EFFECT OF DIFFERENT LEVELS OF RICE POLISH IN BROILER DIETS SUPPLEMENTED WITH ENZYMES ON GROWTH PERFORMANCE, NUTRIENT DIGESTIBILITY AND ECONOMIC EFFICIENCY

M. H. Soliman1 & T. I. Mohamed2

1 Dept. Nutrition and Clinical Nutrition. Fac. of Vet. Medicine. Zagazig University. Egypt

2 Dept. Nutrition and Nutritional Deficiency Diseases. Fac. of Vet. Medicine. Mansoura University. Egypt

ABSTRACT

This study was carried out to investigate the effects of inclusion of different levels of rice polish (RP) in broiler diets supplemented with exogenous enzymes on growth performance, nutrient digestibility and economic benefit. A total of 168 day-old broiler chicks (Cobb-500) were used in this study. The chicks were fed starter diet (23% CP and 3000 Kcal ME/ Kg) for 4 days then randomly divided into 4 equal groups, each with 3 equal replicates. Four isocaloric and isonitrogenous starter diets (23% CP and 3000 Kcal ME/ Kg) were fed up to 2 weeks age. grower diets (21% CP and 3100 Kcal ME/ Kg) were fed up to 4 weeks age and finisher diets (19% CP and 3200 Kcal ME/ Kg) were fed up to 6 weeks age. The first diet (control) was formulated without inclusion of RP and the other three diets were formulated with inclusion of RP at levels 15, 30 and 45% and supplemented with exogenous enzyme (Natuzyme) at a rate of 0.05%. Chicks were randomly fed their respective diets for 6 weeks. Body weight, weight gain, feed consumption and feed conversion were measured at 14, 28 and 42 days of age. Digestibility of DM, CP, and EE were determined using chromic oxide (0.3%). Average feed cost/kg weight gain at each growth phase and the average feed cost/final total weight gain were calculated

The results revealed that inclusion of RP in broiler starter diet up to 30% did not adversely affect the feed consumption and feed conversion ratio but decreased body gain. Inclusion of RP in grower and finisher diets at levels of 15 and 30%, respectively did not affect the growth performance parameters. Inclusion of RP in broiler diets at the three periods of growth at a level of 45% adversely affected all of the growth performance parameters. The digestibility results indicated that inclusion of RP at a level of 15% did not significantly adverse the digestibility of DM, CP, and EE. Inclusion of RP at a level of 30% did not significantly adverse the digestibility of CP. However, the 45%

RP-diet decreased the digestibility of DM, CP, and EE. Also, the results indicated that inclusion of RP up to 30% significantly decreased the cost per Kg broiler. From the results of the present study, it could be concluded that rice polish could be included in the broiler diets up to 15% with supplementation of exogenous enzyme without adverse affecting on the growth performance or the economic efficiency.

INTRODUCTION

Maize, wheat, barley, oats are the most commonly used energy-rich feed stuffs in conventional poultry diets. But their production in Asia, Africa, and Pacific nations has never been adequate both for human consumption and industrial use. Hence, there is a severe shortage of cereals for use in poultry feeds. Similarly the cost of conventionally employed cereal grains, vegetable oil meals/cakes and animal proteins are highly prohibitive and their supply is inconsistent. Therefore, there is a continuous search for some novel energy and protein sources to sustain the traditional poultry farming. Important by-products like broken rice, rice polish (RP), rice bran and wheat bran obtained in the milling processes also serve as good sources of energy, B-complex vitamins and trace minerals. Such feeds can be included at levels 10-20% in poultry diets; depending on the nutritive value; and still maintain optimum growth, egg production, feed conversion and health **(Narhari et al., 1981; Mahbub et al., 1989)**. Replacement of maize by rice bran at 20% level has no any adverse effects on the performance of chicks **(Eswaraiah et al., 1986)**. Among all of the edible grain byproducts, RP is available and cheap ingredient in Egypt throughout the year and might be a partial alternative to maize in the diet of poultry.

Rice polish describes the second by-product remaining after processing the brown rice to give white rice and it constitutes about 10% of the paddy **(Houston and Kohler, 1970)**. It contains a good contents of protein (13.20 to 17.13%), fat (14.00 to 22.90%), carbohydrate (16.10%), fiber (9.50 to 13.20%), and vitamins and minerals **(Vargasgonzalez, 1995; Aljasser and Mustafa, 1996; Ambashankar and Chandrasekaran, 1998)**. Rice polish is characterized by its higher nutrient contents and lower anti-nutritional factors like free fatty acids, saponin, hemaglutinins and tanin **(Barber and Barber, 1980)**. The voluminous nature of the RP and its high phytate phosphorus contents, which reduce the phosphorus and calcium availability when present in the diet with increasing amounts, are the two major constraints for abundant use of RP in lieu of grain in the diet. Due to the naturally occurring enzymatic activity and subsequent hydrolytic rancidity that may occur rapidly in the RP after milling and continue during storage, so it is necessary to stabilize the RP and inactivate the indigenous antinutritional factors just after milling and before storage. Supplementation with antioxidants or feeding fresh RP must be considered. Extensive studies had revealed that all the undesirable factors are protein in nature, with the exception of phytates and non-starch polysaccharides (NSP). Therefore, dietary supplementation of exogenous enzymes could improve utilization of nutrients in RP (**Lu et al., 1991**).

Rice polish contains NSP such as cellulose, xylose, arabinose, and galactonic acid that are not easily digested by poultry. The anti-nutritional effect of these NSP is manifested by poor growth accomplished by depressed nutrient utilization (**Annison and Choct 1991**). These NSPs cannot be digested by the endogenous enzymes of poultry and can have anti-nutritive effects. Also, they can bind to large amounts of water and as a result, the viscosity of fluids in the digestive tract is increased. The increased viscosity causes problems in the small intestine because it reduces the substrate-enzyme interaction, which reduces nutrient availability particularly fat (**Danicke et al., 2000**) and results in increased amount of sticky droppings (**Pettersson et al., 1990**). Their adverse effects can be overcomed by dietary supplementation of exogenous enzymes (**Bedford 1995**). Enzymes have been approved for use in poultry diets because they are natural fermented products and, therefore, will not create a detrimental effect on the animal as well as on consumers. The use of enzymes in poultry feeds has predominantly been related to the hydrolysis of fiber or non-starch polysaccharide (NSP) fractions in cereal grains. Therefore, the present study was designed to investigate the effects of using graded levels of RP with exogenous enzyme supplementation in the broiler diets on growth performance, nutrient digestibility, and economic costs.

MATERIALS AND METHODS

Birds, management and diets:

One hundred sixty eight one-day-old Cobb broiler chicks obtained from a local commercial hatchery were used in this study. Chicks were fed the control diet for the first 4 days. On day 5, the chicks were weighed individually and randomly allocated to four treatment groups. Three replicate groups of 14 chicks with nearly similar initial weight were assigned to each of the four treatments. The chicks were reared in house pens with wood shavings litter. Feed and water were available at all times. Rice polish was obtained from a local rice mill and analyzed for crude protein; ether extract and crude fiber according to **AOAC (1990)**. Four isocaloric and isonitrogenous diets were formulated to meet or slightly exceed the nutrient requirements of broiler chickens (**NRC, 1994**) and the recommendation for Cobb broiler chicks. The dietary treatments consisted of one control and other three experimental diets in which RP was included at rate of 15, 30 or 45 % of the starter, grower and finisher diets (Table 1). Starter diets were provided to chicks from 5-14 days of age, grower diets were provided from 14-28 days of age, while finisher diets were provided from 28-42 days of age. Exogenous enzyme was included at 0.05% of the diets. The exogenous enzymes (Natuzyme™) used in this trial was the commercial powder preparation. Natuzyme™ (Bioproton Pty Ltd, Australia) product contains cellulase, xylanase, β-glucanase, α-amylase, pectinase, protease and phytase.

Data collection and calculation:

Body weight was determined at 14, 28 and 42 days of age. Weight gain, feed consumption and feed conversion ratios were measured for the same periods. Feed cost/ton was calculated by multiplying price/ton (in Egyptian Pound) of feed ingredient by percent of inclusion the ingredient in the diet divided by 100. Average feed cost of weight gain at each growth phase was calculated by multiplying the average feed consumption (kg) by the average feed cost/kg of the feed at the same phase. Average feed cost/kg weight gain at each growth phase was calculated by dividing the average feed cost of weight gain by average weight gain in kg of the same phase. Average feed cost/final total weight gain was calculated by summation of feed cost/weight gain at the three growth phases. Average feed cost/final kg weight gain was calculated by dividing the average feed cost/final total weight by average final weight gain in kg.

Digestibility :

For determination of apparent nutrient digestibility, chromic oxide was included at 0.3% of the diet as indicator. At 42 days of age, three birds per replicate were kept on a plastic sheet placed over the bedding materials. Birds were fed the diet for 5 days as adaptation period followed by 5 days, during which representative samples of fresh fecal matter were collected separately for each replicate. Efforts were made to remove every bit of feathers or any other contaminants from the feces. Fresh collected fecal samples of each replicate were pooled mixed dried in forced air oven at 60 °C for 48 h, allowed to equilibrate at room temperature and milled (1 mm screen) before analysis. Triplicate samples of feed and fecal matter were analyzed for ether extract according to **AOAC (1990)**. Fecal nitrogen was separated from urinary nitrogen by applying trichloro-acetic acid method according to **Jackobson et al. (1960)**. Dry matter digestibility was calculated according to **McDonald et al. (1981)** while digestibility of crude protein and ether extract was calculated according to **Maynard et al. (1979)**.

Statistical analysis :

The data were statistically analyzed by analysis of variance using general linear model procedure (GLM) in a window-based statistical package program, **SAS (1985)**.

RESULTS AND DISCUSSION

Growth performance :

The average weight gain, feed intake, and feed conversion ratio for the experimental broilers fed on diets contained different levels of RP supplemented with commercial enzymes during the three stages of growth are presented in Table 2. Body weight differed significantly (P < 0.5) among the diets at the different growth periods due to inclusion of RP in the diets at different levels (15, 30 and 45%). However, the highest body weight was reported for the broilers fed the control diets followed by the 15% RP-diets and the lowest body weight was reported for the broilers fed the 45% RP-diets.

The data showed that during the first two week of age (starter period), average body gain significantly (P < 0.05) decreased in the broilers fed the diets contained RP at different levels. However, inclusion of RP in the diets at level 15% or 30% did not significantly affect body gain at grower and finisher periods, respectively compared to the control group. Feeding the 45% RP-diets significantly decreased the body gain in different periods of the growth. **Kratzer and Earl (1980)** reported that some factors in rice polish and bran cause a reduction of growth in chickens. **Sherif (2003)** reported that body gain improved on feeding 10-20% RP-diet in first 4 weeks of age while feeding a 30% RP-diet during the period from 4-6 weeks did not adversely affect body gain.

Feed intake was decreased by increasing RP in the diets at different growth periods (Table 2). Feed intake was not affected by inclusion of RP in the broiler diets up to 30% in starter, 15% in the grower, and 30% in finisher diets. However: Inclusion of the RP in the diet at a level of 45% had significantly (P< 0.05) decreased the feed intake in different growth periods. **Sherif (2003)** reported that feed intake of broilers fed 30% RP-diet in first 4 weeks of age was not affected and inclusion of RP in diet up to 40% did not significantly affect feed intake during the period from 4 to 6 weeks.

Regarding the feed conversion ratio, the present results revealed that inclusion of rice polish at levels of 15 and 30% did not significantly affect the feed conversion ratio at the different periods of growth. However, feeding the broilers on the 45% RP-diet significantly (P < 0.05) increased the feed conversion ratio (Table 2). **Sherif (2003)** reported that feed conversion ratio was not affected by feeding the broilers on diets contained up to 40% RP. The results of the present study showed that decreased feed intake with increased RP level in diets that could be due to decreased digestibility of nutrients with increasing the RP level in diets as indicated by the results of determined digestibility (Table 4).

The allover performance data revealed that body weight and weight gain decreased by feeding

RP-diets but feed consumption and feed conversion were not adversely affected by feeding 15% RP-diets. It was reported that feed intake decreased due to decreased nutrient digestibility (**Ranade and Rajmane, 1992; Leeson et al., 1996; Angelovicova and Michalik, 1997**). Also, our results are in accordance with the findings of **Purushothaman et al. (1989); Tiemoko (1992); Jeshwani (1996)** who reported non-significant differences in feed consumption and feed efficiency of birds fed rice polish up to 30%. Similar findings were reported by **Warren and Farrell (1990)**. Also, **Khan et al. (2002; 2003)** reported non-significant differences in feed consumption and feed efficiency of birds fed rice polishing at levels 15, 20 and 25%. In experiments with chicks, cereal grains have been replaced with rice bran, and it was found promising in certain substitutions (**Dafwang and Shwarmen, 1996; Khalil et al., 1997a; b**). **Steyaert et al. (1989)** suggested that rice bran could be used up to 30% in mash for broilers. **Tiemoko (1992)** reported that 30% rice bran in broiler diets replacing maize significantly improved live weight gain, whereas feed conversion efficiency was unaffected. Also, **Saeed (1998)** reported improved growth response in broilers fed rice polish. **Moshad et al. (2003) and Rahman et al. (2005)** reported that feed intake and feed conversion efficiency were improved on abundant use of RP (35%) in diet for adding enzymes, which imply that due to higher phytin phosphorous concentration and NSP declined nutrient utilization with consequent reduced feed conversion efficiency on RP diet. On contrary, **Azam and Howlider (1998)** reported that inclusion of RP in broiler diets reduced feed intake, growth rate and feed utilization on comparison with diets without RP. The differences might be due to inclusion level of rice polish, variety of RP and supplementation of exogenous enzymes.

The enzymes supplementation was reported to improve growth rate in many studies (**Morkunas et al., 1993; Jamroz et al., 1995; Angelovicova and Micalik; 1997; Biswas et al., 1999; Swain and Johri 1999**). These authors concluded that improved feed utilization due to enzyme supplementation was responsible for the increased live weight gain in broilers on similar levels of dietary nutrient concentration. Reported effects of enzyme supplementation on feed intake ranged from no effect (**Ritcher et al., 1994; Adrizal and Ohtani 2002**) to a decrease (**Kadam et al., 1991**), while Ranade and **Rajmane (1992), Leeson et al (1996)** and **Angelovicova and Michalik (1997)**, found increased feed intake due to increased nutrient digestibility.

Digestibility :

The effects of inclusion of RP in the broiler diets on nutrient digestibility of the corn-rice polish based diets are presented in Table 4. The results indicated that inclusion of RP in the diets at a level of 15% did not significantly ($P > 0.05$) affect the dry matter and fat digestibility.

However, inclusion of RP at higher levels (30 and 45%) significantly decreased the dry matter and fat digestibility. Additionally, protein digestibility was not significantly affected by feeding either 15% or 30%-RP diets. Higher level (45%) of RP significantly (P < 0.05) decreased the digestibility of dry matter, protein and fat. The lower digestibility of nutrients due to high levels of rice polish could be attributed to some of anti-nutritional factors in RP. The presence of antinutritional factors in RP and its poor digestibility further aggravate the feeding problem, leading to poor performance of broilers. The antinutritional compounds found in RP include trypsin inhibitors (**Benedito and Barber, 1978; Tashiro and Ikegami, 1996**), pepsin inhibitors (**Mitsuda et al., 1977**), hemagglutinins (Benedito and Barber, 1978), phytates, and an antithiamine factor (**Lu et al., 1991**). However, activity of these compounds is relatively low and can be inactivated by heat treatment (**Lu et al., 1991**).

Cost and profit analysis :

Feed cost was reduced due to inclusion of RP in the broiler diets (Table 3). Inclusion of RP in diets up to 30% in broiler starter, grower and finisher diets reduced the cost per kilogram weight gain and reduced the feed cost per kilogram weight gain throughout the experimental period. Similarly, (**Khalil et al., 1997b**) found that use of rice bran reduced feed cost per kilogram weight gain. Also, **Sherif (2003)** reported that inclusion of RP in broiler diets up to 30% improved the economic efficiency, while 40% RP-diet adversely affected economic efficiency.

From the present study, it could be concluded that rice polish can safely be used up to 15% level with addition of enzymes mixture and had no adverse effect on performance. Based on results of weight gain, feed consumption, feed conversion ratio and feed cost per kg weight gain at different stages of the experiment, it could be concluded that rice polish should be not included in starter diet and could be included at levels of 15 and 30% in grower and finisher broiler diets, respectively.

Table (1) : Ingredient and calculated composition of corn-rice polish based diets supplemented with exogenous enzyme (Natuzyme™).

Ingredient	Starter diets				Grower diets				Finisher diets			
	Control	15% RP	30 % RP	45% RP	Control	15% RP	30%RP	45%RP	Control	15 % RP	30% RP	45%RP
Yellow corn, ground	56.65	43.0	29.75	15.4	60.41	45.6	32.2	20.15	64.5	50.0	37	24.7
Rice polish	0.0	15.0	30.0	45.0	0.0	15.0	30.0	45.0	0.0	15.0	30	45.0
Soybean meal	29.6	27.4	25.0	23.0	25.0	25.2	22.8	17.4	20.0	19.8	17.30	12.0
Corn gluten meal	5.91	6.0	6.55	6.75	5.10	4.0	4.6	6.75	5.0	4.0	4.20	6.75
Fish meal	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Soybean oil	1.50	2.0	2.2	2.9	2.60	3.5	3.8	3.7	3.50	4.3	4.6	4.5
Lysine-HCl, 78%	0.16	0.25	0.25	0.30	0.26	0.25	0.30	0.35	0.27	0.25	0.40	0.40
DL-Methionine, 98%	0.13	0.15	0.15	0.15	0.13	0.15	0.16	0.15	0.13	0.15	0.16	0.15
Limestone	1.20	2.0	2.40	2.80	1.20	2.0	2.44	2.8	1.30	2.0	2.50	2.8
Dicalcium phosphate	1.20	0.50	0.0	0.0	1.60	0.60	0.0	0.0	1.60	0.80	0.14	0.0
Vit. & mineral premix[1]	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
NaCl	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Choline chloride, 50%	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Natuzyme	0.0	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.5	0.05	0:05	0.05
Price/ton(Egyptian £)[2]	1924	1842	1750	1678	1948	1857	1775	1691	1959	18677	1789	1705

Table (1) continued :

Calculated composition[3]	Starter diets				Grower diets				Finisher diets			
	Control	15% RP	30 % RP	45% RP	Control	15% RP	30%RP	45%RP	Control	15 % RP	30% RP	45% RP
ME, Kcal/kg	3011	3007	3004	3002	3107	3107	3107	3108	3208	3202	3205	3212
CP, %	23.0	22.98	23.0	23.0	20.95	21.0	21.16	21.0	19.0	19.0	19.0	19.0
EE, %	4.23	6.07	7.65	9.67	5.36	7.57	9.23	10.53	6.13	8.43	10.1	11.4
CF, %	3.36	3.41	3.46	3.52	3.13	3.29	3.35	3.26	2.89	3.04	3.10	3.02
Ca, %	1.12	1.22	1.22	1.37	1.21	1.21	1.23	1.35	1.23	1.27	1.27	1.33
Total P, %	0.67	0.75	0.76	0.91	0.71	0.68	0.75	0.89	0.69	0.71	0.75	0.87
Lysine, %	1.38	1.42	1.39	1.40	1.32	1.34	1.35	1.29	1.19	1.19	1.28	1.19
Methionine, %	0.58	0.60	0.60	0.60	0.55	0.55	0.57	0.57	0.52	0.53	0.53	0.55

[1] provide per kg diet: vitamin A (palmitate), 12,000 IU; vitamin D (cholecalciferol, 2,500 IU; vitamin E (α-tocopherol) 12 mg; itamin K_3 (menadione), 2.3 mg; vitamin B_1, 1.2 mg; vitamin B2, 6 mg; pantothenic acid, 12 mg; folic acid, 1.2 mg; niacin, 36 mg; pyridoxine, 2 mg; vitamin B_{12}, 0.01 mg; biotin, 0.06 mg; . Choline, 300 mg; Iron, 36 mg; copper, 5 mg; manganese, 72 mg; zinc, 60 mg, iodine, 0.45 mg.; selenium, 0.12 mg.

[2] Average prices (Egyptian pound/ton) prevailing at time of the experiment, yellow corn, 1450; rice polish, 850; soybean meal(44 %), 1750; corn glutein meal (60%), 2700; fish meal (65%), 7300; soybean oil, 4500; L-lysine HCl (78%),13000; Dl-methionine (98%), 21000; Dicalcium phosphate, 3100; vitamin & mineral premix, 56000; NaCl, 175; chloine chloride(50%), 6000, Natuzyme, 90000.

[3] Calculated according to feed composition tables NRC (1994).

Table (2) : Effect of rice polish inclusion level in broiler diets supplemented with enzymes (Natuzyme) on growth performance of broiler chicens.

	Dietary treatments			
	Control	15% RP	30% RP	45% RP
Starter period (5-14 days)				
Initial Body weight, g	105.66 ±3.3	104 ± 2.51	108.66 ± 2.3	109 ± 2.64
Average body weight, g	325 ± 5.7^{a}	295 ± 5.77^{b}	285 ± 7.6^{b}	258.33 ± 6.6^{c}
Average weight gain, g/day	24.37 ± 0.32^{a}	21.22 ± 0.73^{b}	19.59 ± 0.71^{b}	16.59 ± 0.57^{c}
Average feed consumption, g/day	35.81 ± 1.7^{a}	32.14 ± 1.3^{ab}	31.29 ± 1.5^{ab}	28.35 ± 1.1^{b}
Average feed conversion ratio	1.47 ± 0.03^{b}	1.51 ±0.02^{b}	1.6 ± 0.07^{ab}	1.71 ± 0.05^{a}
Grower Period (14-28 days)				
Average body weight, g	1021.66 ± 33.2^{a}	960 ± 11.5^{a}	781.67 ± 8.8^{b}	705 ± 12.6^{c}
Average weight gain, g/day	49.76 ± 2.6^{a}	47.5 ± 0.71^{a}	35.47 ± 0.12^{b}	31.9 ± 0.83^{b}
Average feed consumption, g/day	88.26 ± 2.8^{a}	86.64 ± 2.6^{a}	69.21 ± 2.7^{b}	66.38 ± 2.5^{b}
Average feed conversion	1.77 ± 0.09^{b}	1.82 ±0.02^{b}	1.95 ± 0.03^{ab}	2.08 ± 0.06^{a}
Finisher Period (28-42 days)				
Average body weight, g	1828.33 ± 18.7^{a}	1718 ± 26.1^{b}	1482.33 ± 11.86^{c}	1277.33 ± 51.9^{d}
Average weight gain, g/day	57.62 ± 3.3^{a}	54.14 ± 2.2^{a}	50.04 ± 1.2^{a}	40.88 ± 2.8^{b}
Average feed consumption, g/day	126.52 ± 3.2^{a}	121.45 ± 2.8^{ab}	117 ± 3.7^{ab}	111.5 ± 5.2^{b}
Average feed conversion	2.2 ± 0.08^{b}	2.24 ±0.07^{b}	2.34 ± 0.06^{b}	2.73 ± 0.05^{a}
Allover performance				
Average final body weight, g	1828.33 ± 18.7^{a}	1718 ± 26.1^{b}	1482.33 ± 11.86^{c}	1277.33 ± 51.9^{d}
Average total weight gain, g	1722.66 ± 21.4^{a}	1614 ±24.5^{b}	1373.66 ± 10.73^{c}	1168.33 ± 51.9^{d}
Average total feed consumption, g	3329.33 ± 95.4^{a}	3202.33 ± 55.4^{a}	2888.66 ± 39.5^{b}	2745.66 ± 128.3^{b}
Average feed conversion ratio	1.93 ± 0.06^{c}	1.98 ± 0.02^{c}	2.1 ± 0.01^{b}	2.35 ± 0.05^{a}

^{abc} Means in the same rows with different superscripts are significantly different ($P < 0.05$)

Table (3) : Effect of rice polish inclusion level in broiler diets supplemented with enzymes (Natuzyme) on economic cost of production.

	Dietary treatment			
	Control	15% Rice polish	30% Rice polish	45% Rice polish
Starter period (5-14 day)				
Average weight gain, g	219.33 ± 2.8[a]	191 ± 6.5[b]	176.33 ± 6.3[b]	149.33 ± 5.2[c]
Average feed consumption, g	322.33 ± 25.5[a]	289.33 ± 45.6[ab]	281.67 ± 24.5[ab]	255.33 ±19.4[b]
Average feed cost of weight gain (Egyptian £)	0.62 ± 0.049[a]	0.533 ± 0.048[ab]	0.493 ± 0.043[ab]	0.428 ± 0.032[b]
Average feed cost/kg body gain	2.83 ± 0.23	2.78 ±0.16	2.78 ± 0.15	2.87 ± 0.21
Grower period (14-28 day)				
Average weight gain	696.66 ± 36.2[a]	665 ± 10[a]	496.66 ± 1.67[b]	446.66 ± 11.67[b]
Average feed consumption	1235.66 ±24.12[a]	1213 ±26.05[a]	969 ± 17.9[b]	929.33 ± 36.89[b]
Average feed cost of weight gain	2.42 ± 0.08[a]	2.25 ± 0.07[a]	1.72 ± 0.06[b]	1.57 ± 0.11[b]
Average feed cost/kg weight gain	3.47 ± 0.28	3.39 ± 0.12	3.46 ± 0.14	3.51 ± 0.06
Finisher period (28-42 day)				
Average weight gain, g	806.66 ± 46.4[a]	754.66 ± 31.2[a]	700.66 ± 17.3[a]	572.33 ± 39.6[b]
Average feed consumption	1771.33 ±61.9[a]	1700.33 ±51.49[a]	1638 ±56.4[ab]	1561 ±46.2[b]
Average feed cost of weight gain	3.47 ± 0.14[a]	3.17 ±0.12[ab]	2.93 ± 0.10[bc]	2.66 ± 0.13[c]
Average feed cost/kg weight gain (Egyptian £)	4.31 ± 0.09[ab]	4.19 ± 0.16[b]	4.18 ± 0.11[b]	4.66 ± 0.08[a]
Allover cost				
Average feed cost /final total weight gain (Egyptian £)	6.5 ± 0.18[a]	5.96 ± 0.10[b]	5.14 ± 0.02[c]	4.66 ± 0.23[c]
Average feed cost/final kg weight gain (Egyptian £)	3.77 ± 0.12[b]	3.69 ± 0.02[b]	3.74 ±0.02[b]	3.98 ± 0.02[a]

[abc] **Means in the same rows with different superscripts are significantly different ($P < 0.05$)**

Table (4) : Effect of rice polish level inclusion in broiler diets supplemented with enzymes (Natuzyme) on nutrient digestibility.

Nutrient digestibility, %	Dietary treatments			
	Control	15% Rice polish	30% Rice polish	45% Rice polish
Dry matter	76.93 ±1.26^{a}	74.90 ±1.39^{a}	70.83 ±0.93^{b}	67.0 ±0.91^{c}
Crude protein	79.13 ±1.44^{a}	78.53 ±2.31^{ab}	77.07 ±1.91^{ab}	72.5 ±1.62^{b}
Ether extract	82.10 ±1.57^{a}	80.15 ±.78^{ab}	76.34 ±1.38^{bc}	71.66 ±1.86^{c}

^{abc} **Means in the same rows with different superscripts are significantly different (P < 0.05)**

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الملخص العربى

تأثير عدة مستويات من ناتج تلميع الأرز (Rice polish) مع إضافة الإنزيمات (Natuzyme) فى علائق كتاكيت التسمين على معدلات النمو، معاملات الهضم والكفاءة الاقتصادية

محمد حسين سليمان[١] د/ طارق إبراهيم محمد[٢]

[١] قسم التغذية والتغذية الإكلينيكية - كلية الطب البيطرى - جامعة الزقازيق

[٢] قسم التغذية وأمراض سوء التغذية - كلية الطب البيطرى - جامعة المنصورة

أجريت هذه التجربة لدراسة تأثير إستخدام عدة مستويات من ناتج تلميع الأرز rice polish بالإضافة إلى مخلوط من الإنزيمات (Natuzyme)فى علائق كتاكيت اللحم على معدلات النمو، معاملات الهضم، والتكلفة الاقتصادية كانت المعاملات الغذائية كالتالى :

١- عليقة ضابطة. ٢- عليقة بها ١٥٪ ناتج تلميع الأرز. ٣- عليقة بها ٣٠٪ ناتج تلميع الأرز. ٤- عليقة بها ٤٥٪ ناتج تلميع الأرز. تم إضافة مخلوط إنزيمات (Natuzyme) إلى العلائق التى بها ناتج تلميع الأرز بمعدل ٥ .و٠٪ . تم حساب العلائق لتكون متماثلة فى الطاقة (3000، 3100، 3200 كيلو كالورى/كجم طاقة ممثلة لكل من البادى والنامى والناهى على التوالى) والبروتين (19،21،23% بروتين خام لكل من البادى والنامى والناهى على التوالى). إستخدم عدد 168 كتكوت تسمين Cobb عمر يوم غذيت على عليقة بادى، لمدة 4 أيام، ثم قسمت عشوائياً إلى أربعة مجموعات تجريبية متساوية بكل مجموعة ثلاث مكررات متساوية العدد، تم تغذية الكتاكيت على عليقة البادى من عمر 5 - 14 يوم، وعليقة النامى من عمر 14 - 28 يوم وعليقة الناهى من عمر 28 - 42 يوم، تم وزن الكتاكيت فى كل مرحلة من مراحل النمو وكذلك تم حساب معدل إستهلاك العلف ومعدل الزيادة اليومى ومعامل التحويل الغذائى، تم حساب التكلفة الاقتصادية للتغذية وكذلك تم عمل تجارب هضم لمعرفة معاملات هضم العناصر الغذائية.

ويمكن إيجاز أهم النتائج فيما يلى :-

- عند تغذية الدجاج على علائق بها 15 أو 30% من ناتج تلميع الأرز فى علائق البادى، والنامى والناهى على الترتيب لم يؤثر معنوياً على معدل الزيادة فى وزن الكتاكيت بينما أدى تغذية الكتاكيت على علائق بها 45% من ناتج تلميع الأرز فى العلائق المختلفة إلى نقص معنوى فى وزن الجسم فى فترات النمو المختلفة.
- تغذية الدجاج على علائق بها 15 أو 30% من ناتج تلميع الأرز فى علائق البادى، والنامى، أو 30% من ناتج تلميع الأرز فى الناهى على الترتيب لم يؤثر معنوياً على معدل إستهلاك العلف بينما أدى تغذية الدجاج على علائق بها 45% من ناتج تلميع الأرز فى العلائق المختلفة إلى نقص معنوى فى معدل إستهلاك العلف.
- تغذية الدجاج على علائق بها 15 أو 30% من ناتج تلميع الأرز فى علائق البادى، والنامى والناهى لم يؤثر معنوياً على معامل التحويل الغذائى بينما أدى تغذية الدجاج على علائق بها 45% من تبيض الأرز فى العلائق المختلفة إلى زيادة معنوية فى معامل التحويل الغذائى.

تشير نتائج هذه الدراسة إلى أنه يمكن إستخدام ناتج تلميع الأرز حتى نسبة 15% بالإضافة إلى مخلوط من الإنزيمات فى علائق كتاكيت اللحم المكونة أساساً من الذرة وكسب فول الصويا للحصول على نتائج جيدة بالنسبة لأداء الطيور والتكلفة الاقتصادية