Broiler Chickens Performance as Affected by Animal Fat and Plant Oil under Hot Arid Conditions of Sudan

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ABSTRACT--- ***The influence of dietary animal fat and plant oil on broilers performance under Sudan conditions wasstudied. The experiment lasted seven weeks. One hundred and fifty one - day old, unsexed Lohmann breed chicks were divided randomly into three dietary treatments (50 birds /treatment)with five replicates of ten birds each. Average minimum and maximum temperatures during the experimental period were 26.1◦C and 38.9 ◦C, respectively. Parameters measured were feed intake, body weight gain, feed conversion ratio, and mortality rate.***
Three dietary treatments were used in this study. Diet A with no fat added (NF), diet B was supplemented with 5% peanut oil (PO) and in diet C 5% beef tallow (BT) was added . The three diets were made to be isonitrogenous. All nutrients were calculated to meet the USA National Research Council Requirements (NRC, 1984) for broiler chicks.
The results indicate that during the experimental period feed consumption was not affected by fat addition, irrespective of its source. There was a trend to increase the total body weight gain but the difference did not reach significant level. It was noticed that the ambient temperature during the experiment was very high which might upset the beneficial effect of dietary fat.

Keywords--- Peanut oil, Beef tallow, Broiler, Performance, Sudan

1. INTRODUCTION

Supplemental fat has been used in poultry feed for energy adjustment (a high-density energy source) and to improveefficiency of feed utilization.Song et al. [1] reported that availability of amino acid in Chinese oil corn than in conventional corn. There are many factors influencing fat utilization, such as level of fat inclusion and basal diet composition, degree of saturation of the total lipid fraction, age and temperature.

Environmental temperature is the most important factor affecting bird performance in the tropics. High temperature has adverse effects on the performance of the hen due to in adequate intake of nutrients.In growing chicks and turkeys, growth depression and reduction in feed intake are caused by environmental temperature above 20 °C [2]. Many workers tried toovercome this growth depression. Hurwitz et al.[2] and Charles et al.[3] failed to overcome this depression by increasing both proteinand energy.

In an attempt to diminish the detrimental effects of a constant high environmental temperature, Payne [4] suggested suitable dietary modifications.Fuller and Rendon[5] explained that the " extra calorific " effect of fat resulted from the low heat increment factor of fats,consequently, supplementation of fat has the effect to minimize some detrimental effects of high ambient temperatures.

In Sudan, small-scale broilers production is carried in open poultry houses. Evaporative cooled housing is confined to large poultry projects in Khartoum .Producers avoid rearing broiler during summer months due to hazards of high temperature . Little information is available in Sudan concerning the influence of type of fat on birds' performance during high temperature. This study was therefore conducted to determine:-

1. The role of dietary fat in feed utilization efficiency.
2. Broilers utilization efficiency of vegetable oil versus animal fat.

2. MATERIALS AND METHODS

This experiment was carried out at Faculty of Animal production, University of Khartoum. Minimum and maximum temperatures outside the poultry unit were 26.4°C and 38.9°C respectively. The experiment lasted for seven weeks

2.1Birds

A total of 150 one-day old, unsexed commercial broiler chicks (Lohman) obtained from commercial hatchery, were used in this experiment. They were vaccinated against Merke's disease. Onarrival, all chicks were selected,weighed, so that mean body weight was as uniform as possible(approximately 43 g). The chicks were randomly distributed into 15 pens, and each pen contained 10 birds of approximate equal body weight. The pens were then randomly allocated to the three experimental diets (50birds / treatment).

2.2House and Management

The experiment was carried out on adeep litter floor system. The house long axes were situated in an East-west direction. The house was constructed of iron posts, wire netting sides, corrugated iron roofing, and concrete floor, the pens inside the house were made from iron posts with wire netting. The dimensions of each pen were (1.0 ×1.0 meter). Dry wood-shaving was used as litter materials at a depth of 5 cm .Each pen was provided with clean disinfected feeder and drinker that were filled with feed and water all the time . Light was provided 24 hours in a form of natural light during the day and artificial light during the night. 60 watt bulb was used for each two pens. They were hanged at a low level initially and then raised to a height of 1/2 meter above the floor. The house was cleaned and disinfected with formalin before the commencement of the experiment.

2.3Diets

Three experimental diets were studied. Diet A contained no fat (NF) and served as the control. 5% peanut oil (PO) was added in diet B, and 5% beef tallow (BT) was added in diet C. The composition of these rations is listed in table 1.In the ration in which fat was included, sorghum was replaced with 5% either tallow (BT)or peanut oil (PO). The diets were calculated to be isonitrogenous .The main difference between the diets was in their source of energy. The assumed ME values were 7700 , 8800 kcal /kg for tallow (BT)and peanut oil (PO) , respectively according to NRC[6] .

Bovine abdominal fat was collected from abattoir. The fat was heated to boiling and rendered tallow was separated by filtration. Pure peanut oil was obtained from a commercial oil company.

Vitamins and antibiotics were administrated in the water for five consecutive days for each treatment during the fifth week. The nutrients of the experimental diets were calculated to meet the National Research Council requirement [6] of broiler chicks. The calculated and determined nutrients of the experimental diets are shown in table2 and 3 respectively.

2.4Experimental procedure

This trial was started at one day of age. The chicks were weighed on the first day and then at the end of each week. The experimental diets were fed for the whole seven weeks period.

Feed and water were offered adlibitum(ad-lib) .Records of body weight, feed consumption were maintained on a weekly basis per replicates.

Mortality rate was recorded throughout the experimental period.

2.5Experimental design and statistical analysis

The experimental design of the trial was a complete randomized design. The data obtained (feed intake , body weight gain , and feed conversion ratio) were tabulated and subjected to analysis of variance (ONE –WAY ANOVA) using the SAS computer program . The least significant difference (LSD) test was used for treatment means separation.

3. RESULTS

3.1Feed intake

Table 4shows weekly feed intake as affected by dietary fat source.

Dietary fat source significantly depressed($P<0.01$) feed intake compared to basal diet during the first week. Birds fed oil-supplemented diet consumed lesser ($P<0.05$) feed compared with those receiving tallow supplemented diet. During the second and third weeks, tallowsupplemented diet significantly ($P<0.05$) improved feed intake. Irrespective of fat source feed intake was not influenced by addition of fat from the fourth week up to the end of the experiment.

3.2 Body weight gain

Table5 shows the effect of dietary fat source on average weekly body weight gain of broiler chicks.

Body weight up to 21 days tended to increase with tallow supplemented diet but it did not reach significant level.

Birds fed tallow –supplemented diets had lesser ($P<0.05$) body weight gain at the end of the fourth week compared to basal diet. Inclusion of 5% tallow in broiler diet significantly ($P<0.05$) improved body weight by the end of the fifth week.

Fat supplementation, irrespective of its source did not affected body weight during the sixth week to the end of the experiment.

3.3 Feed conversion ratio

Table 6shows feed conversion ratio (kg/feed consumed / kg body weight gain) as affected by the source of fat.

Both fat-supplemented diets improved feed conversion ratio ($P<0.01$) as comparedtobasal diet during the first week,whereas, in the second and thirdweeks, feed conversion was not affected by the source of fat.

Birds fed 5% tallow had poor feed conversion ($P<0.05$) compared to basal diet at the fourth week. Addition of fat significantly improved feed conversion during the fifth week ($P<0.05$).

Oil-supplementeddiet, significantly decreased feed conversion as compared with basal diet ($P<0.05$) during the sixth week.

Inclusion of 5% fat in the diet tended to decrease feed conversion by the end of the seventh week, but it did not reach significant level.

In summary,table7gives indication about performance during the whole experimental period. There was a trend to increase final body weight by fat supplementation but the differences were not significant. Feed intake was not affected by addition of fat regardless of its source.

Inclusion of both sources of fat in broiler diet tended to improve feed conversion but it did not reach level of significance.

Total mortality during the 49-day experiment was 48 % in group A, 44 % in group B and 40 % in group C and postmortem examination showed that the cause of death was heat stroke rather than related to ration treatments.

4. DISCUSSION

4.1 Feed intake

Feed intake was significantly depressed by addition of fat during the first week (table 4). The data supported the report of Reid and Webber[7] that an increase in the energy of poultry diets results in a decrease in feed intake provided other dietary nutrients are adequate. Likewise, the result is in agreement with the data ofJabarJamal and EbrahimBabaahmady[8] who found that diets containing tallow, mixture of tallow and soybean oil and soybean oil did not affect feed intake during the starter period of broiler chicks. In this study the ME of the tallow –supplemented and oil-supplemented diets was higher than that of the basal diet. During the second and third weeks, feed intake was significantly higher in diets containing 5% tallow (table 4) this may due to palatability factor associated with tallow – supplemented diet.

During the fourth week up to the end of the experiment ambient temperature was very high.

There were no differences in feed intakes during this period between the treatment groups. This result is dis agree with JabarJamaly and EbrahimBabaahmady[8] that during the whole period of growth chicks were consumed fed diets containing a mixture of tallow and soybean oil and soy bean oil diets had higher feed intake compared to the control diet. This may attributed to the effect of heat. This is in agreement with data presented by Hurwitz et al.[2]; Charles et al. [3] and Sinurat and Balnave[9] that high ambient temperature reduced feed intake.

4.2 Body weight gain

Body weight gain of chicks was not affected by diets containing either 5% tallow or peanut oil during the ages of 1 to 21 days (table 5).

The results of this study are in agreement with previous data [10]. Growth of the younger chick seems to be less sensitive to changes in dietary energy. During the fourth week, tallow-supplemented diet depressed weight gain compared to basal diet (table 5). However, during the fifth week, tallow-supplemented diet improved weight gain. This shows that age influenced the utilization of tallow in the growing chick. In the first four weeks, utilization of tallow supplemented diet was lower than the later growing period. Body weight gain was not affected by addition of fat irrespective of its source during the sixth week up to the end of the experiment (table 5) perhaps the expected beneficial effect of fat on body weight gain was masked by the high ambient temperature that occurred during this study. It was noticed that the birds during experiment were panting during most of the day, and lifting their wings. Such activities were reported by Dale and Fuller [11] to be energy-costing process.

4.3 Feed conversion ratio

Both fat supplemented diets improved feed conversion ratio during the first week (table 6). This is resulted from the lower feed intake with the fat supplemented diets during the first week in the present study.

During the second and third week, feed conversion was not affected by addition of tallow. However,at the fourth week, addition of 5% tallow resulted in increased feed conversion ratio. In the fifth week, tallow supplementation improved feed conversion. This may due to age effect, that in the first four weeks, utilization of tallow by birds was less efficient than the latter growing period. It was noticed in the sixth weekto the end of the experiment that inclusion of fat in the diet tended to improve feed conversion but the improvement was not significant .this may due to higher ambient temperature during this period , which affected the utilization of nutrient .

Similar results obtained by Oluyemi and Fetuga[12]that higher ambient temperature in the tropics decreased the utilization of nutrients for body heat maintenance. No explanation was found in the present study for the increase in feed conversion ratio with oil-supplemented diet in the sixth week.

Overall results, there was no difference in feed intake between the three groups treatment (table 7) however; there was a numerical increase in feed intake with tallow added diet. This result supported the work of Bartov[10] who found no effects on feed intake resulted from the dietary fat source (tallow, soybean oil) in broiler during summer.There was a trend to improve total body weight gain with both fat supplemented diets but the differences were not reach significant level (table7).

Feed conversion tended to improve with both fat added diets but the difference was not significant. This supported the previous data of Skinner and Waldroup[13]

The expected beneficial effects of supplemental fat were not obtained. This may due to the effect of higher ambient temperature during the experiment which masked the beneficial effect of fat. Also may due to higher mortality which occurred as a result of the heat wave during the experimental period.

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Table1. Composition of experimental diet

Ingredients %	Treatments		
	Treatment A control(NF)	Treatment B Oil supplement	Treatment C Fat supplemented
Sorghum	58.46	53.46	53.46
Super concentrate	05.00	05.00	05.00
Sesame meal	12.00	12.00	12.00
Groundnut meal	20.30	20.30	20.30
Wheat bran	03.00	03.00	03.00
Oil	-	05.00	-
Animal fat	-	-	05.00
Oyster shell	00.70	00.70	00.70
Salt	00.25	00.25	00.25
Lysine	00.24	00.24	00.24
DL. methionine	00.05	00.05	00.05
Total	100.00	100.00	100.00

Table2. Calculated chemical analysis of the experimental diet

Ingredient (%)	Treatment		
	A	B	C
Crude protein	23.00	22.97	22.97
Metabolizable energy* (kcal/kg)	3051.00	3328.00	243.00
Calcium	1.01	1.008	1.008
Phosphorus	0.75	0.74	0.74
Lysine	1.09	1.08	1.08
D.L. methionine	0.50	0.50	0.50

ME * calculated according to the Nutrient Composition of Sudan Animal Feed Bulletin No 1 (1981) Kuku.

Table3. Determined chemical analysis of experimental diet

Ingredients (%)	Treatments		
	A	B	C
Crude protein	22.75	22.75	21.87
Ether extract	5.10	10.20	9.20
Ash	6.80	7.10	6,80
Moisture	6.20	5.80	5.90
Crude fiber	8.80	8.90	9.10
Nitrogen free extract	50.35	45.25	47.13

Table4. Weekly feed intake (g/bird/day) as affected by source of fat

Treatment				
Age (week)	A (control)	B (oil-supplemented)	C (tallow - supplemented)	SEM
1st week	20.63	12.70 a	13.76 b	0.336
2nd week	22.40	22.10	27.76 a	1.293
3rd week	31.57	30.11	37.25 a	1.622
4th week	54.02	40.50	53.33	2.429
5th week	78.82	75.28	73.52	2.626
6th week	77.82	88.18 a	88.65 a	3.244
7th week	90.61	97.23	97.62	3.918

SEM: standard error of the mean
a-b values within rows with no common superscript differ significantly (P<0.05) .

Table5.weekly body weight (g/bird/day) as affected by source of fat

Age (week)	Treatment			
	A (control)	B(oil-supplemented)	C (tallow-supplemented)	SEM
	Body weight			
1st week	5.718	5.754	6.288	0.213
2nd week	11.720	11.760	14.190	0.869
3rd week	28.350	25.660	27.430	2.799
4th week	33.800 a	28.150 ab	25.660 a	2.065
5th week	24.580 a	34.080 a	44.75 b	3.760
6th week	34.150	23.210	32.210	4.056
7th week	32.980	44.910	43.070	5.097

SEM: standard error of the mean
a-b values within rows with no common superscript differ significantly (P<0.05)

Table 6. Weekly feed conversion ratio (kg feed/kg body weight gain) as affected by source of fat

Age (week)	Treatment			
	A(control)	B(oil-supplemented)	C(tallow-supplemented)	SEM
1st week	3.620	2.208	2.200	0.108
2nd week	1.920	1.900	2.000	0.091
3rd week	1.180	1.220	2.420	0.122
4th week	1.620	1.760	2.120	0.122
5th week	3.600	2.260	1.700	0.370
6th week	2.420	4.520	2.880	0.571
7th week	3.020	2.320	2.280	0.327

Table 7. Effect of dietary fat source on broiler performance

Parameter	Treatment			
	A(control)	B(oil-supplemented)	C(tallow-supplemented)	SEM
Average body weight : initial (1-day).g.	43.16	43.12	43.18	
Final (49-days) .g.	1242.20	1257.80	1398.40	
Average body weight gain .g.	1199.04	1214.68	1355.22	2.321
Feed intake (g/chick/day)	53.58	53.44	55.98	
Total feed intake	2625.00	2618.00	2743.00	5.087
Feed-to-gain ratio (kg feed /kg body wt.)	2.19	2.16	2.02	0.171
Mortality %	48	44	40	0.407