Effects Of Dietary Inclusion Of Fish Oil On Broiler Performance And Feed Utilization

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Abstract: This study was performed to investigate the effect of dietary supplementation of fish oil on broiler performance and feed utilization. Feed consumption, body weight gain, feed conversion ratio (FCR), carcass characteristics, water consumption, mortality, protein efficiency ratio, lysine efficiency ratio, efficiency of energy utilization, relative water consumption، production efficiency factor were studied. Two hundred unsexed broiler chicks, 28 day-old (Ross 308) were used. The Chicks were randomly distributed into 2 treatments experimental groups, designated T1 and T2, each group has 4 replicates of 25 chicks. Birds were fed the experimental diets for 3 weeks. They were fed finisher diets from 29 to 49 day old, in which fish oil was added to the iso-calaric and iso-nitrogenous diet, T1 0% (Control group) and T2 3% fish oil. Two rations (iso-nitrogenous and iso-caloric) were formulated according the requirement of (NRC) National Research council. Adding fish oil improved feed intake, body weight, weight gain, carcass weight, dressing percentage, protein ratio efficiency, efficiency energy utilization, lysine efficiency and production efficiency factor were significantly affected ($P<0.01$) and improved water intake, feed conversion ratio were significantly affected ($P<0.05$) of broilers for the three weeks. No significant differences were observed for relative water intake. Therefore it is concluded that adding fish oil based diets improved broiler performance and feed utilization.

Key Words: Broilers, Fish oil, dressing percentage, protein ratio and energy utilization.

The use of vegetable oils and animal fats in broiler diets has been beneficial for poultry production. They often present higher than expected biological value, increasing dietary metabolizable energy, which usually results in higher growth rates and better feed efficiency. The main factor that influences the nutritional value of fat sources is digestibility, which is affected by fatty acid saturation degree, carbon number in the chain, free fatty acid concentration, position of the glycerol molecule, as well as the interaction between saturated and unsaturated fatty acids (Leeson & Summers, 2001). Fats also provide varying quantities of the essential nutrient linoleic acid [12]. Another important role of fats in diet is its inhibition from de novo lipogenesis in broiler chickens [27] that could increase energy efficiency in diets. The profile of fatty acids is of importance to the quality of the utilization of lipids and to the absorption of these lipids by the bird, and also because it influences the quality of the fat deposited in broiler carcass. Fats and oils are subject to oxidation which is responsible for the development of rancidity. Rancid fat products have an objectionable odor and decrease the palatability of a feed. Rancidity can be prevented or slowed by adding antioxidants. Vitamin E is the major natural antioxidant. When commercial feed fats are used to increase energy in feedlot diets they are usually added at the rate of 2 to 5 percent of the diet's total dry matter. Total fat levels exceeding 6 to 8 percent can cause digestive disturbances, diarrhea and reduce feed intake. [12]. Various researchers have conducted feeding trials using fats and oils in diets. The results indicate that when fat is fed at rates up to 5% of the dry matter; that dry matter intake decreased, with an improvement in average daily gain, and feed efficiency and carcass [3] and [22].

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Fish oil contains high percentages of long-chain polyunsaturated fatty acids, which accounts for the oxidative instability and the transference of characteristic fish flavor to the meat of birds fed fish oil supplements often contain small amount of vitamin E to prevent spoilage, they might also be combined with calcium, iron, or vitamins A, B1, B2, B3, C or D. In general, fish oils are rich sources of omega-3 fatty acids, FA and poor sources of omega-6, and the contents of linoleic acid (LA) are also low. The FA profile of the different oils varies with the time of year, the processing method and the predominant fish species from which they were extracted [1]. Fish oil have a high amount of (EPA) and DHA so are considered as valuable ingredients to enrich poultry meat [5] and [24]. The supplementation of broiler diets with small quantities of fats and oils has also been shown to improve the consistency and palatability of the meat and to stimulate growth. [13] and. [19]. There are many factors which affect feed intake of chickens and hence determine nutrient intake level and efficiency of poultry production. Although the spectrum of these factors is very broad, here the focus will be made on management and environment, feed and water, and physical factors [10]. Differences between the studies may be due to the level of metabolisable energy in the ration. Moreover insignificant effect of fish oil supplementation at 1.2 and 3% concentrations was also reported [8]. There are some contrasting reports, [10], observed that feeding with diets containing fish oil to broilers caused lower feed consumption and body weights and poorer feed conversion efficiency than feeding the control diet. These authors attributed the reduced performance levels to lower palatability. Dietary fatty acid profile can affect carcass and abdominal fat deposition. [25], found less abdominal fat in broilers fed sunflower oil than in those fed tallow, fish oil or lard. Broiler industry is increasing dramatically throughout the developing countries. There have been a notable increase in growth rate and feed efficiency in commercial broiler chickens in the last 20 years. Current commercial hybrids with their high performance require high energy and protein diets which would enable the maximum exploitation of those genetic potentials. Sudan has 90-95% of the feed materials used in poultry feed available locally،but import from abroad about 5-10% of the feed composition which it drains great deal of the cost which reach 23-37% of

the total cost of the feed [2]. In Sudan there is a large amount of fish oil produced daily from fish markets and it's not all used, so it can be used as an alternative energy source in poultry industry.

Materials and Methods

Experimental location and Site:-

This study was conducted at the Poultry Farm، College of Animal Production Science and Technology، Sudan University of Science and Technology during the period from 2^{end} of March to 9th of April 2015. This study was performed to investigate the effect of fish oil on broiler performance and feed utilization including: Feed consumption, body weight gain, feed conversion ratio (FCR), water consumption, carcass characteristics, mortality, protein ratio efficiency, efficiency energy utilization, lysine efficiency and production efficiency factor.

Experimental houses:-

The experiment was conducted in an open side deep litter house 8×5m dimensions ،4m central altitude and 2.5m side altitude، constructed by corrugated iron sheets roofing، wire netting sheets supported by 50cm cement wall at sides and concrete floor. The long axis of the house extended east-west facing the wind direction for efficient ventilation. The house was divided into twelve experimental sections (replicates) of equal area (1.5m^2)، each and 75cm walls altitude which separate experimental sections. The experimental house and equipments were cleaned، burned and disinfected. Then fresh wood shaving litters was spread in the experimental section floor at depth of 5cm. Moreover، each section was provided with one tubular metal feeder and circular plastic drinker. The house had four lamps at 2m altitude، expressed as high from ground.

Experimental birds:-

A total of two hundred 28 day old unsexed broiler chicks (ROSS 308) bought from Enema Poultry Production Company. The experimental period extended for 21 days. The experimental treatments started from day 28 to 49 days of age. Water was supplemented with multi –vitamin from 28 -31 days. Antibiotic Doxystin (Doxycycline Hcl 50mg – colistin sulphate 400000 I.U) as prevention dose from 35 – 40 day.

Experimental Diets:-

The experiment consisted of two treatment groups, designated as T1 control group fed 0 % oil، and T2 fed 3% fish oil. The Chicks were randomly distributed into 3 experimental groups, designated T1 and T2, each group has 4 replicates of 25 chicks. All birds were fed on pre starter ration for the 1st week of age then they were fed on starter fed ration for (8-27 days). Then birds were allocated in to the experimental finisher diets from 29th to 49th day old, in which fish oil was added to the iso-caloric and iso-nitrogenous diet T1 0% (Control group), T2 fed 3% fish oil. Rations were formulated to be approximately iso-caloric and iso-nitrogenous to meet the nutrient requirements for broiler chicks as out lined by the [21. Feed and water were supplied adlibitum during the experimental periods. Live body weight, body weight gain, feed consumption, feed conversion ratio, water consumption, relative water consumption، carcass characteristics and mortality, protein ratio efficiency, efficiency energy utilization, lysine efficiency and production efficiency factor were studied.

Analysis of the finisher experimental ration:

Table (1): *composition (%) and calculated analysis of experimental finisher diets:*

Treatment / Ingredients %	T1	T2
Sorghum grains	74.7	48.7
Wheat bran	0.1	1.9
G.N.C	18.46	39.8
Lime stone	0.74	0.85
D.C.P	0.57	0.29
Lysine	0.43	0.3
Methionine	0.05	0.05
Common Salt	0.01	0.1
Super Concentrate	5	5
Fish Oil	0	3
Calculated analysis		
Premix	0.01	0.01
ME(Mj/kg)	13.39	13.39
CP%	20.01	20
CF%	3.21	3.61
Ca%	1	1.01
Av.p%	0.44	0.45
Lysine%	0.93	1.11
Methionine%	0.50	0.51

[26]

Table (2): *Chemical composition of concentrate:*

Item / Ingredients	ME Mj/kg	CP %	Ca %	AV.P %	Lysine %	Methionine %	CF %
Concentrate	10.02	35	10.6	4.9	1.1	4.3	1.5

Source: *lab of Hendrix Company،Netherlands.*

Data collection:-

During the experimental period live body weight (LBW)،body weight gain (BWG)، feed consumption(FC)، feed conversion ratio(FCR)، were determined on weekly basis،while temperature، water consumption (WC)، and mortality were recorded daily. At the end of the 7th week the birds were fasted for twelve hours for the final body weight and slaughtered then dressing% was determined. The rate of mortality was calculated which is the ratio between the number of the dying birds and the initial total number of birds multiplied by 100.

$$\text{Mortality} = \frac{\text{number of dead birds} \times 100}{\text{Total number of bird}}$$

Calculations:-

Production Efficiency Factor (PEF) = (final bird weight, kg x livability %)/(age days x feed conversion ratiox100) [15].

Protein Efficiency Ratio (PER): Weight gain divided by protein intake [11].

Energy Efficiency Ratio (EER): Weight gain x100/total ME intake [11].

Lysine efficiency: Lysine intake (mg)/weight gain (g)

Calculation of European Production Efficiency Factor Live weight (kg) x Liveability (%) x 100

Age at depletion (days) x Feed conversion efficiency

Production Efficiency Factor Live weight (lb.) x Live ability - (whole bird condemns + 50 percent part condemns x 100 Age at depletion (days) x Calorie conversion (megacalories/lb. live.

Estimation of water intake rate during the experimental period (standard intake) was carried-out using a regression analysis between water consumption in water- restricted birds and age (variable X). Compensatory consumption in the period from 28 to 49 days of age was calculated as the difference in water intake between the groups previously submitted to water restriction and the control group [23].

Statistical analysis:-

Completely randomized design (CRD) was used in the current study. The data were subjected to analysis of variance (One – way- ANOVA) and the means were suppurate by the least significant difference (LSD) using the statistical package for social science (SPSS) version 16.0 (2007) computer program.

Results:

Table (3): *Weekly minimum and maximum temperature of experimental period.*

Temperature / Weeks	Minimum	Maximum
Week 1	28.7	40
Week 2	28.3	40
Week 3	28.3	39.8

Table (4): *Effect of Adding fish oil 3% (finisher) diet on broiler performance*

Parameters	Weeks / Treatment	Week 1	Week 2	Week 2
Water intake (ml)	Control	209.9 ± 82.23	373.7 ± 47.86	449.9 ± 53.84
	Fish oil	248.04 ± 25.42	453.4 ± 24.23	730.93 ± 66.20
	Significance	*	**	**
Feed intake(g / bird):	Control	71.45 ± 13.09	86.5 ± 7.14	88.35 ± 14.95
	Fish oil	98.71 ± 10.49	103.61 ± 11.98	117.5 ± 7.80
	Significance	**	**	**
Body weight (g)	Control	761.6 ± 78.84	991.2 ± 131.52	1257.6 ± 151.41
	Fish oil	882.4 ± 91.97	1247.6 ± 121.91	1677.1 ± 126.82
	Significance	**	**	**
Weight gain (g)	Control	25.14 ± 9.32	38.57 ± 5.38	50.23 ± 11.34
	Fish oil	44.2 ± 2.99	58.14 ± 3.8	85.05 ± 14.77
	Significance	**	**	**
Feed conversion ratio	Control	2.39 ± 0.22	2.28 ± 0.35	1.81 ±0.40
	Fish oil	2.25 ± 0.30	1.78 0.17	1.42 ± 0.25
	Significance	*	**	**

**: High significant difference (P < 0.01) .
*: significant difference (P < 0.05).

Table (5): *The overall performance results of three weeks of broiler chicks fed fish oil.*

Parameter / Treatment	Control	Fish oil 3%	Significance
Feed intake (g)	82.10 ± 8.50	106.64 ± 4.90	**
Water intake (ml)	345.81 ± 39.51	476.53 ± 20.25	**
Body weight (g)	1257.62 ± 151.43	1677.12 ± 126.82	**
Weight gain (g)	37.92 ± 6.63	62.52 ± 3.95	**
Feed conversion ratio (g)	2.24± 0.36	1.71 ±1= 0.13	**
Carcass weight (g)	61.98 ± 1.09	64.42 ± 0.85	**

**: High significant difference (P < 0.01).

As seen in tables (4) and (5), the results showed that birds fed 3% fish oil scored significantly high (p< 0.01) feed intake, water intake, body weight, weight gain, feed conversion ratio and carcass weight compared to those birds fed the control diet for the three weeks.

Table (6) : *Effect of fish oil (finisher) diet on feed utilization of broilers*

Parameters	Weeks / Treatment	Week 1	Week 2	Week 3
Protein Ratio Efficiency Factor	Control	1.81 ± 0.77	2.24 ± 0.39	2.88 ± 0.66
	Fish oil	2.26 ± 0.299	2.84 ± 0.34	3.61 ± 0.60
	Significance	**	**	**
Efficiency energy utilization	Control	269.9 ± 115.5	335.0 ± 53.7	431.4 ± 99.7
	Fish oil	338.4 ± 44.8	423.8 ± 51.06	540.4 ± 89.6
	Significance	**	**	**
Lysine efficiency	Control	269.9 ± 115.5	335.0 ± 53.7	431.4 ± 99.7
	Fish oil	338.4 ± 44.8	423.8 ± 51.06	540.4 ± 89.6
	Significance	**	**	**
Production efficiency factor	Control	10.05 ± 1.57	11.4 ± 2.93	15.4 ± 3.54
	Fish oil	12.46 ± 1.75	18.14 ± 2.54	26.15 ± 4.5
	Significance	**	**	**
Relative water consumption (RWC):-	Control	27.46±9.3	38.84±6.7	35.94±3.4[a]
	Ration added camel fat	28.70±6.1	37.10±4.5	28.97±3.4[b]
	Significant	NS	NS	**
	** : significance difference (p < 0.01)			

Results of weekly feed utilization are presented in table (6). The results are affected by supplementation of fish oil 3%. Most studied parameters (protein ratio efficiency Factor, efficiency energy utilization, lysine efficiency and production efficiency factor) scored significantly high differences (p< 0.01) for the three weeks of the experimental period compared to the control, except relative water consumption, which showed no significant difference in the first and second week but showed significantly high difference (p< 0.01) for the third

week compared to the control.

Mortality:-
The mortality% was 4% for all treatments of experimental period.

Livability:-
Through the experimental period livability was 96% for all treatments.

Discussion:-
The objective of this study was to investigate the effects of adding 3% fish oil on the performance and feed utilization of broilers. The overall performance results of the present study showed a significantly high (P<0.01) improvement in mean total feed intake (g/bird), water intake (ml/bird), body weight (g/bird), weight gain (g/bird), feed conversion ratio (g/bird) and carcass weight (g/bird) compared to those fed control diet. These results might be due to the rich content of omega-3 fatty acids (eicosapentaenoic) (EPA) and docosahexaenoic acid (DHA) in fish oil. These fatty acids are well known as essential nutrients for health and important for numerous normal body functions and play vital role immune response. A number of researches have examined the effect of dietary long-chain polyunsaturated fatty acids (PUFA), such as those contained in fish oil in the diets and found that caused no adverse effects on the productive efficiency of the animals, either in terms of mortality, final body weight, or feed conversion ratios, as compared with the inclusion of vegetable oils throughout the experimental period, or could be possible that the increase of polyunsaturated fatty acids in the increase diet digestibility and stimulate growth and feed efficiency [7] and [26]. The results of feed intake of broiler fed fish oil were highly significant (P<0.01), which results in improvement in feed intake, fish oil contains vitamin E, A, B1, B2, B3, C and D. These results are in agreement with the results reported by [17], [20] and [13], they showed that broiler feed intake increases linearly with decreasing dietary energy level. The results of water intake for of broiler fed fish oil was significantly high (P<0.05). These results might be due to composition of diet, while the results of relative water was not significantly affected; during the three weeks. [20], reported that levels of (2 and4 %) fish oil inclusion in diets of broiler decreased weight gain. These results are similar to the results of the current study. [10], observed that the feeding of diet containing fish oil to broilers caused lower body weight than the control diets, those authors attributed the reduced performance levels to lower palatability and higher calcium levels. [17], reported that adding 3% fish oil increased and improved the body weight. The result of body weight in this study showed highly significant difference (P<0.01), It improve body weight because fish oil contain omega-3 fatty acids (EPA and DHA) and good sources of energy. This result agree with the results of [20] but disagree with [10]. The results of feed conversion ratio of broiler fed fish oil were significantly high (P<0.01), these results are similar to [17], who reported that the adding of 3% fish oil; improved feed conversion ratio. [20], reported that adding fish oil levels (2, 4 %) did not affect feed conversion ratio while [1], reported that adding fish oil levels (2, 4 %) improved feed conversion ratio. The results of carcass weight of broiler fed fish oil were highly significant (P<0.01), the result showed that the fish oil improved and increased carcass weight which might be due to the content of fish oil which contain n-3 and n-6, birds fed fish oil have deposited more quantities of unsaturated FA in the abdominal fat because fish oil is a good sources of energy, these results are similar to the results obtained by [21], [4], and [5]. The results of protein ratio efficiency, efficiency energy utilization, lysine efficiency and production efficiency factor of broiler fed fish oil were the results showed significantly high (P<0.01) increase, in protein ratio efficiency, efficiency energy utilization, lysine efficiency and production efficiency factor of birds fed fish oil compared to birds fed control diet, the result might be due to the nutritional values of fish oil and composition of diet.

Conclusions:
Positive effect of inclusion of fish was observed during the three weeks. Fish oil significantly affected the feed intake, water intake, body weight, weight gain, feed conversion ratio, carcass weight and dressing percentage, protein ratio efficiency, efficiency energy utilization, lysine efficiency and production efficiency factor (p<0.01).

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