g enzyme/kg diet) through 1-9 weeks of the age.

Each experimental group of chicks was allotted on one of the experimental diets, avizyme used contains enzymes produced by strains of Trichoderma and Bacillus, and has xylanase, protease, and amylase activity. The experimental diets were formulated based on the **NRC (1994**) requirements for quails and were isocaloric and isonitrogenous during the growing period (1-9 weeks of age). Composition and calculated analysis of the experimental diets are shown in Table 1.

Chicks were grown in brooders with raised wire floors and exposed to 24 hours of a constant light. Feed and water were supplied *ad-libitum* throughout the experimental period. Individual body weight was recorded at one, five and nine weeks of age; feed consumption and conversion were recorded during the periods 1-5, 5-9 and 1-9 weeks of age.

Data were statistically analyzed on a 2 × 5 factorial design basis according to **Snedecor and Cochran (1982)** using SPSS® software statistical analysis program **(SPSS, 1999)**,by adopting the following model:

$$Y_{ijk} = \mu + T_i + E_j + (TE)_{ij} + e_{ijk}$$

Where:

Y_{ijk} = an observation,

μ = the overall mean,

T_i = effect of DDGS level,

E_j = effect of enzyme level,

Table 1. Composition and calculated analysis of starter and finisher diets

Ingredient (%)	Starter					finisher				
	DDGS level (%)									
	0	7.5	15	22.5	30	0	7.5	15	22.5	30
Corn	58.58	54.25	49.90	45.41	41.03	65.0	60.36	55.67	50.35	46.0
Soybean 48%	30.0	26.0	22.33	18.70	14.7	22.0	18.3	15.4	13.0	9.0
Gluten	5.1	5.4	5.3	5.3	5.5	5.70	5.80	5.30	4.50	4.83
DDGS	-	7.5	15.00	22.5	30.0	-	7.5	15.0	22.5	30.0
Oil	1.8	2.3	2.9	3.5	4.1	3.2	3.9	4.5	5.5	6.0
L-Lysine	0.33	0.42	0.50	0.58	0.67	0.30	0.38	0.42	0.48	0.57
Methionine	0.14	0.13	0.12	0.11	0.10	0.08	0.08	0.07	0.07	0.05
Di Calcium	1.85	1.75	1.65	1.55	1.45	1.6	1.5	1.4	1.3	1.2
Limestone	1.20	1.25	1.30	1.35	1.45	1.12	1.18	12.4	1.3	1.35
Premix	0.3	0.3	0.3	0.3	0.3	0.30	0.30	0.30	0.30	0.30
NACL	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Choline chloride	0.1	0.1	0.1	0.1	0.1	0.10	0.10	0.10	0.10	0.10
BiCarbonate	0.1	0.1	0.1	0.1	0.1	0.10	0.10	0.10	0.10	0.10
Anti toxin	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Anti Coccidial	0.1	0.1	0.1	0.1	0.1	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100	100	100	100	100	100
C.P.	23.02	23.07	23.02	23.05	23.03	20.02	20.06	20.06	20.09	20.15
M.E.	3051.9	3051.26	3050.7	3050.3	3052.4	3205.4	3210.5	3200.7	3204.9	3204.3
Ca	1.01	1.01	1.00	1.00	1.01	0.90	0.90	0.90	0.90	0.90
P	0.45	0.45	0.45	0.45	0.45	0.40	0.40	0.40	0.40	0.40
Lysine	1.35	1.35	1.35	1.35	1.35	1.11	1.11	1.10	1.11	1.11
M+C	1.03	1.03	1.03	1.03	1.03	0.90	0.91	0.90	0.90	0.90
C.F	2.53	3.10	3.46	3.83	4.19	2.75	2.93	3.32	3.71	4.07

TE_{ij} = effect of the interaction between DDGS and enzyme and

e_{ijk} = experimental random error.

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

RESULTS AND DISCUSSION

Growth Performance

Live body weight and daily body weight gain

Effect of DDGS levels

The average values of body weight and body weight gain as affected by DDGS meal levels in growing Saso broiler diets regardless of Avizyme supplementation are presented in Tables 2 and 3.

Concerning live body weight, results in Table 2 show that no significant effects of DDGS levels were detected on BW at all ages studied (1, 5 and 9 weeks of age). However, BW was insignificantly increased in chicks fed diet containing 22.5% DDGS when compared with control and other treatment groups.

With regard to BWG, results illustrated in Table 3 show that, it was significantly ($P<0.05$) affected due to DDGS levels only at the period of 5-9 weeks of age. It is worth noting that, the best BWG was found in 22.5% DDGS group (29.20 g/day), followed by that of 30% DDGS (27.67 g/day) compared with the control and other DDGS levels. However, body weight gain was insignificantly affected at the periods of 1-5 and 1-9 weeks of age, increasing body weight gain may be related to increasing feed intake, this means that incorporated DDGS in the control diet upto30% did not exert any detrimental effect on body weight at 5 and 9 weeks of age.

These results are in agreement with results of several researchers, who reported no negative effects of DDGS inclusion rates (5, 10, 15, 20 and 25%) on live body weight and body weight gain (**Masa'deh, 2011; Jiang *et al.*, 2013).** On contrary, **Ghazalah *et al.* (2012)** who used DDGS in broiler diets cleared that there was significant effect ($P\leq0.05$) on body weight gain and body weight. **El-Abd (2017)** showed that quail chicks fed DDGS had the highest ($P\leq0.05$) body weight, body weight gain compared to the control group. **Abd El-Hack *et al.* (2015)** reported that replacing soybean meal in the control diet with DDGS up to 75% (16.5% DDGS in the diet) did not exert any detrimental ($P\leq0.05$) effect on final body weight and body weight change in laying hen during the whole experimental period (22-42 weeks of age). However, **Romeo *et al.* (2010)** reported that body weight from 26 to 34 weeks of age was not affected by dietary inclusion of DDGS. **Wang *et al.* (2008)** used DDGS in broiler diets at levels 0, 10, 20, 30, 40 and 50%, he showed that at 14th day post hatch, the higher levels of DDGS numerically reduced the body weight at 35, 42 and 49 day, being reduced gradually as DDGS increased.

Effect of Avizyme supplementation

The average values of body weight and body weight gain of Saso broiler chicks as affected by dietary Avizyme supplementation regardless of dietary DDGS level are presented in Tables 2 and 3. The effect of enzyme supplementation was highly ($P<0.01$) significant on both BW (only at 9 weeks of age) and BWG (at all periods studs except 1-5 weeks of age). It could be noticed that chicks fed diets supplemented with Avizyme gained more weight compared to those fed unsupplemented diet. This improvement was to the extent 6.32 for live body weight at 9 weeks of age, and 14.50 and 20.4% for body weight gain during 5-9 and 1–9 weeks of age, respectively. **Masa'deh (2011)** found that BW was improved due to enzyme supplementation to layer diets. Conversely, **Yoruk *et al.* (2006)** found that supplementation of a multi-enzyme to a corn-soybean diet did not negatively affect body weight.

The improvement in live body weight and body weight gain due to enzyme supplementation may be attributed to feed intake (Table 5). 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-starch polysaccharides **(NSP)** contained in the feed and favor their digestion **(Classen, 1996 ; Cowan *et al.,* 1996).** It is well known

Table 2. Live body weight, g ($\overline{X}$ ±SE) for growing Saso broilers as affected by DDGS levels, enzyme supplementation and their interaction

Item		Initial (1 week)	5 weeks	9 weeks
DDGS level effect		NS	NS	NS
0.00%		107.75±0.09	1023.05±16.69	1750.47±34.20
7.50%		107.96±0.08	1025.63±8.54	1709.95±32.59
15.00%		107.71±0.09	1009.22±7.81	1677.82±54.99
22.50%		107.89±0.05	1011.96±14.95	1829.54± 48.65
30.00%		107.96±0.12	1002.11±9.80	1776.99±45.87
Enzyme effect		NS	NS	**
Without		107.88±0.05	1014.72±8.26	1691.88^{b} ±28.31
With		107.83±0.07	1014.06±6.91	1806.03^{a} ±24.10
Interaction effect		NS	*	NS
0.00% DDGS	**Without**	107.82±0.09	1057.50^{a} ± 16.80	1758.84±69.96
	With	107.68±0.15	988.60^{g} ± 15.05	1742.10±22.77
7.50% DDGS	**Without**	107.95±0.15	1023.60^{c} ± 8.83	1655.16±43.28
	With	107.98±0.10	1027.66^{b} ± 16.10	1764.73±32.91
15.00% DDGS	**Without**	107.68±0.10	1007.66^{e} ± 6.96	1586.13±48.89
	With	107.74±0.16	1010.78^{e} ± 15.33	1769.51±78.21
22.50% DDGS	**Without**	107.99±0.05	1000.63^{f} ± 25.25	1742.06±67.75
	With	107.80±0.05	1023.28^{c} ± 17.89	1917.03±36.78
30.00% DDGS	**Without**	107.98±0.08	984.22^{h} ± 9.14	1717.21±70.07
	With	107.93±0.24	1020.00^{d} ± 12.30	1836.77±50.27

Means in the same column within each classification bearing different letters are significantly different (P<0.05 or 0.01), *= Significant (p<0.05), ** = Significant (p<0.01) and NS = Not significant.

Table 3. Daily body weight gain, g/day ($\overline{X}$ ±SE) for growing Saso broilers as affected by DDGS levels, enzyme supplementation and their interaction

Item		1-5 weeks	5-9 weeks	1-9 weeks
DDGS level effect		NS	*	NS
0.00 %		32.69±0.60	25.98^{ab}±1.21	29.33±0.60
7.50 %		32.78±0.30	24.44^{b}±1.22	28.61±0.58
15.00 %		32.20±0.28	23.88^{b}±1.78	28.04±0.98
22.50 %		32.29±0.53	29.20^{a}±1.39	30.74±0.87
30.00 %		31.94±0.35	27.67^{ab}±1.60	29.80±0.82
Enzyme effect		NS	**	**
Without		32.39±0.30	24.18^{b}±0.94	28.29^{b}±0.51
With		32.37±0.25	28.28^{a}±0.81	30.33^{a}±0.43
Interaction effect		*	NS	NS
0.00% DDGS	**Without**	33.92^{a}±0.60	25.05±2.19	29.48±1.25
	With	31.46^{bc}±0.53	26.91±1.21	29.19±0.41
7.50% DDGS	**Without**	32.70^{ab}±0.31	22.56±1.41	27.63±0.77
	With	32.85^{ab}±0.58	26.32±1.61	29.59±0.59
15.00% DDGS	**Without**	32.14^{b}±0.25	20.66±1.56	26.40±0.87
	With	32.25^{b}±0.55	27.10±2.34	29.68±1.40
22.50% DDGS	**Without**	31.88^{bc}±0.90	26.48±1.68	29.18±1.21
	With	32.70^{ab}±0.64	31.92±1.11	32.31±0.66
30.00% DDGS	**Without**	31.29^{c}±0.33	26.18±2.71	28.74±1.25
	With	32.58^{b}±0.44	29.17±1.75	30.87±0.89

Means in the same column within each classification bearing different letters are significantly different (P<0.05 or 0.01), *= Significant (p<0.05), ** = Significant (p<0.01) and NS = Not significant.

also that, 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 therefor a better use of the diet. **Marquardt *et al.* (1996)** detected that enzymes caused a decrease in the water content of excreta, which will benefit a management productivity and quality of the end product.

Interaction effects (DDGS× Enzyme)

The interaction effects due to dietary DDGS level and Avizyme supplementation on live body weight and body weight gain at different ages are given in Tables 2 and 3. The interaction between DDGS levels and enzyme supplementation was significant (P<0.05) on BW at 5 weeks of age; and BWG at the first period (1-5 weeks of age). It could be noticed that, within each dietary DDGS and enzyme supplementation improved live body weight and body weight gain when compared with unsupplemented one. Chicks fed diet contained 22.5% DDGS supplemented with enzyme recorded the highest values of live body weight at 9 weeks of age and body weight gain during all the experimental periods. While, chicks fed diet contained 0 % DDGS with enzyme supplementation recorded the lowest live body weight and body weight gain during the four mentioned periods. The present results are in agreement with **Ali (2013)** who found that significant differences due to the interaction between DDGS and enzymes supplementation were observed for body weight and body weight gain. Birds fed 40%DDGS replacement for SBM with enzymes supplementation had significantly higher body weight while,the lowest was by those fed 60% DDGS without enzymes supplementation. Similarly, **Moran and Lehman (2008)** noted more improvement in BWG when DDGS was supplemented with enzyme mixture contain amylase, protease, xylanase and Phytase. **Masa'deh (2011)** found no significant interaction effects between level of DDGS and enzyme inclusion for live body weight of Hy-Line W-36 White hens.

Feed intake and feed conversion ratio

Effect of DDGS level

The average feed consumption and feed conversion ratio as affected by dietary DDGS level irrespective of Avizyme supplementation during the different experimental periods are shown in Tables 4 and 5.

As shown in Table 4, the impact of DDGS inclusion level was significant (P<0.05) only 9 weeks of age. Birds fed the 30% DDGS diet consumed more feed compared with the control and other DDGS levels. No statistical differences were noticed on daily feed intake due to DDGS levels in the diet during 1-5 and 5-9 weeks of age. Similarly, **Lumpkins *et al.* (2005)** and **Świątkiewicz and Koreleski (2006)** found no difference in feed intake for hens fed up to 15 or 20% DDGS, respectively. Moreover, **Roberson *et al*. (2005)** reported that feed consumption was not affected by DDGS levels. Also, **Masa'deh (2011)** reported that feed intake was not affected by dietary DDGS concentration or enzyme levels with an average of 102 g/hen/ day. **El Abd (2017)** showed that quail chicks fed DDGS had the highest (P≤0.05) feed intake while, there was no significant effect on feed conversion ratio compared to the control group

With regard to feed conversion ratio (FCR) Results exhibited in Table 5 show the effect of different incorporation levels of DDGS with or without enzyme supplementation on (FCR) of Saso broiler chickens. Excluding the total period (1-9 weeks of age), FCR was statistically (P<0.05 or 0.01) different due to DDGS inclusion. During the period of 1-5 weeks of age, the best FCR (1.75) was found in 7.5% DDGS group. While, the group of 22.5% DDGS gave the best FCR value (3.15) during 5-9 weeks of age. It is obvious that the highest level of DDGS (30%) accompanied by the worst FCR during 2-5 weeks of age; meanwhile, the intermediate level of DDGS (15%) resulted in the worst FCR during 5-9 weeks of age. **Jiang *et al.* (2013)** found that feeding 20% DDGS in the diets yielded the worst feed conversion compared with the 0% DDGS (P ≤ 0.05). Contrarily, **Romeo *et al.* (2010)** reported insignificant (P = 0.09) improvement in feed conversion (1.98 vs. 2.04 g of feed/g of egg mass) of hens fed 20% DDGS diets as compared with those fed the no DDGS diets. **El Abd (2017)** showed that quail chicks fed DDGS had no significant effect on feed conversion ratio compared to the control group

Table 4. Daily feed intake, g/day ($\overline{X}$ ±SE) for growing Saso broilers as affected by DDGS levels, enzyme supplementation and their interaction

Item		1-5 weeks	5-9 weeks	1-9 weeks
DDGS level effect		NS	NS	*
0.00%		57.85±0.76	87.92±1.59	72.88^{b}±1.08
7.50%		57.28±0.54	86.03±2.19	71.65^{b}±1.22
15.00%		56.68±0.46	87.42±2.46	72.05^{b}±1.37
22.50%		57.42±0.46	90.74±1.69	74.08^{ab}±0.93
30.00%		59.16±0.61	94.41±2.70	76.79^{a}±1.61
Enzyme effect		NS	NS	NS
Without		57.73±0.46	88.09±1.55	72.91±0.98
With		57.63±0.32	90.51±1.35	74.07±0.74
Interaction effect		NS	NS	NS
0.00% DDGS	**Without**	58.30±1.14	88.72±3.23	73.51±2.09
	With	57.40±1.12	87.12±1.01	72.26±0.90
7.50% DDGS	**Without**	56.50±0.66	83.25±1.28	69.87±0.84
	With	58.07±0.73	88.80±3.94	73.43±2.03
15.00% DDGS	**Without**	56.49±0.68	86.05±3.55	71.27±2.08
	With	56.87±0.71	88.79±3.78	72.83±2.02
22.50% DDGS	**Without**	57.55±0.85	87.50±1.06	72.52±0.93
	With	57.30±0.52	93.98±2.29	75.63±1.25
30.00% DDGS	**Without**	59.81±1.11	94.95±5.04	77.38±3.03
	With	58.52±0.45	93.86±2.91	76.19±1.65

Means in the same column within each classification bearing different letters are significantly different (P<0.05 or 0.01), *= Significant (p<0.05) and NS = Not significant.

Table 5. Feed conversion ratio, g feed/g gain ($\overline{X}$ ±SE) for growing Saso broilers as affected by DDGS levels, enzyme supplementation and their interaction

Item		1-5 weeks	5-9 weeks	1-9 weeks
DDGS level effect		**	*	NS
0.00 %		1.77^{b}±0.03	3.43^{ab}±0.13	2.49±0.03
7.50 %		1.75^{b}±0.01	3.57^{ab}±0.15	2.51±0.05
15.00 %		1.76^{b}±0.02	3.77^{a}±0.22	2.58±0.06
22.50 %		1.78^{b}±0.02	3.15^{b}±0.12	2.42±0.05
30.00 %		1.85^{a}±0.03	3.47^{ab}±0.17	2.58±0.06
Enzyme effect		NS	**	**
Without		1.79±0.02	3.72^{a}±0.11	2.59^{a}±0.04
With		1.78±0.01	3.23^{b}±0.07	2.45^{b}±0.03
Interaction effect		**	NS	NS
0.00 % DDGS	**Without**	1.72^{d}±0.03	3.60±0.20	2.50±0.04
	With	1.82^{b}±0.01	3.26±0.15	2.48±0.06
7.50 % DDGS	**Without**	1.73^{d}±0.02	3.73±0.19	2.53±0.05
	With	1.77^{c}±0.02	3.41±0.23	2.49±0.09
15.00 % DDGS	**Without**	1.76^{c}±0.03	4.22±0.26	2.70±0.07
	With	1.76^{c}±0.04	3.32±0.16	2.46±0.06
22.50 % DDGS	**Without**	1.81^{b}±0.03	3.34±0.20	2.50±0.08
	With	1.76^{c}±0.03	2.95±0.06	2.35±0.02
30.00 % DDGS	**Without**	1.91^{a}±0.04	3.71±0.28	2.70±0.09
	With	1.80^{b}±0.03	3.24±0.12	2.47±0.02

Means in the same column within each classification bearing different letters are significantly different (P<0.05 or 0.01), *= Significant (p<0.05), ** = Significant (p<0.01) and NS = Not significant.

Effect of Avizyme supplementation

The average feed intake and feed conversion of Saso broiler chicks as affected by Avizyme supplementation, irrespective of dietary DDGS levels, during the different growing periods are shown in Tables 4 and 5. Results indicated that feed intake insignificantly increased as the diets were supplemented with Avizyme during the periods 5-9 and 1-9 weeks age. It is worth noting that feed consumption increased by 2.67 and 1.57% for chicks fed the diets supplemented with Avizyme during 5-9 and 1-9 weeks of age, respectively when compared with unsupplemented one.

Regarding feed conversion ratio, results in Table 5 show that, feed conversion was significantly affected due to Avizyme supplementation during 5-9 and 1-9 weeks of age compared to the control. It is clear that Avizyme supplementation significantly ($P< 0.01$) improved feed conversion ratio by about 13.17% and 14% for birds received Avizyme as compared to birds fed unsupplemented diets during 5-9 and 1-9 weeks of age. **Pettersson and Aman (1989)** established that supplemented diets with an appropriate enzyme can partially degrade feed endosperm cell walls, giving more rapid and extensive digestion of starch, protein and other nutrients in the small intestine, and consequently higher feed intake and better feed conversion efficiency. In addition, enzyme supplementation increases the rate of passage, which may improve feed intake **(Brenes *et al.*, 1996).**

The present results are in agreement with those obtained by **Khan *et al*. (2006)** who found that, at the end of trial, birds fed enzyme 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 day decreased the feed intake and improved gain feed ration. **Ahsanul *et al.* (2012)** revealed that, the broiler fed different enzymes, significantly consumed 5.9- 9.9% more feed and improved feed conversion ratio by 3.5 - 7.5% as compared with the control. **Amerah *et al.* (2015)** observed that enzyme supplementation improved ($P < 0.05$) feed conversion ratio compared with the unsupplemented diets. However, other investigators indicated that Avizyme preparations failed to obtain significant improvement in feed intake and feed conversion ratio **(Mohamed and Hamza, 1991; Ghazalah *et al.*, 1994**).

Interaction effects (DDGS × enzyme)

Results reflection averages feed consumption and feed conversion of Saso broiler chicks as affected by the interaction between dietary DDGS level and Avizyme supplementation during the different experimental periods are presented in Tables 4 and 5.

In view of the results, it seems that the interaction effects between dietary DDGS level and Avizyme supplementation were not significant either on feed consumption or feed conversion through all the different experimental periods (1-5, 5-9 and 1-9) weeks of age except FC during 1-5 weeks of age in which the interaction was significant. Within any DDGS level, Avizyme supplementation improved feed intake and FC insignificantly when compared with the groups fed diets without Avizyme supplementation. It is worthy to note that, chicks fed on diets contained 30% DDGS with or without Avizyme supplementation had the highest feed intake values, while the chicks fed on diets contained 7.5% DDGS without Avizyme supplementation had the lowest feed intake. **Ali (2013)** found that significant differences due to the interaction between DDGS and enzymes supplementation were observed for FI and FCR values.

Moran and Lehman (2008) noted more improvement in FCR when DDGS was supplemented with enzyme mixture contain amylase, protease, xylanase and phytase. The feed conversion ratio of the groups received 60% DDGS without enzymes and those received 20% DDGS with enzymes had the best FCR with no significant differences between them.

In conclusion it could be concluded that, DDGS could be used in Saso broiler diets up to 22.5% with enzyme supplementation (0.5 g/kg diet) without adverse effect on their growth performance.

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تأثير التغذية على نواتج تقطير الأذرة بالسوائل مع إضافة أو عدم إضافة الإنزيمات على أداء النمو لكتاكيت اللحم

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صممت تجربة عاملية (٥× ٢) تتضمن ٥ مستويات من نواتج تقطير الذرة بالسوائل (صفر، ٧,٥، ١٥، ٢٢,٥ و٣٠% في العليقة) ومستويين من الإنزيم (بدون و ٠,٥ جم انزيم في الكيلو في العليقة) في عمر من أسبوع إلى ٩ أسابيع، تم تقسيم ٣٠٠ كتكوت ساسو تسمين في عمر أسبوع إلى عشر مجموعات كل منها تحتوي علي ٣٠ كتكوت و ٣ مكررات كل منها تحتوي علي ١٠ كتاكيت، تم تخصيص عليقة لكل مجموعة تجريبية لدراسة تأثير نواتج تقطير الذرة بالسوائل في العليقة - مع إضافة أو عدم إضافة إنزيم الافزيم – علي معدلات نمو كتاكيت الساسو (وزن الجسم الحي, معدل الزيادة في وزن الجسم، ومعدل استهلاك و تحويل العلف)، أوضحت النتائج انه لم يتم ملاحظة اي تأثير لمستويات نواتج تقطير الذرة بالسوائل علي وزن الجسم في جميع الأعمار (أسبوع ، ٥ أسابيع و٩ أسابيع)، تم التأثير علي اكتساب وزن الجسم بشكل كبير ($P<0.05$) نتيجة لمستويات نواتج تقطير الذرة بالسوائل في الفترة من عمر ٥ ال ٩ اسابيع.و من الجدير بالذكر ان افضل اكتساب لوزن الجسم كان بنسبة ٢٢,٥% من نواتج تقطير الذرة بالسوائل (٢٩,٢٠ جم/ في اليوم) و يتبعها ٣٠% من نواتج تقطير الذرة بالسوائل (٢٧,٦٧ جم في اليوم مقارنة بالمجموعة الضابطة ومستويات نواتج تقطير الذرة الاخرى، و قد استهلكت الكتاكيت التي تم تغذيتها بنظام ٣٠% من نواتج تقطير الذرة بالسوائل علف اكثر مقارنة بالمجموعة الضابطة و المستويات الاخري لنواتج تقطير الذرة بالسوائل، و في خلال الفترة من عمر أسبوع الي خمس اسابيع كان افضل معامل تحويل غذائي (١,٧٥) موجود في مجموعة نواتج تقطير الذرة بالسوائل ٧,٥%، في حين أن مجموعة نواتج تقطير الذرة بالسوائل ٢٢,٥% أعطت أفضل قيمة معامل تحويل غذائي (٣,١٥) في العمر من خمس إلى تسع أسابيع، وقد أشارت النتائج إلى أن عليقة الكتاكيت المعاملة بالافزيم اكتسبت وزن اكبر مقارنة بتلك التي لم يتم معاملتها، و أظهرت النتائج أن تناول العلف قد تأثر بشكل لا يذكر خلال كل مراحل التجربة التي تمت دراستها، في حين أن معدل تحويل العلف قد تحسن بشكل معنوي ($P<0.05$) نتيجة للمعاملة بالأفزيم خلال عمر من ٥ إلى ٩ أسابيع و من ١ إلى ٩ أسابيع مقارنة بالمجموعة الضابطة، أن التداخلات بين مستويات نواتج تقطير الذرة بالسوائل و المعاملة بالإنزيم كانت تأثيرها معنوي عند مستوي ($P<0.05$) علي وزن الجسم في عمر خمس أسابيع، وعلى معدل الزيادة في وزن الجسم و معامل التحويل في عمر من أسبوع إلى خمس أسابيع، أن أنظمة تغذية الكتاكيت التي تحتوي علي ٢٢,٥% من نواتج تقطير الذرة بالسوائل التي تمت معاملتها بالانزيم أدت إلى تحسين قيمة وزن الجسم الحي في عمر ٩ اسابيع، ومعدل الزيادة في الوزن و معامل التحويل في جميع مراحل التجربة، في الختام يمكننا أن نوصي بامكانية استخدام نواتج تقطير الذرة بالسوائل في كتاكيت ساسو تسمين حتي ٢٢,٥% مع المعاملة بالإنزيم (٠,٥ جم/ك.ج عليقة) دون تأثير سلبي علي أداء نموها.

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