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The effects of date presscakes supplemented with exogenous enzyme on the growth performance, gastrointestinal and nutrient digestibility of broiler chicks

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ABSTRACT- This study was designed to investigate the effects of adding different levels of date presscakes (DP), with and without enzyme supplementation (ES), on the ileal digestibility and growth performance of broiler. A completely randomized design containing 2 × 5 factorial arrangement of treatments (with and without enzyme supplementation and 5 levels of DP) was used. The enzyme complex contained 3500 U ß –glucanase, 600 U xylanase and 10.2 U cellulase activities per g of product. Five experimental diets with similar composition as the control were prepared by partial replacements of corn by DP at the levels of 0, 25, 50, 75 and 100 g/kg diet. Day-old male broiler chicks were allocated into 40 cages at random (4 replicates per treatment, 10 birds per cage). Body weight gain, feed intake, feed conversion ratio and apparent ileal digestibility of nutrients were determined. Substitution of corn by 75 and 100g DP/kg increased (linear, P<0.05) the body weight gain and feed intake. Enzyme supplementation of the diets at 50, 75 and 100g DP/kg improved (P<0.05) the daily gain of birds as compared with the birds that were fed the control diet without enzyme. Enzyme supplementation at 0, 50 and 75 g DP/kg diet improved (P<0.05) the crude protein digestibility. The data indicated that DP with ES, included at the levels of up to 100g/kg diet might enhance the growth performance of broilers..

INTRODUCTION

Because conventional feedstuffs like corn and soybean meal, to produce poultry economically, are considerably limited in many regions of the world, alternative sources need to be found. This limitation is becoming even worse due to the use of different crops such as corn in biofuel production resulting in subsequent increase in the price of energy sources in poultry rations (Swiatkiewicz and Korleski, 2008).

Egypt, Saudi Arabia, Iran, Iraq, United Arab Emirate, Algeria and Pakistan are seven leading countries that produce more than 90% of the world's date (Daghir, 2008). Dates are also used for the production of molasses, alcohol, vinegar, yeast and several other products, and the date by-products are used in animal feeding (Daghir, 2008). In date packing and processing operations, we have to find a way to use the disposals in order to decrease disposal problems and costs and to improve the economics of the operation. The main by-products are cull dates and date pits from packing operations, and pits and presscakes from date processing. A considerable proportion (20%) of produced dates is not used for human consumption because of its poor quality (Al-Homidan, 2003).

Date waste is an ingredient with a high energy content that can be a potential alternative for conventional energy feed ingredients in the poultry industry. Its only disadvantage is the high fiber content. Wasted dates might replace part of cereal in the diet of broiler (Al-Yousef, 1985), laying hens (Nagib et al., 1994), and breeder quails (Al-Yousef, 1985).

Vandepopuliere et al. (1995) reported that whole dates and date fruits supported growth and feed conversion ratio which were comparable to, or even better than, those provided by the control diet. Similarly, Hussein et al. (1998) reported that the application of 100 g dates /kg diet had no adverse effect on the growth and feed conversion ratio in broilers.

Date presscake (DP) is a by-product remaining from the extraction of dates for syrup and alcohol production. It is the exhausted date flesh with some residual sugar with or without the pits incorporated, depending on the type of extraction. The use of DP in ruminant diets is a common product in some areas; but it is limited in the non-ruminant diets, especially poultry, due to its high fiber content. Limited research has been conducted to increase the nutritional contents of DP as one of the measures to reduce and/or eliminate the constraints of utilizing DP in poultry diets. The method used to achieve this target is either through physical, chemical, biological or a combination of these treatments. However, enzyme treatments of DP seem to improve the nutrient value of DP. This method is considered as the most suitable and practical treatment for DP. The use of enzymes in animal feed rations targets the specific indigestible parts of the dietary components, and several studies in poultry have reported beneficial effects of enzyme supplementation (ES) on the growth performance in poultry (Choct, 1997). The anti-nutritive properties of these products have been documented, with their viscosity contributing to their negative effects (Choct, 1997).These diets are therefore often treated with enzymes to reduce the viscosity and to improve their nutrient availability and growth in broilers (Choct, 1997).

The aim of this study was to investigate the performance of broiler chickens fed on a corn-soybean meal based diet substituted with 0, 25, 50, 75 or 100g DP/kg diet with or without ES.

MATERIALS AND METHODS

Birds, Diets and Experimental Design

In total, 400 day-old male broiler chicks (Ross 308) were fed one of 10 diets from 1 to 42 days.The chicks were randomly distributed in groups of ten into 40 wired-floor cages. The birds were reared in cages of identical size (100×100cm^2 floor area and 80 cm height) for 42 days. The birds were maintained according to the guidelines set by the Iranian Council on Animal Care (1995).

Date presscake was purchased as residues of food industry from Shahdad city in Kerman, Iran, and dried in a force-draft oven at 65˚C for 24 hours and then ground in a hammer mill before being mixed with the diets. Depending on the type of extraction, the pits might have been incorporated. Moisture level of the end product was around 700g/kg and would deteriorate quickly. Date presscake (DP) resulted from (excluding the pits) ground in a hammer mill was passed through 1 mm mesh sieve producing a fine powder. A representative sample of DP was collected for proximate chemical analyses of dry matter (DM, Method 967.03), crude protein (CP, Method 984.13), ether extract (EE, Method 920.39), and ash (Method 942.05) according to AOAC (2000). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined as described by Van Soest et al. (1991). Sucrose was determined after extracting the DP with aqueous ethanol (800 ml/l) by shaking at 50 ºC for 30 min. After centrifugation (3000 rpm for 10 min), the supernatant was collected and concentrated using a rotary evaporator at 40 ºC. Sucrose content was determined by HPLC as described by Saafi et al. (2008). The composition of dried DP used is presented in Table 1.Crude protein (CP) (Method 984.13) and crude fiber (CF) (Method 962.09) of basal diet were analyzed according to the standard AOAC methods (AOAC, 2000).

Birds had ad libtium access to feed and water. The compositions of experimental diets in the mash form are presented in Table 2.The 5×2 factorial arrangement of treatments involved 5 levels of DP: 0, 25, 50, 75 and 100g/kg substituting for corn, and the addition of two levels of 0.0 and 3g/kg diet enzyme complex that contained 3500 U ß –glucanase, 600 U xylanase and 10.2 U cellulase activity per g product. There were four replicates per treatment, and each replicate cage contained ten birds. Cages were randomly allocated to treatments. The mash diets met or exceeded the nutrient requirements of chickens. The National Research Council (1994) feed ingredient tables were used for calculation.

Growth Performance And Digestive Tract Measurements

Body weights (BW), feed intake (FI) and feed conversion ratio (FCR) were recorded weekly. Feed was removed 3 h before weighting. Body weight gain (BWG) and average daily FI (ADFI) adjusted for mortality to 21 and 42 days of age were used to calculate the FCR. At day 42, two birds from each replicate cage were randomly selected, BW was recorded and the birds were killed by intracardial injection of sodium pentobarbitone solution (Anathal, 300 mg sodium pentobarbitone/ml, South Island Chemical Ltd, Christchurch, New Zealand). Feed was removed 3 h before slaughter.

The gastrointestinal tract was carefully removed. Empty body weight and the length of duodenum (pancreatic loop), proximal ileum (from the pancreatic loop to Meckel’s diverticulum), distal ileum (from Meckel’s diverticulum to ileocaecal junction) and caeca (left and right) were recorded. The relative organ weights (g/kg BW) and the relative length (cm/kg BW) were then calculated.

Table 1. Chemical compositions (g/kg DM) and ME value (MJ/kg) of date presscakes (DP).

Material	Moisture	CP	EE	Ash	NFE	Sucrose	NDF	ADF	AME[a]
DP	38	81	28	20	652	33.9	62.1	52	14.05

DM= dry matter, CP= crud protein, EE=ether extract, NFE= nitrogen free extract, ADF= acid detergent fiber, AME= apparent metabolisable energy

[a]Calculated according to Carpenter and Clegg (6) by applying the equation:

AME (Kcal/kg) = (35.3 × CP %) + (79.5 × EE %) + (40.6 × NFE %) + 199.

Nitrogen Free Extract (NFE) = 100 - (%Moisture + %Protein + %Fiber + %Ash + %Fat)

Determination of Coefficient Apparent Ileal Digestibility (CAID)

At 38 days of age, chickens were fed their respective diets to which 3 g chromic oxide /kg of diet was added as an indigestible marker. On day 42, eight birds (two birds per replicate, the same birds used for digestive tract measurements) were euthanized by an intracardial injection of a sodium pentobarbitone solution and the contents of the lower half of the ileum were collected. The ileum was defined as that portion of the small intestine extending from the Meckel's diverticulum to a point approximately 40mm proximal to the ileo-cecal junction. The ileum was divided into two halves and the digesta were collected from the lower half towards the ileo-cecal junction. The diet and digesta samples were then analyzed for DM, and crude protein (AOAC, 2000), and chromic oxide content as described by Sahin and Kucuk (2003).

Table 2. Composition of the experimental basal diets (g/kg as fed basis)[a].

	Starter (1 to 21 days)	Grower (22 to 42 days)
Ingredients (g/kg)		
Corn	578.5	633.8
Soybean meal (480 g/kg CP)	338.7	281.5
Corn oil	38	38
Dicalcium phosphate	10.5	12.5
Ground limestone	23.5	23.4
DL-Methionine	1.8	01.8
Iodized salt	4	4
Vitamin premix[b]	2.5	2.5
Mineral premix[b]	2.5	2.5
Calculated nutrient content		
Metabolisable energy, (kcal/kg)	3058	3130
Crude protein (g/kg)	230.3	202.1
Methionine + cysteine (g/kg)	9	7.3
Lysine (g/kg)	13.8	11.2
Threonine (g/kg)	7.5	6.3
Analysed values		
Crude protein(g/kg)	228	199
Crude fiber (g/kg)	37.1	39.1

[a] Date presscakes (25, 50, 75, 100 g/kg) were added as a replacement for corn.

[b]Provides per kg of diet: vitamin A palmitate, 6,600 IU; cholecalciferol, 2,200 IU; menadione dimethylpyrimidinol bisulfite, 2.2 mg; riboflavin, 4.4 mg; pantothenic acid, 13 mg; niacin, 40 mg;
choline chloride, 500 mg; biotin, 1 mg; vitamin B12, 22mg; ethoxyquin, 125 mg; iron, 50 mg; copper, 6 mg; zinc, 40 mg; manganese, 60 mg; selenium, 0.2 mg.

Statistical Analyses

Data were subjected to two-way factorial arrangement of treatments using the general linear model procedure of the SAS Institute (1999). Mean comparison was performed by the Duncan's *post hoc* test and the differences were considered to be significant at $P<0.05$. The linear and quadratic effects of the dietary DP inclusion levels were studied using polynomial contrasts.

RESULTS AND DISCUSSION

Broiler Performance

The BW gain from 1 to 21 days of age was greater for birds fed 75g DP/kg than bird fed 25g DP/kg and control diets (linear, $P<0.05$) and was equal to those fed the 50 and 100g DP/kg diet (Table 3). The FI of broilers fed 75g/kg and 100g DP/kg diets was significantly higher (linear, $P<0.05$) than that of broilers fed 25g/kg and control diets. There were no significant differences in FCR among treatments.

From 21 to 42 days, BWG was not influenced by dietary treatments. The broilers fed diets containing 100g DP/kg had significantly higher ADFI in compared with levels to 25g/kg and control diets during the 21 to 42 day of age (linear, $P<0.05$). Throughout the experimental period (day 1 to 42), the use of DP at 75 and 100g/kg did affect BW gain. However, when DP was increased to 75 and 100g/kg, BW gain was increased (linear, $P<0.05$) by 10 and 9% as compared with control diet, respectively. The corresponding ADFI was increased (linear, $P<0.05$) when 75 and 100g DP/kg was included in the basal diet. During this period FCR was unaffected (Table 4).

From 1 to 21 days, and from 1 to 42 days, BWG and FI of broilers fed the ES diet was improved ($P<0.05$) over the control broilers. Feed to gain ratio was not affected by ES (Tables 3 and 4).

From 21 to 42 days and from 1 to 42 days of age, there were significant differences in ADG, and FI among birds fed 0, 25, 50, 75 or 100g DP/kg with or without ES (Tables 3 and 4). However, there were significant increases in ADG and FI in birds given 75g DP/kg with ES than control group birds during 21 to 42days of the experimental period (Table 3). From day 1 to 42, the use of 50, 75 and 100g DP/kg with ES increased ($P<0.05$) ADG of birds than birds that fed control group without enzyme (Table 4).

Intestinal Characteristics

The relative weight and length of proximal ileum and caeca increased (linear, $P<0.05$) as the level of DP increased (Tables 5 and 6). Enzyme supplementation to the experimental diets (50, and 100g DP/kg diet) decreased ($P <0.05$) the relative weight of caeca than the same diets without enzyme (Table 5).

Table 3. Effects of date presscakes (DP) and enzyme supplementation (ES) (g/kg) on body weight gain (BWG, g/bird/d), average daily feed intake (ADFI, g/bird/d) and feed conversion ratio (FCR, g feed/g gain) of broiler (1 to 21 and 21 to 42 days of age)[a].

Item	BWG				ADFI				FCR			
	1−21days		21−42days		1−21days		21−42days		1−21days		21−42days	
	−Enz	+Enz	−Enz	+Enz	−Enz	+Enz	−Enz	+Enz	−Enz	+Enz	−Enz	+Enz
DP (g/kg)												
0	26.8	29.2	79.3^{b}	83.0^{b}	37.4	43.2	149.1^{d}	149.8^{cd}	1.46	1.37	1.91	1.83
25	23.9	30.5	77.1^{b}	78.3^{b}	36.6	44.8	147.9^{d}	148.8^{cd}	1.48	1.40	1.91	1.70
50	29.4	31.1	82.7^{b}	84.9^{b}	42.5	44.2	150.4^{cd}	164.0^{ab}	1.35	1.33	1.94	1.82
75	31.4	33.4	86.4^{ab}	94.8^{a}	45.2	47.4	160.4^{bc}	173.8^{a}	1.39	1.35	1.95	1.88
100	30.1	32.2	82.2^{b}	85.8^{ab}	44.8	47.8	156.6^{bcd}	157.5^{bcd}	1.40	1.38	1.96	1.92
SEM[b]	1.83		3.63		2.23		4.36		0.07		0.07	
P−value												
Source of variation												
DP	*		NS		**		**		NS		NS	
ES	**		NS		**		*		NS		NS	
DP × ES	NS		*		NS		*		NS		NS	
Linear effect	**		NS		**		*		NS		NS	
Quadratic effect	NS		NS		NS		NS		NS		NS	
Main effects												
DP (g/kg)												
0	28.0^{b}		81.1		40.3^{b}		149.5^{bc}		1.42		1.88	
25	27.2^{b}		82.7		40.7^{b}		147.4^{c}		1.44		1.81	
50	30.2^{ab}		83.8		43.3^{ab}		157.2^{ab}		1.34		1.88	
75	32.4^{a}		88.5		46.3^{a}		158.5^{ab}		1.37		1.92	
100	31.1^{ab}		86.1		46.3^{a}		165.6^{a}		1.39		1.94	
ES(g/kg)												
0	28.3^{b}		83.5		41.3^{b}		153.1^{b}		1.39		1.91	
3	31.3^{a}		85.3		45.5^{a}		158.2^{a}		1.38		1.85	

BWG= body weight gain, ADFI= average daily feed intake, FCR= feed conversion ratio, -Enz= the diet without enzyme, +Enz= the diet with enzyme, NS= Non−Significant [a−c] Means within a row or column without common superscripts differ significantly ($P < 0.05$). NS: Non−Significant [a] Each value represents the mean of four replicate samples
[b] Pooled standard error of mean. * $P < 0.05$ ** $P < 0.01$.

Table 4. Effects of date presscakes (DP) and enzyme supplementation (ES) (g/kg) on body weight gain (BWG, g/bird/d), average daily feed intake (ADFI, g/bird/d) and feed conversion ratio (FCR, g feed/g gain) of broiler (1 to 42 days of age)[a].

	BWG		ADFI		FCR	
	1−42days		1−42days		1−42days	
Item	−Enz	+Enz	−Enz	+Enz	−Enz	+Enz
DP (g/kg)						
0	53.1^{c}	56.0^{abc}	93.2	96.5	1.65	1.64
25	54.4^{bc}	55.5^{abc}	92.2	95.8	1.66	1.59
50	56.0^{abc}	58.0^{ab}	96.4	104.1	1.64	1.59
75	58.9^{ab}	63.5^{a}	102.8	105.8	1.66	1.64
100	56.1^{abc}	59.6^{a}	101.1	102.0	1.67	1.66
SEM[b]	1.76		2.41		0.04	
P−value						
Source of variation						
DP	**		**		NS	
ES	*		**		NS	
DP × ES	*		NS		NS	
Linear effect	**		**		NS	
Quadratic effect	NS		NS		NS	
Main effects						
DP (g/kg)						
0	54.6^{b}		94.8^{c}		1.65	
25	55.0^{b}		94.0^{c}		1.63	
50	57.0^{ab}		100.3^{b}		1.61	
75	59.8^{a}		102.4^{ab}		1.64	
100	59.2^{a}		106.0^{a}		1.67	
ES(g/kg)						
0	55.9^{b}		97.2^{b}		1.63	
3	58.3^{a}		101.8^{a}		1.65	

BWG= body weight gain, ADFI= average daily feed intake, FCR= feed conversion ratio, -Enz= the diet without enzyme, +Enz= the diet with enzyme, NS= Non−Significant [a-c] Means within a row or column without common superscripts differ significantly ($P < 0.05$). NS: Non−Significant [a] Each value represents the mean of four replicate samples
[b] Pooled standard error of mean. * $P < 0.05$ ** $P < 0.01$.

Table 5. Effects of date presscakes (DP) diet supplemented with enzyme supplementation (ES) on relative weight (g/kg BW) of small intestine and caecum of broilers [a].

	Parameter							
	Duodenum		Distal ileum		ADFI		FCR	
Item	−Enz	+Enz	−Enz	+Enz	−Enz	+Enz	−Enz	+Enz
DP (g/kg)								
0	0.53	0.50	1.12	1.22	0.88	0.77	0.16^{d}	0.15^{d}
25	0.57	0.59	1.24	1.21	0.88	0.88	0.17^{cd}	0.17^{cd}
50	0.61	0.53	1.25	1.20	0.95	0.93	0.21^{ab}	0.17^{cd}
75	0.60	0.56	1.30	1.22	0.96	0.94	0.22^{ab}	0.18^{bcd}
100	0.66	0.59	1.31	1.23	1	0.98	0.24^{a}	0.18^{bcd}
SEM[b]	0.04		0.08		0.05		0.02	
	P−value							
Source of variation								
DP	NS		NS		*		*	
ES	NS		NS		NS		NS	
DP × ES	NS		NS		NS		**	
Linear effect	NS		NS		*		*	
Quadratic effect	NS		NS		NS		NS	
Main effects								
DP (g/kg)								
0	0.54		1.17		0.86^{b}		0.16^{c}	
25	0.56		1.23		0.88^{b}		0.17^{bc}	
50	0.59		1.23		0.93^{ab}		0.19^{ab}	
75	0.59		1.25		0.94^{ab}		0.19^{ab}	
100	0.61		1.27		0.99^{a}		0.20^{a}	
ES(g/kg)								
0	0.58		1.24		0.94		0.19	
3	0.57		1.22		0.90		0.17	

BW= body weight, -Enz= the diet without enzyme, +Enz= the diet with enzyme, NS= Non−Significant

[a−c] Means within a row or column without common superscripts differ significantly ($P < 0.05$).

[a] Each value represents the mean of eight replicate samples

[b] Pooled standard error of mean. * $P < 0.05$, ** $P < 0.01$

Table 6. Effects of date presscakes (DP) diet supplemented with enzyme supplementation (ES) on relative length (cm/kg BW) of small intestine and caecum of broilers [a].

	Parameter							
	Duodenum		Distal ileum		Proximal ileum length		Caecums length	
Item	−Enz	+Enz	−Enz	+Enz	−Enz	+Enz	−Enz	+Enz
DP (g/kg)								
0	1.13	1.03	2.92	2.86	2.82	2.80	0.66	0.53
25	1.21	1.20	2.93	2.88	2.92	2.78	0.70	0.57
50	1.22	1.17	2.94	2.87	2.95	2.83	0.72	0.61
75	1.23	1.17	2.96	2.87	2.99	2.89	0.74	0.60
100	1.27	1.04	3.07	3.01	3.25	2.95	0.74	0.66
SEM[b]	**0.08**		**0.13**		**0.11**		**0.03**	
	P−value							
Source of variation								
DP	NS		NS		*		**	
ES	NS		NS		NS		NS	
DP × ES	NS		NS		NS		NS	
Linear effect	NS		NS		*		**	
Quadratic effect	NS		NS		NS		NS	
Main effects								
DP (g/kg)								
0	1.18		2.88		2.81^{b}		0.66^{b}	
25	1.19		2.91		2.85^{b}		0.71^{ab}	
50	1.20		2.93		2.91^{b}		0.75^{a}	
75	1.20		2.97		2.92^{b}		0.75^{a}	
100	1.22		2.97		3.15^{a}		0.77^{a}	
ES(g/kg)								
0	1.20		2.95		2.97		0.73	
3	1.16		2.91		2.88		0.72	

BW= body weight, -Enz= the diet without enzyme, +Enz= the diet with enzyme, NS= Non−Significant

[a−c] Means within a row or column without common superscripts differ significantly ($P < 0.05$).

[a] Each value represents the mean of eight replicate samples [b] Pooled standard error of mean. * $P < 0.05$, ** $P < 0.01$

Apparent Ileal Digestibility of Nutrients

A non-significant depression in protein digestibility was observed when DP increased from 0 to 75g/kg of the diet, whereas 100g DP/kg resulted in linear significant depression in protein digestibility compared with the control diet (Table 7). In general, the interaction between enzyme and DP was showed that ES improved protein digestibility in all levels of DP diets, but the inclusion of the enzyme in the 0, 50, and 75g DP/kg diet significantly improved protein digestibility (Table 7). However, throughout the overall period (day 1 to 42), inclusion of the enzyme in basal diets significantly increased dry matter and protein digestibility (P<0.05).

Table 7. Effects of date presscakes (DP) inclusion and enzyme supplementation (ES) on the coefficient of apparent ileal digestibility of dry matter and crude protein in broiler[a].

Item	Dry matter[c]		Crude protein	
	−Enz	+Enz	−Enz	+Enz
DP (g/kg)				
0	0.69^{bc}	0.71^{bc}	0.78^{bcd}	0.83^{a}
25	0.65^{bc}	0.72^{bc}	0.78^{bcd}	0.82^{ab}
50	0.70^{bc}	0.71^{bc}	0.77^{cd}	0.81^{ab}
75	0.67^{bc}	0.73^{ab}	0.78^{bcd}	0.81^{ab}
100	0.62^{c}	0.70^{bc}	0.72^{d}	0.76^{cd}
SEM[b]	3.57		1.47	
Source of variation	P−value			
DP	NS		**	
ES	*		**	
DP × ES	*		NS	
Linear effect	NS		**	
Quadratic effect	NS		NS	
Main effect				
DP (g/kg)				
0	0.71		0.80^{a}	
25	0.70		0.80^{a}	
50	0.68		0.80^{a}	
75	0.70		0.80^{a}	
100	0.66		0.74^{b}	
ES (g/kg)				
0	0.67^{b}		0.77^{b}	
3	0.71^{a}		0.81^{a}	

-Enz= the diet without enzyme, +Enz= the diet with enzyme, NS= Non−Significant

[a−c] Means within a row or column without common superscripts differ significantly (P < 0.05).

[a] Each value represents the mean of eight replicate samples

[b] Pooled standard error of mean.

[c] Nutrient digestibility = 1 – {(dietary Cr_2O_3/fecal Cr_2O_3) × (feces nutrient/dietary nutrient)}.

* P < 0.05, ** P < 0.01.

DISCUSSION

Corn is the major feed in broiler diets, but it has increasingly been diverted toward ethanol production; therefore, it is necessary to identify alternative by-products that could partially replace corn in broiler diets. The results of this study indicated that FI increased as dietary inclusion rate of DP increased from 25 to 75 or 100g/kg. However, there were no significant differences in FCR in birds given different levels of DP diets during 1 to 21 days of the experimental period. Feed consumption in poultry is regulated to maintain constant caloric intake (Hill and Danski, 1954). If low energy diets are offered to birds, their FI is increased (Vieira et al., 1992). As the energy contents were similar across the diets in the present diet, the increased FI may be due to counteracting the possible anti-nutritive of DP by ES.

The results of the overall experimental period (1 to 42 days) indicated that the highest rate of DP inclusion positively influenced growth performance parameters. It was interesting to note an improvement in BWG, with a similar increase in FI of highest rate of DP inclusion. This is in agreement with an earlier observation reported by Besbes et al. (1993) who found that essential fatty acids of date may compensate its high content of crude fiber. This may also be due to the high levels of glucose and fructose as available carbohydrate in whole inedible date (500 g/kg) and some sucrose (Sawaya et al., 1998). This might also be a compensatory factor especially at the growth stage as date waste meal might provide birds with their energy requirement. Al-Homidan (2003) found that adding dietary date to broiler diets resulted in increased weight gain.

From 1 to 21 days, and from 1 to 42 days, BWG and feed consumption of broilers fed the diet with ES was improved (P<0.05) over the unsupplemented control. This improvement has been suggested to be due to increased FI as well as improved nutrient availability (Pettersson et al., 1991).

Throughout the experimental period (day 1 to 42), the use of DP at 50, 75 and 100g/kg with ES significantly increased daily gain of birds compared to that of birds that were fed as the control group without enzyme. The benefit gained by the enzyme addition is largely due to the partial degradation of the soluble non starch polysaccharides which reduces the viscosity of intestinal contents and improves FI and nutrients absorption (Rotter et al., 1991).

The increase in the small intestine weight (proximal ileum) in chickens fed PD diets (100g/kg) may have been due to the increase in small intestine length or in its absorptive area. Brenes et al. (1993) found that feeding diets based on viscous grains resulted in significant increases in the relative size of the digestive tract of broiler chickens. It is well documented that the bird’s intestine responds to the presence of fibrous substances in the diets in terms of length, weight, absorptive area and rate of turnover of entrocytes (Savory and Knox, 1991). The increase in caecal weight with 100g DP/kg may be due to the presence of highly fibrous materials, which passed to the bird’s hindgut undigested and provided a suitable environment for microbial growth. This probably increased the fermentation processes that may lead to an increase in the length of the caeca. The length of the caeca (relative to BW) closely and positively correlated with dietary fiber content (Pendergast and Boag, 1973; Savory and Gentle, 1976). The addition of enzyme proportional to 100g DP/kg significantly (P<0.05) decreased the relative weight of caeca in comparison to the same diets without enzyme.

The decrease in the CIAD of protein when 100g DP was added per kg diet indicated that probably high fiber content of DP had a significant effect on the digestibility of cellular nutrients, such as proteins. On the other hand, dietary fiber causes an increase in faecal N which occurs with all types of fibers and fiber sources (Gallaher and Scheeman, 1986). Supplementation of diet to give 15% ADF decreased apparent N digestibility in rats from 91 to 83% (Garrison et al., 1978). It is possible to interpret this in three ways: (i) there is an effect of dietary fiber on the digestion and absorption of protein; (ii) the protein associated with the dietary fiber in the diet is intrinsically less digestible; (iii) fermentation of dietary fiber in the colon stimulates bacterial growth and increases the content of bacterial N in the stools. The observed results may be due to a combination of all three possibilities. The lack of difference between different levels (25, 50 and 75g/kg) of DP and control diet in CIAD of dry matter and crude protein suggested that corn could be partially replaced by DP as a source of energy for feeding birds**.**

CONCLUSIONS

In conclusion, this study is one of the very few that has thoroughly investigated the use of DP and its improvement with the addition of exogenous enzymes as an energy source to substitute the corn. The data suggested that DP can be successfully used up to 100g/kg in broiler diets to support and enhance growth performance, which will reduce feed costs for the poultry industry.

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تاثیر لرد خرما با آنزیم بر عملکرد رشد، دستگاه گوارش و قابلیت هضم مواد مغذی در جوجه های گوشتی

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قابلیت هضم پروتیین

چکیده- این آزمایش به منظور بررسی مقایسه سطوح مختلف لرد خرما با و بدون آنزیم بر صفات عملکردی رشد در جوجه های گوشتی انجام شد. ۵ جیره آزمایشی با ترکیبات مواد مغذی مشابه با جیره شاهد آماده شد که قسمتی از ذرت در جیره شاهد با سطوح مختلفی از لرد خرما جایگزین شد (۰، ۲۵، ۵۰ و ۱۰۰ گرم/کیلوگرم). جوجه های گوشتی نر یکروزه به طور تصادفی در ۴۰ قفس قرار داده شدند (۴ تکرار برای هر تیمار و ۱۰ پرنده در هر قفس) و جوجه ها تا سن ۴۲ روزگی با جیره های آزمایشی مربوطه تغذیه شدند. وزن بدن، مصرف خوراک و ضریب تبدیل در صول دوره آزمایش ثبت گردید. در پایان دوره قابلیت هضم ظاهری مواد مغذی اندازه گیری شد. نتایج نشان دادند، مصرف جیره هایی که با ۷۵ و ۱۰۰ گرم لرد خرما /کیلوگرم جایگزین شده بودند، وزن بدن و مصرف خوراک بالاتری داشتند (P<۰/۰۵). پرندگانی که جیره هایی با ۵۰، ۷۵ و ۱۰۰ گرم لرد خرما /کیلوگرم همراه با آنزیم دریافت کرده بودند، نسبت به گروه شاهد بدون آنزیم، اضافه وزن روزانه بهتری داشتند (P<۰/۰۵)، همچنین در این گروه ها قابلیت هضم پروتئین خام بهبود یافته بود(P<۰/۰۵). نتایج نشان دادند که جایگزینی لرد خرما تا سطح ۱۰۰ گرم/کیلوگرم، همراه با آنزیم می تواند صفات عملکردی رشد را بهبود دهد.