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Research Article

FEEDING VALUE OF SINGLE CELL PROTEIN, PRODUCED FROM DATES, FOR LAYING HENS

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ABSTRACT
The main objective of this research was to feed microbial protein, produced from date waste to Poultry. An experiment was conducted using different levels; 0, 5, 10 and 15 % of single cell protein yeast in the diets of laying hens. An intensive chemical analysis and True Metabolizable Energy determination were performed on the yeast. Based on these analyses an iso-nitrogenous, iso-caloric layer diets were formulated to feed sixty, 35 week old layers. The layers were distributed in 12 cages each containing 5 birds. The treatments were then distributed among the cages. A Completely Randomized Design was adopted. Data of the study were analyzed by the GLM procedure of SAS. Differences among means were tested by Duncan Multiple Range Test. The experiment continued for 24 weeks. The results of the energy determination and chemical analysis of the yeast showed that the True Metabolizable Energy was about 3380 kcal/kg, while the protein content was 48 %. This protein was found to be rich in Lysine (1.02 %). Level of fat in the yeast was only 6.41 %; however, its content from Oleic acid was 43.2%. Performance of the hens in terms of hen-day egg production, egg mass, egg weight and feed conversion was significantly ($P<0.05$) better when 5 % yeast was included in the ration. 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 waste to the poultry diet, produce no adverse effect to the performance of the birds and may be included in their diet.

Keywords: *Microbial Protein, Laying Hens, Single Cell Protein, Date Waste*

INTRODUCTION
Availability of animal feed is a major constraint on animal production in some of the developing countries. Therefore, one possibility for covering shortage in animal feed in these countries is the use of locally produced single cell protein. This microbial protein (SCP) is high in protein content with reasonably well balanced amino acid profiles. SCP is also an excellent source of some vitamins and minerals and possesses usable lipids and carbohydrates (Spinelli, 1980). One of the crops most suited for SCP production in the Middle East is date. Date production normally accompanies with large quantity of date by-products including culls, damaged dates, and calyxes, rejects of sorting/grading operations, low grade date and fallen or premature fruits. These by-products are rich in sugar that is needed by the yeast or bacteria to produce the microbial protein. More than thirty years ago, Shacklady (1967 and 1969) reported the first use of SCP as a protein source for poultry. Since then an increasing interest has developed on the use of SCP in the diets of broilers and laying hens (Waldroup and Flynn, 1975; Shannon *et al.*, 1976; White and Balloun, 1977; Hewitt and Labib, 1978). Lee and Chen (1983) found that egg production and final body weight of 400 White Leghorn hens, 72 weeks of age were significantly greater with ad-libitum feeding of SCP. When single cell protein was fed to layers no depression in egg production was observed and the nucleic acid content in tissues and eggs were not affected (Al-Ani, 1985).

Najib (1996) studied the effect of incorporating Yeast Culture "*Saccharomyces cerevisiae*" in the Saudi Baladi and White leghorn layers diet, he found that best performance in terms of egg production , egg weight, feed conversion , feed intake was achieved when 0.3 % yeast was fed to the local birds and 0.2 % to the white leghorn.

The present paper focuses on the suitability of SCP (*Saccharomyces cerevisiae*) grown over the date residues as an alternative feed ingredient to replace protein sources in the layer diets.

MATERIALS AND METHODS

Birds and Management

Two hundred day-old Hi sex chicks were weighed by groups and fed starter diets, containing 20% crude protein and 2900 Kcal/Kg Metabolizable energy (ME). The chicks were kept on this starter diet till reached the breeder's target weight when they were switched to the grower diets. Ingredients and calculated composition of the grower diets are presented in Table 1, Leeson and summers (2001) recommended that pullets should not be moved to grower diets till they reach breeder target weight. Chicks were exposed to continuous lighting during the first three days of their life and then lighting decreased by two hours weekly till it reached 9 hours, at which time it was held constant.

Experimental Procedure

Moisture, crude fat, protein, ash and crude fibers were determined using standard analytical procedures (AOAC, 1990). Determination of Amino Acids as described in 996.01 AOAC was done using, amino acid analyzer (model Biochrom 20, Amersham Pharmcia, Cambridge, UK).

Total lipids extract was obtained according to the AOAC official method 996.01(Acid Hydrolysis Capillary Gas Chromatographic Method) (AOAC, 1996). Fatty acid methyl esters were determined by capillary gas chromatography. Saturated and unsaturated fats were calculated as sum of individual fatty acids.

True metabolizable energy (TME) of the yeast was determined according to the method developed by Sibbald (1976): TME was estimated according to the following equation:

TME (Kcal/g air dry) = (GEf * X) – (Yef- Yec)/X (Sibbald, 1976).

Where:

GEf is the gross energy of the feeding stuff (Kcal/g),
Yef is the energy voided as excreta by the fed bird,
Yec is the energy voided as excreta by the unfedbird, and
X is the weight of feedingstuff fed, (g)

TME values and other 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 2). Birds at the age of 35 weeks were distributed on cages (60 cm length * 51 cm width * 43 cm height) at the rate of 5 birds per cage. Four dietary treatments; 0, 5, 10 and 15 % were randomly distributed among the 12 cages in such a way that each treatment was assigned to 3 cages. Lighting hours were set for 16 daily.

Eggs were collected daily; however, calculation of hen-day egg production and egg weight were made on bi-weekly basis. At the end of each period, three days of egg collection were used for shell quality determination, Haugh unit (albumin height) and yolk color (La Roche scale). Specific gravity method was used to measure the shell quality of the eggs. This method was described in North (1984). Feed were given ad-libitum. Daily feed left was weighed at the end of each week to determine feed intake. The feeding trial continued for 12 -2 weeks periods.

RESULTS AND DISCUSSION

True Metabolism Energy (TME) Determination

The result of the yeast TME determination was 3380 kcal/kg (based on Sibbald, 1976 procedure). This value was much higher than that of the Soy Bean Meal, 2485 Kcal/kg (NRC, 1994) and as a matter of fact

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very much comparable to the energy in the corn, 3470 Kcal/kg (NRC, 1994). It is believed that most of the energy in the biomass was derived from the carbohydrates and not fat (Table 3). In this case the single cell protein produced from dates may not only be able to replace SBM but possibly the corn. The true metabolism energy may be more accurate than the apparent metabolism energy since it takes in account the metabolic and endogenous energy losses (sloughed intestinal cells, hormones, enzymes and endogenous urinary energy). However there is some criticism of this procedure, such as those birds may refuse the ingredients and so synergism between ingredients cannot be accommodated (Leeson and Summer, 2001). This had not happened in our experiment.

Protein Content of the Yeast and its Amino Acid Profile

Crude protein level for the biomass was higher than that of the SBM, 48.5 % (NRC, 1994) (Table 3). This would certainly make this product a good replacement to the SBM if no adverse side effect occurs. Lysine, the 2nd limiting amino acids in poultry diet, was found to be high in the yeast which will probably help in overcoming the deficiency of this amino acids, frequently found in the corn-Soy poultry diets (Table 4).

Fats and Fatty Acids in the Yeast

Level of fat in the yeast is not high (Table 3); however, it is interesting to note that Oleic acid is abundant in *Saccharomyces cerevisiae* (Table 5). Oleic acid is essential to the human body but technically not an essential fatty acid, because humans can manufacture a limited amount. Other essential fatty acids would have to be present for the body to be able to produce oleic acid. Oleic acid, also 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.

Performance of the Laying Hens

The effect of feeding different levels; 0, 5, 10 and 15 % of *Saccharomyces cerevisiae* to the laying hens at the age of 35 weeks is presented in Table 6. It is clear that a significant reduction in the bird's performance in terms of hen-day production, egg mass and feed efficiency was observed when they were fed 15 % yeast.

Table 1: The composition of the diets during the starting and growing Periods

	Starter 0 – 6 wk	**Grower 6 – 10 wk**	**Developer 10 – 16 wk**	**Pre-lay 16 – 18wk**
Calculated Composition :				
Crude Protein, %	20.00	18.00	16.00	16.00
Metabolizable E., Kcal/kg	2900	2900	2850	2850
Calcium, %	1.00	0.98	0.99	2.25
Av. Phosp, %	0.47	0.46	0.47	0.45
Methionine, %	0.48	0.43	0.47	0.37
Meth. + Cyst., %	0.78	0.71	0.71	0.71
Lysine, %	1.14	1.02	0.96	0.82
Tryptophan, %	0.30	0.27	0.24	0.24
Threonine, %	1.65	1.77	1.62	2.48
Riboflavin, mg/kg	1.84	1.86	1.70	1.67
Niacin, mg/kg	29.89	34.50	37.64	36.54
Pantothenic A., mg/kg	8.21	8.44	8.41	8.36
Choline, mg/kg	1370	1283	1104	1100

On the opposite, better performance than the control was achieved when 5 % yeast was fed to the birds. Hen-day egg production, egg mass, egg weight and feed conversion were numerically better in the 5% treatment level. However, no significant differences were found among 0, 5, and 10 % in the theses performance traits.

Table 2: The feed ingredients and calculated composition of the experimental diets (layers, diet)

Feed Ingredients	***Saccharomyces cerevisiae***			
	control	**5 %**	**10 %**	**15 %**
Corn	60.10	55.00	54.00	54.10
SBM	25.2	21.4	13.0	9.1
Wheat bean	0.00	4.00	6.50	6.50
Fish Meal	3.00	1.15	2.47	1.00
Limestone	8.16	8.50	8.50	8.60
MVMIX[1]	0.25	0.25	0.25	0.25
DL-Meth	0.20	0.25	0.35	0.40
DIC .PHO.	0.60	0.90	0.90	1.00
L-LYSINE	0.10	0.05	0.15	0.25
CHOL-CL	0.40	0.50	0.94	1.21
Salt	0.40	0.40	0.40	0.40
Veg. oil	1.49	2.50	2.44	2.09
Antioxidant	0.10	0.10	0.10	0.10
Saccharomyces cerevisiae	0.00	5.00	10.00	15.00
Total	100.00	100.00	100.00	100.00
Calculated composition				
Protein, %	18.00	18.00	18.00	18.00
ME, Kcal/Kg	2800	2800	2800	2800
Calcium, %	3.52	3.59	3.66	3.55
Av-phos., %	0.33	0.33	0.38	0.32
Riboflavin, mg/kg	1.71	1.56	1.43	1.22
Niacin, mg/kg	23.38	27.48	30.18	27.21
PA, mg/kg	6.68	6.96	7.56	5.72
Choline, mg/kg	1403	1321	1413	1444
Methionine, %	0.49	0.49	0.57	0.57
Met + Cys, %	0.79	0.75	0.79	0.76
Lysine, %	1.13	0.95	0.91	0.87
Tryptophan, %	0.24	0.21	0.17	0.14
Threonine, %	1.30	1.24	1.28	1.24
Linoleic Acid, %	1.43	1.37	1.36	1.33

[1]The multi vitamin-minerals premix provide the following per ton of diet: 7000000 IU, vit A; 1500000 ICU, vit D3; 30000 IU, vit E; 50000 mg, vit C; 2300 mg, vit K; 1400 mg, vit B1; 5520 mg, vit B2; 2300 mg, vit B6; 12 mg, vit B12; 27600, mg Niacin; 920 mg, Folic acid; 6900 mg, PA; 92 mg, Biotin; 50000 mg, Antioxidant (BHT); 220 mg, Cobalt; 4400 mg, copper; 800 mg, Iodine; 26400 mg, Iron; 44000 mg, Manganese; 180 mg, Selenium; 44000 mg, Zinc.

Al-Ani (1985) reported that when single cell protein was fed to layers no depression in egg production was observed and the nucleic acid content in tissues and eggs were not affected. Layers performance was optimized when single cell protein was fed at 2.5 % of dry matter or 10 % of dietary protein. When single cell protein was fed at 0, 5, 10, 15 % levels to poultry, best growth occurred at the 5 and 10 % levels (Al-Shadeedl, 1988).

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Table 3: Chemical macro-analysis for single cell protein yeast

Nutrients	yeast
Crude protein, %	51.88
Total Fat, %	6.41
Carbohydrate, %	28.21
Ash, %	9.35
Fiber, %	0.00

Table 4: The amino acid profile of microbial protein

Amino Acid	Yeast[1]
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
Tryptophan, %	0.09
Cysteine, %	0.07

[1]Percent of the protein sample

Table 5: Fatty Acids profile of the yeast biomass[1]

Fatty Acid Profile*	Value
Lauric Acid $C_{12}H_{24}O_2$, %	0.175
Myristic Acid $C_{14}H_{28}O_2$, %	0.640
Myristoleic Acid $C_{14}H_{26}O_2$, %	0.140
Palmitic Acid $C_{16}H_{32}O_2$, %	11.100
Palmitoleic Acid $C_{16}H_{30}O_2$, %	35.095
margaric Acid $C_{17}H_{34}O_2$, %	0.110
Stearic Acid $C_{18}H_{36}O_2$, %	5.560
Elaidic Acid $C_{18}H_{34}O_2$, %	0.140
Oleic Acid $C_{18}H_{34}O_2$, %	43.240
Linoleic Acid $C_{18}H_{32}O_2$, %	0.850
Linolenic Acid $C_{18}H_{30}O_2$, %	0.135
11-Eicosanoic Acid $C_{20}H_{38}O_2$, %	0.150
Docosanoic (bhenic) Acid $C_{22}H_{44}O_2$, %	1.365
Pentacosanoic Acid $C_{25}H_{50}O_2$, %	0.140

[1]Percent of the yeast fat
**Any fatty acid value below o.1 was omitted*
Remark: Total saturated fatty acids, 20 %; Total unsaturated fatty acids, 80%

Ageev *et al.*, (1984) used a paprin derived from the yeast *Candida* grown in N-Paraffins with broiler chickens and layers. They found that addition of 3 to 4% of paprin to the basal diet increased the livability rate, improved feed efficiency and slightly increased egg yield (by 3%).

Table 6: The effect of feeding different levels of yeast SCP derived from date syrup on production traits of Single Comb White Leghorn hens

Source of Variation	**GBD**	**EM**	**EW**	**HD**	**FC**	**LIV**
Levels	**	**	NS	**	*	NS
0	101.41[a]	37.69[a]	55.53[a]	68.94[a]	2.587[b]	99.76[a]
5	93.00[b]	41.12[a]	59.61[a]	69.01[a]	2.418[b]	100.00[a]
10	93.16[b]	37.22[a]	59.33[a]	62.49[a]	2.927[ab]	100.00[a]
15	94.47[b]	30.20[b]	59.09[a]	51.18[b]	3.546[a]	99.68a
P =	0.0005	0.0015	0.2068	<.0001	0.0252	0.4853

[1]*Means Within columns carrying different superscripts are significantly different, P<0.05.* ***NS*** *= Not significant, P>0.05. ** Significant at 1 % level of probability,* ***GBD****, gram per bird per day, daily feed intake;* ***FC****, Kg feed per Kg eggs, feed conversion;* ***EW****, gram egg weight;* ***HD,*** *percent hen-day production;* ***LIV****, percent livability;* ***EM****, gram per hen-day egg mass (% HD * EW),* ***Levels*** *= 0, 5, 10, and 15 % of the yeast*

Table 7: The effect of feeding different levels of SCP yeast derived from date syrup on some egg quality traits

Source of Variation	**SPG**	**HU**	**YC**
Levels	**NS**	**NS**	**NS**
0	1.099[a]	75.47[a]	9.203[a]
5	1.095[a]	74.63[a]	9.336[a]
10	1.092[a]	76.83[a]	9.281[a]
15	1.089[a]	74.14[a]	9.277[a]
P =	0.2582	0.4620	0.9856

[1]*Means Within columns carrying different superscripts are significantly different, P<0.05.* ***NS*** *= Not significant, P>0.05. ** Significant at 1 % level of probability. SPG = Specific gravity of the egg, HU = Haugh unit, YC = Yolk color, Levels = 0, 5, 10, and 15 % of the yeast*

Effect of feeding different levels of yeast SCP on egg quality characteristics was not significant (P>0.5) (Table 7).

Lee and Chen (1983) fed 400 White Leghorn hens, 72 weeks of age, ad-libitum or restricted. No significant differences were found among treatments in mortality, feed conversion, egg weight and Haugh unit index.

Widjajanti *et al.*, (1990) reported no significant differences between 0 and 5 % dietary dried brewer grain plus yeast in Haugh unit, body weight and percent egg shell weight of laying hens (69 – wk. old) raised under warm environmental temperature (24 and 27° C).

Conclusion

The results obtained in this study indicate that supplementing the layer diet with 5 - 10 % SCP may produce no harm effect to the performance of layers and can be included in their diets.

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