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EFFECT OF WHOLE INEDIBLE DATE AND AMINO ACID SUPPLEMENTATION ON GROWTH PERFORMANCE OF ROSS 308 BROILER CHICKS

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ABSTRACT

This work aims to assess the potential of discarded date meal (DDM) as an alternative ingredient in broiler diets. The effect of substituting 5 or 10% of corn and soybean meal (SBM) with DDM on performance, carcass characteristics, serum constituents and nutrients retention of broilers from 12 to 35 d of age was evaluated. A total of 150 chicks were randomly distributed in a factorial arrangement (3x2) into six treatments. Three levels of DDM (0, 5 and 10%) and 2 levels of AAs (normal and high) were utilized. A significant interaction was detected for BWG (P<0.01) and FCR (P<0.001). Birds which had received 0% and 5% DDM and high AAs converted feed more efficiently when compared to those which had received low AAs. When examining the main effects for FCR, both DDM and AAs showed a significant effects on FCR (P<0.01 and 0.05, respectively). Birds received 5% DDM converted feed more efficiently as compared to 0 and 10%. Also, birds received the high AAs level converted feed more efficiently as compared to the normal level. On the other hand, breast muscle yield and abdominal fat were affected by DDM and AAs (P<0.01 and 0.05, respectively). Birds on the 0% DDM had higher breast muscle yield as compared to 5 or 10% DDM. Also, high AAs increased breast yield by 1.5% as compared to normal AAs. The results revealed that birds received 5% DDM performed better than the control or 10%. Also, supplementing diets with higher AAs level improved the performance. Based on presented evidences, it is recommended to substitute 5% of corn and SBM withDDM.

Keywords: Amino acids (AA's), Broilers, Discarded date meal (DDM), Growth performance, Nutrients retention, Serum metabolite.

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Contribution/ Originality

This study contributes in the existing literature regarding the utilization of dates as a potential ingredient that could partially replace corn in broiler diets. This study documents that DDM could be incorporated in poultry diets as a cheap untraditional ingredient to reduce feeding cost. This study is one of very few studies which have investigated the effect of amino acids supplementation to DDM as a method to improve the nutritive value.

1. INTRODUCTION

Broiler feed is based primarily on corn as a source of energy and soybean meal as a source of protein. In most areas of the world corn is the predominant source of energy in feed because of its abundance and digestibility, roughly 60-75% of the total makeup of broiler diets is corn. Historically high corn prices, prompting nutritionists to search for other suitable raw materials to provide required nutrients for poultry to maintain productivity and to lower feed cost [1].

Dates (*Phoenix dactylifera*) are considered a main crop in Saudi Arabia. In the year 2012, the total production quantity was 1,050,000 tons which represented 15.1% of total world production. However, more than 20% of dates are considered inedible for humans [2]. Dates which are not used for humans can be grinded and mixed with other livestock and poultry feed [3]. Discarded date meal (DDM) is considered to be a potential ingredient that could partially replace corn in broiler diets. Al-Harthi [4] stated that DDM could be incorporated in poultry diets as a cheap untraditional ingredient to reduce feeding costs. In comparison with corn, DDM has low crude protein (5 to 7%) and essential amino acids (AAs) lysine (Lys), methionine (Met) and threonine (Thr).It has a fair ME level because it contains 7 to 10% fat and 55 to 65% crude carbohydrate however; it contains high crude fibre content (10 to 20%) [5].

Several studies were conducted on the effect of inclusion rate of DDM on broiler performance. Kamel, et al. [6] Concluded that whole Zahdi dates at the expense of corn at 5, 10 and 30% supported growth performance of broilers as efficiently as the control diets. El-Deek, et al. [7] Concluded that whole inedible dates which consisted of date fruits (85%) and date pits (15.0%) could be used up to 15% in broiler diets from 15 and 42 days of age without any adverse effects on performance, digestibility of nutrients and meat quality measurements.

In practical feeds the total sulfur AAs (Met+Cys), Lys and Thr are usually considered as the most limiting amino acids in for growing chickens fed corn-SBM diets [8]. Methionine, Lys and Thr may interact with one another to improve broiler performance [9]. Overall dietary Lys: Met and Lys: Thr interactions were apparent to optimize meat accretion. According to Kidd, et al. [10] if broilers feed is fortified with Lys above the NRC [11] recommendations [11], Thr requirements will increase. Increasing dietary Lys without an increase in Met and Thr may limit protein synthesis and reduce meat accretion [12, 13]. It was reported that diets fortified with Lys and Met (106 and 112% of the NRC [11], respectively) interacted to optimize carcass and breast meat yields of male broiler compared to control diet [14]. Other research found no interactions between Lys and Met in broiler diets when both were fed equal or above the NRC [11] suggested recommendations [15]. This trial was intended to evaluate the effect of substituting corn and SBM with discarded date meal (DDM) supplemented with two levels (normal and high) of AAs (Lys, Met and Thr).

2. MATERIALS AND METHODS

The study was conducted at King Saud University, Riyadh, Saudi Arabia. Dates were obtained from the local market and the whole date was ground (the pits and the flesh). Chicks were randomly distributed in a factorial arrangement into six treatments [3 levels of DDM (0, 5 and 10%) and 2 levels of AAs (100% of AAs as used in commercial practices (normal) and 115% (high))]:

T1 = control corn-SBM diet (0% DDM+100% AAs (Lys, Met. and Thr).

T2 = 0%DDM + 115% AAs (Lys, Met and Thr).

T3 = 5% DDM+100% AAs (Lys, Met and Thr).

T4 = 5% DDM + 115% (Lys, Me and Thr).

T5= 10% DDM +100% AAs (Lys, Met and Thr).

T6 = 10% DDS + 115% (Lys, Met and Thr).

Before mixing the experimental diets, samples of raw materials were analyzed for chemical composition (Table 1). The chicks were given common starter diet for two weeks (Table 2) and were given the experimental diets from 15 to 42 days of age (Table 3).

A total of 150 chicks were obtained from a commercial hatchery and were grouped by weight, then chicks were allotted into 30 experimental cages with five chicks per cage in a four-deck cage system and received the experimental diets in electrically heated battery brooders with raised wire floors. This experiment was conducted at the environmentally controlled battery room at the Animal Production Department, College of Food and Agriculture Sciences, King Saud University. The initial environmental temperature was kept at 35°C in the first week and then decreased to 22°C until the end of the experiment. At the hatchery, the chicks were vaccinated against Infectious Bronchitis, Marek's disease and Newcastle disease.

2.1. Measurements

The pen average for feed consumption (FI) and body weight gain (BWG) were recorded weekly and FCR was computed. Mortality was checked daily and weights of dead birds were used to adjust FCR.

A digestion trial was performed on a separate group of chicks. Thirty six birds (3 replications per diet) were housed (2 birds / cage) in 18 cages with wire bottoms. At 35 day of age, all finisher diets were supplemented with 3g kg^{-1} chromic oxide as an analytical marker for the digestibility trial and were offered to the birds for 5 days as an adaptation period. After the adaptation period, approximately 200 grams of clean excreta were collected to for analysis. Excreta and feed samples were dried and dry matter was determined by oven-drying at 60°C for 72 h, and then was ground to pass through a 1.0 mm screen. The following analyses were performed in duplicates, crude protein (N x 6.25), ether extract, NDF and AME according to the procedures established by the A.O.A.C. [16]. Chromic oxide was analyzed according to Williams, et al. [17]. AME values were determined using the following equation: AME (kcal/kg of diet) = GE diet - [GE excretes or digesta x (Marker diet/Marker excretes or digesta] and the following equation was used for calculation of percent retention: % Nutrient retention = 100 - ((Diet Cr_2O_3/Fecal Cr_2O_3 x Fecal nutrient/diet nutrient) x 100 [18]. At 35 days of age a total of 36 birds (six/ treatment) were weighed then slaughtered to evaluate carcass characteristics and meat quality attributes. Weights of wings, back, legs, drumsticks and breast were recorded. The birds were processed using manual evisceration; dressing and parts yield were calculated.

At 42 days of age, six birds per treatment were selected and kept without feed for 12 h then were bled from a cutaneous ulnar vein. Blood samples were centrifuged for 15 min at 2, 500 × g, and serum was harvested and stored at -80°C unless fresh sample is required for the analysis. The following analysis were conducted by using enzymatic colorimetric kits: total protein (Biuret method), albumin (Bromoreesol green method), globulin concentration was calculated, thereafter, as the difference between TP and albumin concentrations, total lipid (Sulfo-phosphate vanillin method), cholesterol (Trinders color method), glucose (Modified trinder / GOD method), uric acid (End point method), sodium (Sodium dependent β-galactosidase activity), potassium (Turbidimetric method), and chloride (Thiocyanate method); all analyses were carried out in duplicate.

2.2. Statistical Analysis

Data were evaluated by ANOVA for a complete randomized block design with 3x2 factorial arrangements of treatments, using the general linear models procedure of SAS software [19]. The data were tested for main effects of DDM, AAs and for interaction effects of DDM x AAs.

3. RESULTS AND DISCUSSION

Performance results of Ross 308 broilers are shown in Table 4. No significant difference in feed intake was observed due to treatment ($P>0.05$). However, just numeric increase in feed intake was observed as the inclusion rate of DDM increased in the diet. A significant interaction was detected for BWG ($P<0.01$), this could be explained by the fact that bird on the high level of AAs gained more weigh at 0% DDM as compared to normal AAs (1855.9 vs. 1603.3 g, respectively). While those on the 5 and 10% DDM gained less weight at high AAs as compared to low AAs (1803.6 vs. 1850.7 g for birds received 5%; 1745.7 vs. 1817.7 g for birds received 10%, respectively). As a result, a significant interaction was detected for FCR ($P<0.001$). Birds which had received 0% and 5% DDM and high AAs converted feed more efficiently when compared to those which had received low AAs (1.713 vs. 1.842 g: g for birds received 0% DDM; 1.713 vs. 1.727 g: g for birds received 5% DDM, respectively). In the contrary, birds which had received normal AAs and 10% DDM converted feed more efficiently when compared to those which had received high AAs (1.769 vs. 1.807 g: g, respectively). When examine the main effects for FCR, both DDM and AAs showed a significant effects on FCR ($P<0.01$ and 0.05, respectively). Birds received 5% DDM converted feed more efficiently as compared to 0 and 10% (1.720, 1.777 and 1.788 g: g, respectively). Also, birds received the high AAs level converted feed more efficiently as compared to the normal level (1.744 vs. 1.779 g: g, respectively).

In general, dates have abundant nutrients (approximately 7 to 5% crude protein; 10 to 7% fat; 20 to 10% fiber; 65 to 55% crude carbohydrate). Dates which are not used for humans can be grinded and mixed with other livestock and poultry feed [3]. It was concluded that whole Zahdi dates at the expense of corn at 5, 10 and 30% supported growth performance of broilers as efficiently as the control diets, but the incorporation of 47.7% of whole Zahdi dates as a total replacement of corn resulted in some growth depression and a slight decrease in feed utilization [7]. It was reported that whole inedible dates which consisted of date fruits (85%) and date pits (15.0%) could be used up to 15% in broiler diets from 15 and 42 days of age without any adverse effects on performance, digestibility of nutrients and meat quality measurements [7]. However, based on the FCR in this trial, it's recommended to add 5% DDM with the high AAs level or 10% with normal AAs. The DDM is a cheaper energy source for poultry when compared to corn and replacing part of the corn with DDM will reduce the diet cost. However, dates should be dry and very hard when ground. A problem in the grinding processes that dates smears and clogs the sieves of the hammer mill. To solve the problem of caking in the machinery, it is recommended to make a premix with another ingredient such as corn for example and then grind the mix.

The mean percentage of carcass parts is documented in Table 5. The results revealed no significant differences in dressing percentage and leg quarter ($P<0.05$). However, breast yield and abdominal fat were affected by DDM and AAs ($P<0.01$ and 0.05, respectively). Birds on the 0% DDM had higher breast muscle yield (33.8%) as compared to 5 or 10% DDM (31.1 and 31.2%, respectively). Also, high AAs increased breast yield by 1.5% as compared to normal AAs. Hickling, et al. [14] Described that diets fortified with 106% Lys and Met 112% of the NRC [11] interrelated to enhance breast meat yields of male broilers. Café and Waldroup [20] reported that breast yield of broilers (35 d) fed diets supplemented with 115 or 130% Met of NRC [11] and 120% Lys of NRC [11] levels were greater than that of birds fed 100% (control).

Abdominal fat increased in birds which had received 10% DDM as compared to those which had received 0 and 5% (3.3 vs. 2.4 and 2.5, respectively). High AAs decreased abdominal fat by 0.5% as compared to normal AAs (2.5 vs. 3.0%).

Data related to serum biochemistry are shown in Table 6. No interaction was detected between DDM and AAs for blood biochemistry. However, serum glucose, Na^+ and Cl^- were significantly affected by DDM level ($P<0.001$, $P<0.01$, $P<0.01$, respectively). Serum glucose level increased as the inclusion rate of DDM increased in the diet (200.8, 202.7 and 203.8 mg/dl for 0, 5 and 10%, respectively). Conversely, Na^+ and Cl^- level decreased as the inclusion rate of DDM increased. Serum albumin decreased at high AAs level as compared to normal (2.54 vs. 2.78 g/dl, respectively) while, globulin increased as a response to high AAs level (0.77 for high vs. 0.68 g/dl for normal). Serum cholesterol decreased at high AAs level (90.6 mg/dl) as compared to normal

AAs (112.7 mg/dl) (P<0.01). Attia, et al. [21] reported that feeding low-CP diet fortified with Met and Lys resulted in higher plasma cholesterol, the result obtained in this trial disagree with that, since we found lower serum cholesterol in birds fed fortified diets. Neither DDM nor AAs had a significant effect on protein, total lipids, uric acid or K^+ (P>0.05).

Table 7 shows nutrients retention for broilers which received the experimental diets. Neither DDM nor AAs had a significant effect on crude protein or ether extract retentions (P>0.05). A lower NDF retention was observed as the inclusion level of DDM increased in the diet (P<0.01). Conversely, a higher AMEn retention was observed as the DDM inclusion rate increased (P<0.05).

4. CONCLUSION

In summary, based on the FCR in this trial, it's recommended to add 5% DDM with the high AAs level or 10% with normal AAs. The DDM is a cheaper energy source for poultry when compared to corn and replacing part of the corn and SBM with DDM will reduce the diet cost.

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Table-1. Chemical composition of the raw materials used to mix the diets

ID	%, As is basis						Gross Energy kcal/kg
	DM%	Ash%	CP %	EE %	CF %	NFE %	
Corn	93.31	1.69	9.98	4.52	1.53	82.28	4463
SBM	95.10	7.08	48.30	1.63	2.64	40.36	4703
DDM	91.47	8.44	4.24	0.66	4.96	81.70	3853

Table-2. Dietary ingredients (%) of the starter diets

Ingredients	%
Corn	62.45
SBM	31.0
Palm oil	2.19
D.C.P	2.50
	Continue

Limestone	0.73
Salt	0.25
MV Mix[1]	0.20
DL-Methionine	0.26
Lysine-HCL	0.18
Threonine	0.07
Na-Bicarbonate	0.12
Choline CL	0.05
Total	100
Chemical composition:	
ME, kcal/kg	3000
Crude protein, %	21.5
Methionine, %	0.55
Lysine, %	1.2
Meth&Cys, %	0.9
Threonine, %	0.9
Calcium, %	1.0
Phosphorus, %	0.5

[1]Vitamin-mineral premix contains in the following per kg: vitamin A, 2400000 IU; vitamin D, 1000000 IU; vitamin E, 16000 IU; vitamin K, 800 mg; vitamin B1, 600 mg; vitamin B_2, 1600 mg; vitamin B_6, 1000 mg; vitamin B_{12}, 6 mg; niacin, 8000 mg; folic acid, 400 mg; pantothenic acid, 3000 mg; biotin 40 mg; antioxidant, 3000 mg; cobalt, 80 mg; copper, 2000 mg; iodine, 400; iron, 1200 mg; manganese, 18000 mg; selenium, 60 mg, and zinc, 14000 mg.

Table-3. Dietary ingredients (%) of the experimental diets

Ingredients	**1**	**2**	**3**	**4**	**5**	**6**
Corn	66.91	66.91	61.91	61.91	58.90	58.90
SBM	26.63	26.03	25.6	25.22	22.98	22.64
Date	0.0	0.0	5.0	5.0	10.0	10.0
Palm oil	2.8	3.0	3.8	3.8	4.4	4.4
Dicalcium phosphate	2.0	2.0	2.0	2.0	2.0	2.0
Limestone	0.59	0.59	0.59	0.59	0.59	0.59
Salt	0.25	0.25	0.25	0.25	0.25	0.25
MV Mix[1]	0.12	0.12	0.12	0.12	0.12	0.12
DL-Methionine	0.20	0.28	0.20	0.28	0.20	0.28
Lysine-HCL	0.24	0.42	0.24	0.42	0.24	0.42
Threonine	0.11	0.24	0.14	0.24	0.16	0.24
Na-Bicarbonate	0.11	0.11	0.11	0.11	0.11	0.11
Choline CL	0.04	0.04	0.04	0.04	0.04	0.04
Total	100	100	100	100	100	100
Chemical composition						
ME POULTRY	3100	3100	3100	3100	3100	3100
Crude protein, %	20.0	20.0	19.2	19.2	17.0	17.0
Methionine, %	0.48	0.56	0.48	0.56	0.48	0.56
Lysine, %	1.10	1.26	1.10	1.26	1.10	1.26
Meth&Cys, %	0.80	0.85	0.80	0.85	0.80	0.85
Threonine, %	0.80	0.92	0.80	0.92	0.80	0.92
Calcium, %	0.85	0.85	0.85	0.85	0.85	0.85
Phosphorus, %	0.40	0.40	0.40	0.40	0.40	0.40

[1]Same as in the starter diet (Table 2).

Table-4. Performance of broiler chickens given the experimental diets

Treatment	DDM°	AAs¥	Performance		
			Feed (g)	BWG (g)	FCR (g: g)
					Conti
1	0%	Normal	2953.1	1603.3	1.842
					Conti
2	0%	High	3177.9	1855.9	1.713
3	5%	Normal	3194.6	1850.7	1.727
4	5%	High	3088.4	1803.6	1.713
5	10%	Normal	3218.6	1817.7	1.769
6	10%	High	3150.9	1745.7	1.807
SEM±			90.9	50.8	0.018
DDM Average					
0%			3065.5	1729.6	1.777[a]
5%			3141.5	1827.2	1.720[b]
10%			3184.9	1781.7	1.788[a]
SEM±			64.2	35.9	0.013
AAs Average					
Normal			3122.2	1757.2	1.779[a]
High			3139.1	1801.7	1.744[b]
SEM±			52.5	29.3	0.010
Statistical Probabilities					
DDM			NS	NS	**
AAs			NS	NS	*
DDM*AAs			NS	**	***

°DDM: discarded date meal. ¥AAs: amino acids. High: 15% extra lysine (Lys.), methionine (Met.) and threonine (Thr.) added to the basal diet.

[ab]means in the columns with different superscripts differ significantly (* P < 0.05, **P < 0.01, ***P< 0.001, N.S: Not significant)

Table-5. Effect of different treatments on parts yield as percentages of broiler dressed weight

Treatment	DDM°	AAs¥	%			
			Dressing	Leg	Breast	Fat
1	0%	Normal	75.9	40.2	32.5	2.8
2	0%	High	76.1	39.7	35.0	1.9
3	5%	Normal	76.1	40.9	30.6	2.7
4	5%	High	75.9	40.1	31.5	2.4
5	10%	Normal	76.2	40.3	30.6	3.5
6	10%	High	76.0	39.9	31.7	3.1
SEM±			0.6	0.7	0.8	0.3
DDM Average						
0%			76.0	39.9	33.8[a]	2.4[b]
5%			76.0	40.5	31.1[b]	2.5[b]
10%			76.1	40.1	31.2[b]	3.3[a]
SEM±			0.4	0.4	0.60	0.2
AAs Average						
Normal			76.0	39.9	32.8[a]	2.5[b]
High			76.1	40.5	31.3[b]	3.0[a]
SEM±			0.3	0.4	0.5	0.1
Statistical Probabilities						
DDM			NS	NS	**	**
AAs			NS	NS	*	*
DDM*AAs			NS	NS	NS	NS

°DDM: discarded date meal

¥AAs: amino acids. High: 15% extra lysine (Lys.), methionine (Met.) and threonine (Thr.) added to the basal diet.

[ab]means in the column with different superscripts differ significantly (* P < 0.05, **P < 0.01, N.S: Not significant).

Table-6. Effect of dietary treatments on some serum constituents in broilers

Treatment	DDM°	AAs¥	Protein	Albumin	Globulin	Total lipids	Glucose	Cholesterol	Uric Acid	Na	Cl	K
			(g/dl)			(mg/dl)				mEq/L		
1	0%	Normal	3.57	2.73	0.84	329.0	200.5	115.9	10.5	108.3	90.3	7.96
2	0%	High	3.35	2.45	0.90	356.5	201.0	85.3	9.8	95.6	77.3	8.07
3	5%	Normal	3.36	2.65	0.71	379.8	201.8	104.9	12.4	104.4	82.7	8.00
4	5%	High	3.36	2.48	0.79	345.3	203.6	83.5	10.3	87.7	67.7	6.98
5	10%	Normal	3.43	2.94	0.48	326.0	204.3	117.3	10.9	79.6	61.2	7.00
6	10%	High	3.23	2.70	0.52	341.8	203.4	102.9	11.1	84.2	66.7	7.88
SEM±			0.10	0.12	0.09	31.5	0.69	9.1	0.74	5.7	5.8	0.53
DDM Average												
0%			3.46	2.58	0.87	342.8	200.8	100.6	10.18	101.9	83.9	8.01
5%			3.36	2.57	0.79	362.6	202.7	94.2	11.36	96.0	75.2	7.49
10%			3.33	2.83	0.50	333.9	203.8	110.1	10.97	81.9	63.9	7.43
SEM±			0.07	0.09	0.06	22.3	0.48	6.4	0.52	4.06	4.12	0.38
AAs Average												
Normal			3.45	2.78^{a}	0.68^{b}	344.9	202.2	112.7^{a}	11.28	97.4	78.1	7.65
High			3.31	2.54^{b}	0.77^{a}	347.9	202.7	90.6^{b}	10.39	89.2	70.6	7.64
SEM±			0.05	0.07	0.05	18.2	0.39	5.3	0.43	3.3	3.36	0.31
Statistical Probabilities												
DDM			NS	NS	NS	NS	***	NS	NS	**	**	NS
AAs			NS	*	**	NS	NS	**	NS	NS	NS	NS
DDM*AAs			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

°DDM: discarded date meal

¥AAs: amino acids. High: 15% extra lysine (Lys.), methionine (Met.) and threonine (Thr.) added to the basal diet.

* P < 0.05, **P < 0.01, ***P < 0.001, N.S: Not significant.

Table-7. Apparent nutrient retention of broiler chickens.

Treatment	DDM°	AAs¥	CP	EE	NDF	AMEn
			(%)			(kcal/kg)
1	0%	Normal	59.8	70.2	29.3	2934
2	0%	High	60.7	70.3	28.9	2911
3	5%	Normal	59.8	70.2	28.0	3037
4	5%	High	60.0	70.2	27.3	3068
5	10%	Normal	58.9	71.1	26.5	3085
6	10%	High	59.8	71.3	26.6	3072
SEM±			0.4	0.5	0.5	55
DDM Average						
0%			60.3	70.3	29.1	2923
5%			59.9	70.2	27.6	3053
10%			59.4	71.2	26.6	3079
SEM±			0.3	0.4	0.4	39
AAs Average						
Normal			59.2	70.5	27.9	3017
High			60.2	70.6	27.6	3018
SEM±			0.2	0.3	0.3	32
Statistical Probabilities						
DDM			NS	NS	**	*
AAs			NS	NS	NS	NS
DDM*AAs			NS	NS	NS	NS

°DDM: discarded date meal
¥AAs: amino acids. High: 15% extra lysine (Lys.), methionine (Met.) and threonine (Thr.) added to the basal diet.
abcmeans in the column with different superscripts differ significantly (* P < 0.05, **P < 0.01, N.S: Not significant).