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EFFECT OF DIETARY LEVELS OF PROTEIN AND PHYTASE ON PERFORMANCE AND NUTRIENTS DIGESTIBILITY OF BROILER CHICKS

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ABSTRACT

An experiment was conducted to study the effect of using different levels of protein (high, HCP; medium, MCP and low, LCP) along with different levels of phytase (0.0, 500, 750 and 1000 FTU/kg diet) in broiler diets on their growth performance, nutrients digestibility and economic efficiency. A total number of 360 one day old Arbor Acers broiler chicks were randomly divided into 12 groups (30 chicks each) of three replicates each (10 chicks/replicate). Twelve experimental diets were formulated in a 3 × 4 factorial design (i.e. three levels of protein; HCP, MCP & LCP each was assigned to four levels of phytase; 0.0, 500, 750 and 1000 FTU/kg). The experimental birds were reared under similar managerial and veterinarial conditions and fed the experimental diets up to 7 weeks of age. At 7 weeks of age, a digestion trials were carried out to study the effect of treatment on nutrients digestibility, energy metabolizability, nitrogen balance and minerals retention.

The obtained data revealed that the chicks fed HCP diets recorded significantly the best growth performance including live body weight (LBW), body weight gain (BWG), feed intake (FI), feed conversion (FC) and performance index (PI) compared to the other levels (MCP and LCP), while did not affect CP digestibility, energy metabolizability and nitrogen balance (NB), but lowered crude fiber (CF), nitrogen free extract (NFE) and organic matter (OM) digestibility, and improved EE digestibility. Supplementing diets with phytase at levels up to 1000 FTU/kg improved all growth performance parameters, with the level of 750 FTU/kg diet being the best compared to control (the unsupplemented diet). The addition of phytase did not affect nutrients digestibility except CF digestibility which improved by adding 750 FTU/kg diet. Concerning the interaction effect, the obtained data revealed that the group of chicks fed HCP + 500 FTU/kg recorded significantly the heaviest LBW and BWG and consumed higher amount of feed allover the experimental period (0 – 7 wks), while the group of LCP + zero enzyme recorded significantly the lowest values of LBW, BWG, FI, FC and PI, as compared to the control. The group of chicks fed HCP + 1000 FTU/kg diet revealed significantly the best values of FC and PI as well as better values of CP, EE and OM digestibility, energy metabolizability and NB compared to the control, while those having LCP diet without phytase supplementation exhibited worst values of FC and PI. However, the group of chicks fed MCP diet + 750 FTU/kg recorded the highest CF digestibility. Meanwhile, the group of chicks fed LCP diet + 750 FTU/kg recorded the lowest feed cost needed to obtain one kilogram of BWG. It could be concluded that supplementing MCP broiler diets with microbial phytase at 750 FTU/kg improved their growth performance and nutrients digestibility being similar to the control, however, supplementing LCP diet with 750 FTU/kg resulted in the least feed cost/kg gain.

Keywords: crude protein, phytase, levels, broilers, growth, feed utilization, digestibility, retention.

INTRODUCTION

Plant feedstuffs, specially cereals, legumes and oilseed meals, are considered the most least cost ingredients of poultry diets. About two-thirds of the phosphours of plant origin is present as phytic acid in the form of myoinositol phosphates (Cromwell, 1980). Phytate phosphours (P) utilization by monogastric animals are complex process that is influenced by many factors. Dietary ingredients and feed processing seem to be the most important factors related to the diet, while age and type of birds could also affect phytate-P utilization (Reddy *et al.*, 1982; Sebestian *et al.*, 1998 and Attia, 2003). Adding phytase increased availability of phytate-bound minerals and reduced environmental pollution through lowering P and N excretion. Dietary supplementation with microbial phytase increases the availability of phytate-P (Simons *et al.*, 1990; Denbow *et al.*, 1995 and Attia *et al.*, 2001 and Attia, 2003) and improves body weight gain (Broz *et al.*, 1994, Attia, 2003 and El-Ghamry *et al.*, 2005), in corn-soybean meal diets. Lim *et al.* (2003) reported that phytase significantly increased digestibility of DM, P and fiber, while other nutrients were not affected. Abd El-Samee (2002) revealed that phytase significantly improved mineral retention and digestion coefficients of nutrients, except for crude fiber. In this connection, Um and Paik (1999) showed that retention of DM, fat, ash, Ca, Mg and Zn were significantly higher with phytase supplementation than control (without phytase).

Shams El-Deen (2005) found that high protein levels in broiler diets improved their growth performance, while El-Sherbiny *et al.* (1997), Abd El-Hady and Abd El-Ghany (2003) found no significant differences in growth performance among broilers fed different levels of protein. Abd El-Samee *et al.* (2001) found that using optimal level of CP in broilers diets significantly increased OM, CP, EE, CF and NFE digestibilities and NB.

Due to this confliction and bearing in mind the economic aspects, the present work was conducted to study the effect of using different levels of protein along with different levels of phytase in broiler diets on their growth performance, nutrients digestibility and minerals retention.

MATERIALS AND METHODS

The experimental work was carried out at El-Kanater Poultry Farm, Animal Production Research Institute, A.R.C., Egypt, in winter 2001.

This experiment was conducted to study the effect of using three levels of protein (high, HCP; medium, MCP and low, LCP) each with four levels of microbial phytase (0.0, 500, 750 and 1000 FTU/kg) in broiler diets on their growth performance, nutrients digestibility, minerals retention and economic efficiency.

A total number of 360 unsexed one-day old Arbor Acers broiler chicks were divided into 12 groups (30 chicks each) of three replicates each (10 birds/replicate). Twelve starter experimental diets were formulated in which the 1st four diets (T_1 – T_4) were assigned to be HCP (23 %) and supplemented with four levels of phytase (0.0, 500, 750 & 1000 FTU/kg, respectively), the 2nd four diets ($T_5 - T_8$) were assigned to be MCP (21 %) and also supplemented with phytase at the above mentioned levels, respectively, while the 3rd four diets ($T_9 - T_{12}$) were assigned to be LCP (19 %) and also supplemented with the same forementioned levels of phytase, respectively. The diets of grower and finisher periods were formulated as the same manner of the starter diets, but CP levels were lowered to be 20, 18 & 16 % for the HCP, MCP & LCP category groups during the grower period and 18.5, 16.5 & 14.5 % for the HCP, MCP & LCP category groups during the finisher period. All diets were iso-energetic of about 3100 kcal ME/kg for the starter diet and 3200 kcal ME/kg for the grower and finisher diets. With the exception of CP, nutrients requirements were calculated according to Arbor Acers broilers recommended catalogue. The feeding system durated between 0 – 3, 4 – 5 and 6 – 7 weeks for starter, grower and finisher periods, respectively. The composition and calculated analysis of the experimental basal diets (without phytase supplementation) are presented in Table (1). The birds were reared in broiler batteries under similar managerial and veterinarial conditions and fed the experimental (starter, grower & finisher) diets up to 7 weeks of age. Feed and water were offered ad lib. The criteria of growth performance in terms of live body weight (LBW) and feed intake (FI) were recorded to calculate body weight gain (BWG), feed conversion (FC) and performance index (PI). At the end of the 7th week, a digestibility trial using only the experimental finisher diets was conducted in which feed intake and excreta voided were recorded along 3 days collection period. The collected excreta were sprayed by 2 % boric acid solution to prevent any loss in ammonia, then dried in an oven at 60 ° C for 24 hrs, thereafter weighed, finely ground and kept for chemical analysis. Feed and excreta were analyzed according to the official methods of analysis (A.O.A.C., 1990). Fecal nitrogen was determined according to Jakobsen *et al.* (1960). Digestion coefficients and feeding values in terms of energy metabolizability and nitrogen balance (NB) were calculated as described by Shaapan (2004). The experimental dietary treatments were economically evaluated based upon the price of local market at the time of the experiment. The economic efficiency of the dietary treatments were expressed as the feed cost needed to obtain one kilogram of live body weight gain.

A completely randomized design in a 3 × 4 factorial arrangement of treatments; three dietary levels of CP (high, medium, low) and four levels of microbial phytase (zero, 500, 750, 1000 FTU/kg) was used. The obtained data were subjected to analysis of variance using the general linear model of SAS software (SAS, 1990) and means were compared using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth performance:

Data of the chick growth performance are given in Table (2). The initial LBW at one-day of age for all treatments was nearly similar and ranged from 58.2 to 59.0 g without significant differences. This may create a suitable condition to appraise the effect of dietary treatments during the subsequent periods.

Table (1): Composition and calculated analysis of the basal starter, grower and finisher experimental diets (without phytase supplementation)

	Starter (0 – 3 wks)			Grower (4 – 5 wks)			Finisher (6 – 7 wks)		
Ingredients	T_1	T_5	T_9	T_1	T_5	T_9	T_1	T_5	T_9
Yellow corn	54.65	61.90	68.89	63.64	68.60	75.84	67.00	74.10	81.13
Soybean meal 44%	30.33	24.26	18.38	21.39	18.80	12.52	20.50	14.48	8.65
Corn gluten meal 60 %	7.84	7.80	7.77	7.92	5.94	6.17	5.84	5.84	5.79
Soybean oil	3.31	2.10	0.94	3.24	2.87	1.60	3.11	1.91	0.74
Di – Ca – P	1.73	1.75	1.84	1.64	1.66	1.72	1.57	1.61	1.64
Limestone	1.11	1.15	1.13	1.09	1.11	1.11	1.00	1.04	1.05
Vit &Min.* (premix)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
NaCl	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
DL-Methionine	0.11	0.08	0.05	0.11	0.08	0.05	0.09	0.05	0.02
L-lysine HCl	0.17	0.21	0.25	0.22	0.19	0.24	0.14	0.22	0.23
Total	100	100	100	100	100	100	100	100	100
Calculated analysis**									
ME kcal/kg	3100	3100	3100	3200	3200	3200	3200	3200	3200
CP %	23.07	21.01	19.02	20.00	18.00	16.03	18.51	16.52	14.51
Ca %	0.90	0.90	0.90	0.85	0.85	0.85	0.80	0.80	0.80
Av. P %	0.45	0.45	0.45	0.42	0.42	0.42	0.40	0.40	0.40
Met. %	0.50	0.45	0.40	0.47	0.40	0.35	0.42	0.35	0.30
Met + Cys %	0.90	0.82	0.74	0.82	0.73	0.65	0.75	0.66	0.58
Lys. %	1.18	1.07	0.97	1.01	0.90	0.80	0.90	0.83	0.70

* Supplied per kg of diet: Vit.A, 12000IU; Vit.D_3,2200IU; Vit.E, 10mg; Vit.K_3, 2mg; Vit.B_1, 1mg; Vit.B_2, 5mg; Vit.B_6, 1.5mg; Vit.B_{12}, 10µg; Nicotinic acid 30mg; Folic acid, 1mg; pantothenic acid, 10mg; biotin 50µg; choline, 250mg; copper, 10mg; iron, 30mg; manganese, 60mg; zinc, 50mg; iodine, 1mg; selenium, 0.1mg, and cobalt, 0.1mg

** According to NRC (1994)

Effect of protein level: As shown in Table (2), the final live body weight (LBW) at 7 wks old for chicks fed HCP, significantly (P<0.01) recorded the heaviest value (2091 g) followed by those of MCP (2035 g) and LCP (1874 g). The results of body weight gain (BWG), feed conversion (FC) and performance index (PI) (during 0 – 7 wks) followed statistically the same trend as that of LBW, since the chicks of HCP level recorded better values (being 2033 g, 1.99 and 105.08 %) followed by those of MCP (1977 g, 2.09 and 97.37 %) and finally the group of LCP (1815 g, 2.24 and 83.66 %) in the same order, respectively. However, no significant differences were found between the dietary treatments in FI values.

These results meaning that increasing CP in broiler diets had clearly positive effect on their growth performance, which are in agreement with those of Shams El-Deen (2005) who found that high protein levels in broiler diet improved their growth performance. In this connection, Colonge *et al.* (1991) and Abou El-Wafa *et al.* (2001) observed a depression in growth performance when chicks were fed low protein diets. While El-Sherbiny *et al.* (1997), Abd El-Samee *et al.* (2001) and Abd El-Hady and Abd El-Ghany (2003) found no significant differences in growth performance among broilers fed different levels of protein.

Table (2): Performance of broiler chicks fed different dietary crude protein levels without or with microbial phytase supplementation.

Items	Treatments	Initial[1] LBW (g)	Final[2] LBW (g)	BWG[3], g (0-7 wks)	FI[4], g (0-7 wks)	FC[5] (0-7 wks)	PI[6] (0-7 wks) %
CP levels %	23, 20 & 18.5 (HCP)	58.2 ±0.16	2091^{a} ±22.6	2033^{a} ±22.6	4054 ±49.9	1.99^{a} ±0.01	105.08
	21, 18 & 16.5 (MCP)	58.4 ±0.17	2035^{b} ±31.2	1977^{b} ±31.2	4136 ±69.7	2.09^{b} ±0.01	97.37
	19, 16 & 14.5 (LCP)	58.9 ±0.13	1874^{c} ±35.9	1815^{c} ±35.9	4074 ±77.4	2.24^{c} ±0.01	83.66
Phytase levels FTU/kg	Zero	58.5 ±0.18	1862^{b} ±44.4	1804^{b} ±44.6	3793^{b} ±47.3	2.10 ± 0.03	88.67
	500	58.6 ±0.20	2021^{a} ±47.7	1963^{a} ±47.7	4170^{a} ±51.24	2.13 ± 0.04	94.88
	750	58.5 ±0.25	2066^{a} ±29.8	2007^{a} ±29.8	4201^{a} ±56.21	2.09 ± 0.03	98.85
	1000	58.7 ±0.18	2052^{a} ±30.1	1993^{a} ±30.2	4186^{a} ±50.34	2.10 ± 0.03	97.71
T_1	HCP + zero	58.2 ±0.23	1979^{bcd} ±15.5	1920^{bcd} ±15.7	3868^{bcd} ±87.5	2.01^{cd} ±0.03	98.46
T_2	HCP + 500	58.3 ±0.63	2146^{a} ±12.1	2088^{a} ±12.5	4157^{a} ±44.7	1.99^{cd} ±0.01	107.94
T_3	HCP + 750	58.2 ±0.33	2123^{a} ±25.0	2064^{a} ±25.3	4132^{ab} ±112.0	2.00^{cd} ±0.04	106.15
T_4	HCP + 1000	58.4 ±0.13	2118^{a} ±39.9	2060^{a} ±39.8	4058^{abc} ±82.5	1.96^{d} ±0.02	108.06
T_5	MCP + zero	58.4 ±0.32	1915^{d} ±18.1	1857^{d} ±18.4	3822^{cd} ±36.6	2.05^{bcd} ±0.01	93.41
T_6	MCP + 500	58.6 ±0.06	2041^{abc} ±88.3	1982^{abc} ±88.3	4191^{a} ±152.0	2.11^{b} ±0.01	96.73
T_7	MCP + 750	58.4 ±0.58	2094^{ab} ±51.8	2036^{ab} ±51.3	4222^{a} ±105.0	2.07^{bc} ±0.02	101.16
T_8	MCP + 1000	58.5 ±0.41	2092^{ab} ±9.93	2033^{ab} ±10.1	4308^{a} ±41.9	2.11^{b} ±0.03	99.15
T_9	LCP + zero	59.0 ±0.26	1694^{e} ±28.0	1634^{e} ±28.1	3689^{d} ±95.8	2.25^{a} ±0.03	75.29
T_{10}	LCP + 500	58.8 ±0.23	1877^{d} ±32.7	1818^{d} ±32.6	4162a ±76.5	2.28^{a} ±0.04	82.32
T_{11}	LCP + 750	58.9 ±0.38	1980^{bcd} ±40.9	1921^{bcd} ±40.7	4250^{a} ±101.0	2.21^{a} ±0.01	89.59
T_{12}	LCP + 1000	59.0 ±0.29	1945^{cd} ±22.5	1886^{cd} ±22.08	4194^{a} ±78.6	2.22^{a} ±0.02	87.61

a – e Means within the same column with different superscripts are significantly different ($P<0.05$).

1 – 6: Denote to initial live body weight, final live body weight, body weight gain, feed intake, feed conversion and performance index, respectively.

Effect of phytase: Apart from dietary protein level, it was found that the group of chicks fed diets supplemented with microbial phytase at 750 FTU/kg resulted in the highest values of LBW, BWG and FI (Table 2), followed by those of 1000 and 500 FTU/kg in a descending order without significant differences among them. While the control group (zero phytase) significantly recorded the lowest values. The results of FC revealed nearly similar values with no significant differences among the all dietary treatments. However, the group of chicks fed diet supplemented with 750 FTU/kg recorded numerically the best PI value compared to the other groups and the control. This means that phytase supplementation in broiler diets at levels up to 1000 FTU/kg had a beneficial effect on growth performance, with the level of 750 FTU/kg being the best. These results are in agreement with those of Sohail and Roland (1999) who found that phytase supplementation (300 or 600 FTU/kg) improved growth performance of broilers. Similar results were also found by Johnston and Southern (2000) using 200 FTU/kg. While Sebastian *et al.* (1995) and Yan *et al.* (2001) found no significant effect for phytase on broiler performance.

Data on broilers performance as affected by the combination of dietary CP and phytae levels (Table 2) showed the presence of significant differences among the dietary treatments. The group of chicks fed HCP + 500 FTU/kg (T_2) resulted in the better growth performance values (i.e. LBW, BWG, and FC), as compared to the control, while those of LCP + zero phytase (T_9) recorded the lowest values. The other dietary treatments recorded intermediate values. It is worthy to note that groups of chicks fed diets with 2 % lower CP than the recommended (i.e. MCP) did not differ significantly in their growth performance after supplementing their diets with microbial phytase at 750 FTU/kg. This observation may be an indication to a better utilization of feed by the birds fed the MCP diets compared to the control one as well as those having the HCP diets. Absence of significant differences in the obtained growth performance among the dietary treatments in the present study may be an indication to a low CP requirement for Arbor Acres broiler chicks during starter, grower and finisher periods when their diets being supplemented with microbial phytase. The beneficial effect of microbial phytase observed herein, may be attributed to a better utilization of protein and amino acids of such lower protein corn-soybean meal diets (Attia, 2003 and Rutherfured *et al.*, 2004).

Nutrients digestibility, energy metabolizability and nitrogen balance :

Data of nutrients digestion coefficients, energy utilization and nitrogen balance of broilers fed different levels of protein, phytase and their interaction are presented in Table (3). It is interesting to note that the values of dry matter ratio (DMR) for all dietary treatments were nearly similar and the differences did not reach significance. This may aid in appraising the effect of dietary treatments on nutrients digestibility, energy utilization and nitrogen balance of the experimental finisher diets on the basis of equal DMR.

Effect of protein levels : With the exception of CP digestibility, the digestion coefficients of the other nutrients recorded significant differences among the dietary treatments. Although the CP digestibility of the HCP group was higher than those of MCP and LCP, neveresless no significant differences were detected among them. The digestibility values of EE and CF showed that the chicks fed HCP and MCP diets surpassed those of LCP diet, while the opposite trend was detected for NFE digestibility. However, no significant differences were found among all dietary CP levels regarding the energy metaboizability and nitrogen balance values, irrespective of microbial phytase supplementations. This means that the level of dietary CP had no clear effect on digestibility coefficients and determined ME.

Effect of phytase levels: With the exception of CF digestibility the addition of microbial phytase in broiler diets did not affect either nutrients digestibility, energy metabolizability or nitrogen balance parameters since no significant differences were detected among all treatments. However, the group of chicks which received 750 FTU/kg significantly surpassed the other dietary treatments in CF digestibility.

Effect of interaction: As shown in Table (3), only significant differences (P<0.05) in both CP and EE digestibility were found between HCP diet + 1000 FTU/kg (T_4) and LCP diet + 1000 FTU/kg (T_{12}), while, the differences among the other treatments did not reach significance. Chicks fed MCP diets supplemented with 750 FTU/kg significantly recorded the highest CF digestibility, while those fed HCP diet + 500 FTU/kg, MCP + zero phytase, LCP + zero phytase and LCP + 1000 FTU/kg had significantly the worst values. However, no clear trend could be observed in NFE and OM digestibility. It is worthy to note that the group of chicks fed HCP diet supplemented with phytase at 1000 FTU/kg utilized dietary energy similar to that fed LCP diet with 750 FTU/kg of phytase supplementation. Values of nitrogen balance percentages had the same trend. This means also the possibility of reducing dietary CP of broiler chick diets fortified with microbial phytase at 750 FTU/kg, since the addition of phytase at 1000 FTU/kg gave no further improvements in digestibility of nutrients as was previously mentioned in the performance.

Table (3): Effect of dietary protein and phytase levels and their combination on nutrients digestibility, energy metabolizability and nitrogen balance of broiler chicks.

Items	Treat.	DMR[1]	CP[2]	EE[3]	CF[4]	NFE[5]	OM[6]	Met. %[7]	NB[8]
CP levels %	HCP (18.5 %)	0.25	69.07	80.92^{a}	26.67^{b}	85.50^{b}	78 83^{b}	77 33	55 86
	MCP (16.5 %)	0.24	67.08	80.75^{a}	32.08^{a}	87.08^{b}	80.08^{ab}	78.67	52.30
	LCP (14.5 %)	0.23	67.51	71 58^{b}	22.58^{b}	89.25^{a}	81.67^{a}	79.58	55 21
Phytase levels FTU/kg	Zero	0.23	68.06	80.56	22.89^{b}	87 67	81.00	79.67	55.40
	500	0.24	67.58	76.22	25.22^{b}	86.44	79.11	77.44	53.31
	750	0.20	67.27	76.67	35.11^{a}	86 78	79.67	77 89	55.07
	1000	0.22	68.64	77.56	25.22^{b}	88.22	81.00	79.11	54.05
T_1	HCP + zero	0.23	68.08^{ab}	82.67^{a}	35.00^{ab}	87.33^{abc}	80.00^{abc}	54.76^{ab}	79.00^{abc}
T_2	HCP + 500	0.27	67.94^{ab}	80.00^{ab}	16.00^{d}	83.00^{d}	76.33^{c}	55.94^{ab}	75.00^{c}
T_3	HCP + 750	0.25	66.72^{ab}	77.67^{ab}	32.33^{abc}	83.67^{cd}	77.00^{bc}	52 36^{ab}	75.33^{bc}
T_4	HCP + 1000	0.22	73.51^{a}	83.33^{a}	23.33^{cd}	88.00^{ab}	82.00^{ab}	60 38^{a}	80.00^{abc}
T_5	MCP + zero	0.24	68.50^{ab}	80.67^{ab}	16.00^{d}	87.67^{abc}	81.00^{abc}	55.17^{ab}	80.00^{abc}
T_6	MCP + 500	0.24	65.39^{ab}	76.00^{ab}	36.33^{ab}	86 00^{bcd}	78.33^{abc}	49 55^{b}	76 67^{abc}
T_7	MCP + 750	0.25	65.67^{ab}	81.00^{ab}	41.33^{a}	87.00^{abc}	79.67^{abc}	51.80^{ab}	78.00^{abc}
T_8	MCP + 1000	0.21	68.74^{ab}	85.33a	34.67^{ab}	87.67^{abc}	81.33^{abc}	52.66^{ab}	80.00^{abc}
T_9	LCP + zero	0.24	67.58^{ab}	78.33^{ab}	17.67^{d}	88.00^{ab}	82 00^{ab}	56.26^{a}	80.00^{abc}
T_{10}	LCP + 500	0.2	69.39^{ab}	72.67^{ab}	23.33^{cd}	90.33^{a}	82.67^{a}	54.44^{ab}	80.66^{a}
T_{11}	LCP + 750	0.22	69.42^{ab}	71.32^{ab}	31.67^{bc}	89.67^{ab}	82.33^{a}	61.04^{a}	80.33^{ab}
T_{12}	LCP + 1000	0.25	63.66^{b}	64.00^{b}	17.67^{d}	89.00^{ab}	79.67^{abc}	49.10^{b}	77.33^{abc}

a – c Means within the same column with different superscripts are significantly different (P<0.05)

1 : Denote to (excreta DM/feed intake DM).

2 – 8: Denote to crude protein, ether extract, curde fiber, nitrogen feed extract, organic matter, energy metabolizability and nitrogen balance, respectively.

Limited informations are available regarding the effect of combination between protein and phytase levels on nutrients digestibility and energy utilization, however in this respect, Abd El-Samee *et al.* (2001) and Abd El-Samee (2002) found that using optimal level of CP in broiler diets significantly increased OM, CP, EE, CF and NFE digestibilities and NB. Also, Ali (2004) showed that feeding broilers high protein diets significantly improved CP and EE but did not affect CF, NFE, OM digestibilities and NB values when compared with those fed low protein diets. On the other hand, Shaapan (2004) reported that phytase supplementation in broiler diets has a positive effect on CP and EE digestibilities, NB and apparent ME while had no effect on CF digestibility.

Minerals retention:

The effect of dietary levels of protein, phytase and their combination on some minerals retention (being P, Ca, Mg & Zn) of broiler chicks are illustrated in Table (4). The analysis of variance proved that none of P, Ca, Mg or Zn retention was significantly affected by either decreasing dietary CP level from 18.5 to 14.5 % or microbial phytase and their combination, under the condition of the present study. Absence of significant differences in minerals retention among dietary treatments may be an indication to: 1) the adequacy of these minerals in the experimental diets, since the dry matter ratio was similar among all treatments and 2) the absence of effect of either dietary CP, phytase level or their combination on the availability of these minerals. In this connection, Farrell and Martin (1998) found that phytase supplementation had no influence on mineral retention. However, our findings are not in line with those obtained by Attia *et al.* (2001) and Abd El-Samee (2002) who stated that addition of phytase to broiler diets improved the availability of P and Ca. Similarly, Thiel and Weigand (1992) found that, addition of phytase at 800 FTU/kg diet increased Zn retention by chicks.

Table (4): Effect of dietary different protein and, phytase levels and their combination on P, Ca, Mg and Zn retention%, in broiler chicks.

Items	Treatments	P	Ca	Mg	Zn
CP levels %	HCP	58.11 ±0.01	48.49 ±0.27	31.38 ±0.09	28.97 ±0.07
	MCP	58.09 ±0.02	50.51 ±1.33	30.98 ±0.22	28.84 ±0.11
	LCP	58.05 ±0.01	48.83 ±0.[illegible]	31.18 ±0.08	28.77 ±0.16
Phytase levels FTU/kg	Zero	58.10 ±0.02	[illegible] ±0.24	31.17 ±0.11	28.90 ±0.11
	500	57.05 ±0.02	50.52 ±1.83	30.87 ±0.28	28.91 ±0.16
	750	58.11 ±0.02	48.85 ±0.40	31.41 ±0.14	28.76 ±0.19
	1000	58.06 ±0.01	48.77 ±0.42	31.28 ±0.07	28.86 ±0.10
T_1	HCP + zero	58.09 ±0.01	48.30 ±0.30	31.50 ±0.11	28.83 ±0.02
T_2	HCP + 500	58.10 ±0.01	48.31 ±0.50	31.26 ±0.26	28.99 ±0.18
T_3	HCP + 750	58.17 ±0.01	48.81 ±0.00	31.56 ±0.30	29.08 ±0.18
T_4	HCP + 1000	58.08 ±0.00	48.57 ±0.10	31.21 ±0.02	28.97 ±0.21
T_5	MCP + zero	58.14 ±0.02	49.09 ±0.27	31.03 ±0.18	28.87 ±0.23
T_6	MCP + 500	58.07 ±0.05	53.90 ±5.55	30.14 ±0.67	29.02 ±0.38
T_7	MCP + 750	58.06 ±0.04	49.44 ±0.53	31.61 ±0.13	28.85 ±0.20
T_8	MCP + 1000	58.08 ±0.05	49.64 ±0.41	31.16 ±0.17	28.60 ±0.08
T_9	LCP + zero	58.09 ±0.05	49.57 ±0.38	30.98 ±0.14	29.00 ±0.29
T_{10}	LCP + 500	58.00 ±0.01	49.36 ±0.80	31.23 ±0.25	28.71 ±0.32
T_{11}	LCP + 750	58.09 ±0.00	48.29 ±1.14	31.07 ±0.16	28.34 ±0.47
T_{12}	LCP + 1000	58.03 ±0.03	48.11 ±0.35	31.45 ±0.07	29.01 ±0.16

* Differences among all the dietary treatments were not significant.

Economic efficiency:

Regardless the effect of either dietary protein or phytase levels, Table (5) showed the effect of interaction between protein and phytase levels on the economic efficiency of the experimental treatments (EEF). The group of chicks fed LCP diet with added phytase at 750 FTU/kg (T_{11}) recorded the lowest feed cost needed to obtain one kg BWG, while those fed LCP diet + 500 FTU/kg (T_{10}) recorded the highest value. It is worthy to note that chicks fed HCP diet supplemented with 750 FTU/kg of microbial phytase (T_7) were economically similar to the control group fed HCP diet without supplementation (T_1). If the later group was taken for comparison, the obtained values could be defined as relative feed cost/kg gain. Accordingly, T_{11} (LCP + 750 FTU/kg) was the best one (89.5 %) while T_{10} (LCP + 500 FTU/kg) was worse, relative to the control. In addition, T_7 (MCP + 750 FTU/kg) was completely equal to the control one (HCP diet without phytase supplementation).

Table (5): Effect of experimental treatments on the economical efficiency (EEF).

Items	Treatments											
	HCP				MCP				LCP			
	Zero	500	750	1000	Zero	500	750	1000	Zero	500	750	1000
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}
Average FI kg/bird/starter	0.868	0.913	0.892	0.916	0.880	0.925	0.927	0.930	0.852	0.920	0.934	0.944
Average FI kg/bird/grower	1.489	1.545	1.499	1.503	1.443	1.617	1.597	1.516	1.417	1.541	1.620	1.565
Average FI kg/bird/finisher	1.511	1.696	1.740	1.638	1.499	1.648	1.698	1.763	1.419	1.701	1.695	1.684
Price of feed PT/kg/starter(1)	83.01	84.01	84.51	85.01	79.90	80.90	81.40	81.90	77.01	78.01	78.51	79.01
Price of feed PT/kg/grower(1)	80.09	81.09	81.59	82.09	75.58	76.58	77.08	77.58	72.65	73.65	74.15	74.65
Price of feed PT/kg/finisher(1)	75.83	76.83	77.33	77.83	73.12	74.12	74.62	75.12	69.81	70.81	71.31	71.81
Feed cost PT /starter	72.05	76.70	75.38	77.87	70.31	74.83	75.46	76.17	65.61	71.77	73.33	74.58
Feed cost PT /grower	119.25	125.28	122.30	123.38	109.06	123.83	123.10	117.61	102.94	113.49	120.12	116.83
Feed cost PT/finisher	114.57	130.30	134.55	127.48	109.61	122.15	126.70	132.44	99.06	120.45	120.87	120.93
Total feed cost LE	3.06	3.32	3.32	3.29	2.89	3.21	3.25	3.26	2.68	3.06	2.74	3.12
Total BWG (kg) (0-7 weeks)	1.920	2.088	2.064	2.060	1.857	1.982	2.036	2.033	1.634	1.818	1.921	1.886
Feed cost/kg BWG(2)	1.594	1.590	1.608	1.597	1.556	1.619	1.594	1.603	1.640	1.683	1.426	1.654
Relative Feed cost/k BWG(3)	100	99.7	100.9	100.2	97.6	101.6	100.0	100.5	102.9	105.6	89.5	103.8

1.According to the prices of different ingredients in ARE at the experimental time (2001).
2. The feed cost relative to each kilogram of live body weight gain.
3. Relative feed cost = assuming that T_1, the general control equals 100.

This means that addition of phytase at 750 FTU/kg to low protein diets could improve the economical efficiency of broiler as they lowered the feed cost to obtain one kg BWG. In this respect, Attia *et al.* (2001), Abd El-Samee (2002) and Shaapan (2004) found that phytase supplementation in broiler diets resulted in better EEF compared with those unsupplemented.

Conclusion

The results of this study indicate that dietary crude protein level can be decreased by 2 % in broiler starter, grower and finisher diets in the presence of 750 FTU/kg phytase supplementation without adversely affecting their growth and feed utilization.

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تأثير استخدام مستويات مختلفة من البروتين الخام وإنــزيم الفيتيــز علــى الأداء الإنتاجي ومعاملات الهضم لكتاكيت اللحم

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يهدف هذا البحث الي دراسة تأثير استخدام مستويات مختلفة من البروتين مع مستويات مختلفة من الفيتيز في علائق بداري التسمين على الأداء الإنتاجي ومعاملات الهضم والكفاءة الاقتصادية. كانت مستويات البروتين : عالية (٢٣ ، ٢٠ ، ١٨,٥ %) ، متوسطة (٢١ ، ١٨ ، ١٦,٥ %) ، منخفضة (١٩ ، ١٦ ، ١٤,٥ %) في مراحل البادئ والنامي والناهي على التوالي كل تم استخدامه في تصميم عاملي ٣ X ٤ مع اربع مستويات من إنزيم الفيتيز الميكروبي (صفر ، ٥٠٠ ، ٧٥٠ ، ١٠٠٠ وحدة/كجم عليقة).

استخدم في الدراسة عدد ٣٦٠ كتكوت اربوز ايكرز عمر يوم مقسمة عشوائيا على ١٢ مجموعة (كل مجموعة ٣٠ طائر) في ثلاث مكررات (بكل مكرر ١٠ طيور). تم تسكين الطيور تحت ظروف رعاية واحدة وغذيت على علائق البادئ من ٠ – ٣ أسبوع ثم علائق النامي من ٤ – ٥ أسابيع ثم علائق الناهي من عمر ٦ – ٧ اسابيع. وفي نهاية الأسبوع السابع اجريت تجارب الهضم لدراسة تأثير المعاملات المختلفة على معاملات هضم المركبات الغذائية ، معدل الاستفادة من طاقة الغذاء ، ميزان النيتروجين والمحتجز من العناصر المعدنية.

أظهرت النتائج المتحصل عليها أن الطيور المغذاة على مستوي البروتين المرتفع سجلت معنويا أفضل أداء إنتاجي (وزن الجسم – الوزن المكتسب – الغذاء المستهلك ومعامل التحويل الغذائي) بالمقارنة بالمستويات الأخرى (المتوسط والمنخفض). بينما لم تؤثر على معاملات هضم البروتين ومعدل الاستفادة من طاقة الغذاء وكذلك ميزان النيتروجين. في حين انخفض معامل هضم كل من الألياف والمستخلص الخالي من النيتروجين والمادة العضوية وتحسن معامل هضم مستخلص الأثير بالمقارنة مع المستويات الأخرى.

أدى إضافة الفيتيز إلى العلائق بمستويات حتى ١٠٠٠ وحدة / كجم إلى تحسن قياسات الأداء الإنتاجي وخاصة مستوى الإضافة ٧٥٠ وحدة / كجم علف بالمقارنة بمجموعة المقارنة (بدون إضافة الفيتيز) ، وفي نفس الوقت لم تؤثر إضافة الفيتيز على معاملات الهضم باستثناء معامل هضم الألياف والذي حدث به تحسن بإضافة مستوى فيتيز ٧٥٠ وحدة / كجم عليقة.

فيما يتعلق بالتداخل بين مستويات البروتين ومستويات الإنزيم سجلت مجموعة الطيور المغذاة على مستوى مرتفع من البروتين مع ٥٠٠ وحدة فيتيز / كجم أعلى النتائج معنويا لكل من وزن الجسم والوزن المكتسب كما زاد الغذاء المستهلك طول فترة التجربة (من عمر يوم حتى ٧ أسابيع) ، بينما سجلت تلك المغذاة على مستوى منخفض من البروتين بدون إضافة إنزيم أقل القيم بالمقارنة بالكنترول ، في حين سجلت مجموعة الطيور المغذاة على مستوي مرتفع من البروتين وإضافة ١٠٠٠ وحدة أنزيم / كجم عليقة أفضل النتائج لكل من معامل التحويل الغذائي ودليل الأداء الإنتاجي وكذلك أفضل النتائج لمعاملات هضم البروتين ومستخلص الأثير والمادة العضوية ومعدل الاستفادة من الطاقة (%) وميزان النيتروجين وذلك بالمقارنة بالكنترول او المستوى المنخفض من البروتين في العليقة (وبدون إضافة الأنزيم) حيث سجلت معنويا أقل القيم لكل من معامل التحويل الغذائي ودليل الأداء الإنتاجي ، بينما سجلت مجموعة الطيور المغذاة على مستوى متوسط من البروتين مع مستوى انزيم ٧٥٠ وحدة / كجم أعلى معامل هضم للألياف في العلائق.

ومن الناحية الاقتصادية فقد سجلت مجموعة الكتاكيت المغذاة على المستوى المنخفض من البروتين مع إضافة ٧٥٠ وحدة من الفيتيز الميكروبي / كجم عليقة اقل تكلفة للغذاء اللازم للحصول على كيلوجرام من الزيادة في وزن الجسم.

يستنتج من هذه الدراسة أن إضافة ٧٥٠ وحدة من الفيتيز الميكروبي لعلائق كتاكيت اللحم ذات المحتوى المتوسط من البروتين (٢ % اقل من الاحتياجات المصرح بها) يمكن أن يحسن الأداء الإنتاجي وكذا معاملات هضم المركبات الغذائية فضلا عن خفض تكاليف التغذية.