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## **Feeding Value of Single Cell Protein Produced from Date Palm (*Phoenix dactylifera*) Fruits for Broiler Chickens**

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**Author's contribution**

*This whole work was carried out by the author HN.*

**Original Research Article**

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### **ABSTRACT**

Saudi Arabia produces about 0.5 million tons and about 130,000 tons of poultry meat and eggs respectively per year and depends mainly on imported protein concentrate for feeding these birds. Therefore, it is important to produce poultry feed using locally available materials. The objective of this research was to find the feed value of the microbial protein, produced from date waste to broiler chickens. Experiment was conducted using different levels of single cell protein yeast, *Saccharomyces cerevisiae*, (0, 5, 10 and 15 %) in the diets of broiler chickens. Diets were formulated to feed 120 day old broilers. The chicks were randomly distributed in to 12 battery pens each contained 10 chicks. The dietary treatments were assigned to the cages in such a way that each dietary treatment was assigned to 3 battery pens (replicates). Results of the chemical analysis showed that level of the yeast protein was 51.88 %. This protein was found to be rich in Lysine (1.02 %). Methionine level of the protein was not as high as the Lysine (0.27 %). Level of fat in the yeast was only 6.41 %; however, its content from Oleic acid was 43.2 %. Linoleic and Linolenic levels were 0.85 and 0.14 %, respectively. Performance of the birds revealed no significant differences ( $P > 0.05$ ) between the control birds and birds on 5 % level of the yeast in terms of final body weight and final cumulative feed conversion. However there was a clear indication that addition of 15 % single cell protein may be harmful to the birds. It was concluded that adding 5 % single cell protein, produced from Date Palm fruit waste to the broilers, produce no adverse effect to the performance of the birds and can be included in their diet.

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## 1. INTRODUCTION

Availability of animal feed is a major constraint on animal production in Saudi Arabia. Single Cell Protein (SCP) is an excellent source of protein, some vitamins and minerals and possesses usable lipids and carbohydrates [1]. Therefore, one possibility for covering shortage in animal feed in Saudi Arabia is the use of the surplus Saudi Date Palm fruit (date) as a substrate for the production of single cell protein.

In a series of studies including, two types of SCP, were tested, a protein (SCP produced from methanol-utilizing bacteria) and a Laver-type yeast utilizing the normal paraffins of heavy gas oil (LA). The inclusion of 90 to 150 gm of protein and LA per Kg of broiler chicken diet depressed growth rate [2]. However, this result was encountered by the addition of arginine [2]. The reason for this depression could be due to lower feed intake, they further added [2]. Similar weight gain depression was observed on the growth of broilers at the finishing period, fed the same above diets [3].

A protein biomass from marine algae was used in feeding broiler chickens [4]. It was found that inclusion of 0.4% dried protein additive from marine algae improved average body weight by 8.5%, feed conversion by 6.3% and produced higher quality carcass [4]. In another study, fishmeal was replaced by bacterial bio protein in broiler chickens fed with high proportions of cotton seed and sunflower oil meals [5]. They found no significant differences among groups; however, final body weight and feed efficiency were higher with 2 and 4% bacterial bio protein [5].

Feeding value of Iranian SCP for broiler chickens has been determined [6]. They found that SCP concentration in the diet (0, 3, 6, or 9%) significantly affected performance [6]. As the dietary level of single cell protein increases in broiler chickens diets, the gain, feed conversion, and feed intake decreased [6,7]. Result of an experiment provided evidence that 6 % of either basic or autolysed bacterial protein can replace soybean meal in diets for broiler chickens without impairing growth performance [8]. Recently, Single Cell Protein was produced from dried poultry manure using seven strains of yeast (*Candida utilis*, *Candida tropicalis* and 3 strains of *Saccharomyces cerevisiae*, *S. uvarum* and *Rhodotorula*) [9]. They found that inclusion of up to 9 % of dried poultry manure treated with yeast in broiler chicken diet had no adverse effect on growth performance of broiler chickens up to 4 weeks of age [9].

The objective of this research was to evaluate the effect of feeding SCP, produced from date waste to broiler chickens

## 2. MATERIALS AND METHODS

### 2.1 Chemical Analyses

Moisture, crude fat, crude protein, ash and crude fibers were determined using standard analytical procedures [10]. Determination of Amino Acids as described in 996.01 AOAC was done using, amino acid analyzer (model Biochrom 20, Amersham Pharmacia, Cambridge, UK).

Total lipids extract was obtained according to the AOAC official method 996.01 (Acid Hydrolysis Capillary Gas Chromatographic Method) [10]. Test portion was first digested with hot HCl. Hydrolyzed fat components were extracted into ethyl and petroleum ethers, and then evaporated. Fatty acid methyl esters were determined by capillary gas chromatography.

## 2.2 Experimental Procedure

One hundred and twenty day-old chicks were distributed intermingled in 12 battery pens, each contained 10 chicks. Four levels of SCP meal were used in this study 0, 5, 10 and 15 %. These dietary treatments were assigned at random to the pens in such a way that each dietary treatment was assigned to 3 battery pens (replications). These battery pens were equipped with a source of heat, feeders and waterers. Birds were weighed individually every week and weight gain was determined according to that. Feed was added, as necessary and weekly and cumulative feed intake was determined from feed left as opposed to feed given. Weekly mortality was calculated based on the number of birds that die in a specific day of the week. Four birds, two males and two females, from each treatment were selected randomly and sacrificed for dressing analysis. The experiment lasted 35 days. Values obtained from the chemical analysis were used to formulate the dietary treatments. Rations were mixed according to the required treatments to the nearest gram (Table 1) as follows: Micro ingredients were carried with 3 kg yellow corn and mixed well in a small mixer (3.5 kg capacity). This amount was then mixed with the rest of the ingredients in a larger mixer (40 kg capacity).

**Table 1. The feed ingredients and calculated composition of the broiler, diets**

Feed Ingredients	<i>Saccharomyces cerevisiae</i>			
	0	5	10	15
CORN	59.00	59.00	56.70	55.60
SBM	30.9	26.2	21.2	16.3
Wheat Bran	0.00	0.50	3.00	4.60
Fish Meal	4.00	3.00	2.00	1.00
Limestone	1.29	1.15	1.50	1.38
MVMIX <sup>1</sup>	0.20	0.20	0.20	0.20
DL-Meth	0.20	0.31	0.40	0.50
Di-calcium Pho.	0.50	0.98	0.90	1.20
L-Lysine	0.00	0.10	0.25	0.40
Salt	0.30	0.30	0.30	0.30
Veg.Oil	3.53	3.19	3.47	3.42
Antioxidant	0.10	0.10	0.10	0.10
<i>Saccharomyces cerevisiae</i>	0.00	5.00	10.00	15.00
Total	100.0	100.0	100.0	100.0
<b>Calculated composition</b>				
Protein, %	21	21	21	21
ME, Kcal/Kg	3100	3100	3100	3100
Calcium, %	0.96	0.94	0.98	1.10
Available phos, %	0.41	0.46	0.42	0.43
Riboflavin, mg/kg	1.88	1.67	1.52	1.54
Niacin, mg/kg	26.84	25.47	27.19	28.11
PA, mg/kg	7.98	7.21	6.93	7.06
Choline, mg/kg	1444	1262	1086	1087

**Table 1 Continued.....**

Methionine, %	0.56	0.62	0.67	0.74
Met + Cys, %	0.87	0.89	0.90	0.97
Lysine, %	1.24	1.19	1.19	1.25
Tryptophan, %	0.31	0.27	0.23	0.23
Linoleic Acid, %	3.08	2.91	3.03	2.61

<sup>1</sup>The multi vitamin-minerals premix provide the following per Kg of diet: 7000 IU, vit A; 1500 ICU, vit D3; 30 IU, vit E; 50 mg, vit C; 2.3 mg, vit K; 1.8 mg, vit B1; 5.5 mg, vit B2; 2.3 mg, vit B6; 0.011 mg, vit B12; 27.6, mg Niacin; 0.92 mg, Folic acid; 6.9 mg, PA; 0.092 mg, Biotin; 50 mg, Antioxidant (BHT); 8 mg, copper; 0.35 mg, Iodine; 0.26 mg, Iron; 0.44 mg, Manganese; 0.18 mg, Selenium; 44 mg, Zinc

### 2.3 Statistical Analysis

A Completely Randomized Design (CRD) was adopted. Data of the experiments were analyzed by the GLM procedure of SAS [11]. Differences among means were tested by Duncan Multiple Range Test [12].

## 3. RESULTS AND DISCUSSION

### 3.1 Chemical Analyses

Crude protein level of the yeasts (51.88 %) was higher than that of the Soybean meal (SBM), 48.5 % [13], (Table 2). Lysine, the 2<sup>nd</sup> limiting amino acids in poultry diet, was high in the microbial protein which will probably help balancing this amino acid in the corn-soy diets (Table 3). Oleic acid was abundant in the yeast (Table 4). Oleic acid, known as Omega 9 fatty acid, is a mono-unsaturated fatty acid that is found in almost all natural fats. Oleic acid lowers the risk of heart attack, arteriosclerosis, and aids in cancer prevention.

**Table 2. Chemical macro-analysis for single cell protein yeasts**

<b>Nutrients</b>	<b><i>Saccharomyces cerevisiae</i><sup>1</sup></b>
Crude protein	51.88
Total Fat	6.41
Carbohydrate	28.21
Ash	9.35

<sup>1</sup>On dry matter basis

### 3.2 Performance of the broilerchickens

The effect of including SCP yeast derived from date syrup in the broiler chicken diet on performance was not consistent (Table 5). However, there was a clear indication that higher level (15 %) of the yeast may be harmful to the birds. Body weight and body weight gain deteriorated at this level with advancing age. A decrease in broiler chicken weight gain, feed conversion, and feed intake was reported with the increase in the dietary level of Single Cell Protein [6,7]. Similar depression was observed on the growth of broiler chickens fed methanol-utilizing bacteria [2]. Differences were not significant at 5 % level of probability between the control group and birds having 5 % yeast in terms of final body weight and cumulative feed conversion. Soybean meal was partially replaced with basic bacterial protein (BBP) meal or autolysed bacterial protein (AUT) meal [8]. They concluded that 6 % of either basic or autolysed bacterial protein can replace soybean meal in diets for broiler chickens

without impairing growth performance [8]. Daily and cumulative feed intake in this experiment were not significantly ( $P>0.05$ ) affected by the treatment levels.

**Table 3. The amino acid profile (relative percentage) of *Saccharomyces cerevisiae***

Amino Acid	Unit <sup>1</sup>	<i>Saccharomyces cerevisiae</i>
Aspartic Acid	%	0.40
Threonine	%	0.47
Serine	%	0.26
Glutamic Acid	%	0.79
Glycine	%	0.26
Alanine	%	0.58
Valine	%	0.57
Methionine	%	0.27
Isoleucine	%	0.26
Leucine	%	0.49
Tyrosine	%	0.72
Phenyl alanine	%	0.42
Histidine	%	0.36
Lysine	%	1.02
Arginine	%	0.52

<sup>1</sup>Relative percentage in the material

**Table 4. Fatty acid profile of *Saccharomyces cerevisiae***

Description	Unit*	<i>Saccharomyces cerevisiae</i> Result
<b>Fatty Acid Profile</b>		
Lauric Acid C12H24O2	%	0.175
Myristic Acid C14H28O2	%	0.640
Myristoleic Acid C14H26O2	%	0.140
Palmitic Acid C16H32O2	%	11.100
Palmitoleic Acid C16H30O2	%	35.095
margaric Acid C17H34O2	%	0.110
Stearic Acid c18H36O2	%	5.560
Elaidic Acid C18H34O2	%	0.140
Oleic Acid C18H34O2	%	43.240
Linoleic Acid C18H32O2	%	0.850
Linolenic Acid C18H30O2	%	0.135
11-Eicosanoic Acid C20H38O2	%	0.150
Docosanoic (bhenic) Acid C22H44O2	%	1.365
Pentacosanoic Acid C25H50O2	%	0.140
Hexacosanoic Acid C26H52O2	%	0.745

\* Percent in fat

No significant differences ( $P\leq 0.05$ ) were found among yeast levels pertaining to dressing percentage, gizzard percentage and heart percentage, however, the significant effect was evident on fat percent ( $P\leq 0.05$ ), liver percent ( $P\leq 0.052$ ) among treatments. Birds on 15 % dietary treatment accumulated more fat and possessed larger liver than others while the control birds had lower fat pads and smaller liver. If the birds under these treatments consumed lower amount of feed than the 15 % group, it would have been concluded that the

lower fat was due to the lower feed consumption but that was not the case in this study (Table 6)

**Table 5. Performance of broilers fed different levels of yeast SCP derived from date syrup**

Traits	Yeast, %	Weeks in Experiment				
		1	2	3	4	5
Body weight, gm	0	132.50	302.80 <sup>a</sup>	553.80 <sup>a</sup>	903.52 <sup>a</sup>	1390.80 <sup>a</sup>
	5	115.38	281.44 <sup>a</sup>	528.12 <sup>ab</sup>	894.46 <sup>a</sup>	1343.00 <sup>a</sup>
	10	124.68	284.18 <sup>a</sup>	489.80 <sup>b</sup>	819.86 <sup>b</sup>	1275.80 <sup>b</sup>
	15	118.62	242.44 <sup>b</sup>	427.88 <sup>c</sup>	722.42 <sup>c</sup>	1130.20 <sup>c</sup>
	<b>P =</b>	<b>0.1098</b>	<b>0.0002</b>	<b>0.0001</b>	<b>0.0001</b>	<b>0.0001</b>
Body weight gain, gm	0	86.78	170.30 <sup>a</sup>	251.00 <sup>a</sup>	349.72 <sup>ab</sup>	484.02 <sup>a</sup>
	5	68.40	166.06 <sup>a</sup>	246.68 <sup>a</sup>	366.34 <sup>a</sup>	448.54 <sup>b</sup>
	10	78.90	159.50 <sup>a</sup>	205.62 <sup>b</sup>	330.06 <sup>b</sup>	455.94 <sup>ab</sup>
	15	71.86	123.82 <sup>b</sup>	185.44 <sup>b</sup>	294.54 <sup>c</sup>	407.78 <sup>c</sup>
	<b>P =</b>	<b>0.0743</b>	<b>0.0012</b>	<b>0.0001</b>	<b>0.0026</b>	<b>0.0014</b>
Daily feed intake, gm	0	18.06	36.98	78.60	100.00	128.60
	5	18.54	35.74	78.55	100.28	131.46
	10	18.30	35.46	78.38	100.28	131.46
	15	18.82	35.18	78.89	100.00	128.60
	<b>P =</b>	<b>0.3418</b>	<b>0.5980</b>	<b>NA</b>	<b>0.5847</b>	<b>0.5847</b>
Cumulative feed intake, gm	0	126.46	385.32	808.86	1250.00	1600.00
	5	129.96	380.20	800.24	1252.02	1622.02
	10	128.14	376.42	798.28	1252.02	1622.02
	15	131.76	378.04	796.28	1250.00	1600.00
	<b>P =</b>	<b>0.3242</b>	<b>0.8357</b>	<b>0.5969</b>	<b>0.5847</b>	<b>0.5847</b>
Weekly feed conversion kg /kg <sup>2</sup>	0	1.462	1.528 <sup>b</sup>	2.195 <sup>b</sup>	2.011 <sup>b</sup>	1.867 <sup>c</sup>
	5	2.020	1.516 <sup>b</sup>	2.237 <sup>b</sup>	1.933 <sup>b</sup>	2.055 <sup>ab</sup>
	10	1.634	1.566 <sup>b</sup>	2.695 <sup>a</sup>	2.130 <sup>b</sup>	2.022 <sup>bc</sup>
	15	1.854	2.006 <sup>a</sup>	3.004 <sup>a</sup>	2.387 <sup>a</sup>	2.209 <sup>a</sup>
	<b>P =</b>	<b>0.0707</b>	<b>0.0026</b>	<b>0.0002</b>	<b>0.0029</b>	<b>0.0026</b>
Cumulative feed conversion Kg/kg <sup>3</sup>	0	0.955 <sup>b</sup>	1.274 <sup>b</sup>	1.692 <sup>c</sup>	1.815 <sup>c</sup>	1.827 <sup>c</sup>
	5	1.150 <sup>a</sup>	1.357 <sup>b</sup>	1.767 <sup>bc</sup>	1.827 <sup>c</sup>	1.929 <sup>bc</sup>
	10	1.030 <sup>ab</sup>	1.330 <sup>b</sup>	1.894 <sup>b</sup>	1.977 <sup>b</sup>	2.021 <sup>b</sup>
	15	1.115 <sup>a</sup>	1.567 <sup>a</sup>	2.180 <sup>a</sup>	2.260 <sup>a</sup>	2.240 <sup>a</sup>
	<b>P =</b>	<b>0.0553</b>	<b>0.0046</b>	<b>0.0001</b>	<b>0.0001</b>	<b>0.0001</b>
Livability, %	0	100.00	100.00	100.00	100.00	100.00
	5	100.00	100.00	100.00	99.71	98.00
	10	100.00	100.00	100.00	99.71	98.00
	15	100.00	100.00	100.00	100.00	100.00
	<b>P</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>0.5847</b>	<b>0.5847</b>

<sup>1</sup> Means within columns, for each trait, not carrying the same superscripts are significantly different, P<0.05; P≤0.01 = highly

Significant; P≤0.001 = extremely significant; 0, 5, 10, 15 = percent SCP levels

<sup>2</sup> Kg feed / Kg body weight gain

<sup>3</sup> Kg feed / Kg body weight

NA = not applicable

**Table 6. The effect of SCP level on dressing parameters**

Source of Variation Among levels	Traits				
	Dressing, % NS	Gizzard, % NS	Liver, % *	Heart, % NS	Fat, % *
0	79.30	2.44	2.66 <sup>d</sup>	0.66	1.36 <sup>d</sup>
5	77.36	2.59	3.18 <sup>a</sup>	0.68	1.76 <sup>ab</sup>
10	77.93	2.37	3.04 <sup>ab</sup>	0.69	1.55 <sup>b</sup>
15	77.77	2.62	3.26 <sup>a</sup>	0.76	2.33 <sup>a</sup>
<b>P =</b>	<b>0.7611</b>	<b>0.6020</b>	<b>0.0519</b>	<b>0.7191</b>	<b>0.0208</b>

Means within a column not followed by the same superscript are significantly different,  $P \leq 0.05$  = significant;  $P \leq 0.01$  = highly

Significant;  $P \leq 0.001$  = extremely significant; 0, 5, 10, 15 = percent SCP levels

#### 4. CONCLUSION

A substrate suitable for single cell protein production from *S. cerevisiae* was prepared from date syrup and appropriate propagation processes developed. The amino acid profile of the proteins was high-quality containing most of the essential amino acids, especially lysine. The biomass contained many essential fatty acids of the yeasts which were mostly of the preferred unsaturated ones.

The results obtained in this study indicate that supplementing the broiler chicken diets with up to 5 % SCP may produce no harm effect to the growth of broiler chickens and may be included in their diets. On the other hand, and based on these results it is concluded that higher levels of SCP inclusion (10 % and higher) may be harmful to the broilers in terms of productive performance.

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#### COMPETING INTERESTS

Authors has declared that no competing interests exist.

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