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EFFECT OF DIFFERENT DIETARY SOURCES OF FAT ON BROILER CHICKENS 1-PERFORMANCE AND IMMUNE RESPONSE

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ABSTRACT: These studies were conducted to the effect of different dietary fat sources i.e. dried fat, corn oil, blend oil and blend oil heated for 8 , 24 and 48h. on broiler chickens. The responses of broilers tested in this study were feed intake, weight gain ,food conversion and immune response , as well as food cost per kg body gain was calculated .

A total of 90 one- day old broiler chicks were randomly distributed into 6 experimental groups and fed a standard broiler diet for 8 d and fed from 9 to 52 day of age an isocaloric and isonitrogenous diets containing 7.02% of six different fat sources dried fat, corn oil, frying oil, frying oil heated for 8, 24 and 48h fir the six respective groups. Live performance of broiler chicks, was determined at 35 days of age while food cost was measured at 52 days of age.

The different dietary fat sources had no specific effect on feed intake and . Significant response of poultry chicks to the uses of heated oils was observed in food cost, body gain and feed conversion.

Serum protein was affected by dietary heated oil for 24 hr, where as α globulin, ß globulin and γ globulin were increased in broiler chickens fed diet containing heated oil for 24 hr by 47.62% , 42.0% and by 3.18 % respectively compared with those fed diet containing

unheated oil. The statistical analysis of serum GPT showed significantly elevation by feeding diet containing dried fat while serum GOT did not affected by dietary unheated or heated oils.

INTRODUCTION

Diets used to raise broiler chickens generally include fat as a concentrated source of metabolizable energy. It is well known that the degree of fatty acid saturation affects fat digestibility and the concentration of metabolizable energy provided by each source of fat may be calculated using pre-established formulae **(Wiseman et al., 1991)** . It is commonly assumed, however, that . once the fat is absorbed, the calories from fatty acids of varying degrees of saturation are used equally for metabolic purposes. Thus, animal

fats or vegetable oils are indiscriminately included in isoenergetic diets (in terms of metabolizable energy) for broilers. Several experiments have shown that an increase in energy concentration produces a decrease in feed intake but does not negatively affect daily gain, resulting in an improvement in feed efficiency **(Hulan et al., 1984)**.

There is limited information on the effect of dietary oxidized fat on broiler chickens. Fat blends for poultry feeding based on fat waste from frying operations or on byproducts such as distillation residues from edible oil for human and animal consumption has been the subject of research over many years. The purpose of the present study was to investigate the effects of feeding diets containing dried fat, corn oil, frying oil and heated frying oil for 8,24 and 48 h respectively on broiler chicken performance, their immune response, and the economical evaluation of such diets.

MATERIALS AND METHODS

Birds, housing and management

A total of ninety one –day old, broiler chicks of the Arbor Acres strain, obtained from a commercial source, were reared conventionally in floor pens. For acclimatization the chicks were started on a control starter diet for a period of 8 days. On the 9th day of age the birds were distributed at randomly into six equal groups (each of 15 chicks) and assigned for six experimental dietary treatments. Food and water were provided on *ad libitum* basis and continuous lighting was applied. Birds were weighed at the start of the experiment and weekly thereafter for five weeks, after a 12 h over night fast. The daily feed intake for each group was recorded.

Diets

A starter diet (table1) was formulated using corn, soybean meal and broiler concentrate; with supplementation of DL. Methionine and dicalcium phosphate; while energy was augmented by adding oil or fat.

The diet was formulated to contain 23% protein and 3200 Kcal, ME/kg and fed allover the experimental period in order to fix one rate of oil addition allover the experimental period. Also 1% mineral-vitamin premix was added, in spite of that present in the broiler concentrate to ensure richness of the diet and to cover the safety margins recommended. For the six chick-groups there kinds of fats were used; the commercially used dried fat, corn oil and the frying oil (korsal), assigned for the first three groups, while the korsal oil(blend oil) was heated for three different periods 8,24 and 48 h and assigned for the last three groups respectively. The oils were considered to have an equal energy value and were added at fixed ratio of about 7% in the diets. For the six chick-groups there kinds of fats were used; the commercially used dried fat, corn oil and the blend oil (korsal), assigned for the first three groups, while the korsal oil(blend oil) was heated for three different periods 8,24 and 48 h and assigned

for the last three groups respectively. The oils were considered to have an equal energy value and were added at fixed ratio of about 7% in the diets.

Oils and heat treatment:-

The dried fat used for the first group was composed of a mixture of different vegetable oils. while the frying oil is a blend of cottonseed, soybean and sunflower oils, the percentage of each is not advertised. The heat treatment was performed in the laboratory using a large frying pan and the heating was continuous and unbroken for 48 h at about 180 ± 10C° taking the quota of each treatment at its respective time 8,24 and 48 h. samples of the different oils. raw or heated were taken for analysis.

Chicken growth performance

The performance was measured as the daily weight gain, the rate of feed consumption and the correlation between them was tested by estimating the food conversion ratio calculated as the amount of food consumed per unit live weight gained.

Immune response

a) Cellular immune response:

Heparinized blood samples of 3 birds from each experimental group were taken before slaughter and used for carrying out the cellular immune response tests including: lymphocyte blastogenesis microassay blastogenesis microassay measured according to **Denizot and Lang (1991)** as modified by **Maslak and Reynolds (1995)** and phagocytosis assay according to **Woldehiwet and Rowan (1990)**.

b) Humeral immune response:

Blood samples were collected at slaughtering without using an anticoagulant for the separation of the serum for carrying out the humeral immune response tests including the determination of total protein and electrophoretic fractions according to **Loemmli (1970)**

Liver and kidney function tests:

Liver and kidney function tests were carried on by determining total serum protein **(Weichselbaum,1946)**. serum glutamic pyruvic transaminase and serum glutamic oxaloacetic transaminase **(Reitman and Frankel 1957),** serum alkaline phosphates **(Belfield and Golberg 1971)**, serum bilirubin (**Jendrassik 1938),** serum creatinine **(Houoto 1985)** and serum uric acid and **(Caraway 1963)** in serum

Table (1) :Composition of the basal diet

Ingredients		Amount %
Ground yellow corn		50.10
Soybean meal (solvent-extracted, 44% CP)		30.80
Broiler concentrate (52% CP)*		10.00
Oil**		7.02
Mineral-vitamin premix		1.00
Dicalcium phosphate		0.88
DL. methionine		0.10
Coccidiostat		0.10
Calculated energy and chemical components* **		
Crude protein	%	23
Metabolizable energy	k cal/kg	3200
Methionine	%	0.60
Lysine	%	1.62
Calcium	%	1.16
Available phosphorus	%	0.66

*Broiler concentrate contains CP. 51.98%; CF, 0.07%; EE, 6.76 %; calcium, 8.66%; available phosphorus, 3.66%; methionine, 1.79%; methionine + cystine. 2.4% lysine. 2.82%; salt, 2% and ME, 3083 kcal/ kg .

**The oils added were dried fat(DF). corn oil(CO). frying oil(FO) and heated frying oil for 8.24 and 48h (FO_8, FO_{24} and FO_{48})for the six groups respectively:

the amount of saturated fatty acids was 46.92, 19.5., 22.55 , 24.09. 28.59, and 27.98 %for the six dietary oils respectively

the amount of unsaturated fatty acids was 53.59, 80.50, 77.23 . 75..35, 74.01 and 72.39 % for the six dietary oils respectively

The six diets are orderly coded as DFD, COD, FOD, FOD_8, FOD_{24} and FOD_{48}.

***The chemical composition of the basal diet was calculated according to the **(NRC 1994)** tables

Economical evaluation :

As broiler industry is based on monetary returns rather than maximal chick performance, so the cost of producing one unit of live weight was calculated. In determining the cost, the expenses were generally represented by the combined cost of feed and chick charges with no regard to the cost of litter, building and equipment charges, or any other miscellaneous ones, making these costs as a financial base of comparison rather than a real meat production cost.

Statistical analysis

The obtained data were statistically analyzed according to **Armitage (1971).**

RESULTS AND DISCUSSION

Chicken growth performance

The results presented in table (2) and (Fig 1,2) illustrate the growth performance of the chicks in the different groups. As to the feed intake, table 2 shows no group difference and no effect, for the type of oil, raw or heated, exerted. The chickens consumed in the 35 day of age from 106.03 to 116.97g with an average of 111.29 g In spite of the nearly equal feed intake of a diet having the same nutrient and energy concentration, the daily body gain varied from 40.72g in the dried fat to 47.75 g in corn oil and 54.01 g in the frying oil-diet. Frying oil is the richest in unsaturated fatty acids while the dried fat is the lowest. Frying oil, might be the most easily digested and eventually the highest in Metabolizable energy. This fact is supported by the data given in table (1), in which the used oils were analyzed for its content of fatty acids. The dried fat appeared to contain more than double the amount of saturated fatty acids found in corn oil or the frying one. The saturated fatty acids are of low digestible energy value in poultry. Heating the frying oil did not affect its value so much but only decreased the gain by 3.7% when heated for 24h and 7.4% for 8 hours and it is the 48 h which scored the highest negative effect and the decrease reached 11%. On the reverse **Lin et al, 1989** explained the decrease in body weight in broilers fed an oxidized sunflower diets, to be due to the toxic effect of oxidation products and decrease in biological value of the heated oil. The nearly feed intake equality but the differences in body gain resulted in feed conversion indices varying from 2.15 in frying oil and 2.25 in corn to 2.87 in dried fat and from 2.16 in 8 and 24 hours - frying heating to 2.21 in the 48 hours one. The increasing effect of heat on the content of thiobarbituric acid (0.65 in the raw oil to 1.14% in 48 heated one) and decreasing one on the Unsaponifiable matter from 0.97 to 0.84%, considering the two properties a fore mentioned the decrease in body gain and bad feed conversion of group fed on diet containing heated frying oil for 48 h.

the bad effect of heating to 48 h, on the body weight gain and efficiency of feed conversion can be explained to be due to the toxic effect of the oxidation products and the lowered biological value of the oil. This in addition to the destruction of the fat soluble vitamins and carotenoids. The oxidation products may also react with the dietary protein and negatively affect its quality

Table(2):Performance of broiler chicks fed diets containing different fat sources:

Items	Raw oil groups			Heated oil groups		
	DFD	COD	FOD	$HFOD_8$	$HFOD_{24}$	$HFOD_{48}$
Daily feed intake (g)	116.97	107.37	116.37	109.12	111.88	106.03
Daily body gain (g)	40.72	47.75	54.01	50.45	51.89	48.07
Feed conversion ratio	2.87	2.25	2.15	2.16	2.16	2.21

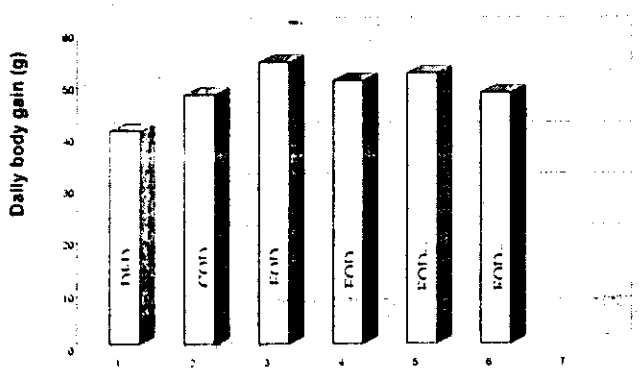

Fig (1): Body gain (g) of different experimental groups

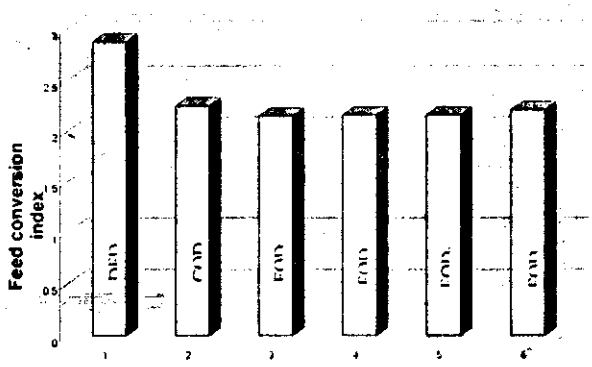

Fig (2):Food conversion index of different experimental groups

Immune response

a) Cellular immunity

The statistical analysis of the obtained data concerning Lymphocyte transformation and phagocytosis percentage (table 3) showed that the dietary fat has no specific effect on cellular immune response. Generally the effects of the amount of fat on T lymphocyte proliferation in vitro were variable. High fat diets increased (**Ossman et al 1980),** decreased (**Erickson et al. (1983),** or did not have any effect (**Locniskar - et. al. (1983)**. In addition, it was reported that sera from animals fed a high fat diet, in comparison with sera from animals fed a low fat diet, inhibited T lymphocyte proliferation (**Friend et al. (1980)** or did not have an effect **(Locniskar et al. (1983))**. Diets containing a high amount of linoleic acid do not inhibit lymphocyte proliferation (**Email et al. (1988)**. Generally the modulating effect on the immune system depend on the duration of feeding and the type of fat consumed and the organ examined. In conclusion the feeding diets containing 7.02% dried fat, corn oil, raw or heated frying oil did not suppress lymphocyte transformation and had non specific effect on phagocytic activity.

b) Protein electrophoresis

Data shown in table (3) represent the total serum protein expressed by g % and its differential electrophoretic patterns in broiler chick sera. The statistical analysis of the obtained data reveled that the serum protein was affected by dietary heated fat at 180±10 C for 24 hours. Serum globulin content is dependent on type and thermal treatment of the fats, where as dietary heated oil for 48 hours leads to an increase of serum α globulin , ß globulin and γ globulin by 47.62% , 42.0% and 318% respectively compaired with serum of broiler received unheated blend oil . The increment of globulin fractions may be due to the interaction of lipid hydroperoxides with protein, membranes. These reactions can affect vital cell functions by damage to membranes, enzymes and proteins and ended by different degree of impaired liver function.

Table (3): Immune response of broiler chicks fed diets containing different oils

Items / Parameters	Raw oil groups			Heated oil groups		
	DFD	COD	FOD	$HFOD_8$	$HFOD_{24}$	$HFOD_{48}$
Cellular immunity Lymphocyte Transformation	1.34±0.06	1.39±0.08	1.36±0.07	1.38±0.08	1.34±0.05	1.46±0.11
Phogocytic activity %	71±1.53	80±2.65	78±1.00	79±3.21	76±4.16	76.67±3.84
Humeral immunity						
Total protein g/dl	b 3.95±0.04	a 3.50±0.04	b 3.95±0.04	c 4.18±0.05	e 5.10±0.06	d 4.86±0.05
Albumin g/dl	a 2.10±0.02	b 2.28±0.04	c 2.38±0.03	b 2.28±0.02	e 3.04±0.03	d 2.66±0.03
Globulin g/dl & globulin	d 0.59±0.007	a 0.31±0.003	b 0.42±0.005	d 0.57±0.006	c 0.51±0.006	e 0.62±0.007
ß globulin	d 0.65±0.007	a 0.31±0.003	b 0.50±0.005	c 0.61±0.007	f 0.98±0.01	c 0.71±0.008
γ globulin	b 0.62±0.007	b 0.60±0.007	c 0.66±0.007	d 0.72±0.008	a 0.57±0.006	e 0.87±0.0098

The chicks fed heated oil for 48 h in diet showed the highest serum cholesterol concentration (185.12 mg/dl) compared with those fed unheated oil (118.37 mg/dl, Table 4. Generally an increase in serum cholesterol esters occurs in biliary obstructions and due to unsaturated fatty acids. The statistical analysis of serum GOT showed that the serum GOT did not affected by dietary unheated or heated oil treatments. On the other hand the serum GPT showed significantly elevation by feeding diet containing dried fat since tocopherol destruction in oxidized oil causes liver cell damage.The increment of serum bilirubin may be due to hepatocellular damage as a result of toxic effect of materials present in heated oils.

As shown in table (4) the creatinine and uric acid serum levels were not affected by different dietary treatment, this means that broiler diet containing heated frying oil did not cause renal dysfunction up to the end of the growth period.

Table (4) represents the triglycerides level in different chick groups. The broiler chicks fed diet containing 48 h heated frying oil showed higher serum triglycerides (100.07 vs 90.06) since this group received high saturated fat, Simillar results were obtained by **(Locniskar et al 1983)**

Table (4): Blood biochemistry in different chick groups.

Items	Units	DFD	COD	FOD	HFOD		
					$HFOD_8$	$HFOD_{24}$	$HFOD_{48}$
Total protein	G/dl	3.95±0.04	3.50±0.04	3.95±0.04	4.18±0.05	5.10±0.06	4.86±0.05
Total bilirubin	Mg/dl	0.41±0.05	0.35±0.004	0.37±0.004	0.30±0.003	0.28±0.003	0.24±0.005
Cholesterol	Mg/dl	113.89±1.311	193.39±2.121	118.37±1.298	160.05±1.755	93.39±1.024	185.12±2.030
GOT	U/L	144.56±1.586	130.57±13432	144.86±1.589	146.89±1.611	149.22±1.637	149.22±1.637
GPT	U/L	12.01±0.132	7.13±0.079	4.01±0.0044	4.10±0.045	4.00±0.044	5.91±0.065
Alkaline phosphatesase	U/L	68.24±0.748	73.72±0.809	72.23±0.792	71.17±0.781	66.71±0.731	70.99±0.779
Creatinine	Mg/dl	0.35±0.04	0.57±0.006	0.57±0.006	0.26±0.003	0.83±0.009	0.39±0.004
Uric acid	Mg/dl	1.80±0.02	4.68±0.05	7.56±0.08	2.88±0.03	6.84±0.08	6.12±0.07
Triglycerides	Mg/dl	95.78±1.26	97.87±1.23	90.06±1.16	86.25±1.04	88.16±1.14	100.07±1.29

Economical evaluation

From the economical point of view for broiler industry, nutrient requirements should be satisfied basing on monetary returns rather than maximum chick performance. The efficiency of each fat source as a diet ingredient meeting the energy requirement was estimated and presented in (table 5) and Fig. 3. It was found that during a 44 d-period the raw frying oil-diet was the most efficient in producing the most cheapest gain c 2.4 LE compared with 2.74 in corn oil-diet and 3.2 in dried fat diet. The abused frying oils surpassed the raw material and the length of heating period seemed to be uneffective. Generally the feeding of frying oil increase the maximum profit for body gain and meat production in broiler industry.

Table (5): Economical evaluation of different experimental diets

Items	DFD	COD	FOD	HFOD		
				$HFOD_8$	$HFOD_{24}$	$HFOD_{48}$
Cost of 1 kg feed intake (L.E)	1.1129	1.2182	1.1158	1.0076	1.0076	1.0076
Cost of feed intake / 35 d (L.E)	4.5560	4.5780	45445	3.8446	3.945	3.7393
Cost of 1 kg body gain (L.E.)	3.1964	2.7390	2.4041	2.1774	2.1726	2.2241

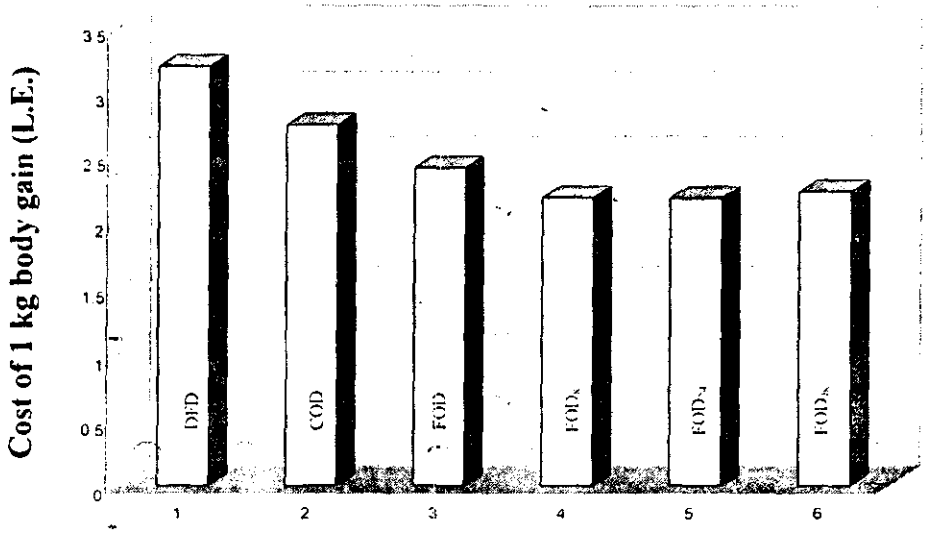

Fig (3): Cost of 1 kg body gain (L.E.) of different experimental groups

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