بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Graduate Studies

Effect of Feeding Diet Contained Fish Oil on Broilers Performance and Blood Profile

تاثير العليقة المحتوية علي زيت السمك علي اداءوبعض مقاييس الدم لدجاج اللحم

By:

MARIAM ALZEBAIR MUSA EDIREES

A Thesis Submitted in Partial Fulfillment of Requirements for the Degree of M.Sc. in Tropical Animal Production

B. Sc. (Hon) in Veterinary Medicine and Animal Production

(2012)

Supervisor:

Brof. Dr. MOHAMAD TAGELDEN

2016

بسم الله الرحمن الرحيم

قال تعالي :

(ولقد كرمنا بني ادم وحملناهم في البر والبحر ورزقناهم من الطيبات وفضلناهم علي كثير ممن خلقنا تفضيلا)

الاسراء الاية (70)

صدق الله
العظيم

DEDICATION

I like to dedicate this research with love and respect to:

The soul of my late father.

My mother for her loves and supports me for education and life.

My teacher who gave me support, encouragement and believed in the importance of education.

To my Parent,

Teacher Omer Msaed,

My family,

My friends,

And all who gave help to me,

I dedicate this work.

i.

List of contents

Item		Page no
Dedication		2
List of contents		2
Acknowledgement		2
List of abbreviations		2
English abstract		2
Arabic abstract		2
List of tables		2
Introduction - Chapter one		
1	Introduction	1
1-1	Objective	2
literature review - Chapter tow		
2-1	Poultry nutrition	3
2-1-1	Carbohydrates	3
2-1-2	Fats and Oils	3
2-1-3	Minerals	4
2-1-4	Vitamins	4
2-1-5	Water	4
2-1-6	Feed additives	5
2-2	feed intake	5
2-3	Water intake	6
2-4	Plant oil	6
2-4-1	Cotton oil	7
2-4-2	Sunflower oil	7
2-4-3	Linseed oil	8

2-4-4	Palm oil	8
2-5	Fish oil	9
2-5-1	Effect of diet that contained fish oil on performance serum parameters and the fatty acid composition of meat in broilers.	10
2-5-2	Effects of Fish Oil on Carcass Characteristics of Broiler Chicks	11
2-5-3	Omega-3 and 6 fatty acids	12
Materials and methodsChapter three		
3	Materials and methods	13
3-1	Experimental location and site	13
3-2	Experimental houses	13
3-3	Experimentalbirds	13
3-4	ExperimentalDesign	14
3-5	Experimental Diet	14
3-6	Health program	14
3-7	Determination of the rate of mortality	14
3-8	Analysis of the experimental ration	15
3-9	Data collection	16
3-10	Blood sampling	16
3-11	Hematological analysis of blood	17
3-12	Statistical analysis	17
Chapter four : Results , DiscussionConclusions and Recommendations		
4-1	Results	18
4-1-1	Overallperformance Results	18
4-1-2	Mean weekly feed intake	18
4-1-3	Mean weekly water intake and relative water	19
4-1-4	Mean weekly body weight	20
4-1-5	Mean weekly weight gain	20
4-1-6	Mean weekly feed conversion ratio	21
4-1-7	Carcass weight , dressing percentage and Cholesterol	21
4-1-8	Blood analysis	22
4-1-9	Protein ratio efficiency	22

4-1-10	Efficiency energy utilization	23
4-1-11	Lysine efficiency	24
4-1-12	Production efficiency factor	24
4-2	Discussion	25
4-3	Conclusions and recommendations	28

ACKNOWLEDGMENTS

Thank for Allah who supported me in my life. Thank for Allah for giving me fortune, aptitude and patience to conduct this study.

I would like to express deepest thank to my supervisor Prof Mohamed Tagelden for his support, guidance, encouragement, direction and valuable advice during this study.

Thanks Dr. Omer Msaed for his help throughout this study.

Thanks my friends. I am greatly indebted to my mother, brothers and sister for their generous help. Thanks also go to all my colleagues.

List of abbreviations

GNC	Ground neet cake
DCP	Dicateium phosphate
ME	Metaboligable Energy
CP	Crude protein
CF	Crude fibre
Ca	Calcium
Av.p	Avlapul phosphate
HB	Haemoglobin
PCV	Packed cell volume
WBC	White blood cell
RBC	Red blood cell
MCV	Mean cell volume
MCH	Mean cell Haemoglobin
MCHC	Mean cell Haemoglobinconcentrati
CHOL	Cholesterol

Abstract

The study was conducted at the College Farm of Science and Technology of Animal Production, Sudan University of Science and Technology to investigate the effect of adding fish oil (3 % and 0%) to the finisher ration on broiler performance. Were used 200 birds were aged three weeks average weight was (683.3g).They divided into two groups, each group contains four replicatetwenty five birds. The ration (iso-nitrogenous and iso-caloric) was formulated according the requirement of (NRC) National Research council (1944).

The objective of study to provide cheaper source of energy and to decrease the total cost.

The effect of fish oil supplementation was studded on broiler performance feed intake (g/bird) , water intake (ml/bird) , relative water (ml/bird) , body weight (g/bird) , weight gain (g/bird) , feed conversion ratio (g/bird) , carcass weight (g/bird) ,dressing percentage (%) , blood analysis , protein ratio efficiency(g) , efficiency energy utilization(g) , lysine efficiency(g) and production efficiency factor(g) .

Adding fish oil improved feed intake (g/bird) , water intake (ml/bird), body weight (g/bird), weight gain (g/bird) , carcass weight (g/bird) ,dressing percentage (%), protein ratio efficiency(g) , efficiency energy utilization(g) , lysine efficiency(g) and production efficiency factor significant(g) ($P<0.01$) and improved significantly ($P<0.05$) somebloodparameters of broiler chicks.

No significant difference were the effaced for relative water (ml/bird) and feed conversion ratio (g/bird) ($P>0.05$) in this study.

مستخلص الدراسة

اجريت هذه الدراسة في مزرعة كلية علوم وتكنولوجيا الانتاج الحيواني جامعة السودان للعلوم والتكنولوجيا لمعرفة تأثير اضافة زيت السمك علي اداء الدجاج اللاحم . اضيف زيت السمك بنسبة (0% – 3 %) في عليقه الدجاج اللاحم . تم استخدام عدد (200) طائر في عمر 3 اسابيع بمتوسط وزن (683.3) وقسمت الطيور لمجموعتين كل مجموعة تحتوي علي 4 تكرارات بعدد (25) طائر في كل تكرار. تم تركيب عليقة دجاج لاحم متوازنة غذائيا حسب ما ورد في منشورات NCR (1994) .

وكان الهدف من هذه الدراسة توفير مصدر طاقة رخيص وتقليل من التكلفة في تغذية اللاحم.

تمت دراسة تأثير زيت السمك علي اداء الدجاج اللاحم علي متوسط العلف المستهلك (جرام / طائر) , متوسط الماء المستهلك (مليلتر / طائر), متوسط الوزن المكتسب (جرام / طائر) , نسبة الماء المستهلك للوزن (ملتر / طائر), متوسط وزن الجسم (جرام / طائر) , متوسط معدل التحويل الغذائي (جرام علف / وزن مكتسب) , وزن جسد الذبيحة ونسبة التصافي (جرام / طائر) , تحليل الدم , كفاءة استهلاك البروتين , كفاءة استهلاك اللايسين , كفاءة الطاقة وعامل كفاءة الانتاج .

اضافة زيت السمك بنسبة 3% نتج عنة تحسين معنوي باحتمالية ($P<0.01$) في العلف المستهلك (جرام / طائر) , متوسط الماء المستهلك (مليلتر / طائر) , متوسط وزن الجسم (جرام / طائر) , متوسط الوزن المكتسب (جرام / طائر), وزن جسد الزبيحة ونسبة التصافي (جرام / طائر) , كفاءة استهلاك البروتين , كفاءة استهلاك اللايسين , كفاءة الطاقة وعامل كفاءة الانتاج وباحتمالية ($P<0.05$) في تحليل الدم .

و اظهرت الدراسة عدم وجود فروق معنوية ($P>0.05$) في نسبة الماء المستهلك للوزن (مليتر / طائر) ومعدل التحويل الغذائي (جرام / طائر).

List of table

Table no	Table	Page no
1	Composition % and calculated analysis of experimental finisher diets	15
2	The overall performance results of three weeks old broiler chicks as effected by feeding of fish oil	18
3	Effect of feeding fish oil (finisher) on weekly feed intake of broiler chicks (g/bird)	19
4	Effect of feeding fish oil (finisher) on weekly water intake and relative water of broiler chicks (ml/bird)	19
5	Effect of feeding fish oil (finisher) on weekly body weight and initial weight of broiler chicks (g/bird)	20
6	Effect of feeding fish oil (finisher) on weekly weight gain of broiler chicks (g/bird)	20
7	Effect of feeding fish oil (finisher) on weekly feed conversion ratio of broiler chicks (g/bird)	21
8	Effect of feeding fish oil (finisher) carcass weight and dressing percentage of broiler chicks (g/bird)	21
9	Effect of feeding fish oil (finisher) blood analysis .of broiler chicks	22
10	Effect of feeding fish oil (finisher) on weekly protein ratio efficiency of broiler chicks (g/bird)	23
11	Effect of feeding fish oil (finisher) on weekly efficiency energy utilization of broiler chicks (/bird)	23
12	Effect of feeding fish oil (finisher) on weekly lysine efficiency of broiler chicks (g/bird)	24
13	Effect of feeding fish oil (finisher) on weekly production efficiency factor of broiler chicks (/bird)	24

:Introduction

The growing poultry industry in the Sudan is developing on the utilization of local ingredients to minimize feed cost, which limits poultry production in developing countries as financial constrain. In addition the competition between man and animal for protein and energy sources in developing countries made the utilization of non-conventinalfeed sources to increase the nutrient utilization efficiency of cheap feed ingredients (kinsella*et.al*, 1990 and knapp 1991). Feeding poultry with diets that contain fat can counter several economic advantages by providing increased energy levels and fatty acid composition (Newman *et.al*, 2002).If the poultry is expected to show high performances, their high energy and protein needs should be provided through their feed. Providing their high energy needs requires the use of different fat sources (Lopez- Ferrer .*et al*, 2001). If diets with similar energy and protein and compared with chickens fed with rations that contain oil showed better performances than birds fed diets without the inclusion of oil (Moura, 2005). The composition of fatty acid in the broiler meat can be changed by addition of vegetable oil, fish oil or animal fat to diet because difference of fatty acid profile and reduction in endogenous produced .fatty acid occur (Lopez *et.al*, 2001)

Fish oil contain high level of n-3 fatty acid and linolenic acid (c18;3n-3) that are converted in the body to other n-3 fatty acids such as eicosapentaenoic acid (c20;5n-3) and docosahexaenoic acid (c22;6n-3) which have been shown to reduce the risk of cardio vascular diseases in humans (Gebauer *et.al* 2006). Various studies have been conducted on the inclusion of fish oil in the diet of broiler chickens. (Crespo *et.al*, 2002), reported that fish oil was found to have had appositive effect on the fatty acid profile by improving the lipid composition of the meat. Very

important dietary n-3 polyunsaturated fatty acid (PUFA) and in particular , eicosapentaenoic acid (EPA)and doocosahexaenoic acid (DHA),which have well known to have an effects on human health (Kinsella *et.al* , 1990 and Knapp 1991) Numerous research activities have focused on enhancing the levels of increase fatty acids in widely consumed products of animal origin (Hargis *et.al*, 1991).

The objectivesof this study to were to investigate the effects of diet that contain 3% fish oil on the body weight (BW) ′ body weight gain (BWG)′ feed intake (FI) ′ water intake (WT) ′feed utilization and provide cheaper .source of energy and decrease the total cost

2-1: Poultry nutrition

Poultry nutrition is more than just giving any available feed to your birds. Market poultry – broilers and turkeys - require proper nutrition to grow and finish out.Similarly, poultry require the correct balance of five classes of nutrients (proteins, carbohydrates, fats and oils, vitamins, minerals, and water) for optimum growth, maintenance, finishing, work, reproduction, and production. Poultry diets must supply daily nutrient requirements from the five classes of nutrients. National Research Council (NRC) nutrient requirements for poultry assume an average of approximately 85% ingredient bioavailability (Baker. *et al*., 2000).

2-1-1: Carbohydrates:

Carbohydrates are organic compounds that include sugars, starches, celluloses, and gums. Carbohydrates are produced by photosynthetic plants and contain only carbon, hydrogen, and oxygen, usually in the ratio 1:2:1.Sugars and starches are highly digestible and make up almost 75% of an animal's diet. Starch and sugar carbohydrates contain 4 kilocalories per gram. Excess carbohydrates are deposited as the fat in the animal body (Baker.*et al*., 2000).

2-1-2: Fats and Oils:

In terms of providing energy, fats and oils serve the same function as digestible carbohydrates. Fats and oils are the densest forms of energy and derived from plants and animals. At room temperature, fats are solid and oils are liquid. They both provide 2.25 times more energy than do carbohydrates (9 kilocalories per gram versus 4 kilocalories per gram for digestible carbohydrates and protein). Poultry require only small amounts of fats and oils(Baker.*et al*., 2000).

2-1-3: Minerals:

Minerals are naturally occurring as inorganic solids, with a definite chemical composition, and an ordered atomic arrangement which are important for life and good health. Many are essential components of body substances, such as the calcium and phosphorus in bones and the iron in hemoglobin. Calcium to phosphorus ratio is very important in poultry diets; 2 to 1 with respect of dietary calcium to available phosphorus. Animals need very small amounts of trace minerals, usually ranging from 0.05% to 0.25%. However, this small percentage is critical for performing essential body functions associated with life (Baker. *et al*., 2000)

2-1-4: Vitamins:

Vitamins are essential organic (carbon based) compounds needed in small amounts by the body. They are absolutely critical to all life processes such as growth, maintenance, reproduction. They assist many of the enzymes controlling the metabolic processes of life and are often referred to as co-enzymes. Large amounts of fat-soluble vitamins can be deadly to an animal (Baker. *et al*., 2000).

2-1-5: Water:

All animals require water for body functions. Water is necessary for digestion and absorption of nutrients, removal of waste, production of milk, shaping of cells, and regulation of body temperature. Water is perhaps the single most important factor for life. Water is the largest component of bodies and constitutes approximately 50% of body mass. The animal's feeding habits directly affect the amount of water consumed. Chickens usually consume approximately two times (2X) as much water as they consume feed (Baker. *et al*., 2000).

2-1-6: Feed additives:

Feed additives are important to the business of food in world. With the help of feed additives, producers can grow more economically the food-producing animals that represent a large percentage of the protein consumed. Feed additives are compounds that producers add to a diet for reasons other than to supply nutrients to the animal. Different additives affect different parts of the body. In general, the purposes of feed additives are to enhance production efficiency, to improve health, and to reduce morbidity. Feed additives are typically mixed into the feed in very small amounts (Leeson and Summers. 2005).

2-2: feed intake:

Feed intake is an important parameter in poultry production not only because of economic implications but equally because of the fundamental role it plays as a variable in the interpretation of nutritional responses. Thus nutritional effects can often be explained solely in terms of food intake (Károly. 2011).

Knowledge of individual examples is of fundamental importance to poultry production as intake invariably determines both the level of production and economic output. Moreover, feed formulation itself is controlled to a large extent by the level of intake anticipated. Thus, in terms of either protein or mineral requirements, if two birds have dissimilar levels of intake for whatever reason, then they will require separate diets; that which eats less will require one of a higher concentration of protein and minerals. It is for this reason that there have been considerable efforts within poultry production devoted to the study of the precise reasons why intake varies and how to control them (Károly. 2011).

:water intake :2-3

The water requirement of meat birds depends on the environmental temperature and relative humidity, the composition of the diet, growth rate and the efficiency of water resorption by the kidney. Meat birds drink at least twice as much wateras the amount of feed consumed on a weight basis. Actual water consumption relative to feed intake varies depending environmental temperature and dietary factors. Increasing dietary crude protein increases water intake and water: feed ratios (Marks and Pesti, 1984). Crumbled or pelleted feed increases both water and feed intake relative to mash diets, but water: feed ratios stay relatively the same. Increasing dietary salt and other osmotically active minerals increase water intake in attempt to flush excess minerals via the kidneys(Marks, 1987). Water availability is dependent upon stocking density and access to drinker space, drinker placement and height, drinker design, and water .flow capacity (Marks and Pesti, 1984)

2-4: Plant oils:

Plant oils represent an important renewable resource from nature. Plant oils consist almost entirely of triacylglycerol (TAG) esters containing three fatty acids (FAs) with chain lengths of C8-C24, with C16 and C18 is being the most common. Plant oils are used primarily for food. The annual production of animal fats (tallow, lard and butter) is approximately 22 million tonnes, while fish oils represent about 1 million tonnes (Gunstone and Harwood, 2006). Together with the plant oils, these oils represent the world's natural oil supply. The majority of vegetable oils are produced from just four crops, namely oil palm, soybeans, rapeseed and sunflower, which together account for approximately 79% of the total

production. It is estimated that about 14% of the fats and oils are used chemically and 6% as feed material (Patel et al., 2006).

2-4-1: Cotton oil:

The utilization of cotton oil is limited by the presence of the natural yellow pigment denominated gossypol which is a toxic or anti-nutritional element. It causes iron deficiency and lysine unavailability due to mail lard reactions, thus reducing the nutritional value of proteins when utilized in the meal form. Ferrous sulphate must be added to broiler diets in which cotton oil is included, because it chelates gossypol, preventing its absorption in the digestive tract and thus neutralizes its deleterious effects. Broilers tolerate levels higher than 100 ppm of free gossypol. The presence of cyclopropenoic fatty acids (malvalic and sterculic) intensifies the effects of gossypol, resulting in green yolk and pink coloration of the albumen (Leeson and summers. 2001 and Butolo. 2002).

:Sunflower oil :2-4-2

If has been reported that better growth and feed conversion of birds fed with diets containing sunflower oil when compared to birds fed olive oil. It was suggested that the difference was a function of the fatty acid composition of the different vegetable oil (Alao and Balnave, 1984), fed broilers with sunflower oil or a mixture of beef tallow/lard, the utilization of saturated fats resulted in greater abdominal fat deposits than unsaturated fats. The utilization of a source of unsaturated lipids reduces fat and increases protein on the broiler carcasses. The difference in protein accretion was attributed to the level of saturation of the fat, since the energy derived from unsaturated fat may be used for other metabolic purposes, whereas the energy derived from saturated sources is less promptly utilized. Sanz *et al*., (2000) evaluated inclusion levels of 8% of

two lipid sources, one saturated (beef tallow) and one unsaturated (sunflower oil). There was a significant reduction in the abdominal fat of birds fed diets with sunflower oil. The reduction in the fat deposit of these birds seemed to be a function of higher fat oxidation rates (catabolism) and lower synthesis of fatty acids. Using 8% of inclusion of three lipidic sources (sunflower oil, fish oil and beef tallow) in broiler feeding Newman *et al*., (2002) observed a higher proportion of linoleic acid and higher polyunsaturated/saturated ratio in the composition of the fat of .birds fed with sunflower oil

:Linseed oil :2-4-3

The effects of soybean, canola, sunflower and linseed oils on the nutritive and organoleptic traits of the meat and the profile of fatty acids were evaluated in 5-week-old broilers (López-Ferrer *et al*., 1999). Rosa (1999) used three types of oils (linseed, soybean and a mixture of linseed and fish) at inclusion levels of 1, 2 and 3% in broiler diets and observed that the composition of fatty acids of the rations influenced the fatty acid profile of the breast and thigh. It has been suggested that the size of fat deposits may be changed according to the fatty acid profile of the diet. The use of beef tallow, olive oil, sunflower oil and linseed oil in broiler diets evidenced that fat sources rich in polyunsaturated fatty acids produce less fat deposits than the ones rich in saturated or monounsaturated fatty acids (Crespo and Esteve 2002).

:Palm oil :2-4-4

Palm oil or mixtures of palm oil, fatty acids distilled from the palm and calcic soap are sources of vegetal oils with a fatty acid profile that might replace animal fats without any kind of negative impact on carcass .quality (Rodriguez *et al*., 2002)

2-5: Fish oil:

Fish oil is produced by the compression of whole fishes and sub-products for industries of fishery. This kind of 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 animals fed fish oil. 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. Fish oil is used for a wide range of conditions, and it is most often used for condition related to the heart and blood system. Some people use fish oil to lower blood pressure or triglyceride levels (fats related to cholesterol). In general, fish oils are rich sources of omega-3 FA and poor sources of omega-6, and linoleic acid (LA). 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 (Alparsan .et al., 2005).Fish oil is one of the available sources used in the diet to provide energy for fowls while its supplementation has been shown to improve body weight gain, feed conversation ratio and safety in the poultry products (Schreiner et al., 2005 and Farboom and Chekaniazer, 2009), Phetteplace and Watkins (1990) Evaluated different relations of poultry fat and fish oil in broiler feeding. Birds fed diets containing more fish oil have deposited more quantities of unsaturated fatty acids in the abdominal fat, as well as more n-3 fatty acids. On the other hand, both total n-6 fatty acids and the relation of n-6: n-3 was higher in the abdominal fat of birds fed with rations containing higher quantities of poultry fat.

Chanmugam et al., (1992)demonstrated that the content of omega-3 fatty acids in the thigh of broilers might be increased by the addition of linseed oil or fish oil in the diet. Therefore, it has been suggested that inclusion of

low dietary levels of fish oil together with another source of linoleic fatty acid to obtain an acceptable product with increased ratio between -3: -6 fatty acids.

Diet inclusion of 8% of sunflower oil, fish oil or beef tallow resulted in lower deposition of corporal fat on birds fed with fish oil and sunflower oil. It was concluded that feeding broilers with sources of n-3 and n-6 produced less carcass fat, and also improved feed conversion ratio. The results are interesting both from an economical point of view and from the point of view of the health of consumers (Newman et al., 2002).

2-5-1: Effect of diet that contained fish oil on performance serum parameters and the fatty acid composition of meat in broilers.

Feeding poultry with diets that contain fat can counter several economic advantages by providing increased energy levels and fatty acid composition (Newman .et al, 2002). If the poultry is expected to show high performances, their high energy and protein needs should be provided through their feed. Providing their high energy requires the use of different fat sources (Lopez-Ferrer .et al, 2001 and Sanz .et al, 2000). Diets with similar energy and protein are compared, chickens fed with rations that contain oil showed better performances than birds fed diets without the inclusion of oil (Moura, 2005). It has been demonstrated that the fatty acid (FA) composition of broiler meat can be altered by the type of the fatty acid (FA) content in their diet (Yau .et al, 1991). Dietary long-chain n-3 polyunsaturated fatty acids (LC-PUFA; n-3), eicosapentanoiec acid (EPA; 20:5) and docosahexanoeic acid (DHA; 22:6) have been reported to prevent cardiovascular disease, improve the immune response, and reduce the serum cholesterol concentration (Simopoulous, 1991). The differential action of n-6 PUFA as a pro-inflammatory factor and n-3 PUFA as an anti-inflammatory factor in animals and humans has been

reported due to the effects of an increase in the concentration of n-3 fatty acid and a consequent decrease in the n-6:n-3 in poultry meat showed thedietary PUFA reduced plasma triglycerides (TG) and cholesterol (CHL) in broiler chickens when compared to groups fed with saturated FA(Calder, 2001 and Newman .et al, 2002).

Studies have examined the effects of dietary LC-PUFA, supplied as fish oil or fish meal, on the FA composition of the broiler carcass , fish oil has several positive effects, such as the physiological or metabolic effects due to LC-PIFA on the performance parameters of broiler chickens (Nash .*et al*, 1995 and Lopez-Ferrer. *et al*, 1999, 2001).

Effects of Fish Oil on Growth Performance and Carcass :2-5-2 :Characteristics of Broiler Chicks

Dietary n-3 polyunsaturated fatty acids (PUFA) and in particular, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), have well known effects on human health (Knapp, 1991 and Kinsella *et al*., 1990). Numerous research activities have been focused to enhancing the levels of these fatty acids in widely consumed products of animal origin (Hargis *et al*., 1991 and Huyghebaert, 1995). Fish oils have a high amount of EPA and DHA, so are valuable ingredients to enrich poultry meat (Chanmugam *et al*., 1992 and Pinchasov & Nir, 1992). Previous reports have indicated that inclusion of fish oil in the diets 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 (Nash *et al*., 1995 and Huang *et al*., 1990). There are some contrasting reports too. Hulan *et al*.,(1988) 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. In poultry, 60 to 65% of the ingested dietary is excreted via excreta; this means that only 40 to 35% of dietary protein are retained by birds. Low protein diets supplemented with synthetic amino acids resolved this problem. Although acceptable productive performance can be achieved by feeding low protein diets, this will be associated with an increase in abdominal and whole-body fat deposition (Aletor *et al*., 2000 & 2002).

:Omega-3 and 6 fatty acids :2-5-3

:Omega-3 fatty acids

Omega-3 fatty acids are a group of fatty acids important for human health. There are three main types of omega-3 fatty acids: eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and alpha linolenic acid (ALA), which is converted in our bodies to EPA or DHA after consumption. High concentrations of omega-3 fatty acids are found in fish and plant oils, in addition to eggs from chickens fed a fishmeal .diet (Jenkins and Josse, 2008)

Omega-6 fatty acids:

Omega-6 fatty acid is also a polyunsaturated fat, essential for human health because it cannot be made in the body. For this reason, people must obtain omega-6 fatty acids by consuming foods such as meat, poultry, and eggs as well as nut and plant-based oils such as canola and sunflower oils (Hibbeln. 2006).

Types of omega-6 fatty acids linolenic acid and Arachidonic acid(Hibbeln. 2006)

-Material and Methods 3

-:Experimental location and site :3-1

The study was conducted at the College of Animal Production Science and Technology Farm, Sudan University of Science and Technology,during the period from 21 March to 9 of April 2015.

3-2: Experimental houses:-

The experiment was conducted in an open side deep litter house in 4×5m dimensional 4 m central altitudes and 2.5m side altitude. The roof was constructed from corrugated iron sheets. The sides were made from 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 four experimental sections (replicates) of equal area $(1.5m)^2$ each walls altitude was 75 cm which separate experimental sections. The experimental house and equipments were cleaned, burend disinfected. Then fresh wood shaving litters were spreadon the floor at depth of 5cm, moreover, each section was provided with one circular metal feeder and circular plastic drinker, four lamps at .1m high from ground were provided

-:Experimentalbirds :3-3

A total of two hundred, one day old, unsexed broiler chicks (ROSS) from Enemaa Poultry Production Company. The rearing period extended for 21 day and the experimental treatment was started from day 28 to 49 days of .age

-:Experimental Design :3-4

The experiment consisted of two treatment groups designated as T1 contain group fed no fish oil diet, T2 group fed (3%) fish oil. The birds were divided in to two groups, each group consists of hundred birds and .each group contains four replicates of twenty five birds to each replicate

-:Experimental Diet :3-5

All birds were fed on pre starter ration for the 1st week of age then they are fed on the experimental diets (from 28 to 49 day).Experimental diet combined from one type of diet, And then the bird were allocated in % experiment finisher diet.All rations were formulated to be approximately iso-caloric and iso-nitrogenous to meet the nutrient requirements for broiler chicks as out lined by the National Research Council (NCR, 1994), feed and water were supplied a dlibitum during the experimental .periods

:**Health program :3-6**

Water was supplemented with multi – vitamin from 28 -31 days. Anti-biotic ((DOXYSTIN (Doxycycline HCL- Colistinsulphate / AVICO. CO- .Made in Jordan)) as prevention dosage from 35-40 days

3-7: Determination of the rate of mortality:-

The rate of mortality is the ratio between the number of the dying .birds and the initial total number of birds multiplied by 100

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

-:Analysis of the experimental ration :3-8

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

(%) Fish oil	(%) Control	Treatment Ingredients
60.8	74.6	Sorghum grains
10.9	0.1	Wheat bran
18.88	18.85	G.N.C
0.85	83.	Lime stone
0.01	0.01	D.C.P
0.48	0.5	Lysine
0.06	0.06	Methionine
01.	0.04	Cemmon Salt
5	5	*Super Concentrate
3	0	Fish oil
0.01	0.01	Premix
100	100	Total
Calculated analysis		
13.398	13.397	ME(Mj /Kg)
19.86	19.85	(%) CP
4.8	4	(%) CF
1	1	(%) Ca
62.	60.	(%) Av. p
1	1.01	(%) Lysine
0.50	0.50	(%) Methionine

(Yousif and Afaf. 1999)

:The chemical composition of concentrate*

ME(Mi/Kg) 10.02, CP(%) 35,AV.P(%) 4.9, Lysine (%) 1.1, Metioine .(%) 4.3 and CF 1.5

.Source: lab of Hendrix Company, Netherlands

:Data collection :3-9

During the experimental period live body weight (LBW), was determined on weekly basis, while temperature, water consumption (WC),feed consumption (FC) and mortality were recorded daily.

At the end of the 7^{th} week, the birds were fasted for twelve hours for the final body weight; then slaughtering and the carcass weight (CW) and blood samples, were taken for analysis for ((Hb, PCV, WBC, RBC, MCV, MCH, MCHC) and serum (Cholesterol %)).

Body weight gain (BWG), feed conversion ratio (FCR), relative water intake ,dressing percentage (%), protein ratio efficiency, efficiency energy utilization, lysine efficiency and production efficiency factor , were calculated.

:Blood sampling :3-10

Two birds were randomly selected from each replicate (4 bird treatment) .for blood sampling

Blood samples(volume) were collected from the jugular vein and received in two labeled test tubes; one with anticoagulant(EDTA), the other without which were placed horizontally on racks at room .temperature. Blood serum was separated by centrifugation

-:Hematological analysis of blood :3-11

Anti coagulant (EDTA) was used for the determination of the hematological parameters hemoglobin (HB), packed cell volume (PCV), and blood cell count. Determination of hemoglobin content was done according to (Van-kampan and zijlstre. 1961); packed cell volume was done to **(**Strumia *et al*. 1954). Method red blood cell (RBC) count and total levkocyte count (TLC) according to routine clinical method. These values were utilized for collocated mean corpuscular hemoglobin concentration (MCHC) according to Deice and lewis. (1977).

-:3-12: Statistical analysis

The data were subjected to (independent t-test) and the using the Statistical Package of social science (SPSS) version 16.0 (2007) computer program. A probability of ($p \leq 0.05$) was required for statements of significance.

:Results :4-1

:Overallperformance Results: 4-1-1

As seen in table (2) the overall performance of birds effected by addition fish oil for three weeks. The birds fed by 3% fish oil showed ahigher significantly different for feed intake (g/bird/day), water intake (ml/bird/day), body weight (g/ bird/week), and weight gain (g/bird/day). Carcass weight (g/bird) was higher significantly at ($p<0.01$), the results showed that no significant difference for feed conversion ratio .(g/bird/day)compared to those birds fed 0% fish oil (control diet)

Table (2): The overall performance results of three weeks old broiler chicks as effected by feeding of fish oil.

Treatment Parameter	Fish oil	Control	Significance
Feed intake (g/bird)	2003.69±196.4	1666.4±143.8	**
Water intake (ml/bird)	8664.95±894.0	6390.54±1146.4	**
Body weight (g/bird)	1677.07±126.8	1257.77±151.3	**
Weight gain (g/bird)	1141.62±121.5	894.8±201.7	**
Feed conversion ratio (g/g)	1.76±0.2	1.90±0.3	NS
Carcass weight (g/bird)	1214.41±61.3	843.9±76.4	**

**: High significant difference
NS: NO significant difference

:Mean weekly feed intake:4-1-2

The results of mean weekly feed intake (g/bird) for the three weeks were affected by addition fish oil is presented in table (3). The birds fed by fish oil 3% werehigher significantly($p<0.01$) during weeks 1st and 3rd. No significant difference ($P >0.05$) during the 2nd week compared to birds fed 0% fish oil (control diet).

Table (3): Effect of feeding fish oil (finisher) on weekly feed intake of .broiler chicks(g/bird)

Week 3	Week 2	Week 1	Weeks Treatment
587.39±39.0	725.30±83.9	691.00±73.5	Fish oil
444.05±76.7	696.92±1.4	525.43±65.7	Control
0.00	0.08	0.00	Significance
**	NS	**	

**: High significant difference.
NS: NO significant difference.

:Mean weekly water intake and relative water:4-1-3

The results presented in table (4) show the effectof fish oil on water intake (ml / bird) and relative water (%). The birds fed fish oil 3 % fish oil was higher significantly (P < 0.01) for water intake during all three weeks. The results showed that the was no difference in relative water between birds fed 3% fish oil and birds fed 0% fish oil,the results of relative water show that no significant difference (P > 0.05) at 1st, .2ndweeks compared to 3rdweek at (P < 0.01)

Table (4): Effect of feeding fish oil (finisher) on weekly water intake and relative water of broilerchicks (ml/bird).

Weeks Treatment	Week 1		Week 2		Week 2	
	Water intake	Relative water	Water intake	Relative water	Water intake	Relative water
Fish oil	1836.30±393.4	209.34±43.7	3174.00±169.6	259.89±29.9	3654.65±331.0	218.64±22.8
Control	1488.30±596.9	192.23±65.1	2651.46±280.1	271.88±46.6	2250.78±269.4	179.68±17.1
Significance	0.01	0.25	0.00	0.15	0.00	0.00
	**	NS	**	NS	**	**

**: High significant difference.
NS: Nosignificant difference.

:Mean weekly body weight :4-1-4

The results of body weight and Initial weight (g/bird) for bird fed 3% fish oil are presented in table (5). The resultsshow that high significantly (p<0.01) at initial weight. Birds fed3% fish oil washigher significantly .different (p<0.01) for body weight during weeks 1st, 2nd and 3rd

Table (5): Effect of feeding fish oil (finisher) on weekly body weight and initial weight of broiler chicks (g/bird).				
Weeks Treatment	Initial weight	Week 1	Week 2	Week 3
Fish oil	705.50±11.3	882.36±92.7	1247.57±121.9	1677.07±126.8
Control	661.00±20.0	761.57±78.8	991.19±131.4	1257.77±151.3
Significance	0.00	0.00	0.00	0.00
	**	**	**	**
**: High significant difference.				

:Mean weekly weight gain:4-1-5

The results of mean weekly weight gain (g/bird) are presented in table (6) The results ofbirds fed 3%show thathigher significantly(p< 0.01) .during 1st and 2ndweeks , no significance difference at 3rd week

Table (6): Effect of feeding fish oil (finisher) on weekly weight gain .of broiler chicks (g/bird)			
Week 3	Week 2	Week 1	Weeks Treatment
425.12±73.8	407.00±26.6	309.50±21.1	Fish oil
251.41±56.7	315.87±55.9	327.52±89.1	Control
0.00	0.00	0.30	Significance
**	**	NS	
**: High significance difference / NS: NO significance difference.			

:Mean weekly feed conversion ratio :4-1-6

The results of mean weekly feed conversion ratio for bird fed fish oil are show in table (7). Birds fed 3% fish oil washigher significantly (p < .0.01) in 1st, 2ndand 3rd weeks compared to birds fed the control diet

Table (7): Effect of feeding fish oil (finisher) on weekly feed .conversion ratio of broiler chicks (g/bird)			
Week 3	Week 2	Week 1	Weeks Treatment
1.42±0.3	1.78± 0.2	2.25±0.3	Fish oil
1.82±0.4	2.27±0.4	1.76±0.6	Control
0.00	0.00	0.00	Significance

**	**	**	
**: High significance difference.			

:Carcass weight and dressing percentage :4-1-7

The results of carcass weight and dressing percentage for bird fed by fish oil are presented in table (8).Birds fed 3% fish oil washigher significantly (p< 0.01) for carcass weight and dressing percentage .compared to birds fed the control diet

Table (8): Effect of feeding fish oil (finisher) carcass weight and dressing percentage of broiler chicks (g/bird).

Parameter Treatment	Carcass weight	dressing percentage
Fish oil	**1214.41±61.3**	**63.90±0.5**
Control	**842.9±85.9**	**62.15±1.3**
Significance	**0.00**	**0.00**
	**	**
**: High significance difference.		

:Blood analysis :4-1-8

The results of blood analysis for bird fed by fish oil are presented in table (9) (HB, PCV, WBC, RBC, MCV, MCHand MCHC).Birds fed 3% fish oil was higher significantly at (p< 0.01) forHB,WBC and MCHC and higher at level (p< 0.05) forcholesterol, PCV and MCH.While results show that there was no significant differences were observed for (p> .0.05) in RBC and MCV

.Table (9): Effect of feeding fish oil (finisher) blood analysis of broiler chicks

CHOL Mg/dl	MCHC (g/dl)	MCH (pg)	MCV (fl)	RBC*10^3/ ml	WBC*10^3/ ml	PCV (g/dl)	HB (%)	Parameter Treatment
113.20±19.7	**0.43±0.03**	**24.9±4.6**	**56.56±8.**	**5.21±0.7**	**6.94±0.7**	**29.02±2.**	**12.89±1.**	**Fish oil**

		3	5			4	6	
96.36±6.3	0.34±0.01	19.3±3.80	57.11±4.8	4.68±0.4	4.81±0.2	27.00±0.8	9.45±0.5	Control
0.04	0.00	0.02	0.87	0.07	0.00	0.05	0.00	Significance
*	**	*	NS	NS	**	*	**	

**: High significance difference.
*: significance difference.
NS: NO significance difference.

Mean weeklyprotein ratio efficiency :4-1-9

The results of mean weekly protein ratio efficiency at ratio for bird fed by fish oil were presented in table (10). The results show that the bird's .fed3% fish oil was higher significantly ($p< 0.01$) at 1^{st},2^{nd} and 3^{rd}weeks

Table (10): Effect of feeding fish oil (finisher) on weekly protein ratio efficiency of broiler chicks(g/bird).

Weeks / Treatment	Week 1	Week 2	Week 3
Fish oil	15.89±2.1	19.88±2.1	18.10±3.0
Control	22.47±7.7	15.89±2.8	14.44±3.5
Significance	0.00	0.00	0.00
	**	**	**

** : significance difference

Mean weekly efficiency energy utilization:4-1-10

The results show thateffected efficiency energy utilization for bird fed fish oil is presented in table (11). Birds fed 3% fish oil was higher significantly($p< 0.01$) during 1^{st},2^{nd} and 3^{rd}weekscompared to birds fed .control diet

Table (11) : Effect of feeding fish oil (finisher) on weekly efficiency energy utilization of broiler chicks(/bird)			
WeeksTreatment	Week 1	Week 2	Week 3
Fish oil	23.66±2.8	29.68±3.5	27.00±4.5
Control	34.16±11.2	23.66±4.2	21.5±5.0
Significance	0.00	0.00	0.00
	**	**	**
** : significance difference			

:Mean weekly lysine efficiency: 4-1-11

The results of weekly lysine efficiency for bird fed fish oil are presented in table (12) The results show that the Birds fed 3% fish oil was higher . significantly ($p<0.01$) during 1st ,2nd and 3rd weeks

Table (12) : Effect of feeding fish oil (finisher) on weekly lysine efficiency of broiler chicks(g/bird)			
Weeks Treatment	Week 1	Week 2	Week 3
Fish oil	174.44± 23.8	137.20±17.5	79.00±15.0
Control	136.29± 46.9	175.00±28.00	100.00 ±20.0
Significance	0.00	0.00	0.00
	**	**	**
** : significance difference			

:Mean weekly production efficiency factor: 4-1-12

The results of mean weekly production efficiency factor for bird fed fish oil are presented in table (13) The Birds fed 3% fish oil was higher .significantly($p< 0.01$) during weeks 1st ,2nd and 3rd

Table (13) : Effect of feeding fish oil (finisher) on weekly production efficiency factor of broiler chicks(/bird)

Weeks Treatment	Week 1	Week 2	Week 3
Fish oil	**87.22±12.6**	**126.98±17.5**	**125.7±5.27.1**
Control	**104.51± 28.7**	**79.24±14.0**	**76.7±17.55**
Significance	**0.00**	**0.00**	**0.00**
	**	**	**
** : significance difference			

4-2: Discussion:

The overall performance results of the present study showed a highly significant (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) for birds fed 3% fish oil compared to those fed control diet . These results might be due to the rich content of omega-3 fatty acids (eicosapentaenoic acid (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 a vital role immune response. A number of researches have examined the effect of dietary long-chain polyunsaturated fatty acids (PUFA), such as those contained fish oil. Growth performance of broiler fed fish oil has improved performance parameter due to the dietary fat composition with type of long-chain n-3 fatty acids that make it possible to increase diet digestibility and to stimulate growth and feed efficiency (Fedna, 1999, Moura, 2005, Schreiner *et al.*, 2005 and Saleh, 2009).

The results of feed intake of broiler fed fish oil was (higher significantly) has improved feed intake (P<0.01) due to the fish oil content vitamin E, A, B1, B2, B3, C and D. These results agreed with the results (Navid, 2011). (Navidshad, 2009) how reported that levels (2and 4 %) of added fish oil did not affect feed intake, (Leeson *et al*., 1996) showed that broiler feed intake increases linearly with decreasing dietary energy level.

The results of water intake of broiler fed fish oil were(higher significantly) ($P<0.01$) has improved water intake bird fed fish oil, these results might be due to composition of diet, but results of relative water were highly significant ($P<0.01$) for the 3rd week and no significant ($P>0.05$) during weeks 1st and 2nd.

(Navidshad, 2009) reported that levels added (2 and 4 %) fish oil in diets of broiler chicken decreased weight gain, but (Z.Dobrzanski *et .al*. 2001) reported that an increased in daily weight gain by adding 3% fish oil to the diet. The results of (Z.Dobrzanski) similarity with the results of this study.(Hulan *et al*., 1988) observed that the feeding of fish oil to broilers caused lower body weight than feeding the control diets , (Navid., 2011) reported that adding 3% fish oil increased and improved the body weight . The result of body weight in this study was higher significantly ($P<0.01$), because fish oil contain omega-3 fatty acids (EPA and DHA) and good source of energy. This result agrees with the results with the reported by of Navid. Butdisagree result Hulan et al., 1988).

The result of feed conversion ratio of broiler fed fish oil was not significantly affected differ. This result showed that no effect by fish oil. These resultsdisagree with (Navid. 2011) who reported that adding 3% fish oil improved feed conversion ratio. (Navidshod, 2009) report that added levels (2 and 4 %) fish oil did not affect feed conversion ratio, (Nagwa, 2013) reported that at adding levels (4 and 6 %) to fish oil , improved feed conversion ratio.

The result of carcass weight of broiler fed fish oil was higher significantly than broiler fed control diet ($P<0.01$). The result showed that the fish oil improved and increased carcass weight because the fish oil contains n-3 and n-6, birds fed fish oil.That may be have deposited move quantities of

unsaturated FA in the abdominal fat and fish oil good sources of energy, the result of this study is similar to the result of (Lopez-Ferres, 2001 and Chanmugam *et al*., Pinchasov (1992) , the result of dressing percentage was higher significantly (P<0.01).

The results of blood of broiler fed fish oil was higher significantly (P<0.01) inHB,WBC and MCHC, and significant (p< 0.05) incholesterol, PCV and MCH. The results showed that no significant differences (p> 0.05) were observed RBC, MCV, the result showed that fish oil affect the blood, these results agree with Alparslan, (2006) who reported that fish oil does not affect on the some blood parameters, (Newman et al., 2002) and (Leaf and weber, 1988) reported that fish oil reduces level of cholesterol, these results disagree with the result of study that showed the fish oil affect the cholesterol level (P<0.05).

The results of protein ratio efficiency, efficiency energy utilization, lysine efficiency and production efficiency factor of broiler fed fish oil were higher significantly (P<0.01), the results showed that improvement to ratio efficiency, efficiency energy utilization, lysine efficiency and production efficiency factor of birds fed fish oil compared to birds fed control diet, these result might be due to the nutritional values of fish oil and composition of diet.

4-3: Conclusionsandrecommendations:-

Conclusions:

The following conclusionsin this study can be given:

- The supplementation of fish oil in broiler diets resulted in positive effect on broiler performance. Positive effect of fish oil supplementation was observed during the week 1^{st}, 2^{nd} and 3^{rd}.
- Added fish oil was sig ($p<0.01$) affected the feed intake , water intake , body weight , weight gain , feed conversion ratio , carcass weight and dressing percentage(g) .
- The inclusion of 3% fish oil in broiler diets resulted in positive effects on protein ratio efficiency, efficiency energy utilization, and lysine efficiency and production efficiency factor.

Recommendations:

The following recommendations in this studycan be given:

- We can use the fish oil for ratio broiler chicks.
- Move study and research about the effect of fish oil on fat profile.
- Further studies can be conducted to investigate the effect of fish oil on egg quality and production.

Reference:

Alao, S. J, and D. Balnave. (1984). Growth and carcasscomposition of broilers fed sunflower oil and olive oil.Br. Poult. Sci. 25:209–219.

Alparslan, G., Ozdogan, M. (2005) The effects ofdiet containing fish oil on some blood parametersand the performance values of broilers and costefficiency. Int. J. Poultry Sci. 5: 415-419.

Aletor, V.A., II. Hamid, E. Niess and E. Pfeffer. (2000). Low protein aminoacid-supplemented diets in broiler chickens: Effects on performance,carcass characteristics, whole-body composition and efficiencies ofnutrient utilization. *J. Sci. Food Agric*., 80: 547–554.

Aletor, V.A., F.X. Roth, B.R. Paulicks and D.A. Roth-Maier, (2002). Growth,body-fat deposition, nitrogen excretion and efficiencies of nutrientutilization in broiler-chicks fed low-protein diets supplemented withamino acids, conjugated linoleic acid or an L-glucosidase inhibitor. *Arch. Geflu¨gelkd*, 66: 21–30.

Baker, J. K. et al. (2000) *Animal Health*. Danville, IL: Interstate Printers & Publishers, Inc.

Butolo JE. (2002)Qualidade de ingredientesnaalimentação animal. Campinas: ColégioBrasileiro de Nutrição Animal; 430p.

Calder, P.C. (2001). Polyunsaturated fatty acid,inflammation, and immunity. Lipids, 36: 1007-1024.

Chanmugam, P., M. Boudreau, T. Boutte, R. S. Park,J. Hebert, L. B. Berrio, and D. H. Hwang.(1992). Incorporationof different types of n-3 fatty acids into tissue lipids ofpoultry.Poult. Sci. 71:516–521.

Crespo N, Esteve-Garcia E (2002). Nutrient and fatty acid deposition in broilers fed different fatty acid profiles. Poultry Science; 81:1533-1542a.

Dacie. J.AND Lewis. S.M.(1977).Practical hematology 5th ED; PP297.Chuchill Living stone, London.

Károly Dublecz. (2011) Poultry nutrition: Lecture notes for students of .MSc courses of Animal Science and Nutrition and Feed Safety

Farhoom and P. and S. Chekaniazer (2009). Effects of graded levels of dietary fish oil on the yield and fatty acid composition of breast meat in .broiler chickens. Journal of Applied Poultry Research, 18: 508 – 513

Fedna.(1999)Normas FEDNA para la formulación de piensoscompuestos. .Madrid: Ediciones Peninsular

Gebauer S.K, Psota T.L, Harris W.S, Kris-Etherton, (2006).PM. N-3 Fatty acid dietary recommendations and food sources to achieve essentiality and Cardiovascular benefits.Am J ClinNutr. 83(6suppl):1526 S-35S.

Gunstone, F.D. and Harwood, J.L. (2006) Occurrence and characterization of oils and fats. In The Lipid Handbook, 3rd edn(Gunstone, F.D., Harwood, J.L. and Dijkstra, A.J., eds). BocaRaton, FL: Taylor & Francis Group, pp. 37–142.

Hargis , P . S ., M . E .d Van Elsmyck and B . M .Hargis , (1991) . Dietary modification of yolk lipid with menhaden oil .Poult .Sci ., 70 : 874 – 883.

Hibbeln, Joseph R. (June 2006). “Healthy intakes of n−3 and n−6 fatty acids: estimations considering worldwidediversity.”. American Journal of Clinical Nutrition 83 (6, supplement): 1483S–1493S. American Society for Nutrition.PMID 16841858.

Huang, Z. B., R. G. Ackman, W. M. N. Ratnayake,and F. G. Proudfoot. (1990). Effect of dietary fish oil on n-3fatty acid levels in chicken eggs and thigh flesh. J. Agric.Food Chem. 38:743–747.

Hulan, H.W., Ackman, R.G., Ratnayake, W. M.N., Proudfoot, F. G. (1988) Omega-3 fatty acidlevels and performance of broilers chickens fedredfish meal or redfish oil. Can. J. Animal Sci.68: 533–547.

Huyghebaert, G., (1995). Incorporation of Polyunsaturated fatty acids in egg yolk fat at varying dietary fat levels and composition.Arch. Geflugelkd, 59:145-152.

Jenkins, D. J, and A. R. Josse.(2008). Fish oil and omega-3 fatty acids. Can Med Assoc J 178:150.

Kamran Z., Sarwar M., Nisa M., Nadeem M., A., Mahmood S., Babar M.,E. and Ahmed S., 2008. Effect of Low-protein diets having constant energy to protein ratio on performance and carcass characteristic of broiler chickens from one to thirty five days of age, Poultry Science journal 87:468-474.

Kinsella, J. E., B. Lokesh and R. A. Stone, (1990). Dietary n-3 Polyunsaturated fatty acid and amelioration of cardiovascular disease . Possible mechanisms. J. Food. Sci. Technol, 52 : 1 – 28

Knapp, H. R., (1991). Effects of dietary fatty acid on blood pressure: epidemiology and biochemistry. In: Gary, J. Nelson (ed), Health Effects of Dietary fatty acid , pp : 94 – 106 . American oil chemistry society, champaign, 11Linois.

Leaf, A., Weber, P. C. (1988) Cardiovascularеffects of n-3 fatty acids. N. Engl. J. Med.318: 549-557.

Leeson, S., and J. D. Summers.(2001). Scott's Nutritionof the Chicken.4th ed. University Books, Guelph, Ontario,Canada.

Leeson S, Caston L, Summers JD. (1996). Broiler response to diet energy. .Poultry Science; 75(4):529-535

Lemme A., Frackenpohl U., Petri A. and Meyer H., 2006.Response of male BUT big 6 turkeys to varying amino acid feeding programs, P .science journal 85:652-660

Lopez-Ferrer, S., Baucells, M. D., Barroeta, A.C., Grashorn, M. A. (1999) N-3 enrichment ofchicken meat using fish oil: alternative substitution with rapeseed and linseed oils.Poultry Sci. 78: 356-365.

Lopez-Ferrer, S., Baucells, M.D., Barroeta, A.C., Grashorn, M. A. (2001) N-3 enrichment ofchicken meat. 1. Use of very long-chain fattyacids in chicken diets and their influence onmeat quality: fish oil. Poultry Sci. 80: 741-732.

M.Schreiner, H.W. Hulan,E. Razzazi-Fazeli, J. Bohm, R Moreira, (2005) ; *Journal of the Science ofFood and Agriculture*, 85, 216-226.

Marks, H.L., (1987). Water and feed intake, feed efficiency, and abdominal fat levels of dwarf and normal chickens selected under .different water: feed ratio environments Poult. Sci., 66: 1895-900

Marks, H.L. and G.M. Pesti, (1984).The role of protein and diet form in water consumption and abdominal deposition in broilers.Poult. Sci., .63:1617-25

Moura, B. H. S. (2005) Desempenho e composicaoda carcaca de frangos de cortealimentados comdifferentesniveisenergeticos com e semoleo [dissertacao]. Belo Horizonte: Escola deVeterinaria,UFMG. Brazilian. J. Poultry Sci. 7: 129-141.

Nasr S., Kheiri F., Solati A., Hajibabaei A. and Senemari M., 2011. The efficiency of energy and protein of broiler chickens fed on diets with different lysine concentrations, Journal of animal and veterinary advances 10(18):2394-2397.

National Research Council.(1994) NutrientRequirements of Poultry. 9 revised edition.National Academy Press. Washington, DC,USA.

Nash, D.M.,R.M.G. Hamilton,K .A., Sanford and H.W., Hulan,. (1996). The effect of dietary menhaden meal and storage on the omega-3 fatty acid and sensory attributes of egg yolk in laying hens. Can. J. Anim. Sci. .76: 377-383

Nagwa A.A., (2013). Effect of feeding graded levels of fish oil on Performance and lipids profile of broiler chicks.

Nash, D.M., Hamilton, R. M., Sanford, K. A.,Hulan, H. W. (1995) the effect of dietarymenhaden meal and storage on the omega-3fatty acid and sensory attributes of egg yolk inlaying hens. Can. J. Ani. Sci. 76: 377-383.

Navidshad, B., (2009). The Effects of Fish oil on growth performance and carcass characteristics of broiler chicks fed a low-protein diet. *Int. J. .Agric. Biol*., 11: 635–638

Navid HosseiniMansoub(2011) . Effect of fish oil Fed a Low-protein Diet on performance, carcass characterizes and blood indices in Broiler chicks. *Islamic Azad University, Maragheh branch, Maragheh, Ira*

Newman, R. E., Bryden, W. L., Fleck, E., Ashes,J. R., Buttemer,W. A., Storlien, L. H., Downing,J. A. (2002) Dietary n-3 and n-6 fatty acids alteravian metabolism: metabolism and abdominalfat deposition. Br. J. .Nutr. 88: 11–18

Patel, M., Crank, M., Dornburg, V., Hermann, B., Roes, L., Hu¨ sing, B., Overbeek, L., Terragni, F. and Recchia, E. (2006) Medium andLong-Term Opportunities and Risks of the BiotechnologicalProduction of Bulk Chemicals from Renewable Resources – The Potential of White Biotechnology. Utrecht, The Netherlands:Utrecht University Available at:http://www.chem.uu.nl/brew/BREW_Final_Report_September_2006.pdf (last accessed 15February 2008).

Phetteplace, H.W. and B.A. Watkins, (1990). Lipid measurements inchickens fed different combinations of chicken fat and menhaden oil. *J. Agric. Food Chem*., 38: 1848–1853.

Pinchasov, Y. and I. Nir, (1992). Effect of dietary polyunsaturated fatty acidconcentration on performance, fat deposition and carcass fatty acid Composition in broiler chickens.*Poult. Sci.*, 71: 1504–1512.

Rodriguéz MA, Crespo NP, Cortés M, CREUS E, Medel P. (2002)Efecto deltipo de grasa de la dietaen la alimentacion del broiler, con enfasisenlosproductosderivados del aceite de palma. Seleccionesavícolas; 44(10):693-702.

Rosa FC.(1999) Teor de ácidosgraxospoliinsaturados ômega-3 no peitoe coxa de frangos de cortealimentados com raçõescontendotrêsfontes de óleo [dissertação].Lavras:Universidade Federal de Lavras.

Salen , H ., Rahimi , Sh ., KarimiTorshizi , M . A. (2009). The effect of diet that contained fish oil on performance , serum parameters , the immune system and the fatty acid comlosition of meat in broiler . Int .J . .Vet .Res . 3,2:69-75

Sanz, M., Flores, A., Lopez-Bote, C. J. (2000).The metabolic use of energy from dietary fat inbroilers is affected by fatty acid saturation. J. Brit. Poultry Sci. 41: 61-68.

Sanz, M., A. Flores, P. Pe´rez De Ayala and C.J. Lo´Pez-Bote, (1999). Higherlipid accumulation in broilers fed on saturated fats than in those fedon unsaturated fats. *Brazilian Poult. Sci.*, 40: 95–101.

Schreiner, M., Hulan, H. W., Razzazi-Fazeli, E.,Bohm, J., Moreira, R. (2005). Effect of differentsource of dietary omega-3 fatty acid on general performance and fatty acid profiles of thigh,breast, liver and portal blood of broilers. J. Agri.Food Chem. 85: 216-226.

Simopoulos, A. P. (1991) Omega-3 fatty acids inhealth and disease and in growth anddevelopment.Am. J. Clin. Nutr. 54: 438-463.

Strumia, M.M.,Sample,A.B. and Hart ,E.D.,Amer J, Clin Path ., (1954).

S. Leeson and J.D. Summers. (2005). Commercial *Poultry Nutrition 3rd edition*.University books, P.O. Box 1326 Guelph, Ontario, Canada.

Yau, J. C., Denton, J. H., Bailey, C. A., Sams, A.R. (1991).Customizing the fatty acid content ofbroiler tissues. Poultry Sci. 70: 167-172.

Young, DS (1990): Effects of Drugs on Clinical Laboratory Tests. Third Edition. 1990: 3: 6-12.

Yousif, R. and Afaf, A. (1999). The nutrient composition of Sudanese animal feeds bulletin (3). Central Animal Nutrition Research Laboratory, animal production research center. Khartoum north, Sudan

Van-Kampen, E.J and W. G, Zijlstre (1961), Standrigation of hemoglinometry 11 the haemoglobinocyaitide method, J.Clin. Chem. Acta 6:538-544.

Z.Dobrzański, D. Jamroz, P Bykowski, T Trziszka (2001).*Electronic Journal of Polish AgricultureUniversities*. 1, 43-51.

-:Hematological analysis of blood

Cell Volume (f1) = packed cell volume /dI*10 / RBC/MB (10^{N}**Mean**

Mean Cell Hemoglobin (Pg) = packed cell volume / dI*10 / RBC/ /$N^{L}{}_{10}{}^{N}$

(%) **Mean Cell Hemoglobin Concentration** = (g/dI*100 /BCV

(Deice and lewis. 1977)

:Manual procedure of serum

Wavelength nm 550 – 500

Cuvette 1cm light pa

`Temperature 20 – 25 or 37c

Zero adjustment against reagent blank

Specimen serum or plasma

Blank	Standard	Specimen	Specimen
R2 Standard(250) Specimen(200)	ml 1.0 ..……	ml 1.0 nl 10	ml 1.0 ..... 10nl

Mix, incubate for 5 minutes at 37c or minutes at 20-25 c. Measure the absorbance of specimen ($A_{specimen}$) and standard ($A_{standard}$) against reagent blank. The color is stable for 60 minutes. (Young. 1990)

Temperature:-

Date	Minimum temperature	maximum temperature
22/3	28.9	35.8
23/3	28.7	35.2
24/3	28.9	36.9
25/3	28.7	36.4

26/3	29	36.1
27/3	28.9	36.4
28/3	28.7	40
29/3	28.5	39
30/3	28.3	40
31/3	29.2	39.1
1/4	28.7	38.3
2/4	28.6	38.2
3/4	28.8	38.7
4/4	28.7	38.9
5/4	29.4	39.3
6/4	28.3	39.7
7/4	29.3	39.8
8/4	29.2	38.6
9/4	28.4	39.2

Equations

Production efficiency factor (PEF):

= (Bird final weight/ kg χ livability %) / (age in days χ feed conversion ratio (FCR) χ 100) (Lemme *et al.,* 2006).

Protein efficiency ratio (PER):

= weight gain/ protein intake (Kamran *et al.,* 2008).

Energy efficiency ratio (EER):

= (weight gain χ 100) / energy intake (Kamran *et al.,* 2008).

Lysine efficiency:

= Lysine intake (mg) / weight gain (Nasr *et al.,* 2011).