EFFECT OF USING DRY FAT ON PERFORMANCE, NUTRIENTS DIGESTIBILTY, CARCASS TRAITS AND BLOOD CONSTITUENTS OF BROILER CHICKS.

By

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Received**: 5/3/2007** Accepted**: 7/5/2007**

Abstract: *An experiment was conducted to study the effect of using different sources of dry fat (Kem dry fat, KDF; calcium dry fat, CDF and Duna dry fat, DDF) at the rate of 4% either individually or in double or triple mixture in broiler diets on their growth performance, nutrients digestibility, carcass characteristics, tibia calcium and phosphorus retention, blood constituents and economical efficiency. A total number of 480 one day old Arbor Acres broiler chicks were used. They were divided equally into 8 groups each of 6 replicates (10 birds/ replicate). The results revealed that the chicks fed KDF diet recorded numerically the best growth performance including final live body weight (LBW), body weight gain (BWG), feed intake (FI), feed conversion (FC) and performance index (PI) compared to the control diet and other treatments. Concerning digestion coefficients, also KDF diet showed numerically the highest CP and NFE digestibility, while KDF, KDF+ CDF and KDF+ CDF+ DDF significantly improved EE digestibility compared to the control diet. Results of organic matter (OM) digestibility and nitrogen balance (NB) % showed no significant differences among the experimental groups. It was noticed that all groups of chicks fed diets supplemented with all dry fat sources (either solely or in combination) resulted in better carcass measurements than the unsupplemented group (the control). However, control group recorded significantly the lowest blood plasma values of total cholesterol, total lipids, high density lipoprotein (HDL) and low density lipoprotein (LDL), while it showed the highest values of plasma calcium and phosphorus compared to dry fat-supplemented groups. No significant differences among all dietary groups for tibia calcium and phosphorus percentages were observed.*

It is concluded that supplementing broiler diet with 4% Kem dry fat (KDF) is beneficial to improve growth performance, carcass characteristics and return from feeding compared to the other dry fat sources.

INTRODUCTION

Adding oils and fats in broiler diets as a source of energy and essential fatty acid can exert an improvement in weight gain, feed utilization and palatability of feed.

Thus, degree of saturation and chain length of fatty acids both have marked influences on determined apparent metabolizable energy (AME) values of fats **(Wiseman, 1984).**

Recently, new sources such as dry fat are present commercially to avoid rancidity, as well as to ease mixing with other feed ingredients. It is produced from the processing of hydrognated oil, fat or their mixture. It has low fat digestibility and low metabolizable energy for poultry, however, the AME of a dry fat differ according to its composition of vegetable oil and/ or animal fats **(Ramadan, 2005)**. Results regard to dry fat inclusion in broiler diets are encouraging **(Smith et al., 2003;El-Metnawy, 2005 and El-Gabri, 2005)**, some others are discouraging **(Ramadan, 2005),** so the results are conflicting.

The aim of this experiment was to study the effect of using different sources of dry fat in broiler diets on their growth performance, nutrients digestibility, some carcass characteristics, tibia mineral retention and some blood constituents from 1 to 49 days of age.

MATERIALS AND METHODS

The experimental work was carried out at El-Fayoum Poultry Research Station, El-Fayoum governorate, Egypt.

This experiment was conducted to evaluate three different commercial sources of dry fat (KDF, which contains palm oil, cottonseed oil, soybean oil, linseed oil, purified marine oil & carrier (kernel);CDF, which is the calcium salts of palm oil and soybean oil and DDF, which contains fish oil 99.5%. Each was incorporated at the rate of 4% in broiler diets, either individually or in double or triple mixture, to investigate their effects on growth performance, nutrients digestibility, some carcass traits, tibia minerals, (calcium and phosphorus), some blood constituents and economical efficiency.

The commercial sources of dry fat KDF, CDF and DDF were obtained from Kemen-Belgium, Ibex Company, Egypt and Ayrodona-Germany, respectively.

A total number of 480 one-day old unsexed Arbor Acres broiler chicks were divided equally into 8 groups (60 chicks each) of 6 replicates each (10 birds/ replicate). Eight iso-nitrogenous and iso-caloric diets (22% CP and 3100 ME Kcal/ Kg diet) during starter period (0 -28 day of age) and 20% CP and 3150 kcal ME/ kg during finisher period (29-49 day of age), were formulated.

The eight experimental treatments and diets were:

T1: Diet without dry fat supplementation (control diet)

T2: Diet containing 4% Kem dry fat (KDF).

T3: Diet containing 4% dry calcium dry fat (CDF).

T4: Diet containing 4% Duna dry fat (DDF).

T5: Diet containing 2% KDF+ 2% CDF.

T6: Diet containing 2% KDF+ 2% DDF.

T7: Diet containing 2% CDF+ 2% DDF.

T8: Diet containing 1.333 KDF+ 1.333 CDF+ 1.333 DDF.

Diets were formulated to meet the requirements of Arbor Acres broiler chicks. The composition and calculated analysis of the experimental diets are presented in Tables (1 and 2). The birds were reared in broiler batteries under similar managerial and veterinarian conditions and fed the experimental (starter and finisher) diets up to 7 weeks of age. Feed and water were offered *ad lib*. Fatty acid profile of the different tested dry fat sources used was determined according to the method outlined by **Soliman *et al.* (1979),** as illustrated in Table (3). Depending upon the dry fat content of saturated (Ts) and unsaturated (Tu) fatty acids, the apparent metabolizable energy content of such dry fat sources was calculated according to the equation of **Wisman *et al.*, (1991):** AME (MJ/ kg)=

37.046-11.994 x e $^{(-0.675x\ Tu/Ts)}$ .The criteria of growth performance in terms of live body weight (LBW) and feed intake (FI) were recorded to calculate body weight gain (BWG), feed conversion (FC) and European Production Efficiency Index (EPEI). At the end of the 7th week of age, a digestibility trial using only the experimental finisher diets was conducted in which feed intake and excreta voided were recorded along 3 days collection period. The collected excreta were sprayed with 2% boric acid solution to prevent any loss in ammonia, then dried in an oven at 60^{o}C for 24 hrs, thereafter weighed, finely ground and kept for chemical analysis. Feed and dried excreta were analyzed according to the official methods of analysis **(A.O.A.C, 1990)**. Fecal nitrogen was determined according to **Jakobsen *et al*. (1960)**. Slaughter test was performed at the end of the experimental period (7 weeks). Three birds with nearest average live body weight of each treatment were randomly taken. The assigned birds were deprived of feed for 16 hours prior to slaughtering thereafter they were individually weighed, slaughtered to evaluate dressing, total edible parts and abdominal fat percentages.

Blood samples were individually taken at the same time of slaughtering from 3 birds of each group. Plasma total lipids, total cholesterol, high density lipoprotein cholesterol (HDL), low density lipoprotein cholesterol (LDL), calcium and inorganic phosphorous were determined using commercial kits. From the same chicks selected for carcass traits and blood sampling, the left tibia for each chick was removed and cleaned of adhering flesh, then dried at 100^{o}C for 24 hours. Tibia calcium and phosphors were determined according to the official methods **(A.O.A.C. 1990)**. The experimental dietary treatments were economically evaluated based upon the price of local market at the time of the experiment. The economic efficiency of the dietary treatments were expressed as the feed cost needed to obtain one kilogram of live body weight gain as previously reported by **Ghazalah *et al.*,(2006).** Analysis of variance was conducted on all data obtained using the General Linear Model procedure **(SAS, 1990)**. Significant differences between treatment means were separated using Duncan's Multiple Range Test **(Duncan, 1955)**.The statistical model used for analyzing data obtained was:

Yij = M+ Ti+ Eij

Where: Yij = the individual observation

M = the overall mean

Ti = the effect of treatments (Fat source)

Eij = the experimental error

RESULTS AND DISCUSSION

Fatty acids profile and apparent metabolizable energy of the tested dry fats:

Results in Table (3) show that palmitic acid was the major constituent of the saturated fatty acids (25.54 for KDF, 29.84 for CDF and 32.30 % for DDF). It was observed that DDF recorded the highest percentage of total saturated fatty acids (38.88 %) followed by CDF (35.51 %) and KDF (30.71 %). However, percentages of unsaturated fatty acids were higher in all sources, when compared with saturated fatty acids. The results indicated that KDF contained the highest % of unsaturated fatty acids (65.44 %), followed by CDF (63.92 %) and then by DDF (60.02). Oleic acid was the major constituent of total unsaturated fatty acids in mentioned dry fats and were ranged between 33.07- 48.31 % followed by linoleic acid (15.69- 26.95 %), while linolenic acid was trace in KDF (0.78 %) and not detected in both DDF and CDF. The results revealed that KDF and CDF contained higher levels of oleic acid (48.31 and 48.09 %, respectively) than DDF (33.07 %). Linoleic acid, the essential fatty acid was higher in DDF (26.95 %) compared to KDF and CDF (16.35 and 15.69 %, respectively). The highest ratio between unsaturated fatty acids/ saturated fatty acids was found to be 2.13 (KDF), followed by CDF (1.80) then DDF (1.54). In general, it can be concluded that the KDF is superior in its content of unsaturated fatty acid compared to CDF or DDF, while its content of saturated fatty acids was lower than that of CDF or DDF. Accordingly, by calculation, the apparent metabolizable energy of such dry fat sources were 8.294, 8.134 and 7.975 k cal/kg of KDF, CDF and DDF, respectively. The AME values are clearly parallel to the Tu/Ts ratio which showed the superiority of KDF compared to the other sources, while, DDF was the lowest one (Table, 3)

Nearly, similar results were found by **EL-Gabri (2005)** who indicated that DDF gave the highest total saturated fatty acids (TSFA) (39.31) while, KDF gave the lowest values (31.08%). The results also agree with **Hamilton (1995)** who reported that KDF is rich in oleic acid (18:1) than linoleic acid (18: 2). The same results were reported by **EL-Metnawy (2005)** who reported that KDF had higher total unsaturated fatty acids (TUSFA) than DDF.

Growth Performance:

Data of the chick growth performance are given in Table (4). The initial LBW at one day of age for all treatments was nearly similar. This may create suitable condition to appraise the effect of dietary treatments during the subsequent experimental periods.

LBW at 7 weeks of age for chicks fed KDF (T2) gave numerically the highest LBW (1885 g), while the group fed on diet containing KDF +CDF + DDF (T8) gave significantly ($P<0.05$) the lowest LBW value (1670 g) compared to the other groups including the control.

The results of BWG, FC and EPEI followed the same trend as that of LBW since the chicks of KDF recorded the best values (1845 g, 2.03 and 180.03% respectively). While, the chicks fed dietary KDF + CDF + DDF (T8) recorded the lowest corresponding values (1630 g, 2.29 and 141.39%, respectively). There were no significant differences between the values of KDF and the control regarding the BWG and FCR.

In this concern, **El Metnawy (2005)** reported that KDF recorded higher BWG for the broilers compared to Duna fat, while, **El-Gabri (2005)** observed better BWG in broilers fed diets supplemented with CDF vs. KDF or DDF. On the contrary, **Ramadan (2005)** reported that broiler chicks fed diets containing dry fat had lower BWG than broilers fed soybean oil.

Moreover, **EL-Metnawy (2005)** detected no effect for dry fat supplementation on FCR of broilers, while **Aggoor *et al*. (2000), Smith *et al*. (2003)** and **Ramadan (2005)** found that dry fat showed the worst FCR compared to the other oil sources. **EL-Gabri (2005)** found that CDF showed the best FCR compared with the other dry fat sources.

Concerning FI, it can be concluded that the groups of broilers fed KDF or KDF+ CDF+DDF diets consumed the least amount of feed (3748 and 3741 g, respectively).In this respect, **El-Metnawy (2005)** detected no effect for dry fat supplementation on FI of broilers, while **Ramadan (2005)** found that CDF showed the lowest FI compared to the other oil sources. However, **El-Gabri (2005)** found that CDF showed the highest FI compared to the other dry fat sources. In general, fat may improve the physical form and palatability of the broiler diet to an extent, which promotes increased feed intake **(Dale and Fuller, 1979 and Cherry, 1982).**

Nutrients digestibility and nitrogen balance:

Data of nutrients digestion coefficients and nitrogen balance of broilers fed different sources of dry fat are presented in Table (5).

Digestion coefficient values of crude protein (CP) showed no significant differences among treatments. Chicks fed DDF diet recorded the lowest value (92.17 %), while, KDF group (T2) showed the highest value (94.53 %).

Concerning EE digestibility, KDF (T2), KDF + CDF (T5) and KDF + CDF + DDF (T8) significantly ($P<0.05$) improved EE digestibility (82.27, 81.82 and 79.99 %, respectively) compared to the control. This result could be attributed to the higher unsaturation of KDF compared to the other dry fat sources, as the Tu / Ts values of KDF was higher (2.13) than both CDF (1.8) and DDF (1.54). Perhaps, such observation could be more evident if the fatty acids analysis showed the dry fats content of the poly unsaturated fatty acids (PUFA) particularly, the ω3 and ω6 ones.

Crude fiber digestibility coefficients were significantly ($P<0.05$) improved by CDF (T3), KDF + DDF (T6) and KDF + CDF + CDF (T8) supplementation (43.90, 46.49 and 43.63 % respectively). Results of digestibility of nitrogen free extract (NFE) % showed that the group of broilers fed KDF (T2) diet recorded significantly, ($P<0.05$) the highest digestion coefficient of NFE value (89.66 %) compared to the groups fed either DDF (T4) or a combination of KDF + CDF + DDF (T8) which gave the lowest values (78.67 and 81.12 %, respectively). Results of OM digestibility and NB % showed no significant differences among the experimental groups.

In this respect, **Mateos and Sell (1981) and Mateos *et al.*, (1982)** suggested that supplementing broiler diets with fat decreases the rate of food passage, thereby, permitting better digestion and intestinal absorption of nutrients.

Carcass traits and tibia minerals retention:

Results in Table (6) illustrate carcass traits and tibia calcium and phosphorus retention of broilers as influenced by dietary treatments. No significant differences among dietary treatments were detected for all carcass traits under investigation.

Concerning dressing %, KDF + CDF group (T5) recorded numerically the highest value (68.20 %) while, the group fed the control diet (T1) showed the lowest one (62.5 %), however, the dressing % varied without significant differences in a narrow range between 62.5 and 68.2%

Regarding the proportional weight of edible parts, the highest value (72.9 %) was recorded for chicks fed KDF + CDF (T5) compared to the other treatments, while the control group recorded the lowest one (66.7 %).

The results showed in general that all the tested dry fat sources gave an improve in the dressing as well as the edible parts percentage compared to that of the control group. Such improve ranged between 4.3- 9.1% and 4.2-9.3% for the dressing and edible parts percentage, respectively.

The highest abdominal fat % was for group fed diet supplemented with KDF + CDF (T5). However, no significant differences were detected among all the dietary treatments. It could be noticed that all groups of chicks fed diets supplemented with any of the tested dry fat sources (solely or in combinations) resulted in better carcass measurements than un-supplemented control group.

In this concern, **EL-Metnawy (2005)** found no significant effects among dietary oils or fat sources on all carcass characteristics of the broilers.

In agreement with our results, **EL-Gabri (2005)** showed that the best carcass and total edible parts percentage values were for CDF and KDF products, respectively as compared to the control group.

Tested dry fat sources did not significantly affect tibia calcium content and the recorded values were ranged between 30.51 % (T6) and 33.07% (T5).Values of tibia phosphorus were insignificantly ranged between 13.56 % for the group fed CDF (T3) and 14.13 % for the group fed DDF (T4). This means that all dietary treatments did not embede the Ca and P absorption and transport from the blood into bones.

The values of tibia calcium and phosphorus contents found herein are comparable to those recorded by EL**-Gabri (2005).** Results of this study disagreed with those reported by **Atteh *et al*. (1983)** who found that fat sources had a great effect on bone calcium content. Moreover, this study also disagreed with those reported by **EL-Hussieny *et al*. (2000)** who found that tibia ash and tibia calcium content for broiler fed diets contained palm oil were lower than those fed control diet. Moreover, **Ramadan (2005)** showed that the highest content of tibia phosphorus and calcium were observed with chicks fed the control diet, while the lowest values were observed with chicks fed CDF and palm oil.

Blood Constituents:

As shown in Table (7), broilers fed the control diet recorded significantly ($P<0.05$) the lowest values of plasma total cholesterol (TC), total lipids (TL), high density lipoprotein (HDL) and low density lipoprotein (LDL) (103.73, 393.66, 25.56 and 78.16 mg/100ml, respectively) than the other treatments. While, the groups of chicks fed KDF (T2), DDF (T4) and KDF + DDF (T6) diets gave the highest values of (TL) being 445.40, 443.31 and 436.72 mg/100ml, respectively. Moreover, the KDF group recorded the highest values of TC, HDL and LDL (136.75, 35.67 and 100.99 mg/100ml, respectively). However, the values obtained are close to each other and ranged in a narrow range among treatments. In agreement with the results of this study, **Ramadan (2005)** found that the lowest values for blood cholesterol were observed for broiler chicks fed diet containing soybean oil compared to those fed dry fat supplemented diets. Also, **EL-Gabri (2005)** indicated that broilers fed CDF, KDF and DDF (all supplemented diets) increased both total plasma lipids and total cholesterol values as compared to the control group. While, **El-Metnawy (2005)** observed that the total plasma lipids and cholesterol in broiler chicks were not significantly affected by feeding diet containing different oils and dry fat sources.

Results with plasma calcium and phosphorus (Table 7) showed that broiler groups fed the control diet gave the highest ($P<0.05$) values of plasma Ca and P (10.0 and 6.68 mg/100ml, respectively). While, the other groups of chicks which fed different sources of dry fats had lower plasma Ca and P content which ranged between 6.92-7.28 mg/100ml for Ca and 3.25-4.74 mg/100 ml for P.

The obtained results are in conformity with the findings of **Watkins and Southern (1992)** who found that dietary fat decreased significantly plasma calcium concentration and **Ramadan (2005)** who found that the highest content of total phosphorus and calcium were recorded for the chicks fed the control diet.

Economic efficiency:

The averages of costs and economic efficiency (feed cost/ Kg weight gain) and relative economic efficiency (%) for the different treatments compared to the control one are tabulated in Table (8).

It was observed that the lesser feed cost/ Kg gain was obtained for broiler of T2 containing KDF (2.83 LE) followed by those of T5 which fed KDF + CDF diet (2.93 LE). The relative economic efficiency for the mentioned treatments were 94.97 and 98.32 %, respectively compared to the control (100 %).In addition , that of chicks fed KDF + DDF mixture (T6) was more close to the control (99.33%). However, chicks fed CDF (T3), DDF (T4) or their mixtures (T7 and T8) had recorded higher feed cost/kg gain compared to the control (102.01; 105.37; 102.68 and 105.03%, respectively).This may be attributed either to lower weight gain (T3, T8) or higher feed consumption and feed cost (T4).Such reasons led to increase the cost of feed needed to obtain one kg of weight gain of these treatments. This means that there were considerable saving of feed cost per kilogram gain of broiler due to feeding dry fat sources, particularly KDF either solely (T2) or combined with CDF (T5) or DDF (T6).

It is concluded that supplementing broiler diet with 4% kem dry fat (KDF) is beneficial to improve growth performance, carcass characteristics and return from feeding, compared to both CDF and DDF.

Table (1): Composition and chemical analysis of starter diets.

Ingredients	Control	Treatments*						
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Yellow corn	66.03	59.72	58.55	58.70	57.06	58.29	58.15	58.17
Soybean meal (48%)	21.66	29.14	31.42	31.89	33.50	32.26	31.82	31.22
Corn-gluten meal (60%)	8.52	3.50	2.40	1.60	2.00	1.60	2.40	2.80
Bone meal	2.67	2.65	2.62	2.77	2.43	2.78	2.62	2.82
Sodium chloride	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Vit. &Min mix**.	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
L-Lysine HCl	0.25	0.09	-	-	-	0.05	-	-
Calcium carbonate	0.17	0.13	0.20	0.22	0.20	0.20	0.20	0.17
DL-Methionine	0.05	0.12	0.16	0.17	0.16	0.17	0.16	0.17
Dry-fat	-	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Total	100	100	100	100	100	100	100	100
Chemical analysis %								
Crude protein	21.92	21.79	21.92	21.64	22.11	21.85	21.90	22.09
Crude fiber	2.19	2.71	2.83	2.39	2.36	2.43	2.81	2.46
Ether extract	2.69	4.41	6.14	6.42	5.48	5.72	6.41	5.82
Calculated values:* **								
ME (k cal/kg)	3100	3100	3116	3120	3100	3100	3116	3100
Crude protein %	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Crude fiber %	2.41	2.98	2.62	2.86	2.85	2.85	2.62	2.78
Ether extract %	2.94	4.65	5.91	6.52	5.26	5.55	6.22	5.66
Calcium %	1.00	1.00	1.19	1.00	1.01	1.00	1.07	1.09
Av. Phosphours %	0.45	0.45	0.45	0.47	0.45	0.47	0.45	0.45
Lysine %	1.15	1.15	1.17	1.16	1.15	1.21	1.17	1.17
Methionine %	0.48	0.49	0.49	0.50	0.50	0.50	0.49	0.50
Meth + Cys.	0.85	0.85	0.85	086	0.85	0.85	0.85	0.85
C/P ratio	140	140	143	141	140	140	143	140
Price L.E/ton	1420	1425	1400	1428	1416	1411	1416	1400

* T_1 (Cont.); T_2 (KDF); T_3 (CDF); T_4 (DDF); T_5 (KDF+CDF); T_6 (KDF+DDF); T_7 (CDF+DDF); T_8 (KDF+CDF+DDF).

** Supplied per kg diet: Vit. A, 12000 IU; Vit. D_3, 2200 ICU; Vit. E, 10 mg Vit. B12, 4 mg: Vit. B6, 1.5 mg; B12, 10 mg; nicotinic acid, 20 mg; Folic acid, 1 mg Pantothenic acid, 10 mg; Biotin, 50 mg; Choline chloride, 500 mg; Copper, 10 mg; Iron, 30 mg; Manganese, 55 mg, Zinc, 50 mg; Iodine, 1 mg and Selenium, 0.1 mg.

******* According to the **NRC (1994).**

Table (2): Composition and chemical analysis of finisher diets.

Ingredients	Control T_1	Treatments*						
		T_2	T_3	T_4	T_5	T_6	T_7	T_8
Yellow corn	70.59	64.81	62.98	62.91	63.29	63.65	63.36	63.22
Soybean meal (48%)	14.59	24.03	27.80	28.06	27.70	27.30	27.60	27.73
Corn gluten meal, (60%)	11.20	3.65	1.80	1.60	1.56	1.60	1.60	1.60
Bone meal	2.66	2.71	2.67	2.66	2.68	2.68	2.67	2.68
Sodium chloride	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Vit., & Min. mix**	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
L-Lysine HCl	0.31	0.08	-	-	-	-	-	-
DL-Methionine	-	0.07	0.1	0.12	0.12	0.12	0.12	0.12
Dry-fat	-	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Total	100	100	100	100	100	100	100	100
Chemical analysis%:* **								
Crude protein	19.92	19.83	20.34	20.21	19.94	19.89	20.23	20.11
Crude fiber	2.23	2.41	2.01	2.41	2.53	2.92	2.94	2.8
Ether extract	2.73	4.52	6.23	6.82	5.32	5.43	6.49	5.49
Calculated values:								
ME (k cal/kg)	3150	3150	3150	3145	3145	3150	3150	3150
Crude protein %	20.00	20.00	20.00	20.00	20.19	20.00	20.00	20.00
Crude fiber %	2.72	2.89	2.58	2.76	2.73	2.76	2.67	2.69
Ether extract %	3.08	4.79	6.05	6.66	5.40	5.69	6.36	5.81
Calcium %	0.92	0.95	1.20	0.96	1.07	0.96	1.08	1.04
Av. phosphours %	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Lysine %	1.00	1.00	1.04	1.03	1.00	1.16	1.03	1.03
Methionine %	0.43	0.42	0.43	0.43	0.42	0.43	0.43	0.43
Meth + Cys.	0.78	0.75	0.75	0.76	0.75	0.75	0.76	0.75
C/P ratio	157	157	157	157	157	157	157	157
Price L.E/ton	1428	1369	1345	1371	1348	1373	1358	1344

*T_1 (Cont.); T_2 (KDF); T_3 (CDF); T_4 (DDF); T_5 (KDF+CDF); T_6 (KDF+DDF); T_7 (CDF+DDF); T_8 (KDF+CDF+DDF).

** Supplied per kg diet: Vit. A, 12000 IU; Vit. D_3, 2200 ICU; Vit. E, 10 mg Vit. B12, 4 mg: Vit. B6, 1.5 mg; B12, 10 mg; nicotinic acid, 20 mg; Folic acid, 1 mg Pantothenic acid, 10 mg; Biotin, 50 mg; Choline chloride, 500 mg; Copper, 10 mg; Iron, 30 mg; Manganese, 55 mg, Zinc, 50 mg; Iodine, 1 mg and Selenium, 0.1 mg.

******* According to the **NRC (1994).**

Table (3): Fatty acids profile (%) and apparent metabolizable energy of the studied commercial dry fat products:

Fatty acid	**Dry fat product**		
	KDF	**CDF**	**DDF**
Lauric ($C_{12:0}$)	0.72	1.12	3.95
Myristic ($C_{14:0}$)	2.56	1.55	2.37
Palmitic ($C_{16:0}$)	25.54	29.84	32.30
Stearic ($C_{18:0}$)	1.62	0.00	0.00
TSFA*	30.71	35.51	38.88
Oleic ($C_{18:1}$)	48.31	48.09	33.07
Linoleic ($C_{18:2}$)	16.35	15.69	26.95
Linolenic ($C_{18:3}$)	0.78	0.00	0.00
TUSFA**	65.44	63.92	60.02
Tu/ Ts ***	2.13	1.80	1.54
Calculated AME** Kcal/g**	8.294	8.134	7.975

* T.S.F.A: total saturated fatty acids.
** T.U.S.F.A: total unsaturated fatty acids.
*** Tu/ Ts: Indicate the ratio between the total unsaturated and total saturated fatty acids.
****AME (MJ/Kg) = $37.046-11.994\ xe^{(-0.675xTu/Ts)}$

Table (4): Effect of studied dry fat sources on growth performance and performance index of Arbor Acres broilers.

Item / Treatment	Initial LBW (g)[1]	FLBW[2] (g)	BWG[3] (g)	FI[4] (g)	FC[5] g feed/g gain	EPEI %
Control (T1)	41.0 ± 0.43	1846^{ab}± 20.17	18.05^{ab}± 19.91	3778^{bc}± 17.03	2.09^{de}± 0.02	171.24
KDF (T2)	40.8 ± 0.18	1885^{a} ± 14.68	1845^{a}±14.66	3748^{c}± 32.21	2.03^{e} ± 0.01	180.03
CDF (T3)	41.1± 0.18	1757^{bc} ± 45.99	1716^{bc} ± 45.71	3803^{bc} ± 14.81	2.22^{abc} ±0.05	156.45
DDF (T4)	40.7± 0.40	1835^{ab}±28.61	1794^{ab}± 28.46	4032^{a} ±15.11	2.25^{b}±0.03	159.41
KDF + CDF (T5)	40.5 ± 0.28	1801^{ab} ± 37.90	1760^{ab} ± 37.88	3790^{bc}±30.91	2.15^{bcd} ± 0.04	162.31
KDF + DDF (T6)	41.1± 0.43	1848^{ab} ± 18.82	1806^{ab} ± 18.63	3841^{b} ± 21.99	2.12^{cde} ± 0.02	169.18
CDF + DDF (T7)	40.8 ± 0.36	1772^{b}± 36.41	1731^{b}±36.73	3824^{bc}±22.30	2.21^{abc}±0.03	158.05
KDF + CDF + DDF (T8)	40.3 ± 0.26	1670^{c} ± 36.19	1630^{c} ± 36.15	3741^{c}± 48.77	2.29^{a} ± 0.03	141.39

a- e : Means within the same column with different superscripts are significantly different ($P< 0.05$).
1-6 : Denote to initial live body weight, final live body weight, body weight gain, feed intake, feed conversion and performance index, respectively. EPEI= (average live body weight X % birds alive)/ (feed conversionX total period)X100 **(Ghazalah et al ., 2006).**

Table (5): Effect of studied dry fat products on digestion coefficients of nutrients and nitrogen balance (%).

Item / Treatment	CP[1]	EE[2]	CF[3]	NFE[4]	OM[5]	NB[6]
Control (T1)	93.11± 0.17	72.50^{bc} ± 2.25	38.32^{cd}± 1.03	85.08± 1.94^{ab}	85.59±0.15	72. 67± 0.93
KDF (T2)	94.53±0.11	82.27^{a}±0.34	38.89^{d}±1.42	89.66±0.19^{a}	89.61±0.29	78.47± 0.41
CDF (T3)	93.47±0.16	78.32^{ab}±1.09	43.90^{ab}±1.48	83.18±1.23^{ab}	86.16±0.79	73.80±1.54
DDF (T4)	92.17±1.23	78.80^{ab}±1.25	39.06^{bcd}±2.68	78.67±3.35^{b}	85.84±0.92	70.02±2.32
KDF + CDF (T5)	93.96±1.04	81.82^{a}±1.91	43.14^{abc}±1.67	84.76±2.62^{ab}	88.68±1.95	73.04±4.65
KDF + DDF (T6)	92.85±0.63	71.02^{c}± 3.61	46.49^{a}±0.56	82.84±2.1 3^{ab}	85.53±0.18	73.78±1.82
CDF + DDF (T7)	92.79±0.48	76.11^{abc}±2.09	42.01^{abc}±1.18	83.91±1.43^{ab}	87.42±0.91	73.78±2.32
KDF + CDF + DDF (T8)	93.41±0.57	79.99^{a}±1.76	43.63^{ab}±0.85	81.12± 2.85^{b}	86.89±2.81	78.33±5.41

a- b : Means within the same column with different superscripts are significantly different ($P< 0.05$).
1-6 : Denote to crude protein, ether extract, crude fiber, nirogen free extract, organic matter and nitrogen blance, respectively.

Table (6): Effect of studied dry fat products on some carcass characteristics and tibia calcium and phosphorus retention.

Item / Treatment	Dressing %	Edible parts %	Abdominal fat pad %	Tibia calcium %	Tibia phosphorus %
Control (T1)	62.5 ±2.86	66.7 ±2.87	1.52±0.14	30.97 ± 0.35	13.83 ± 0.13
KDF (T2)	66.9 ±0.81	71.4 ±0.99	1.87 ±0.29	32.85 ± 0.20	13.87 ± 0.40
CDF (T3)	65.8±1.26	70.6 ±1.44	1.63 ±0.12	32.26 ± 0.85	13.56 ± 0.65
DDF (T4)	65.2 ±1.42	69.5 ±1.42	1.61 ±0.34	30.71 ± 1.24	14.13 ± 0.02
KDF + CDF (T5)	68.2 ±0.12	72.9 ±1.26	2.03 ±0.24	33.07 ± 0.72	13.90 ± 0.40
KDF + DDF (T6)	65.63 ±2.50	70.1 ±2.50	1.32 ±0.20	30.51 ± 0.71	13.89 ± 0.08
CDF + DDF (T7)	67.5 ±0.84	71.5±0.95	1.77 ±0.39	31.12 ± 0.80	13.92 ± 0.32
KDF + CDF + DDF (T8)	67.5±0.95	72.1 ±1.09	0.98 ±0.25	30.94 ± 0.88	13.92 ± 0.28

Table (7): Effect of studied dry fat products on blood cholesterol, total lipids, high density lipoprotein, low density lipoprotein, calcium and phosphorus of Arbor Acers broiler chicks.

Item / Treatmen	Total cholesterol (mg/100ml)	Total lipids (mg/100ml)	High density lipoprotein (mg/100ml)	Low density lipoprotein (mg/100ml)	Calcium (mg/100ml)	phosphorus (mg/100ml)
Control (T1)	103.73^{d} ±1.21	393.66^{d} ±1.02	25.56^{e} ±0.66	78.16^{d} ±1.81	10.01^{a} ±0.66	6.68^{a} ±0.17
KDF (T2)	136.75^{a} ±0.89	445.40^{a} ±1.51	35.76^{a} ±0.64	100.99^{a} ±1.30	7.28^{b} ±0.54	3.25^{c} ±0.07
CDF (T3)	133.68^{ab} ±2.93	429.64^{c} ±0.83	34.62^{ab} ±0.23	99.05^{ab} ±2.88	7.12^{b} ±0.56	4.43^{b} ±0.23
DDF (T4)	125.64^{c} ±1.66	443.31^{a} ±1.42	32.68^{d} ±0.26	92.96^{c} ±1.78	6.93^{b} ±0.23	4.62^{b} ±0.05
KDF + CDF (T5)	128.99^{bc} ±2.40	425.83^{c}±2.10	33.75^{bcd} ±0.16	95.24^{abc} ±2.25	7.11^{b} ±0.16	3.93^{bc} ±0.04
KDF + DDF (T6)	130.94^{bc} ±1.03	436.72^{b} ±1.61	34.05^{bc} ±0.43	96.89^{abc} ±1.25	7.09^{b} ±0.51	4.06^{bc} ±0.31
CDF + DDF (T7)	127.12^{c} ±0.87	423.32^{c} ±1.93	32.98^{cd} ±0.36	94.14^{bc} ±0.80	7.07^{b} ±0.29	4.74^{b} ±0.56
KDF + CDF + DDF (T8)	125.52^{c} ±1.45	429.34^{c} ±3.98	32.46^{d} ±0.23	93.05^{bc} ±1.62	6.92^{b} ±0.70	4.10^{bc} ±0.36

a- d : Means within the same column with different superscripts are significantly different ($P < 0.05$).

Table (8): Effect of studied dry fat sources on the economical efficiency of broilers.

Dietary treatments	Weight gain (Kg)	Feed consumption (g)	Feed cost (L.E)	Economical efficiency[1] (L.E)	Relative economical efficiency[2]
Control (T1)	1.80	3778	5.38	2.98	100
KDF (T2)	1.84	3748	5.22	2.83	94.97
CDF (T3)	1.71	3803	5.20	3.04	102.01
DDF (T4)	1.79	4032	5.62	3.13	105.37
KDF + CDF (T5)	1.76	3790	5.15	2.93	98.32
KDF + DDF (T6)	1.80	3841	5.33	2.96	99.33
CDF + DDF (T7)	1.73	3824	5.29	3.06	102.68
KDF + CDF + DDF (T8)	1.63	3741	5.11	3.13	105.03

1- Feed cost/ Kg gain (L.E).
2- Assuming that the relative economical efficiency of the control group equals 100.

REFERENCES

Aggoor, F.A.M.; Y.A.Attia and E.M.A. Qota (2000). *A study on the energetic efficiency of different fat sources and levels in broiler chick fed vegetable diets. J.Agric.Sci., Mansoura Univ., 25 (2) 801-820*

Association of Official Analytical Chemists (A. O.A.C.), (1990). *Official Methods of Analysis 15th ed. Association of Official Analytical Chemists, Washington, DC.*

Atteh, J.O.; S. Lesson and R.J. Julian (1983). *Effects of dietary saturated, unsaturated fatty acids and calcium levels on performance and mineral metabolism of broiler chicks. Poultry. Sci., 62: 2403- 2411.*

Cherry, H.A. (1982). *Non caloric effects of dietary fat and celluose on the voluntary feed consumption of White Leghorn chickens. Poult. Sci.,61:345-350.*

Dale, N. M. and H.L. Fuller (1979). *Effect of low temperature, diet density and pelleting on the performance of broilers for high fat rations. Poult. Sci., 58:1336-1339.*

Duncan, D.B. (1955). *Multiple Range and Multiple F tests. Biometric, 11:1- 42.*

EL- Gabri, Hoda, E. (2005). *Response of poultry performance to non-traditional energy sources in diets. Ph. D. Thesis, Faculty of Agricultural, Cairo University, Egypt .*

El-Husseiny, O.M.; S. Abou El-Wafa and M. Shabaan (2000). *Response of broiler performance to diets containing raw and treated soybean with enzyme or sodium metabisulphite. Egyptian Poult. Sci., 20(4): 721-739.*

El- Metnawy, T.R. (2005). *Evaluation of dietary fat in broiler rations. Ph.D Thesis, Faculty of Agricultural. Al-Azher University, Egypt.*

Ghazalah, A.A.; El-Nagmy and A.S.Bahakim (2006). *Response of broiler chicks to low protein diets supplemented with probiotics preparations. Egyptian Poult. Sci., 26(II):609-627.*

Hamilton, R.J. (1995). *Development in oils and fats. London, Glasgow, New York, Tokyo.*

Jakobsen, P.E.; K. Gertov and S. H. Nilson (1960). *Digestibility experiments with poultry. (in Danish).Beret. Forsagslab. Kobenhavn, 56:1-43.*

Mateos, G.G. and J. L. Sell (1981). *Influence of fat and carbohydrate source on rate of food passage of semi-purified diets for laying hens. Poult. Sci., 60:2112-2119.*

Mateos, G.G.; J. L. Sell and J. A. Eastwood (1982). *Rate of food passage (transit time) as influenced by level of supplemental fat. Poult. Sci., 61:94-100.*

NRC (1994). *Nutrient Requirments of poultry. National Research Council,9th revised ed. Nat. A cad. Press, Washington, D.C., USA.*

Ramadan, Nehad, A. (2005). *Broiler performance as affected by dietary energy source and level. Ph D. Thesis, Faculty of Agriculture, Cairo University, Egypt.*

SAS Institute (1990). *SAS ® STAT User's Guide: Statistics. Version 6,4th Edition. SAS Institute Inc, Cary, NC.*

Smith, M.O; K.K.Soisuvan and L.C.Miller(2003). *Evaluation of dietary calcium level and fat sources on growth performance and mineral utilization of heat-distressed broilers. International Journal of Poult.Sci., 2: 1-23*

Soliman, M.A.; A.A. Mohamed; A.E.A. Hagrass and S.A. Shabrawy (1979). *Fatty acids composition of buffaloes milk fat. Egyptian J. Dairy Sci., 7: 177-182.*

Watkins, K.L. and I.L. Southern (1992). *Effect of dietary sodium Zeolite and graded levels of calcium and phosphorus on growth, plasma and tibia characteristics of chicks. Poultry, Sci., 71: 1048-1058.*

Wiseman, J. (1984). *Fats in Animal Nutrition. University of Nottingham School of Agriculture. London, Wellington.*

Wiseman, J.; F. Salvador and J.Craigon (1991). *Prediction of the apparent metabolizable energy content of fats fed to broiler chicks. Poultry Sci., 70: 1527-1533.*

الملخص العربى

تأثير إستخدام الدهن الجاف على الأداء الإنتاجي، معاملات الهضم ، قياسات الذبيحة ومكونات الدم لكتاكيت اللحم

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أجريت تجربة لدراسة تأثير استخدام مصادر تجارية مختلفة من الدهن الجاف (كيم فات، دهن كالسيومي جاف، دونا فات) كل على حدة أو فى مخاليط ثنائية أو ثلاثية بمستوى إضافة 4% على الأداء الإنتاجي ومعاملات هضم العناصر الغذائية وبعض صفات الذبيحة و محتوى عظام الساق من الكالسيوم والفوسفور وبعض قياسات الدم والكفاءة الإقتصادية.

إستخدم فى الدراسة عدد 480 كتكوت أربور إيكرز عمر يوم مقسمة عشوائيا على 8 مجموعات (كل مجموعة 60 طائر) فى ستة مكررات (كل مكرر 10 طيور)، تم تسكين الطيور تحت ظروف رعاية واحدة وغذيت على علائق البادى (22% بروتين خام، 3100 ك. كالورى طاقة ممثلة/ كجم) من صفر – 4 أسبوع ثم علائق الناهى (20% بروتين خام، 3150 ك. كالورى طاقة ممثلة/ كجم) من عمر 5 – 7 أسابيع وفى نهاية الاسبوع السابع أجريت تجارب الهضم لدراسة تأثير المعاملات المختلفة على معاملات هضم المركبات الغذائية، ميزان النيتروجين والمحتجز من العناصر المعدنية. وفى النهايه اجريت اختبارات الذبح وتقدير بعض قياسات الدم فضلا عن التقييم الاقتصادى للمعاملات التجريبيه.

أظهرت النتائج أن الكتاكيت المغذاة على علائق تحتوى على كيم فات أعطت رقميا أعلى وزن جسم نهائى واعلى معدل كلى للنمو وأفضل كفاءة تحويلية للغذاء وأفضل عائد إقتصادى لانتاج 1 كجم لحم. اظهرت عليقة المقارنة أقل النتائج لهذا الصفات المدروسة. أعطت

معاملة كيم فات أفضل القيم لمعامل هضم البروتين الخام ومستخلص الاثير مقارنة بباقى المعاملات التجريبيه الاخرى سواء التى أضيف إليها مصادر الدهون الجافه المستخدمة لها أو مجموعة المقارنة، بينما لم تسجل اختلافات معنوية فى معامل هضم المادة العضوية أو ميزان النيتروجين بين المجموعات المختلفة. كما تحسنت صفات الذبيحة باضافة أى من مصادر الدهون الجافة محل الدراسة. سجلت مجموعه المقارنه معنويا اقل القيم لمحتوى بلازما الدم من الكولسترول الكلى والليبيدات مقارنة بالمجموعات المضاف لها الدهون الجافه. فى حين ارتفعت قيم البلازما من الكالسيوم والفوسفور فى مجموعة الكنترول مقارنة مع المعاملات التجريبيه الاخرى.

لم تختلف قيم محتوى عظمة الساق فى كل من الكالسيوم والفوسفور معنويا بين معاملات التجربة .من الناحية الاقتصادية سجلت مجموعة الكتاكيت المغذاه على الدهن الجاف كيم فات أقل تكلفة للغذاء اللازم للحصول على كيلو جرام من الزيادة فى وزن الجسم.

يستنتج من هذه الدراسة أن اضافه الدهن الجاف كيم فات لعلائق كتاكيت اللحم يمكن أن يحسن من الأداء الإنتاجي لها وكذا معامل هضم المركبات الغذائية المختلفه فضلا عن خفض تكاليف التغذية التي تلزم لإنتاج كيلو جرام من الزيادة في الوزن الحي مقارنة بمصادر الدهن الجاف الأخرى.