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EFFECT OF SUPPLEMENTATION BROILER DIETS WITH DIFFERENT LEVELS OF POLYUNSATURATED FATTY ACIDS ON PRODUCTIVE AND SOME BIOCHEMICAL TRAITS

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Abstract

The study aimed to evaluate of adding multiple sources of polyunsaturated fatty acids (PUFA's) to diets and their effects on productive performance and some biochemical traits of broiler. The study was conducted at the poultry farm belong to department of animal production/College of Agriculture-University of Anbar from 26/12/2017 to 6/2/2018 (42 day). A total of 210, One-day old unsexed Ross (308) chicks with average weight 40 gm., were randomly distributed to seven treatments with three replicates per treatment (10 chicks/ replicate). Birds in T_1 were fed a basal diet used as control, T_2 included addition of Conjugated Linoleic Acid (CLA) with (3 gm/kg feed), T_3 included addition of Flaxseed Oil (FXO) with (3 gm/kg feed), T_4 included addition of Fish Oil (FO) with (3 gm/kg feed), T_5 included addition of (CLA) and (FXO) with (1.5+1.5 gm/kg feed)respectively, T_6 included addition of (CLA) and (FO) with (1.5+1.5 gm/kg feed)respectively, T_7 included addition of (CLA), (FXO) and (FO) with (1+1+1 gm/kg feed)respectively. All diets were formulated to meet the same requirements. Broiler were fed with water and feed *ad libitum*. The data of Body Weight Gain (BWG), Feed Consumption (FC) and Feed Conversion Ratio (FCR) were recorded weekly.

The results of supplementation CLA, FXO and FO with (1+1+1 gm/kg feed) respectively (T_7) had significant increase ($P<0.05$) in live body weight, Body weight gain accumulative and relative growth rate as compared with T2 addition of (CLA) with (3 gm/kg feed) and T_1 (Control). Also results revealed significant improvement in Accumulative feed conversion ratio of birds in T_2, T_3, T_4, T_5, T_6 and T_7 comparison with T_1 (Control). No significant differences recorded between treatments in Feed consumption and Blood biochemical traits included: Globulin, Albumin, Glucose, High density lipoprotein (HDL), Low density lipoprotein (LDL), Very low density lipoprotein (VLDL), Triglycerides (T.G) and Cholesterol (T.Chol.) at 42 days of age.

Key words : PUFA, Productive performance, biochemical constitutes, broiler.

Introduction

Presently consumers prefer poultry meat for several reasons. The most important being the health because lower fat and better fatty acid composition as compared to other animal fats, In poultry, it is common that dietary fat has a great influence on fatty acid profiles of poultry meat (Crespo and Esteve-Garcia, 2001; Krejcí-Treu *et al.,* 2010). Therefore, some nutritional strategies including changing dietary fatty acid profile have a great potential in converting poultry meat from a simple animal protein source to a valuable functional product. Polyunsaturated fatty acids (PUFAs) are best sources of high-energy oils and their properties are long-lasting in the gastrointestinal tract, which helps digestion and absorption, as well as their importance in growth, development and deposition of omega (n-3) in poultry meat, improving immunity levels to prevention of various diseases. Conjugated linoleic acid (CLA) is a unsaturated essential fatty acid consisting of 18 carbon atoms and contain two double bonds differs in their isomeric forms. its belong to omega-3 (Hur *et al.,* 2007). The consumption of CLA has been associated with a reduction of cardiovascular diseases and some types of cancers (Fritsche and Steinhart, 1998; MacDonald, 2000). However, the dietary inclusion of CLA to broiler diets is one of methods that improve productive performance by reducing fat deposition and increasing muscle growth (Ahnand Du, 2002).

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Commonly used dietary feeds supplemented with (n-3) include FO which provides Eicosapentaenoic acid (EPA), Docosa hexaenoic acid (DHA) and FXO which provides α-Linolenic acid (ALA) are important for a number of bodily functions, including muscle activity, blood clotting, digestion, fertility, and cell division and growth. DHA is important for brain development and function. Alpha Linoleic Acid (ALA) is an "essential" fatty acid, meaning that people must obtain it from food or supplements because the body cannot manufacture it (Kwak *et al*., 2012). Flaxseed is the richest plant source of the (n-3) fatty acid *i.e.* ALA (Gebauer *et al.,* 2006). Flaxseed oil is low in saturated fatty acids 9%, moderate in monosaturated fatty acids MUFA 18%, and rich in polyunsaturated fatty acid PUFA 73% (Cunnane *et al*., 1993). Pellizzon *et al.,* (2007) mentioned flaxs eed oil contain (ALA) the major fatty acid ranging from 39.00 to 60.42% followed by oleic, linoleic, palmitic and stearic acids, which provides an excellent (n-6:n-3) fatty acid ratio of approximately (0.3:1). Although, FXO is naturally high in anti-oxidant like tocopherols and betacarotene, traditional FXO gets easily oxidized after being extracted and purified (Holstun and Zetocha, 1994). The bioavailability of ALA is dependent on the type of Flaxseed (ALAhas greater bioavailability in oils than seeds) (Austria *et al*., 2008). Therefore, the aim of this study is to evaluate effect of different sources of PUFAs on production performance and some biochemical constitutes in broiler chicken (Ross 308).

Materials and Methods

Experimental design and feeding

A total of 210 broiler chicks unsexed (Ross 308) were obtained from a commercial hatchery. At hatch, broilers were weighed with an average body weight 40 gm, and allotted to pens and dietary treatments so that the initial mean weight was similar among treatment groups and placed in 20 floor pens (12 birds/pen) and randomly assigned to seven dietary treatments (Three replicates/ treatment). T_1 were fed a basal diet used as control, T_2 included addition of Conjugated Linoleic Acid (CLA) with (3 gm/kg feed), T_3 included addition of Flaxseed Oil (FXO) with (3 gm/kg feed), T_4 included addition of Fish Oil (FO) with (3 gm/kg feed), T_5 included addition of (CLA) and (FXO) with (1.5+1.5 gm/kg feed) respectively, T_6 included addition of (CLA) and (FO) with (1.5+1.5 gm/kg feed) respectively, T7 included addition of (CLA), (FXO) and (FO) with (1+1+1 gm/kg feed) respectively. The experiment lasted for 42 days. Temperature was controlled and gradually decreased from 35°C on the first day to 22°C at 21 days of age. Broilers were fed a starter diet (0 to 14 d of age), grower diet (15 to 28 d of age) and a finisher diet (29 to 42 d of age). Diets were formulated to be adequate in all nutrients (NRC, 1994). Each pen was equipped with manual plastic feeder and an automatic nipple drinker, Water and experimental diets were provided *ad libitum.* The ingredients and chemical composition of the diets are presented in table 1. All chicks were individually weighed and Feed Intake (FI) were recorded at weekly intervals. Based on the recorded data, Feed Conversion Ratio (FCR), and Body Weight Gain (BWG) were subsequently calculated based on performance values. On day 42 of experiment, six birds represented treatment were randomly selected, allowed to fast for 12 hours, slaughtered. Chemical analyses of plasma were carried out for quantitative determination of blood parameters (Total Proteins, Albumin, Globulin, Triglycerides, Cholesterol, HDL-cholesterol, LDL-cholesterol and VLDL-cholesterol), were determined using commercial kits, following the same steps as

Table 1: Ingredient and Chemical composition calculated of the diets.

Ingredients	Starter	Grower	Finisher
Yellow corn	52.8	58.65	62.4
Wheat	10	10	10
Protein concentrate *	5	5	5
Soybean meal, (48%)	29.8	24	20.5
Vegetable oil	0.3	0.3	0.3
Dicalcium phosphate	0.5	0.35	0.2
Limestone	1.14	1.21	1.22
DL-methionine	0.17	0.17	0.13
Lysine	0.19	0.22	0.15
Salt	0.1	0.1	0.1
Total	100	100	100
Chemical composition, Calculated**			
ME, kcal/kg	2940	2995	3035
CP, %	21.94	19.66	18.29
Crude fat	3.1	3.3	3.4
Crude fibre	2.73	2.64	2.58
Met. + Cys.	1.03	0.97	0.9
Lysine	1.39	1.26	1.11
Ca	0.9	0.88	0.83
Available phosphorus	0.44	0.41	0.38

* Protein concentrate contains: 40% CP, 5% Ca,3.7% Methionine, 4.12% Methionine and Cystine, 3.85% Lysine , 4.68% AP, Metabolizable Energy 2107 Kcal kg^{-1}, 2.50 mg Sodium, 1.70 mg threonine, 0.42mg Tryptophan, 4.20 mg choline and each 1 kg of this concentrate contain: 100000 IU vitamin A, 33000; IU vitamin D3, 100 mg; vitamin E, 2.55 mg; vitamin K3, 25 mg; vitamin B1, 10 mg; B2, 50 mg; vitamin B6, 24 mg vitamin B12; 51 mg niacin; 1.5 mg folic acid; 15 mg; biotin,500 µg and 13.5 mg pantothenic acid.

**Calculated based on feed consumption Tables of (NRC,1994).

described by manufactures.

Statistical analysis

Data obtained from the study were analyzed using computer software by statistical analysis system SAS (2001) and significant differences between means were determined by using Duncan´s multiple ranges test (Duncan, 1955).

Results

The effects of diets supplementation with multiple sources of Polyunsaturated fatty acidson performance are shown in table 2. The results indicated no significant differences between treatments during the period (0-14) days and (15-28) days of age in body weight while a significant increase in live body weight for birdsin T_7 (1+1+1%) of CLA, FXO and FO respectively as compared with other treatments at sixth week, also T_2,T_3,T_4,T_5, and T_6 recorded significant increase as compared to control treatment, which recorded the lowest average in live body weight at 42 days of age. Also, the results of table 2. showed that birds fed multiple sources of PUFA's recorded higher rates of BWG as compared to control treatment at 29 and 42 days of age. Moreover, results indicated significant increase ($P \leq 0.05$) in accumulative body weight gain of birds fed the additives as compared with control treatment which recorded the lowest rate of accumulative body weight gain. No significant differences between treatments during experiment period in FI.

Dietary PUFA' srecorded a significant improvement in feed conversion ratio as compared to control treatment at 14 days. At the age 28 and 42 days, supplementation additions showed a significant improvement in feed conversion ratio and accumulative feed conversion ratio ($P \leq 0.05$) while control treatment recorded the worst rate. A significant improvement in production performance due to biological function of PUFA's. Zhang *et al.,* (2007) who reported that dietary CLA has positively effects related with the total amounts of Monounsaturated Fatty Acids (MUFAs) and Saturated Fatty Acids (SFAs), respectively, in breast muscle. These results were in agreement with the finding of Javadi *et al.,* (2007) dietary CLA resulted in a higher percentage of SFAs and lower percentages of MUFAs and PUFAs in deposition fat in carcass of broilers. Also, Qasim *et al.,* (2017) mentioned that CLA have the ability to stimulate to produce and increase growth hormones in pituitary gland which transport to liver cells. Furthermore, CLA works as gene

Table 2: Body weight , Body weight gain, feed intake and feed conversion ratio of broilers fed with different levels of multiple sources of Polyunsaturated fatty acids.

Items	Dietary treatments*							SEM	*P*-value
	T_1	T_2	T_3	T_4	T_5	T_6	T_7		
BW (g)									
0-14 day	373	336	330	338	345	346	358	21.7	N.S
15-28 day	1367	1339	1348	1389	1337	1353	1356	61.8	N.S
42 day	2727 c	2860 b	2875 ab	2951 ab	2975 ab	2890 ab	3001 a	71.9	0.0068
BWG (g)									
0-14 day	333	296	290	298	305	306	318	14.76	N.S
15-28 day	994	1003	1018	1051	992	1007	998	27.95	N.S
29-42 day	1360 b	1521 ab	1527 ab	1562 ab	1638 a	1537 ab	1645 a	42.4	0.0196
0-42 day	2687 b	2820 a	2835 a	2911 a	2935 a	2850 a	2961 a	71.95	0.0068
FI (g)									
0-14 day	375	400	392	412	426	430	411	16.25	N.S
15-28 day	1653	1497	1508	1508	1541	1492	1548	32.8	N.S
29-42 day	2656	2645	2640	2701	2809	2580	2797	53.0	N.S
0-42 day	4684	4552	4540	4621	4776	4502	4756	159.0	N.S
FCR									
0-14 day	1.12 c	1.35 a	1.35 a	1.38 a	1.39 a	1.40 a	1.29 b	0.119	0.0198
15-28 day	1.66 a	1.49 c	1.48 c	1.43 c	1.55 b	1.48 c	1.55 b	0.074	0.0004
29-42 day	1.95 a	1.73 b	1.72 b	1.72 b	1.71 b	1.68 b	1.70 b	0.106	0.0072
0-42 day	1.74 a	1.61 b	1.60 b	1.59 b	1.63 b	1.58 b	1.61 b	0.045	0.0152

* : T_1= Control, T_2= 0.3% CLA, T_3= 0.3% FXO, T_4= 0.3% FO, T_5= (1.5+1.5) % CLA+FXO, T_6= (1.5+1.5)% CLA+FO, T_7= (1+1+1)% CLA+FXO+FO.

a–c : Means in the same row with different superscripts differ (P < 0.05). N.S: Not significant.

Table 3: Biochemical traits of broilers fed with different levels of multiple sources of Polyunsaturated fatty acids.

Items	Dietary treatment							SEM	*P*-value
	T_1	T_2	T_3	T_4	T_5	T_6	T_7		
Globulin (*gm/dl*)	1.93	2.13	1.76	1.90	2.23	2.03	1.73	0.511	N.S
Albumin(*gm/dl*)	4.10	4.33	4.43	4.63	4.30	4.20	3.93	0.411	N.S
Protein(*gm/dl*)	6.03	6.46	6.20	6.53	6.53	6.23	5.66	0.840	N.S
Glucose(*mg/dl*)	197	199	202	180	185	177	184	11.9	N.S
Triglycerides(*mg/dl*)	67.3	72.3	64.0	66.0	64.0	61.0	63.3	12.5	N.S
Cholesterol(*mg/dl*)	137	147	147	139	150	146	146	13.0	N.S
HDL(*mg/dl*)	43.3	47.6	48.0	39.3	49.0	47.6	47.3	4.98	N.S
LDL(*mg/dl*)	80.3	85.0	86.6	86.3	89.0	86.0	86.6	7.94	N.S
VLDL(*mg/dl*)	13.3	14.6	13.0	13.3	12.6	12.3	12.6	2.69	N.S

*: T_1= Control, T_2= 0.3% CLA, T_3= 0.3% FXO, T_4= 0.3% FO, T_5= (1.5+1.5) % CLA+FXO, T_6= (1.5+1.5)% CLA+FO, T_7= (1+1+1)% CLA+FXO+FO.

a–c : Means in the same row with different superscripts differ (P < 0.05). N.S: Not significant.

receptor for growth hormone and genetic expression. Thus, dietary CLA was positively related with total amounts of PUFAs. Some studies showed that lipid and protein deposition can be change by supplementation of PUFAs either n-3 or n-6 to diets. Broilers fed n-3 or n-6 PUFA's achieved a significant improvement in productive traits. Clarke *et al.,* (1990) observed dietary n-3 PUFA's stimulate *in vitro* modulation of gene transcription rates for mRNA (fatty acid synthesize) which shown a rapid response at 3 hours. Moreover, PUFA's may play a role to modifying membrane fatty acid composition and hence altering hormone release (Clarke and Jump, 1996). Increased availability of n-3 and n-6 PUFA's may change carcass composition by stimulating fatty acid oxidation, Thus, decreasing the availability of fatty acids for triglycerides synthesis and less triglycerides available for storage in adipose tissues and this is probably due to the fact that fish oil have ability to improves the absorption of PUFA's from intestine, which enhance the metabolizable energy because of the dietary fat composition makes it possible to increase diet digestibility and enhance growth rate (Farhoomand and Chekaniazar, 2009). Moreover, FXO and FO could increase the activity and number of lymphocytes in the body and increase the ability to fight disease (Klasing, 1998 ; Kidd, 2004). The significant increase in present study included BW and BWG may be due to the fact that improvement refers to the presence of essential oils in FXO and FO, the rich amount with n-3 lead to activate the bile acids which help in digestion of fats in intestine and increase efficiency of digestion and absorption of feed in intestine which lead to more benefit from diets. Several studies have also reported the role of n-3 and n-6 to improve BW and BWG (Tucker, 2002; Alcicek *et al.,* 2004; Osman *et al.,* 2004 and Abdel-Azeem, 2006). Our results are in agreement with Sahib *et al.,* (2012) that explained the relationship between levels of PUFA's and livability of broiler which lead to improve final BW due to rich amount of FXO and FO with ALA bio converted to EPA and DHA (Stulnig, 2003 Brenna *et al.,* 2009). In addition, Çabuk *et al.,* (2006) found significant improve in productive characteristics of broilers fed mixture of essential oils and significantly improved in FCR which can be attributed to more effective availability of nutrients in diets. However, Al-Daraji *et al.,* (2011) found that supplementation of quail diets with 3% FO and FXO lead to significant improvement in BW. Moreover, Al-Zuhairy and Alasadi (2013) found that FCR were improved significantly ($P \leq 0.05$) in broilers fed diets contained FXO as compared with control group. Also, the results indicated that different types of PUFA's supplementation had no significant ($P<0.05$) effect on FI. Statistical analysis of the experimental data in Table (3) showed non-significant ($P<0.05$) effect on Globulin, Albumin, Protein, Glucose, triglycerides, cholesterol, HDL, LDL and VLDL due to supplementation of different PUFA' sin the feed of broiler birds in comparison to control diet, This finding is in agreement with Alparslan and Özdogan (2006) observed that feeding of FO had no effect on triglycerides, cholesterol and LDL of broilers. Starcevic *et al*., (2014) and Huo *et al*., (2018) also stated that use of FXO had no effect on Albumin, Protein, Glucose, triglycerides, cholesterol of broiler Cobb 500.

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