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Serum Lipids Profile and Production Performance of Broiler Chicken fed Nilotic Silver Cat Fish Oil Supplemented Diet

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Abstract

Fish oil has been used in poultry nutrition to improve performance However, the effect of feeding Nilotic silver cat fish oil had never been studied before. Therefore, this study was designed to evaluate the effect of supplementing Nilotic silver cat fish oil in the diet on the serum lipids profile and production performance of broiler chickens. A total of 90 unsexed one day old (Hubbard15) broiler chicks were used in this experiment. Chicks were distributed in a completely randomized design with three graded levels of silver cat fish oil (0,4 and 6%) (Each treatment contained three replicates with 10 chicks each). Significant ($P < 0.05$) improvement in total weight gain and feed conversion ratio in birds fed 4 and 6% Nilotic silver cat fish oil supplemented diets compared to those fed the control diet. Dietary treatments had no effects on feed intake and mortality rate among. .Birds fed 4 and 6% silver cat fish oil have lower ($P < 0.05$) cholesterol (CH)mg/dL, low density lipids cholesterol (LDL) mg/dL and total triglyceride (Poumès-Ballihaut et al.) mg/dL compared to the control group. High density lipids cholesterol (HDL) mg/dL was not affected by Nilotic silver cat fish oil supplementation. This study concluded that supplementing Nilotic silver cat fish oil in broiler diet significantly improved total weight gain, feed conversion ratio and decreased cholesterol level LDL and TG with no effect on HDL.

Keywords: Functional foods, healthy foods, Life style, human health

Introduction

The growing poultry industry in the Sudan is depending on the utilization of local feed ingredients in order to gain high quality poultry products with lower cost. Functional foods designated to have physiological benefits and / or reduce the risk of chronic diseases and may be similar in appearance to conventional feeds and consumed as a part of regular diet (ARS, 2010). The results of recent worldwide research suggest that dietary and life style factors contributed to

development of many non-infectious diseases including obesity, cardio-vascular and degenerative diseases (Bosma-den Boer et al., 2012, Chakma and Gupta, 2014, Simopoulos, 2016) Supplementing broiler diets with fish oil resulted in a significant increase in n^{-3} poly unsaturated fatty acid (PUFA) Alpha- Linolenic acid (ALA) or its long chain segment such as Escosapentaenoic (EPA) and Docosahexanoic acid (DHA), lower than n^{-6} (PUFA) deposition and n^{-6} : n^{-3} ratio in breast and thigh without affecting organoleptic characters (Kalakuntla et al., 2017, Panda et al., 2016, Panda et al., 2015)Modification of dietary fatty acids composition is one of the most efficient ways to enhance the accumulation of the desired PUFA in chicken meat (Bhalerao et al., 2014). Similarly, using fish oil fat and a mixture sources of fat (Lard + Fish oil) resulted in significant higher body weight gain, EPA and DHA in breast and thigh meat lipids compared to the control (Konieczka et al., 2017). Recently, Abbasi et al., (2019) reported that a remarkable up-regulation was detected the expression on long chain fatty acid desaturated and elongates by nano encapsulated flaxseed oil, they revealed that flaxseed oil – loaded nano emulsion have a potential for targeted delivery and to enrich broiler meat with $omega^{-3}$ fatty acids (EPA and DHA).

The objective of the present study was to evaluate the effect of inclusion of different levels of Nilotic silver cat fish oil on serum lipid profile and production performance of broiler chicken.

Materials and Methods

Study Area

The experiment was conducted at the Poultry Farm of the College of Animal Production, Sudan University of Science and Technology. The average temperature and relative humidity during the experiment ranged between 36-42^{o}C and 9- 19% respectively.

Experimental birds and housing

A total of 90 one day old unsexed broiler chicks (Hubbard 15) were utilized in this study. During the first 5 days, the chicks received multi-vitamins plus ox tetracycline through the drinking water. Birds were kept in an open sided deep litter poultry house. The house was partitioned into nine experimental pens of equal size (1.5X1 m) with enough working allowance. Continuous lighting was provided during the experiment. The experimental house and equipment (feeders and drinkers) were thoroughly cleaned and disinfected before the arrival of the experimental birds. Fresh wood shaving litter was spread in the pens at a depth of 5cm; feed and water were provided *ad libitum* Chicks were vaccinated against Newcastle disease and infectious bronchitis on day 1 (spraying), at 21 days of age Newcastle disease vaccine was administered again through drinking water. At 14 days of age birds were vaccinated against Gumboro disease which was repeated at 21 days of age. Multivitamins were given before and after each vaccination for 5 consecutive days.

Diets formulation

Three isocaloric and isonitrogenous experimental diets were formulated. These diets containing graded levels of Nilotic silver cat fish oil, (T1) (0.0%) which serve as control group, (T2) and (T3) contain 4 and 6% Nilotic silver cat fish oil respectively. The calculation based on the analysis of feed ingredients as outlined by Bolton and Blair, (1974), Suleiman and Mabrouk, (1999).

The diets were formulated to meet the nutrient requirements for broiler as outlined by NRC, (1994) . Table (1) and (2) shows the composition and calculated analysis of the experimental diets respectively.

Preparation of raw fish

Fresh samples of Nilotic silver cat fish (*Bagrus Domac*) were utilized to produce the fish oil.

In order to enhance a successful extraction of the oil, the experimental raw fish material was frozen in a good condition before the commencement of the experiment. The fish was thoroughly washed to remove dirt. The samples were then cut into small sizes to enhance oven drying then gills and intestine were removed. The moisture content of the fish was reduced by oven drying since water is immiscible in oil. The samples were furthered reduced in size and later blended into a finery form according to the methods described in previous study (Abdulkadir et al., 2010)

Fish oil extraction

The extraction of fish oil was carried out using Soxhlet apparatus and n-hexane as a solvent.The extraction was carried out at the boiling point of the solvent.

Parameters assessed

Feed intake and weight gain (g) was weekly and accumulated recorded, feed conversion ratio (g feed/g gain) was accordingly estimated. Mortality rate was recorded when it occurred. At the end of the last experimental week, blood samples were collected from the jugular vein for serum lipid profile analysis.

Serum analysis

Total cholesterol (CH) and high-density lipid cholesterol (HDL) were determined as described by Young, (1997) , while low-density lipid cholesterol (LDL) was calculated by difference. Triglyceride (Poumès-Ballihaut et al.) was also determined as described by Bucolo and David, (1973)

Statistical analysis

Collected data were subjected to the analysis of variance using statistical package for social sciences (SPSS, 2001). Least significant difference test (LSD) was used to assess the significant differences among treatment means (Steel and Torrie, 1980).

Table (1500) Composition of the experimental diets (%)

Diets / **Ingredients**	**Fish oil inclusion rate (%)**		
	0.0	4.0	6.0
Grain sorghum	64.86	50.35	45.0
Groundnut cake	27.79	29.27	30.88
Wheat bran	0.0	9.24	10.96
***Super concentrate**	5.0	5.0	5.0
Fish oil	0.0	4.0	6.0
Dicalcium phosphate	0.52	0.157	0.224
Lime stone	1.61	1.8	1.76

Lysine	0.054	0.027	0.02
Methionine	0.066	0.056	0.056
Multivitamin	0.1	0.10	0.10
Total	100	100	100

*Composition of super concentrate used (%).CP 35,CF3, Crude fat 2.5, Calcium 8.5, Av. Phosphorus 5, Lysine 11,Methionine 4.2, Meth+cyst. 4.5 and ME2000Kcal/Kg.

Table (2) Calculated analysis of the experimental diets

Diets / Components	Fish oil inclusion rate (%)		
	0.0	4.0	6.0
Metabilizable energy MJ/Kg	13.3	13.1	13.1
Crude protein (%)	23.4	23.5	23.5
L.lysine (%)	1.2	1.2	1.2
DL.Methionine(%)	0.5	0.5	0.5
Crude fiber (%)	3.7	4.5	4.7
Calcium (%)	1.1	1.1	1.1
Av. Phosphorus (%)	0.45	0.45	0.45

Results and Discussion

The overall performance results of the present study showed a significant ($P \leq 0.05$) improvement in mean total weight gain (g/bird), final live body weight (g/bird) and feed conversion ratio (g feed/g gain) for birds fed 4 and 6% fish oil compared to those fed the control diet, while no significant differences in feed intake (g/ bird) and mortality rate (Table 3).These results might be due to the rich content of omega-3 fatty acids (EPA) and (DHA) in fish oil (Konieczka et al., 2017)' Growth performance of broiler fed fish oil was found to improve in performance parameters and this improvement might be due to the dietary fat composition which contain type of long-chain fatty acids that make it possible to increase diet digestibility and to stimulate growth and feed efficiency (Konieczka et al., 2017, Saleh et al., 2009). This phenomenon may be explained by the role of n-^{3} poly unsaturated fatty acids (PUFA) in activation of bile, which enhances fat digestion in the intestine, thus increasing the efficiency of feed digestion and absorption (Jameel and Sahib, 2014). The present study results agree to those obtained by previous research (Farhoomand and Checaniazer, 2009, Jameel and Sahib, 2014, Sadeghi et al., 2012) who reported that the supplementation of poultry feeds with fish oil promoted production performance. The same workers mentioned that the energy provided from fish oil has shown excellent energy utilization. These reports may explain the significant improvement in performance parameters (Mean total body weight gain, final live body weight and feed conversion ratio) in the present study. These fatty acids are well

known as essential nutrients for health and important for normal body functions and played a vital role in immune response (Chakma and Gupta, 2014, Simopoulos, 2016, Syadati et al., 2012)The total cholesterol (CH), high density lipids cholesterol (HDL), low density lipids cholesterol (LDL) and Triglyceride (Poumès-Ballihaut et al.) of Nilotic silver cat fish oil are presented in (Table 4)

The results of the effect of Nilotic silver cat fish oil supplementation on lipids profile are shown in Table 5. Cholesterol (CH) level (mg/dl), low density lipid cholesterol (LDL) level (mg/dl) and total triglyceride level (mg/dl) were significantly (P>0.01) decreased by inclusion of fish oil. This results were in accordance with the previous result obtained by other scientist[22] who reported that increasing fish oil was accompanied by increasing n^{-3} PUFA in broiler diet and significantly decreased serum total cholesterol, triglycerides concentration, low density lipids cholesterol (LDL) and very low lipids cholesterol (VLDL) and increased serum high density lipids cholesterol (HDL).This significant decrease might be attributed to the alteration of fluidity and composition of plasma cell walls which known to occur when broiler diets supplemented with fish oil rich in omega[3] fatty acids (EPA) and (DHA).Dietary incorporation of EPA and DHA rich fish oil might have altered the fatty acid composition of meat (Bhalerao et al., 2014, Ibrahim et al., 2018, Konieczka et al., 2017)These results may explain the improvement of lipids profile (Total cholesterol, LDL, HDL and TG) in the present study. On the other hand, many scientific researchers (Shin et al., 2011)reported that incorporation of fish oil in broiler diets significantly improved the balance of n^{-3}: n^{-6} this might be resulted in a significant improvement of lipids profile of broilers fed fish oil in the present study. Also the present study results were in agreement with the results reported by other researcher (Alparslan and Özdogan, 2006, Jameel and Sahib, 2014, Saleh et al., 2009) who indicated that by adding fish oil to broiler diets the amount of triglyceride, cholesterol, total protein, albumin and globulin were decreased and glucose was increased as a result of declined insulin secretion.

Table (3) Overall performance of 6 weeks old broiler chicks

Diets / Parameters	Fish oil inclusion rate (%)			Level of significant
	0.0	4.0	6.0	
Feed intake (g/bird)	2730±17	2980±11	3040±19	NS
Weight gain (g/bird)	1188±8[b]	1600±25[a]	1670±21[a]	*
FCR (g feed/g gain)	2.3±0.03[a]	1.86±0.01[b]	1.82±0.01[b]	*
Mortality (%)	1.73±0.05	1.58±0.08	1.67±0.06	NS

*Values are means of 30 birds/ treatment.
[a,b] Means in rows followed by different superscript letters are significantly different .
*Significant at (P<0.05)
NS: Not significant

Table (4) Lipids profile of Nilotic silver cat fish oil (g/dL)

Components	Value
Cholesterol (CH)	178.4
High density lipids cholesterol (HDL)	35
Low density lipids cholesterol (LDL)	143.4
Triglyceride (Poumès-Ballihaut et al.)	48.16

Means are results of duplicated samples.

Table (5) Serum lipid profile of the experimental bird as affected by dietary treatments

Diets / Parameters	Fish oil inclusion rate (%)			Level of significant
	0.0	4.0	6.0	
Cholesterol (CH)	133.2±3.8[a]	115.8±7.0[b]	109.6±2.0[c]	**
High density lipids cholesterol (HDL)	84.6±13.0	85.8±8.0	91.6±6.0	NS
Low density lipids cholesterol (LDL)	48.6±1.0[a]	30.0±4.0[b]	22.4±2.0[c]	**
Triglyceride	143.6±18.0[a]	113.0±30.0[b]	87.6±14.0[c]	**

* Values are means of 30 birds /treatment
[a,b] Means in rows followed by different superscript letters are significantly different.
* *Significant at (P<0.01)
NS: Not significant

Conclussin

Based on the results of this study Nilotic silver cat fish oil supplementation could increase live body weight and improved feed conversion ratio.

On the other hand, oil of Nilotic fish supplementation resulted in a positive effect on serum lipids profile of broiler chicken.

Further research on the effect of Nilotic silver cat fish oil on broiler meat fatty acid profile should be conducted.

Significance Statements

This study may suggest that the supplementation of Nilotic silver cat fish oil in broiler diet at the tested levels can be beneficial for improvement of broiler weight, feed efficiency and serum lipids profile.

Acknowledhement

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تركيب دهون الدم والأداء الإنتاجي لبدارى التسمين المغذاة على أعلاف مدعمة بزيت السمك النيلي (الكبروس) (Nilotic Silver Cat)

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المستخلص

تم استخدام زيت السمك في تغذية الدواجن لتحسين الأداء. التغذية على زيت السمك النيلي لم تتم حوله دراسات. صممت هذه الدراسة لتقييم تأثير إضافة زيت سمك الكبروس النيلي إلى أعلاف بدارى التسمين على تركيب دهون الدم والأداء الإنتاجي لبدارى التسمين. تم استخدام عدد 90 كتكوت لاحم (Hebbard 15) في هذه التجربة على أساس التصميم العشوائي الكامل قسمت طيور التجربة على ثلاث معاملات وكل معاملة تحتوي على ثلاثة تكرارات (10 طيور/ تكرار). احتوت المعاملات الثلاث على مستويات متدرجة من زيت السمك (صفر، 4، و6%) على أساس المعاملة صفر% معاملة تحكم. تلاحظ أن هنالك تحسن معنوي في الوزن المكتسب الكلى ومعدل التحويل الغذائي للطيور المغذاة على 4% و6% زيت سمك، ولم يتأثر معنوياً كل من العلف المستهلك الكلى ونسبة النفوق مقارنة بتلك المغذاة على علف التحكم. أظهرت نتائج دم الطيور المغذاة على 4% و6% زيت سمك انخفاض معنوي في مستوى الكولسترول منخفض الكثافة، والجلسريدات الثلاثية والكولسترول الكلي مقارنة بدم الكتاكيت المغذاة على علف التحكم، ولم توجد فروق معنوية في مستوى الكولسترول عالي الكثافة.