Sudan University of Science and Technology

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Effect of feeding sheep and camel fat based diet on broiler performance and feed utilization

أثر التغذية بإضافة شحوم الضان والإبل للعليقة علي اداء اللاحم وكفاءة التغذية

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الإستهلال

قال تعالي:-

(وَعَلَى الَّذِينَ هَادُوا حَرَّمْنَا كُلَّ ذِي ظُفُرٍ ۖ وَمِنَ الْبَقَرِ وَالْغَنَمِ حَرَّمْنَا عَلَيْهِمْ شُحُومَهُمَا إِلَّا مَا حَمَلَتْ ظُهُورُهُمَا أَوِ الْحَوَايَا أَوْ مَا اخْتَلَطَ بِعَظْمٍ ۚ ذَٰلِكَ جَزَيْنَاهُم بِبَغْيِهِمْ ۖ وَإِنَّا لَصَادِقُونَ)

صدق الله العظيم

سورة الأنعام الآية (146)

Dedication

To my mother，father，sisters，brothers and friends

I dedicate this work

Acknowledgment

Thanks to Allah for the support to complete this work.

My sincere thank go to my supervisor Prof. Mohamed Tag Eldin Ibrahim for his support and guidance during this study，also I would like to thank Dr/Omer Massaad and all who helped me.

Abbreviations

ALA:	Alpha- Linolenic Acid
FA:	Fatty Acids
HDL:	High Density Lipoprotein
LA:	Linolenic Acid
LDL:	Low Density Lipoprotein
MUSAT:	Mono unsaturated Fatty Acids
PUSAT:	Poly unsaturated Fatty Acids
S F A:	Saturated Fatty Acids
U S F A:	Unsaturated Fatty Acids
VLDL:	Very Low Density Lipoprotein

Abstract

The current study was conducted to examine the effect of sheep and camel fat on broiler performance. Twenty eight day-old unsexed broiler chicks (Ross 308) were randomly selected and distributed into three finisher diet treatment groups (100 chicks per treatment) with 4 replicates of 25 birds each. The birds were fed on the diets for 3 weeks. The finisher diet treatments were control which contained 0% fat; treatment two contained 3%sheep fat while treatment three contained 3% camel fat. Live body weight, body weight gain, feed consumption, feed conversion ratio, protein efficiency ratio, lysine efficiency ratio, efficiency of energy utilization, water consumption, relative water consumption، production efficiency factor, carcass characteristics and blood cholesterol level were determined. High significant values ($p<0.01$) were obtained in live body weight, body weight gain, carcass weight، water consumption ، feed conversion ratio ،lysine efficiency ratio and production efficiency factor for the birds fed sheep and camel fat based diet compared to the control group gave the pest results. Dressing% and blood serum cholesterol showed significant difference ($p<0.05$). No significant differences were found in feed consumption, efficiency of energy utilization and protein efficiency ratio due to diet treatment. The study concluded that feeding sheep and camel fat based diets improved broiler performance.

ملخص الدراسة

صممت التجربة للتحقيق من أثر إضافة شحوم الضان والإبل علي أداء الدجاج اللاحم. حيث استخدمت كتاكيت عمر28 يوم غير مجنسة (روس 308) وزعت عشوائيا إلي ثلاثة مجموعات تحتوي كل مجموعة علي مائة كتكوت، ثم قسمت كل مجموعة إلي أربعة مكررات بكل تكرار(25) كتكوت. تم تغذية كل مجموعة علي علائق الناهي من اليوم (28-49) والتي أضيف لها شحوم الضان والإبل محسوبة من ألعليقه بالنسب التالية: 0%، 3% ،3%. وتم حساب كل من الأتي خلال فترة التجربة : الوزن الحي ، الوزن المكتسب ، العلف المستهلك، كفاءة التحويل الغذائي، نسبة كفاءة البروتين، نسبة كفاءة اللايسين كفاءة استهلاك الطاقة، استهلاك الماء،استهلاك الماء النسبي , عامل كفاءة الأنتاجيه ,خصائص جسد الذبيحة واخذ عينات الدم لتحليل الكولسترول . ولقد كانت معطيات التجربة بأنه يوجد فرق معنوي جدا بين المجموعات في حالة الوزن الحي , الوزن المكتسب، كفاءة التحويل الغذائي , استهلاك الماء ,وزن جسد الذبيحة, نسبة كفاءة اللايسين وعامل الكفاءة الأنتاجية بمستوى معنوية (ح <0,01) حيث كانت المجموعة اللتي أضيفت لها شحوم الإبل والضان الأفضل. نسبة التصافي ونسبة كولسترول مصل الدم وجد فيها فرق معنوي بمستوى معنوية (ح<0,05). لم يوجد فرق معنوي في العلف المستهلك , كفاءة استهلاك الطاقة ونسبة كفاءة البروتين. وعليه فان إضافة شحوم الضان والإبل لعلائق اللاحم أدت إلي تحسين معنوي في الأداء الإنتاجي لفراخ اللاحم.

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Chapter One

Introduction

Broiler industry is dramatically increasing in 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 high performance require high energy and protein diets which would enable them to maximum genetic potential. There is a problem to meet such high energy requirement by feeding conventional ingredients such as maize, wheat, barley and soybean. Fats provide a high energy source in broiler diets. Another problem with new commercial broilers is the accumulation of large amount of fat in the abdominal cavity. In developed countries, fat or oils as energy rich sources are available from animal such as tallow and fish oil or from plant such as soybean oil, sunflower oil and maize oil. Fats also provide varying quantities of the essential nutrient linoleic acid (Leeson and Summers, 2001). Another important role of fats in diet is its inhibition from de novo lipogenesis in broiler chickens (Yeh and Leveille, 1971) that could increase energy efficiency in diets. Tallow and other saturated animal fats are the principal sources that used in poultry nutrition, particularly in the later phases of feeding, because of limited digestibility in young chicken (Leeson and Summers, 2001). The addition of fat to diet, besides supplying energy, improves the absorption of fat-soluble vitamins, diminishes the pulverulence and increases the palatability of the rations. By increasing fat sources in broiler diet, the amount of feed intake decreased and feed efficiency was improved (Jeffri *et al*., 2010).

The experiment was designed to reach the following objectives:-

1- To study the effect of feeding sheep and camel fat on broiler chicks performance.
2- Find local alternative energy source in broiler feed which is safe ,cheep and not altering performance.

Chapter two

2. Literature Review

2.1: Poultry feed in Sudan:-

The real problem of chicken's nutrition in Sudan lies in poultry feed، where feed is one of the most important requirements of the poultry industry، accounting about 70% of total costs (AOAD، 1995). Although Sudan has 90- 95% of the feed materials used in poultry feed are available locally، but import from abroad about 5-10% of the feed composition which drain great deal of the cost (reached 23.37% of the total cost of the feed) Abd alGader *etal.*,(2001)(in Arabic) , beside acute competition in food between humans and animals ، (AOAD،1989). Babiker *et.al*، (2009) reported that sorghum، groundnut cake، sesame cake and wheat bran are considered as the main sources of protein and energy for poultry in Sudan, a though، groundnut meal is used commercially as the main sources of protein for poultry in Sudan (Ali et.al.،2011). Sudan needs to give attention to non-conventional feed resource as valuable feed by conducting research to improve the efficiency of animal production.

2.2: Oil and fat in broiler nutrition:-

The term fat (animal or vegetal) is used as a synonym for lipid in the human food as well as in the ingredients for animal nutrition. The addition of fat to diets, besides supplying energy, improves the absorption of fat-soluble vitamins, diminishes the pulverulence, increases the palatability of the rations, and increases the efficiency of the consumed energy (lower caloric increment). Furthermore, it reduces the passage rate of the digesta in the gastrointestinal tract, which allows a better absorption of all nutrients present in the diet. The terms fat and oil refer to

triglycerides of several profiles of fatty acids. The fats and oils are esters of glycerol; the former are solid, whereas the latter are liquid at room temperature. Lipids constitute the main energy reserve of animals and it has the highest caloric value among all nutrients. The carbon atoms of the fatty acids are chemically more reduced than carbon atoms found in sugar; therefore, the oxidation of triglycerides releases more than twice as much energy as carbohydrates (Baiao and lara,2005). The deposition of 1 g of energy from carbohydrates or protein by an animal requires higher quantities of these nutrients in comparison to the deposition of 1 g of energy from fat. Moreover, carbohydrate and protein reserves would be larger in function of the polar characteristic of these substances, which would include water in these deposits (Lehninger *et al*., 2000). Considering diets with similar nutritive value, chickens fed rations containing oil showed better performance than birds fed diets without oil inclusion (Moura, 2003). Deaton et al. (1981) used diets with similar nutritive values added with 4, 7 and 10% of animal fat, and observed that the increasing fat level of the diet increased the quantity of abdominal fat, corroborating results reported by (Yalçin *et al.*,1998).

2.2.1: Poultry fat:-

Poultry fat is also known as viscera oil and is obtained after the extraction of fat by autoclaving or in a percolator tank and expeller. After extraction, the fat is placed into a decantation tank to extract the acidulated soap stock and moisture excess. At this point, it is ready to be used in ration or to be refined (Neto, 1994). Product yield varies from 1.3 to 1.6% of the live weight of the bird (Mano *et al*., 1999). This range depends on the level and source of energy used in the ration, besides bird sex, age and weight at slaughter.

Higher percentages of fat are obtained when higher levels of energy are used, older birds are slaughtered and consequently with higher live weight; moreover, females

produce more fat than males, independent of dietary energy level and age at slaughter.

Assessing the effects of the mixtures of vegetal and animal fats, corn oil and poultry fat on the proportions of 0, 3, 6 and 9% in the alimentation of broilers, (Griffiths *et al.*,1977) observed that the birds fed with corn oil and poultry fat were significantly heavier than birds non-supplemented with fat.

2.2.2: Beef tallow:-

Newman et al. (2002) fed broilers with 8% of sunflower oil, fish oil or beef tallow in the diet and observed poorer feed conversion in the birds fed with beef tallow.

There was a positive relationship between the composition of the fatty acid present in diet and the composition of the fatty acid of the breast, thigh and skin of broilers fed corn oil, beef tallow or a mixture of both (Marion and Wood roof, 1963).

The type of fat added to the diet has a significant influence on the profile of fatty acids of the abdominal fat, and birds fed tallow have shown higher concentrations of saturated fatty acids and lower concentrations of unsaturated fatty acids compared to the birds fed with acidulated soybean oil soap stock (Thacker *et al*., 1994). Sanz *et al*. (1999) formulated broiler diets containing sunflower oil and bovine/swine fat and reported that the inclusion of saturated fats produced higher accumulation of intramuscular fat and abdominal fat.

In a study using one saturated (beef tallow) and one unsaturated (sunflower oil) lipid source at 8% of inclusion, Sanz *et al.* (2000) observed a significant reduction in the deposit of abdominal fat in the birds that received diets with sunflower oil.

According to Crespo and Esteve-Garcia (2002), the location of fat deposition depends on the kind of fatty acid added to the diet (saturated and polyunsaturated). Birds fed with diets rich on animal saturated fatty acids tended to have proportionally larger abdominal and mesenteric fat than other fat deposits.

2.3: Fatty acid profile:-

The composition of the fatty acids of lipids is determined by the separation of the methyl esters of the fatty acids using gas chromatography (Barbi and Lúcio, 2003). The profile of fatty acids is of importance to the quality of the utilized lipid and to the absorption of these lipids by the bird, and also because it influences the quality of the fat deposited on the broiler carcass.

2.4: Omega fatty acids:-

Omega-3 and omega-6 fatty acids are considered essential fatty acids،which means that they are essential to human and animals health but cannot be manufactured by the body. For this reason، must be obtained from food. They can be found in animal oil and fat. Omega-3 and omega-6 fatty acids are important in the normal functioning of all tissues of the body.

Deficiencies are responsible for a host of symptoms and disorders including abnormalities in the liver and kidney, changes in the blood, reduced growth rates, decreased immune function, depression, and skin changes, including dryness and scaliness. Adequate intake of the essential fatty acids results in numerous health benefits. Prevention of atherosclerosis, reduced incidence of heart disease and stroke, and relief from the symptoms associated with ulcerative colitis, menstrual pain, and joint pain have also been documented.(Linscheer and Vergroesen،1994، ، Barnard ،1998،also stated in Omega-3 fatty acids and depression،2003).

The omega-9 fatty acid, oleic acid, has been suggested to occupy arole in the metabolism of the essential fatty acids (Dhopeshwarkar and Mead 1961، Lowry and Tinsley 1966). These bioactive lipid mediators regulate pro-and anti-inflammatory processes via their ability to stimulate enzymes and produce cytokines and other acute phase molecules (Maskrey،*et al.*،2011).

2.5: Animal fats:-

Animal fats are rendered tissue fats that can be obtained from a variety of animals. Basically, these are the by-products of the meat packing industry, made available as a result of the preparation of meat either for sale as meat percent or from the manufacture of meat product (Sharma *et al* .,2013).

2.5.1: Types of animal fat:-

2.5.1.1: Tallow: It is hard fat rendered from the fatty tissues of cattle that is removed during processing of beef.

There are two types of tallow:

2.5.1.1.1: Edible tallow: The Codex Alimentarius recognizes standard for this as rendered from certain organs of healthy bovine animals.

It is also known as dripping.

2.5.1.1.2: Oleo-stock: It is high grade tallow that is obtained by low temperature wet rendering of the fresh internal fat from beef carcass. It has light yellow color, mild pleasant flavor and free fatty acid content is less than 0.2% (Sonntag (1979). Oleo-stock is also known by the synonym premier jus.

2.5.1.2: Caul fat: It is the fatty membrane which surrounds internal organs of some animals, such as cow, sheep, also known as the greater omentum. It is often used as a natural casing. It is also known as Lace Fat.

2.6: Animal fat Oxidation:-

Oxidation of food is responsible for degradation of the sensory characteristics and nutritional value, lipids are very susceptible to the prooxidant factors, this process once started can be slowed, but cannot be stopped, lowering the life of the food (Banu, 2001).

Off-flavors, nutritional losses and other deteriorative changes in animal fats are concerned with the changes that result from their reaction with atmospheric oxygen, i.e., oxidative rancidity, or by hydrolytic reactions catalyzed by lipases

from food or from microorganisms (Akamittath, *et al.*,1990). The effects of hydrolytic reactions can be minimized by cold storage, good transportation, careful packaging and sterilization. However, oxidative rancidity cannot be stopped by lowering the temperature of storage since it is a chemical reaction with low activation energy (Berset and Cuvelier, 1996; Andreo *et al*., 2003; Andres *et al*., 2004).

Oxidation can cause damage to cell membranes and DNA (Moller and Wallin, 1998) that may be involved in aging process (Lozano *et al*., 2006), hypertension (Russo *et al*., 1999) and cancer growth (Navarro *et al*., 1999). Lipid oxidation is induced by oxy- and/or lipid free radical generation and results in the generation of toxic compounds such as the malondialdehyde and cholesterol oxidation products (Rawls and Van Santen, 1990; Shahidi, 1998).

2.7: Factors that affect water intake of broiler chicks:-

Adlibitum water intake of broilers can be highly variable and depends on diet composition and feed form, on production performance, on intestinal health, stress and on environmental conditions.

Water intake of broilers is increased during physiological stress (Virden *et al.*, 2009).

Effects of dietary fiber on water intake can be two-fold. Whether water intake increases or decreases depends on the nature of dietary fibre.

Effects of these fibres on nutrient digestibility values and gizzard development were presented in more detail by Van der Klis (2012).

Huang *et al.* (2011) showed that a 10% feed restriction resulted in a 3.5% reduction in water intake and as a consequence the water to feed ratio was increased by feed restriction. Also physical quality of feed and feed form affects water intake. Huang *et al.*,(2011) indicated a significantly increased litter moisture in broilers fed pellets instead of fines (as reground pellets) (37.6% vs 31.3%) or

pellets instead of mash diets (42.4% vs 35.4%), which might be related to a higher feed and water intake in broilers fed pelleted diets. Such observation would agree with Serrano *et al.* (2013) who observed an increased water intake with pelleted diets compared to mash diets, whereas water to feed ratio was not affected.

2.8: Factors that affecting feed intake of broiler chicks:-

Control of feed intake is an extremely complex area involving a number of factors and theories which have attempted to explain this phenomenon. Factors such as diet (die nutrient composition, feed formulation and feedstuff inclusion levels, and feed pellet quality) and managerial (feed and water availability to the birds, environmental management, stocking density and disease control). There are theories which are based on both physiological (controlling mechanisms within the bird which limit and encourage consumption of aparticular nutrient or energy yielding components) and physical, the bird eats the maximum gut fill. Both mechanisms require the presence of sensors within the bird by which it is informed of intake. The amount of feed consumed is closely associated with growth performance in meat-type poultry. Modern commercial broilers and turkeys will not grow to their full genetic potential unless they consume their full nutritional requirement each and every day. Aside from adequate diet formulation, maintaining maximum feed intake is the single-most important factor that will determine the rate of growth and efficiency of nutrient utilization، (Peter and Abel ،2006).

2.9: Effect of dietary fat source on growth performance:-

The inclusion of fat and oil is a common practice in modern poultry production to increase the energy content of diet. In addition, dietary fat reduced passage rate of the digesta through the gastrointestinal tract, allowing for better nutrient absorption and utilization (Peebles et al., 2000; Baião and Lara, 2005; Latshaw, 2008).

Digestibility of dietary fats is affected by the fatty acid profiles, and several studies have shown better utilization of unsaturated fats leading to a higher metabolizable energy than saturated fats (Celebi and Utlu, 2004). It was reported that fat metabolism and deposition in poultry can be affected by different dietary fats (Sanz et al., 2000; Pesti et al., 2002).

To date, a number of different fat sources are available for poultry from both animal and vegetable sources and from the rendering industry (Sanz et al., 2000). It was observed that the replacement of tallow by vegetable fats rich in polyunsaturated fatty acids like sunflower oil, soybean oil, or linseed oil resulted in a decrease of abdominal fat deposition in broilers (Newman et al., 2002; Ferrini et al., 2008; Wongsuthavas et al., 2008). Newman et al.، (2002) reported in broilers fed 8% beef tallow in the diet a significant depression of feed efficiency compared to birds fed sunflower or fish oil. Furthermore, adding 3% of canola oil in broiler diet resulted in a significant improvement in body weight and feed conversion ratio when compared to birds fed animal fat (Newman et al., 2002); however, no significant difference was found in carcass traits and organ weight between groups. On the other hand, Shahryar et al. (2011) found that the addition of 6% animal fat in broiler diet led to an increase of abdominal fat and gizzard weight in comparison with those of birds fed un supplemented diets.

2.10: Effect of fat on blood lipid components in broiler chicks:-

Supplementation of lipids from plant or animal sources in commercial broiler diets, as an economic means of producing energy-rich formulations, has become essential to achieve recommended energy concentrations and essential fatty acids (Newman *et al.,* 2002). In the literature, there is an extent of studies concerning the impact of type and quantity of oil to increase the efficiency of

performance, feed utilization, carcass quality and meat quality of chickens. Some of these oil sources are rich in elements such as long chain polyunsaturated fatty acids that can change the proportion of the lipid constituents of the blood in humans and animals. It is possible to control fatty acid profile in blood and meat of birds as a result of transfer of certain components from the diet. The results in the literature regarding the effect of dietary fatty acids intake on plasma cholesterol concentrations are contradictory. Holland *et al.,* (1980) and Mori *et al.,* (1999) verified that polyunsaturated fatty acids of dietetic oils decrease both the meat and the plasma cholesterol concentrations. On the other hand, Bartov *et al*., (1971) and Washburn and Nix (1974) did not observe such effect. The composition of fatty acids in the broiler meat can be changed by including vegetable oil, fish oil or animal fat to diet, because a difference of fatty acids profile and a reduction in endogenous produced fatty acids occurs. Polyunsaturated fatty acids (PUFA), in place of saturated fatty acids (SFA) or carbohydrates, have been shown to lower the plasma low-density lipoprotein cholesterol (LDL) concentration (Kris-Etheton and Yu, 1997). A study was conducted on dietary olive oil and reported that olive oil was associated with significantly raised plasma concentration of LDL, high-density lipoprotein cholesterol (HDL). Another study (Rueda-Clausen *et al.,* 2007) reported that dietary intervention with olive oil in comparison with alternative vegetable oils increased triacylglycerols. Results from different studies on the effect of olive oil consumption on lipid profile are inconsistent. The effect of different lipid sources in diets on serum triglyceride, cholesterol, HDL, LDL and VLDL levels of broilers at day 28 of age was studied by Moslehi *et al.*، (2015). There were significant differences among treatments for triglyceride content, with the highest level in chicks fed diet containing control and the lowest level for those fed diet containing corn or olive oils. There were no significant difference among treatments for serum cholesterol and HDL contents of broiler chicks fed different

lipid sources. Broilers fed diet containing corn oil had higher LDL and lower VLDL as compared to the other groups. The lower LDL was for chicks fed diet containing fish oil and tallow. In another experiment on broilers, it was shown that the increase in the proportion of unsaturated fatty acids in blood may increase beta-oxidation rate that resulted in increase of uptake of fatty acids from blood to the tissues (Sanz *et al.,* 2000). In experiments on rats and humans, the researchers concluded that diets containing different amounts of PUFAs reduced triglycerides, serum cholesterol and LDL, while they increased blood HDL (Sunitha *et al.,* 1997; Oritz-Munoz *et al.,* 2009، Alparsan and Ozdogan 2006).

The quality and quantity of lipids and their fatty acid composition in meat are influenced by internal (age, gender, genotype and castration) and external (temperature, feeding) factors (Masek *et al*., 2013). The oil supplement in diets is a very important resource of either long chain n3- polyunsaturated fatty acids (PUFA), as in fish oil, or as a form of its precursor fatty acid, α-linolenic (ALA), as in linseed oil. The exact content and ratio between ALA and linoleic acid (LA) in linseed depends on the flax variety and could range from 14% to more than 60% of ALA (Zelenka *et al*., 2006). The main reason for incorporating linseed oil in mixtures for broiler chicken is the favorable effect of polyunsaturated fatty acid (PUFA) on animal and human health.

The effect of adding linseed oil is the increase in α-linolenic acid content (Zelenka *et al*., 2006) and in other n3 PUFA (Zelenka *et al*., 2008). Consequently, the ratio between competing n3 and n6 lines is also changed in favour of n3 fatty acids, which are essential for normal growth and development (Simopoulos, 2000). Several trials have shown that an increase in the content of long chain n3 PUFA in chicken broiler meat may be achieved by including linseed oil as a source of precursor, α-linolenic acid (Zelenka *et al*., 2008).

Nevertheless, possible problems arising from including linseed oil in chicken broiler diets comprise the worsening of sensory traits (Lopez-Ferr er *et al*., 1999) and the high economic cost of the linseed diet.

Poultry meat with an enhanced ALA content is more susceptible to oxidative damage than meat with a similar concentration of LA (Kouba and Mourot, 2011).

The balance of volatile compounds resulting from an oxidative breakdown of n3 PUFA causes the occurrence of a fishy aroma and the off-taste, characteristic of the meat of poultry fed a higher level of n3 PUFA (Rymer and Givens 2005).

2.11: Effect of supplemental fat in diets on some blood parameters and carcass characteristics of broiler chicks:-

. The addition of fat to diets, besides supplying energy, improves the absorption of fat-soluble vitamins (Baiao and Lara, 2005), provides varying quantities of the essential fatty acids, diminishes the dustiness, increases the palatability of the rations and improves the energy efficiency (Nitsan *et al*., 1997; Balevi and Coskun, 2000; Palmquist, 2002). Furthermore, it reduces the passage rate of the digesta in the gastrointestinal tract, which allows a better absorption of all diet nutrients (Moav, 1995; Palmquist, 2002). Fats or oils as energy rich feeds are available from animal sources such as tallow and fish oil or from plant sources such as soyabean, sunflower and maize oil. Tallow has traditionally been used in poultry nutrition and its production is noticeable throughout the world and there has been a great use of tallow in blended oil for poultry (Balevi and Coskun, 2000; Tabeidian *et al*., 2005). Tallow has included about 42.5% saturated fatty acids (SFA) and only 1% unsaturated fatty acids (UFA) that all of them are n-6 fatty acids (Sadeghi and Tabeidian, 2005). Soyabean oil stimulated growth rate of chicks when supplemented in poultry diets. Unsaturated vegetable fats or oils are more energetic than saturated animal fats (Nitsan *et al*., 1997). In diets with similar nutritive value, chickens fed with rations containing oil showed better performance

than birds fed diets without oil inclusion (Palmquist, 2002). Accumulation of large amounts of fat in abdominal cavity is a problem in modern broiler strains. Abdominal fat is removed by evisceration, thus decreasing processing yield (Sadeghi and Tabeidian, 2005). Vila and Esteve-Garcia (1996) found that sunflower oil produced less abdominal fat deposition in broilers than tallow at different levels of fat inclusion. Diets rich in UFA have been found to reduce fat deposition in broiler chicks when compared to diets supplemented with the same amount of fats rich in SFA (Sanz *et al*., 1999). All these studies suggest that dietary fatty acid profile could affect abdominal fat deposition. Dietary fat can alter blood composition and serum lipoprotein levels. Generally, SFA increase plasma LDL which are atherogenic, whereas HDL provides protection against atherosis. Dietary polyunsaturated fatty acids (PUFA) decrease serum VLDL, LDL and cholesterol and increase HDL value compared with SFA (Grundy, 1989; Kinsella *et al*., 1990).

Chapter three

3. Materials and Methods

3.1: 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^{Its} of March to 9 of April 2015.

3.2: Experimental houses:-

The experiment was conducted in an open side deep litter house 8×5m dimensional ،4m central height and 2.5m side height، 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 units (replicates) of equal area (1.5m^2 each) and 75cm walls high which separate the experimental units. The experimental house was cleaned، burned and disinfected. Equipments were roughly washed and disinfected. Then fresh wood shaving litters was spread in the experimental unit floor at depth of 5cm، moreover، each unit was provided with one tubular metal feeder and circular plastic drinker. The house had four lamps at 2m height، the ground.

3.3: Experimental birds:-

A total of three hundred one day old unsexed broiler chicks (ROSS 308) obtained from Enemaa Poultry Production Company. The experimental period extended for 21 days (from day 28 to 49 days of bird age). Water was supplemented with multi –vitamin from 28 -31 days. Antibiotic Doxystin

(Doxycycline Hcl 50mg – colistin sulphate 400000 I.U) was provided as prevention dose from 35 – 40 day.

3.4: Experimental treatments and feeding trials:-

The experiment consisted of three treatment groups designated as T1 control group fed nether sheep nor camel fat diet ،T2 group fed (3%) sheep fat diet and T3 group fed (3%) camel fat diet (table،1) ،Each group consist of one hundred birds and each group was further subdivided into four replicates of twenty five per replicate. 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 the birds were allocated into the experimental finisher diets form (28 to 49 days). All rations were formulated to be approximately iso-caloric and iso-nitrogenous to meet the nutrient requirements (Table1) for broiler chicks as outlined by the National Research Council (NCR،1994) ، feed and water were supplied adlibitum during the experimental periods. The nutrient composition of Sudanese animal feeds bulletin (3) by Yousif and Afaf (1999) was used for formulation of feed.

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

Treatment / Ingredients	T1	T2	T3
Sorghum grains	74.57	60.88	60.88
Wheat bran	0.1	10.56	10.56
G.N.C	18.835	18.98	18.98
Lime stone	0.74	0.83	0.83
D.C.P	0.01	0.01	0.01
lysine	0.68	0.66	0.66

Methionine	0.045	0.06	0.06
Common Salt	0.01	0.01	0.01
Super Concentrate*	5	5	5
Sheep fat	0	3	0
Camel fat	0	0	3
Premix	0.01	0.01	0.01
Calculated analysis			
ME(Mj/kg)	13.391	13.394	13.394
CP%	19.84	19.85	19.85
CF%	4	4.8	4.8
Ca%	1	1	1
Av.p%	0.6	0.6	0.6
Lysine%	1.2	1.2	1.2
Methionine%	0.5	0.5	0.5

* Hendrix broiler concentrate consist of ME (Mj/kg) 10.02, CP% 35, Ca% 10.6 , AV.P% 4.9, Lysine% 1.1, Methionine% 4.3, CF% 1.5.

Source: lab of Hendrix Company،Netherlands.

3.5: Data collection:-

During the experimental period live body weight (LBW)،body weight gain (BWG)، feed consumption(FC)، feed conversion ratio(FCR)،protein efficiency ratio(PER)، lysine efficiency(LE)، efficiency of energy utilization (EEU)، production efficiency factor (PEF) and relative water consumption(RWC)، were determined on weekly basis ،while temperature، water consumption(WC)، and mortality were recorded daily after day28. At the end of the 7^{th} week the birds were fasted for twelve hours for the slaughtering. Then dressing% was determined

،abdominal fat and thigh muscle (fat profile) ،blood sample for analysis of (Hb ، PCV ،WBC ،RBC، MCV ،MCH ، MCHC) and serum (Cholesterol) were obtained.

Determination of the rate of mortality**:-**

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

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

3.6: Fatty acid profile:-

The determination of fatty acid analysis including area% and height%: were done using Gas Chromatography،GC.2010 (Appendex1).

3.6.1: Extraction of oil:-

1- 10g of minced poultry meat was homogenized with 100ml $CHCL_{3:}CH_3OH$ (75:25) ml or (60:20) ml.
2- The mixture was then shacked/30minute.
3- The homogenate was centrifuged at 2000rpm/5min to recover the liquid phase.
4- The liquid phase which was recovered was washed with 10ml of 0.9% NaCl (salting) and was shacked/1minute.
5- The mixture was centrifuged at 200rpm/5min to be separated into two phases.
6- The lower chloroform phase containing the lipids was collected.
7- This phase was evaporation the solvents over room air.
8- Dry and collect the fat.

Extraction of oil was made according to the method for the Isolation and purification of total lipid from animal tissues ، (Folch *etal.*، 1957).

3.6.2: Preparation of methyl ester for GC:-

1- Take 1ml (fat) in a 250ml boiling tube.

2- Add 6ml of 0.5m NaOH (methonolic).Boil for 2.5mni if it is fat.

3-Add 6ml of 1% H_2so_4/CH_3OH shake and leave your mixture over night at$50c^o$ to react.

4-Add 2ml of hexane + shake.

5-Add enough saturated NaCl to lowering solubility level to the neck of the boiling tube.

6-Take 1ml of upper hexane layer into glass stopped tube.

7-Add some on hydrousNa_2SO_4 to the 1ml hexane layer to remove the moisture.

8-Sample is now ready for injection into GC.

Preparation of methyl ester for GC according to the method preparation of ester derivative of fatty acids for chromatographic analysis in advances in lipid methodology، Christie ، (1993).

3.7: Blood sampling and analysis of blood and serum:-

Before slaughtering birds were fasted for 12 hours only from feed. Two birds were randomly selected from each replicate (8birds treatment) for blood sampling. Blood samples were collected from the jugular vein and received in labeled test tubes ، which were placed horizontally on racks at room temperature .Blood serum was separated by centrifugation for the determination of cholesterol. Blood samples with anti coagulant (EDTA) were used for the determination of the hematological parameters like (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 Strumia *et al.*، (1954). Red blood cell (RBC) count and total leukocyte count (TLC) according to routine clinical method، these values were utilized for collocated mean corpuscular hemoglobin concentration (MCHC) according Daice and Lewis (1977) as described below:-

MCV (f1) = packed cell volume /dl*10 / RBC/MB (10^N)

MCH (Pg) = packed cell volume /dl*10/RBC/N^L10^N

MCHC = (g/dI*100 / BCV (%)

Hematological analysis of blood was done at the Laboratory of the Veterinary Institute Research (Soba).

3.8: Analysis of serum:-

Manual procedure:

500 – 550 nm	Wavelength
1cm light pa	Cuvette
Temperature	20 – 25 or 37C^0
Zero adjustment	against reagent blank
Specimen	serum or plasma

Blank	standard	specimen	Specimen
R2	1.0ml	1.0ml	1.0ml
Standard(250)	……..	10µl	.....
Specimen(200)	.....	.....	10µl

Mix, incubate for 5 minutes at 37C^0 or minutes at 20-25 C^0. Measure the absorbance of specimen (^{A} $_{specimen}$) and standard (^{A} $_{standard}$) against reagent blank.

The color is stable for 60 minutes، Young، (1990).

3.9: 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

Chapter four

4. Results

4.1: Temperatures of experimental period:-

Weekly maximum and minimum ambient temperature during the experimental period (three weeks) was presented in table (2). It was observed that the minimum environmental temperature was، $28.3C^0$ whereas the maximum temperature was $40C^0$.

4.2: Live body weight (LBW):-

The results showing the effect of feeding added sheep and camel fat to finisher diets on live body weight (LBW) are presented in table (3).The results showed that birds fed sheep and camel fat diets had significantly higher ($p<0.01$) live body weight compared to those fed on control diet during the 1^{st}، 2^{nd} and 3^{rd} week of the experimental period.

4.3: Body weight gain (BWG):-

Results of body weight gain (BWG) of the birds fed on sheep and camel fat added diets are shown in table (4). The results showed no significant difference was noticed during the 1^{st} week of the experimental period. Highly significant difference ($p<0.01$) were noticed during the 2^{nd} week of the experimental period. The result showed that birds fed sheep and camel fat diets significantly ($p<0.05$) had weight gain compared to those fed on the control diet during the 3^{rd} week of the experimental period.

4.4: Feed consumption (FC):-

The results of feed consumption (FC) are presented in table (5).The results showed that of birds fed sheep and camel fat diets feed consumption was highly significant ($p<0.01$) during the 1st and 3rd week of the experimental period. No significant differences were noticed during the 2nd week of the experimental period.

4.5: Feed conversion ratio (FCR):-

The results showing the effect of feeding added sheep and camel fat to finisher diets on feed conversion ratio (FCR) are presented in table (6). With the exception of the 2nd week the feed conversion ratio showed no significant difference between treatments.

4.6: Water consumption (WC):-

Data showing the effect of feeding sheep and camel fat added to diets (finisher) on water consumption are presented in table (7).The results showed that for birds fed sheep and camel fat based diets water consumption was highly significant ($p<0.01$) during the 2nd and 3rd week of the experimental period compared to control. Significant differences ($p<0.05$) were noticed during the 1st week of the experimental period; higher water consumption of those fed sheep and camel fat diet compared to control diet during the 1st ،2nd and 3rd week of the experimental period. Water consumption is generally high during the experimental period (summer).

4.7: Protein efficiency ratio (PER):-

The results of Protein Efficiency Ratio (PER) are presented in table (8). The results showed that for birds fed sheep and camel fat diets Protein Efficiency Ratio no significant differences were noticed during the 1st and 3rd week of the experimental period. But highly significant difference ($p<0.01$) was noticed during the 2nd week of the experimental period. Higher Protein efficiency ratio compared to those fed sheep and camel fat diet compared to those fed on control diet during the 2nd week of the experimental period.

4.8: Efficiency of energy utilization (EEU):-

The efficiency of energy utilization (EEU) of the brides fed on sheep and camel fat added diets table (9) ,Showed no significant differences noticed during the 1st and 3rd week of the experimental period. Highly significant ($p<0.01$) were noticed during the 2nd week of the experimental period; higher efficiency of energy utilization compared to those fed sheep and camel fat diet and the control diet during the 2nd week of the experimental period.

4.9: Production efficiency factor (PEF):-

The results of Production efficiency factor (PEF) are presented in table (10). With the exception of the 1st week the Production Efficiency Factor showed high significant differences ($p<0.01$) between treatments; higher Production efficiency factor was found by birds fed sheep and camel fat diet compared to the control group.

4.10: Lysine efficiency ratio (LER):-

The Lysine Efficiency Ratio (LER) is presented in table (11). No significant differences were noticed during the 1st and 3rd week of the experimental period but highly significant differences ($p<0.01$) were noted during the 2nd week of the experimental period.

4.11: Relative water consumption (RWC):-

Data showing the effect of feeding sheep and camel fat added to diets (finisher) on Relative water consumption (RWC) is presented in table (12). With the exception of the 3rd week the Relative water consumption showed no significant difference between treatments. The highest Relative water consumption was observed in chicks fed on control diet during the 3rd week of the experimental period.

4.12: Carcass weight (grams/bird)، Dressing% and Serum Cholesterol (mg/dl):-

The results of the carcass weight ،dressing% and serum cholesterol are presented in table (13) ،Carcass weight showed highly significant differences ($p<0.01$) between treatments. Dressing % and serum cholesterol showed significant ($p<0.05$) response to dietary treatments, higher serum cholesterol and carcass weight compared to those fed sheep and camel fat added to diet and the control diet during the experimental period. The highest dressing% and carcass weight were observed in chicks fed on sheep fat diet.

4.13: Blood analysis:-

The results of the effect of feeding sheep and camel fat added to diets on the Blood analysis are presented in table (14)،Hemoglobin (Hb g/dl)، Packed cell volume (PCV%)، White blood cell (WBC10^3/ml)، Red blood cell (RBC10^6/ml) and Mean cell hemoglobin concentration (MCHC g/dl) showed high significance ($p<0.01$). Mean cell volume (MCV FL) showed significant ($p<0.05$). No significance differences in Mean cell hemoglobin (MCH pg) were noted.

4.14: Mortality:-

The mortality% was 4% for all treatments throughout the experimental period.

4.15: Overall broiler performance of chicks fed 3% sheep and 3% camel fat added to finisher diet:-

The results of the effect of feeding sheep and camel fat added to diets on the overall performance are presented in table (15) ،live body weight، body weight gain، feed conversion ratio، water consumption، Production Efficiency Factor ، lysine Efficiency Ratio and carcass weight showed high significance ($p<0.01$). No significant differences in feed consumption، efficiency of energy utilization and Protein efficiency ratio were indicated .Dressing % and serum cholesterol showed significance at ($p<0.05$).

Table(2): weekly minimum and maximum Temperatures of the experimental Period:

Temperatures / Week	Minimum ^0C	Maximum ^0C
Week one	28.7	40
Week two	28.3	40
Week three	28.3	39.8

Table(3):Dietary(Finisher) effects of sheep and camel fat on weekly broiler live body weight (LBW) (grams/bird):

Week Treatment	Week one	Week two	Week three
Control	761.57±78.8[b]	991.19±131.4[b]	1257.7±151.3[b]
Ration added sheep fat	881.36±108.6[a]	1293.9±143.6[a]	1667.6±119.7[a]
Ration added camel fat	858.60±104[a]	1260.3±129.71[a]	1619.5±99.2[a]
Significant	**	**	**

[a, b] means within the same column followed by different superscript are significantly (P<0.05) different.

**: Highly significant difference at (p<0.01).

Table(4):Dietary(Finisher) effects of sheep and camel fat on weekly broiler body weight gain (BW G)(grams/bird/day) :

Week / Treatment	Week one	Week two	Week three
Control	46.79±12.7	45.12±7.98[b]	50.28±11.3[b]
Ration added sheep fat	50.59±5.9	65.19±8.6[a]	59.36±11.2[a]
Ration added camel fat	50.90±2.7	62.25±6.5[a]	57.49±10.9[a]
Significant	NS	**	*

[a, b] means within the same column followed by different superscript are significantly (P<0.05) different.

*: significance different at (p<0.05).

**: Highly significant difference at (p<0.01).

NS: No significant difference.

Table(5):Dietary(Finisher) effects of sheep fat and camel fat on weekly broiler feed consumption(FC)(grams/bird/day) :

Week / Treatment	Week one	Week two	Week three
Control	75.06±9.4[b]	92.91±7.8	88.781±15.4[b]
Ration added sheep fat	79.39±0.5[ab]	97.46±.9.7	104.77±11.1[a]
Ration added camel fat	83.63±11.7[a]	95.98±6.3	100.50±8.4[a]
Significant	**	NS	**

[a, b] means within the same column followed by different superscript are at significantly (P<0.05) different.

**: Highly significant difference at (p<0.01).

NS: No significant difference

Table(6):Dietary(Finisher) effects of sheep and camel fat on weekly broiler feed conversion ratio(FCR) :

Week / Treatment	Week one	Week two	Week three
Control	1.76±0.6	2.27±0.4[b]	1.82±0.4
Ration added sheep fat	1.59±0.2	1.56±0.2[a]	1.82±0.4
Ration added camel fat	1.65±0.3	1.61±0.2[a]	1.82±0.4
Significant	NS	**	NS

[a, b] means within the same column followed by different superscript are at significantly (P<0.05) different.

**: Highly significant difference at (p<0.01).

NS: No significant difference.

Table(7):Dietary(Finisher) effects of sheep and camel fat on weekly water consumption(WC) (ml/bird/day):

Week / Treatment	Week one	Week two	Week three
Control	212.61±85.3[b]	378.78±40.0[b]	450.15±53.8[b]
Ration added sheep fat	254.70±72.9[a]	473.86±38.3[a]	479.63±24.7[a]
Ration added camel fat	260.44±72.4[a]	484.05±19.4[a]	487.09±17.5[a]
Significant	*	**	**

[a, b] means within the same column followed by different superscript are at significantly (P<0.05) different.

*: significant difference at (p<0.05).

**: Highly significant difference at (p<0.01).

Table(8):Dietary effects of sheep and camel fat on weekly broiler Protein Efficiency Ratio (PER) /bird/day:

Week / Treatment	Week one	Week two	Week three
Control	3.21±1.1	2.27±0.4[b]	2.88±0.7
Ration added sheep fat	3.19±0.4	3.27±0.4[a]	2.86±0.6
Ration added camel fat	3.12±0.4	3.17±0.4[a]	2.89±0.6
Significant	NS	**	NS

[a, b] means within the same column followed by different superscripts are significantly (P<0.05) different.

**: Highly significant difference at (p<0.01).

NS: No significant difference.

Table(9):The effects of sheep and camel fat on weekly broiler Efficiency of Energy Utilization (EEU) /bird/day:

Week / Treatment	Week one	Week two	Week three
Control	4.80±1.6	3.39±0.6[b]	4.30±0.1
Ration added sheep fat	4.76±0.6	4.89±0.6[a]	4.27±0.9
Ration added camel fat	4.65±0.8	4.74±0.5[a]	4.31±0.9
Significant	NS	**	NS

[a, b,c] means within the same column followed by different superscripts are significantly (P<0.05) different.

**: Highly significant difference at (p<0.01).

NS: No significant difference.

Table(10):The effects of sheep and camel fat on daily broiler Production Efficiency Factor (PEF) /bird/day:

Week / Treatment	Week one	Week two	Week three
Control	14.93±4.1[b]	11.32±2[b]	15.34±3.51[b]
Ration added sheep fat	16.99±1.5[a]	21.16±4.8[a]	20.55±5.8[a]
Ration added camel fat	16.25±2.5[a]	19.94±3.2[a]	20.04±5.1[a]
Significant	*	**	**

[a, b] means within the same column followed by different superscripts are significantly (P<0.05) different.

*: significant difference at (p<0.05).

**: Highly significant difference at (p<0.01).

Table(11):The effects of sheep and camel fat on weekly broiler Lysine Efficiency Ratio (LER) /bird/day:

Week / Treatment	Week one	Week two	Week three
Control	19.30±6.7	25.00±0.4[a]	20.00±0.4
Ration added sheep fat	17.50±2.1	17.10±2.6[b]	20.00±0.5
Ration added camel fat	18.20±3.0	17.60±2.0[b]	20.10±0.4
Significant	NS	**	NS

[a, b] means within the same column followed by different superscripts are significantly (P<0.05) different.

**: Highly significant difference at (p<0.01).

NS: No significant difference.

Table(12):)The effects of sheep and camel fat on weekly Relative Water Consumption (RWC)(/bird/day) :

Week / Treatment	Week one	Week two	Week three
Control	27.46±9.3	38.84±6.7	35.94±3.4[a]
Ration added sheep fat	28.70±6.1	37.10±4.5	28.97±3.4[b]
Ration added camel fat	29.997±5.7	38.82±4.5	30.21±2.5[b]
Significant	NS	NS	**

[a, b] means within the same column followed by different superscripts are significantly (P<0.05) different.

**: Highly significant difference at (p<0.01).

NS: No significant difference.

Table(13):The effects of sheep and camel fat on broiler Carcass weight (grams/bird) Dressing% and Serum Cholesterol :

Item / Treatment	Carcass weight	Dressing%	Serum Cholesterol
control	842.90±85.9[b]	62.15±1.3[b]	96.36±6.3[b]
Ration added sheep fat	1166.10±85.9[a]	65.24±1.5[a]	136.30±47.1[a]
Ration added camel fat	1089.40±18.4[a]	62.87±1.8[ab]	133.80±21.8[a]
Significant	**	*	*

[a, b,] means within the same column followed by different superscripts are significantly (P<0.05) different.

*: significant difference at (p<0.05).

**: Highly significance different at (p<0.01).

Table(14):Dietary (Finisher) effects of sheep and camel fat on broiler Blood analysis:

Item / Treatment	Hb g/dL	PCV%	WBC	RBC	MCV	MCH	MCHC
Control	**9.4500±.45356^{c}**	**27.0000±.75593^{b}**	**4.8125±.24749^{b}**	**4.6825±.39622^{b}**	**57.1050±4.83021^{a}**	**19.2625±3.800006**	**.3475±.01982^{b}**
Ration added sheep fat	**13.3625±.82278^{a}**	**29.2500±1.03510^{a}**	**7.1625±.49839^{a}**	**5.7537±.68153^{a}**	**51.3250±4.87611^{b}**	**23.4650±2.84327**	**.4575±.02866^{a}**
Ration added camel fat	**12.1000±.89283^{b}**	**27.6250±1.40789^{b}**	**7.3250±.66708^{a}**	**5.3762±.51489^{a}**	**51.6500±3.27283^{b}**	**19.9787±8.16577**	**.4375±.03012^{a}**
Significant	******	******	******	******	*****	**NS**	******

$^{a, b,}$ means within the same column followed by different superscripts are significantly (P<0.05) different.
*: significant difference at (p<0.05).
**: Highly significant difference at (p<0.01).
NS: No significant difference.

Table (15): The overall broiler performance (28-49) of birds fed different fat sources and rations cost

Item / Treatment	LBW (gram/bird)	BWG (gram/bird)	FC (gram/bird)	FCR	WC (ml/bird)	Dressing%	1kg cost (SDG)
Control	1257.7±151.3[b]	127.83±28.9[b]	231.39±42.2	1.91±0.3[a]	912.93±163.8[b]	62.15±1.3[b]	4.45
Ration added sheep fat	1667.6±119.7[a]	158.18±30.2[a]	251.70±49.4	1.61±0.1[b]	1077.2±164.4[a]	65.24±1.5[a]	4.28
Ration added camel fat	1619.5±99.2[a]	154.21±28.5[a]	251.40±43.7	1.66±0.1[b]	1092.40±157.7[a]	62.87±1.8[ab]	4.31
Significant	**	**	NS	**	**	*	

[a, b,] means within the same column followed by different superscripts are significantly (P<0.05) different.

*: significance different at (p<0.05).

**: Highly significant difference at (p<0.01).

NS: No significant difference.

Chapter five

5. Discussion

The overall result showed that no significant differences were found in feed consumption, efficiency of energy utilization and protein efficiency ratio. Highly significant different ($p<0.01$) were found in live body weight, body weight gain, carcass weight، Water consumption ، feed conversion ratio ،lysine efficiency ratio and production efficiency factor significant differences ($p<0.05$) were found in dressing% which was improved by entered sheep fat while significant difference was found in blood cholesterol ($p<0.05$) the control group showed lower cholesterol content than the treated groups but still the cholesterol content in the treated groups was below 200mg/dl being the normal accepted level. Growth performance of broilers fed sheep and camel fat was improved due to the addition. Dietary fat probably reduced passage rate of the digesta through the gastrointestinal trait, allowing for better nutrient absorption and utilization (Peebles et al., 2000; Baiao and Lara, 2005; Latshaw, 2008).or might be due to that the dietary fat composition increased diet digestibility so it improve growth and feed efficiency. This due to the higher percentage of long chain fatty acids and higher contents of triglycerides in animal fat. These results are agreement of that reported by (Thacker et al., 1994) and (Celebi and Utlu, 2004). The result of water consumption showed that highly significant different ($p<0.01$). Birds fed 3% sheep and camel fat based diet recorded the highest consumption of water; might be due to the dietary energy content. The results are in agreement with those reported by (Marks and Pesti, 1984). The results of feed consumption showed no significant differences among different experimental groups and highly significant different($p<0.01$) in feed conversion ratio during the experimental period because of the dietary fat composition that affected feed intake and feed efficiency was

improved as reported by (Jeffri et al., 2010).The result showed that supplementation by 3% of sheep as camel fat to broiler chicks showed high significant ($p<0.01$) live body weight، ،body weight gain .This agreed with that studied by Hussein et al. (1996). Who reported that high dietary energy level significantly increased body weight gain (BWG) during the finishing period, increasing energy level significantly increased live body weight (LBW) and BWG (Elmansy, 2006). During the finishing period, increasing energy level significantly increased LBW and BWG (Elmansy, 2006). Nahashon *et al*،.(2005). Greenwood *et al*،. (2004). In contrast, Saxena and Thakur (1985) concluded that LBW and BWG were not significantly affected by dietary energy levels. The result showed that significance ($p<0.05$) in serum cholesterol (CH) level (mg/dl) increased by adding sheep and camel fat. This results agreement with that reported by (Wardlaw and Snook, 1990) who found that tallow produced a significant rise in serum cholesterol. These results may be explained on basis that the high SFAs and low PUFAs contents in sheep and camel fat, which is an important contributing factor to raising serum cholesterol level. Elmansy (2006) reported that the higher level of energy (3200Kcal ME/kg diet) induced a higher level of triglyceride and cholesterol. The results showed that supplementation by 3% of sheep and camel to broiler chicks highly was significant ($p<0.01$) on carcass weight compared to control diet. Also the present study results are in agreement of that reported by Nahashon et al. (2005) who found that carcass weight was significantly improved by increasing dietary energy levels. The dietary treatments had no effect on mortality percentage. Currently sheep and camel fat have no high economical value, but the value increase in case of increases of sorghum price or plant oils price (energy source). Also sheep and camel fat can be substitution for energy sources as alternative local feedstuff to decrease the competition between human and animals.

Currently the addition of sheep and camel fat improved the performance of broiler chicks, however, no significant differences were found in the feed consumption, efficiency of energy utilization and protein efficiency ratio.

Chapter six

6. Conclusion and recommendations

6.1: Conclusion: -

The results showed that addition of sheep and camel fat in broiler finisher diet improved broiler performance parameters as feed conversion ratio, live body weight،water consumption ،body weight gain، Production Efficiency Factor(PEF)، Lysine Efficiency Ratio (LER),it also improve dressing% and carcass weight, when compared with the control diet. Thereby، it reduce the cost of production.

6.2: Recommendations:-

- Restudy the effect of other percents of sheep and camel fat in broiler finisher diet to reach the best added percent to broiler feed.
- Further Studies are needed to investigate the effect of sheep and camel fat on fat profile in poultry.
- Further Studies were needed to study the effect of season on sheep and camel fat diets in poultry nutrition.
- Further Studies can be conducted to investigate the effect of sheep and camel fat on egg production performance.
- Further Studies were needed to investigate on addition of fat from others animal in poultry feeding.

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المراجع العربية:-

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Appendix1

Analysis of Fatty acid profile

Analysis of fatty acid profile of Camel fat										
N of C atom		S F A	U S F A		CHAIN			Omega FA	Area%	Height%
			MUSAT	PUSAT	SHORT	MEDIUM	LONG			
C11:0		1				MEDIUM			0.2781	0.5988
C13:0		1				MEDIUM			5.8751	12.2874
C14:1			2			MEDIUM			1.1	1.2208
C14:0		1				MEDIUM			0.8542	1.9008
C15:1			2				LONG		31.0825	37.3959
C16:1			2				LONG	7	1.1546	1.7305
C17:1			2				LONG		58.8935	43.8665

Analysis of Thigh fatty acid profile Of diet based Camel fat										
N of C atom		S F A	U S F A		CHAIN			Omega FA	Area%	Height%
			MUSAT	PUSAT	SHORT	MEDIUM	LONG			
C14:1			2			MEDIUM			1.1968	3.0246
C15:1			2				LONG		0.2063	0.5856
C15:0		1					LONG		28.9143	30.3133
C17:1			2				LONG		57.1378	47.063

Analysis of Abdominal fatty acid profile Of diet based Camel fat										
N of C atom		S F A	U S F A		CHAIN			Omega FA	Area%	Height%
			MUSAT	PUSAT	SHORT	MEDIUM	LONG			
C14:1			2			MEDIUM			1.5087	4.0583
C14:0		1				MEDIUM			0.1866	0.3208
C15:1			2				LONG		0.1731	0.6676
C15:0		1					LONG		31.3173	31.803
C16:0		1					LONG		0.7029	1.2196
C17:1			2				LONG		58.6848	48.3837
C18:2				3			LONG	6	6.5474	11.2743
C18:1			2				LONG	9	0.1632	0.6355
C18:0		1					LONG		0.1196	0.3174
C20:0		1					LONG		0.5965	1.3197

Analysis of fatty acid profile of sheep fat										
N of C atom		S F A	U S F A		CHAIN			Omega FA	Area%	Height%
			MUSAT	PUSAT	SHORT	MEDIUM	LONG			
C11:0		1				MEDIUM			0.0829	0.4469
C13:0		1				MEDIUM			2.7149	10.057
C14:1			2			MEDIUM			1.0936	3.0025
C14:0		1				MEDIUM			23.5585	34.2533
C16:1			2				LONG	7	71.5901	49.7825
C18:2				3			LONG	6	0.4617	1.125
C18:0		1					LONG		0.4981	1.3328

Analysis of Abdominal fatty acid profile Of diet based sheep fat										
N of C atom		S F A	U S F A		CHAIN			Omega FA	Area%	Height%
			MUSAT	PUSAT	SHORT	MEDIUM	LONG			
C14:1			2			MEDIUM			1.03	2.5011
C15:0		1					LONG		28.4921	30.9541
C16:0		1					LONG		0.4939	0.813
C17:1			2				LONG		0.2937	0.8062
C17:0		1					LONG		61.4774	50.8613
C18:2				3			LONG	6	7.9046	13.3318
C20:0		1					LONG		0.3084	0.7325

Analysis of thigh fatty acid profile Of diet based sheep fat										
N of C atom		S F A	U S F A		CHAIN			Omega FA	Area%	Height%
			MUSAT	PUSAT	SHORT	MEDIUM	LONG			
C13:0		1				MEDIUM			0.2216	0.3592
C14:1			2			MEDIUM			1.6206	3.2605
C15:0		1					LONG		62.2367	56.0525
C16:0		1					LONG		0.6458	1.0967
C17:1			2				LONG		7.9446	2.9864
C18:2				3			LONG	6	17.4258	26.0527
C20:0		1					LONG		6.8979	6.9767
C20:4				3			LONG	6	3.007	3.2151

Appendix2

Equations

Production efficiency factor (PEF):

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

Protein efficiency ratio (PER):

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

Energy efficiency ratio (EER):

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

Lysine efficiency:

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