Sudan University of Science and Technology

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Effect of Feeding Red Sea Fish Waste Meal on Production Performance, Carcass Characteristics and Gut Micro-organisms of Broiler Chickens

أثر التغذية علي مخلفات اسماك البحر الاحمر علي الاداء الانتاجي ، خصائص الذبيحة وجراثيم الامعاء للدجاج اللاحم

A thesis Submitted for the Fulfilment of the Requirements for the Degree of Master of Science in Animal Production

(POULTRY NUTRITION)

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بسم الله الرحمن الرحيم

قال تعالي :

(وهو الذي سخر البحر لتأكلوا منه لحماً طرياً وتستخرجوا منه حلية تلبسونها وتري الفلك مواخر فيه ولتبتغوا من فضله ولعلكم تشكرون) صدق الله العظيم

سورة النحل الآية (14)

Dedication

To my parents

My Brothers

My Supervisor

My Friends

My husband

All who gave help I dedicate this work

Acknowledgement

First and foremost I thank ALLAH who gave me health, patience, ability and strength that enabled me to conduct this work and carry it to end. At the outset I would like to express the deep gratitude which I feel for the serious and patient supervision provided and giving his constructive criticism and guidance and great effort throughout the study Dr. Elfadil Ahmed Adam. Gratitude also extended to all people who helped and encouraged me during the study period.

Abstract

The study was conducted at the Animal Research Canter poultry farm to evaluate the effects of red sea fish waste meal (RSFWM) in the diet of broilers on the performance, carcass characteristics and gut microflora. Ninety six unsexed (Hubbard classic) broiler chickens at seven days of age were randomly distributed into four treatments (24 birds per each treatment).Four experimental diets were formulated, T1 (conventional ration with no RSFWM), T_2 2.5% RSFWM, T_3 5% RSFWM and T_4 7.5% RSFWM. The treatments were randomly assigned with three replications for each of the four experimental rations. The experiment was extended for six weeks. Average body weight was significantly higher in T_4 (2378g) followed by T_2 (2329g), T_3 (2286g) and the control diet T_1 (2133g). Feed intake g/bird (3957.3g,4387g,4255.7g and 4394.8g) for T_1, T_2, T_3 and T_4, respectively were significantly higher in diets fed with rations containing 7.5 and 2.5% RSFWM as compared to the control group and those fed 5% RSFWM. Body weight gain was significantly higher in birds fed 7.5% RSFWM (2215.7g) followed by those fed 2.5% (2162.5g), 5% (2119.8g) RSFWM and finally the control group (1966.1g). No significant differences were observed in feed conversion ratio between all treatments. The results obtained from carcass characteristics analysis indicated that inclusion of RSFWM had no significant effects ($p>0.05$) on dressing present and wing weight of broilers. On the other hand, RSFWM inclusion improved carcass, back, breast, drum stick and thigh weights as compared to those fed on control diet. Feeding RSFWM had no significant effect ($P < 0.05$) on spleen, liver, heart and gizzard weights. Microbial analysis of the intestinal content revealed that no *Salmonella* or *E.coli* microorganisms were detected. It is therefore concluded that red sea fish waste meal can be used up to 7.5% in the diet of broiler chickens without adverse effect on performance and carcass characteristics.

ملخص باللغة العربية

اجريت الدراسة بمزرعة دواجن مركز بحوث الانتاج الحيواني- كوكو لدراسة أثر التغذية علي مسحوق مخلفات اسماك البحر الاحمر علي الاداء الانتاجي ، خصائص الذبيحة وجراثيم الامعاء للدجاج اللاحم . تم توزيع ستة وتسعون كتكوت لاحم (Hubbard classic) عمر سبعة ايام عشوائياً الي اربعة مجموعات (24طائر لكل معاملة) والتي تم تقسيمها لاحقا ًالي ثلاث مكررات لكل مجموعة ويحتوي المكرر علي ثمانية كتاكيت. تم تكوين اربعة علائق للتجربة، العليقة الاولي عليقة التحكم والتي لا تحتوي علي مسحوق مخلفات اسماك البحر الاحمرومن ثم تم اضافة مسحوق مخلفات اسماك البحر الاحمر للعلائق الثلاثة الاخري بنسب متدرجة 2.5% ، 5% ، 7.5% علي التوالي. تم توزيع المعأملات عشوائيا باستخدام التصميم العشوائي الكامل . امتدت التجربة لفترة ستة اسابيع . أظهرت النتائج وجود إختلاف معنوي في متوسط وزن الجسم بين المعاملات حيث كان اعلي وزن (2378g) عند التغذية علي 7.5% ، (2329g) عند 2.5% ثم (2286g) عند 5% واقل وزن (2133g) عند التغذية علي العليقة الضابطة. .تلاحظ وجود فروق معنوية (P>0.05) بين المعاملات الاربع في العلف المستهلك حيث كان استهلاك العلف(,4387g, 4255.7g و 4394.8 g) للمعاملات التي تحتوي علي 2.5% ، 5% و7.5% من مسحوق مخلفات اسماك البحر الاحمر أعلي بالمقارنة مع المجموعة الضابطة (3957.3g) .كان الوزن المكتسب أعلي بشكل ملحوظ في الطيور التي تمت تغذيتها علي (7.5%)(2215.7g) وتليها 2.5% (2162.5g) و 5% (2119.8g) واخيرا المجموعة الضابطة . لم تلاحظ اي فروق ذات دلالة احصائية في نسبة تحويل الأعلاف بين جميع المعاملات . تشير النتائج التي تم الحصول عليها من تحليل خصائص الذبيحة الي ان التغذية علي مسحوق مخلفات اسماك البحر الاحمر لم يكن له تأثيرات معنوية علي نسبة التصافي ووزن الجناح ومن ناحية اخري فإن التغذية علي مسحوق مخلفات اسماك البحر الاحمر ادي الي تحسين وزن الظهر ،الصدر وعص الطبل ووزن الفخذ مقارنة مع تلك التي تمت تغذتها علي العليقة الضابطة .لم يكن للتغذية علي مسحوق مخلفات اسماك

البحر الاحمر اي تاثير معنوي علي وزن الطحال ،الكبد ، القلب والقانصة .التحليل الميكروبي لمحتويات الامعاء اظهر عدم وجود بكتريا السالمونيلا والكولاي. بإعتبارزيادة في وزن الجسم يحبذ إضافة مسحوق مخلفات اسماك البحر الاحمر في علائق فراخ اللاحم حتي 7.5%.

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CHAPTER ONE

1.0 INTRODUCTION

Naturally animals have a capacity to convert feeds into high quality human foods that are rich in protein. But, the production of animal products is not matched by the raised demand by human consumption as a result of the rapid growth of human population which is the major problem in the world in general, and in the developing countries in particular (Rameshwar and Kerthikeyan, 2005). Among the animal production segments, poultry farming may be considered one of the most developed activities in recent times, as a result of advances in genetics, nutrition, sanitation and management. And one of the main goals of poultry production is to efficiently and economically convert the relatively disposable, non-palatable and unattractive raw materials into nutritious foods. In ordering to meet the demand of animal protein in developing countries, improving the performance of chickens is mandatory. The total cost of feed in poultry production accounted for about 60-65% of the total cost of poultry production (Hassan, et al., 2003). The bulk of the feed cost arises from protein concentrates such as groundnut cake, fish meal and soybean meal. Thus, there is the need to look for locally available and cheap sources of feed ingredients particularly those that do not attract competition between human and livestock. One positive cheap source of protein is the fish waste. The availability of major nutrients and unidentified growth factors, well balanced amino acid profile and the presence of omega three fatty acids in FWM increases its importance in the feeding of simple stomached animals (Karimi, 2006; HLPE report 2014). Almost 40 to 50% of fish catch is thrown away as waste (Nithin, et al. 2013). This waste is highly perishable because its high moisture and protein content render it as an ideal medium for growth of microorganisms. If this waste is left unattended, it produces off odor and cause pollution problems. However, such waste could be utilized as source of protein ingredients in animal, poultry and fish feeds (Nithin, et al. 2013).The average fish waste in Port Sudan fish market is about 634kg per day (16.15%) of the daily landing. On the other hand the daily loss due to spoilage was estimated as 50kg this was equivalent to 1.25% of the average daily landing(FAO 2008). Therefore, these massive amount of fish waste was not utilized for animal feeding, but simply released into the environment resulting in pollution not only causing problem related to odour of disposing fish waste. Efforts have not been made yet in Sudan in general and in Port Sudan in particular to utilize this waste product as alternative feed ingredient in broiler rations to minimize the disposal problems. Therefore, this study was conducted to evaluate the performance, carcass characteristics and gut micro-organisms of broiler chickens fed diets containing graded levels of red sea fish waste meal.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Poultry Nutrition:

Nutrition is the most important factor that affects the performance of animals in general and poultry in particular. Poultry feeding and nutrition have been changed more than the feeding and nutrition of any other species. The vast majority of commercial poultry feeds a in large feed mills wherein the maximum of science and technology exists. The current trend in poultry production is toward controlled environment, which usually resulted in lower feed consumption. The nutrient contents of feed (energy, amino acids, vitamins, and minerals) are varied so as to compensate for the reduced feed intake and to meet the requirements which are often taken into consideration (Ensminger, 1990).According to previous studies (Samard, 2000) feed accounts for more than 65-75% of production broilers costs .This has been attributed to the high prices of imported feedstuffs especially protein concentrate. Groundnut cake has been traditionally used as the sole protein source in broiler diets (about 30% of the ration).

2.2 Poultry Feed Resources

2.2.1 Conventional feed resources:

Conventional feed sources are those feeds which are commonly and traditionally used for chicken feed (Yaqoob, 2005). However, conventional feed resources are facing a problem of competition with human foods. Gura (2008) stated that the recent feed price increment may upset many of the plans to further development of industrial poultry productions. Concern on locally available feed sources utilization is very likely to improve prices increments of poultry feeds. Emam and Hassan (2010) reported that the feed cost is the main cost item indifferent poultry-farm types and sizes. While replacing alternative ingredients, equivalency of nutritional values, costs and side effects on birds should be assessed and considered. Moreover, the trend of poultry production and the poultry feed source situation analysis is required. Chad (2007) reported that elevated levels of poultry feed availability will be required to meet feed demands of poultry production. The conventional feeds like wheat milling by product wheat bran and grain sorghum generally had higher crude protein (CP)and ME contents.

2.2.2Non-conventional feed resources:

Non –conventional feed resources (NCFR) are feeds which are not usually common in markets and not traditional ingredients. NCFRs are recognized for being noncompetitive in terms of human consumption, very cheap to purchase, by product or waste product from Agriculture, farm made feeds and processing industries and are able to serve as farm waste management in enhancing good sanitation. All these can be recycled to improve their value if there are economically acceptable and technological means for converting them into usable product sources that had been used in poultry nutrition include: cray fish meal (Ojewole et al., 2005;), sun-dried shrimp waste meal (Oduguwa et al., 2004), shrimp meal (Rosenfeld et al., 1997), grasshopper meal (Aduku, 1993; Ojewole et al., 2005), locally processed fish waste meal (Ojewole et al., 2005), poultry and chicken offal meal and shrimp waste (Rosenfeld et al., 1997). Unconventional feed ingredients as marine waste and frog waste are also available for use.

2.3 Sources of protein in poultry feeds:

The usefulness of a protein feedstuff for poultry depends upon its ability to furnish the essential amino acids required by the bird, the digestibility of the protein, and the presence or absence of toxic substances. As a general rule, several sources of protein produce better results than single protein source. Both vegetable and animal protein supplements are used for poultry (Ensminger, 1990). Most of the protein supplements of animal origin contribute amino acids, minerals and vitamins which significantly affect their value in poultry rations, but they are generally more variable in composition than the vegetable protein supplements (NRC, 1994).Protein supplements of animal origin are derived from meat packing and rendering operations, poultry and poultry processing, milk and dairy processing and fish processing (Denton et al., 2005).Before the discovery of vitamin B-12, it was generally considered necessary to include one or more of these protein supplements in the rations of chickens .Many proteins supplements of animal origin are difficult to process and store without some spoilage and nutrient loss. If they cannot be dried, they must be usually refrigerated. If not heated to destroy disease producing (pathogenic) bacteria, they may be a source of infection. On the other hand, protein availability will be reduced and some nutrients are lost if the feed is heated excessively (Ensminger, 1990). Products currently being utilized include meat meal from ruminants, swine and poultry origin, as well as the blood and fat products from each of these animals. Feather meal, hatchery by-product, spent hens and fishmeal (Cozzi et 'al., 1995: Kersey et al., 1997; Deshmukh and Patterson, 1997; Klemesrud et al. 1998 Grant and Haddad, 1998, Moritz and Latshaw, 2001) in poultry. Other sources of animal protein that are sparingly used are blood meal, meat meal and recently frog meal (Achionye-Nzeh et al., 2003).

2.4 Fish meal:

There is chronic shortage of supply of protein concentrates for poultry that necessitates investigation of the potentials of some feed resources that are cheaper, locally available and have comparative nutritional value as the conventional protein sources. Fish meal is notable feed ingredient with high nutrient density and availability that deserves attention as livestock protein source (Asrat, 2008). Most fish meals are good source of proteins (Donald and William, 2002) and contain omega -3 and -6 fatty acids that protect health and welfare and reduce dependence of chicks on antibiotics and other drugs. Thus the meal is a satisfactory and cheap animal protein that can partly replace expensive plant protein sources such as soybean and oil seed cakes. Fish meal is a well-known source of true protein with high biological value in the nutrition of monogastric animals (Mikule et al. 2004).Karimi (2006) reported that fish meal as a natural balanced feed ingredient is high in protein and other macro and micro nutrients. It is reported by Donald and William (2002) that fish meals vary in their content of crude protein from 55 to 75%.Good quality fish meal is usually marketed at 65% crude protein, but the crude protein content can vary from 57 to 77%, depending on the species of fish used (Miles and Jacqueline, 2006; Scanes et al., 2004). On the other hand, it is also reported by Miles and Chapman (2006) that high-quality fish meal normally contains between 60% and 72% crude protein by weight. Negussie and Alemu (2005) reported 70%crude protein fish meal in Ethiopia. Batal and Dale, (2010) reported Cp contain of fish meal as 53%.Fish meal is added to poultry diets as a source of highly digestible, "high quality", animal protein and excellent source of all amino acids which can offset the deficiencies of certain limiting amino acids in cereal grains (Miles and Jacqueline, 2006; Mikule et al., 2004).. The amino acid profile of fish meal is what makes this feed ingredient as attractive as a protein supplement. Proteins in cereal grains and other plant concentrates do not contain complete amino acid profiles and usually are deficient in the essential amino acids lysine and methionine. The protein in fish meal is an excellent source of the essential amino acids lysine, methionine and tryptophan (Miles and Jacqueline, 2006). It is because of this that fishmeal is often used as a supplement of choice for plant proteins, especially soybean meal. Fishmeal is an excellent source of calcium and phosphorus for poultry. The ash (mineral) content of fish meal can range from 10 to 25% (Miles and Jacqueline, 2006). However, Miles and Chapman (2006) reported the average ash content of good quality fish meal to vary from 17%to 25%. Calcium and phosphorus constitute the majority of the ash found in fish meal 1.5% to 3% (Scaneet al., 2004).

2.4.1 World fish production:

According to Food and Agriculture Organization FAO (2004), the world fish production in 2000was 130.4 million tons of fish, out of which 94.8million tons were from fishing and 35.6 million corresponded to aquaculture production. From1996 to 2000, aquaculture increased from 25.7 to35.6 million metric tons. The aquaculture production for 2001 was estimated as 37.5 million metric tons. In 1997, 122 million metric tons of fish were produced in the world. The world production of aquatic organisms from aquaculture increased from 28.82 in 1997 to 30.86million metric tons in 1998. In the same period, there was a reduction of over 7 million metric tons in the production of captured aquatic organisms(FAO, 2000).Sixty percent of the fish captured worldwide are used in the fresh fish market or processed as frozen, canned or cured foods, generating a considerable amount of waste material. The volume of waste produced by processing plants is calculated to be about 50% of the total processed fish. To that, we can add considerable amount of fishing produce that is considered inadequate for human consumption due to its low commercial value, as well as the amounts discarded (Rebeca et al.; 1991).Thus about 50% of the world fish production becomes waste material, which means an expressive amount of 65.2 million metric tons of fish waste (Ferraz de Arruda, 2004), Fish production in Sudan was 37,508 tons as of 2015. Over the past 55 years this indicator reached a maximum value of 73,698 tons in 2009 and minimum value of 17,100 tons in 1960 (www. Onlinelibrary.wiley.com).

2.5 Utilization of fish waste meal in poultry rations:

The by-products from the fishing industry and fish farming have been shown to be a valuable animal protein source. Hence, studies were conducted to replace the animal protein source in poultry food with locally processed fish wastes, so as to reduce feed cost and mitigate pollution without compromising the growth and wellness of the birds (Darsana et al., 2009). Darsana *et al*.(2009) reported that complete replacement of the animal proteins (fish meal) in the finisher ration of broiler chicken with processed fish wastes reduced the feed cost without compromising the nutritional status, feed efficiency and overall performance. Moreover, studies by Al- Marzooqi *et al*. (2010) on feeding different levels of fish silage waste (guts and gills) on broiler performance showed that diets had significant effects on feed intake and mean weight gain for the overall period (0-35 days) was considered, birds fed diets with fish silage waste gained more than the other groups whereas there was no significant effects on feed conversion ratio. Study was conducted by Alemayehu et al.(2015) at Haramaya university poultry farm to evaluate the effects of locally processed fish waste meal (FWM) in the diet of white leghorn layers on the performance and hatchability, egg quality, sensory flavor and profitability of the rations. The results obtained from partial budget analysis indicated that inclusion of FWM improved the economics of egg production which is attributed to the high cost of soybean meal as compared to FWM and the better efficiency of feed utilization by FWM groups. Thus, FWM inclusion improved egg laying performance and profitability, but imparted moderate fishy flavor beyond 5% inclusion. However, when considering egg production, feed efficiency ratio, net return and egg sale to feed cost ratio, inclusion of FWM in White Leghorn diets at up to 10% is recommended. André et al. (2017) evaluate the increasing levels of fish by-product meal in diets for laying hens on performance, egg quality and economic analysis. Differences ($P < 0.05$) were detected for all variables of performance, in egg weight, yolk and albumen percentage, yolk and albumen height, feed cost and production cost, in which the inclusion of fish by-product meal in the diets showed better results, he concluded that fish by-product meal can be used in diets for hens as alternative feed, with better results in egg production, feed conversion, egg weight, yolk albumen ratio and a reduction in feed cost and production cost.

2.6 Chemical composition of fish waste meal:

The crude protein content of cooked and sun dried FWM produced under Ethiopian condition has been reported to be 44.7 % (Asrat *et al.* 2008). Biazen (2010) also reported a value of 48.75 % for fish byproduct meal. A value of 40.48% CP was also re-ported in Nigeria for locally processed FWM (Ojewola *et al*. 2005). Windsor (2001) noted that fish meal made mainly from filleting offal usually has slightly lower protein content and a higher mineral content. Moghaddam *et al.* (2007) recorded higher EE (22.9%) for the Iranian Kalka fish meal from which fat was not removed. Asrat et al. (2008) and Biazen (2010) reported values of 21.6% and 21.37% for locally produced FWM, respectively; a very low value (8.21%) was reported by Ojewola et al. (2005) for locally processed FWM in Nigeria. Asrat et al. (2008) reported 3160 Kcal/kg dry matter ME for locally produced FWM. Similarly, Biazen (2010) reported 3987.3 Kcal/kg of feed for locally produced fish byproduct meal. Ponce and Gernat (2002) have reported a value of 2600 Kcal/kg of feed for tilapia by product meal samples. According to Koning (2005) the mineral (ash) content of fish meal waste varies considerably from about 10% to 25% depending on the amount of cannery offal used in its production. Fish waste meal produced from offal contains a high concentration of minerals as the bony frames of previously filleted fish species are used (Ponce and Gernat, 2002). Biazen (2010) and Asrat et al. (2008) reported a value of 27.32% and 24.76% total ash, respectively for FWM obtained from local processors at Ethiopian rift valley lakes. Dale et al. (2004) reported a value of 25.5% for eight tilapia byproduct meal. The FWM have higher ash content because the product contains bones and scales than conventional fish meal (Ingweye et al. 2008). Nadeem (2003) noted that composition of fish meal can vary depending upon species of the fish and the method used to prepare the meal. Choo and Sadiq (1982) and Khatoon (2006) reported an inverse correlation between fat, ash and crude protein contents of fish waste meal. That is fish waste meal with low protein contains high levels of fat and ash and vice versa. Solid fish waste consists of head, tails, skin, gut, fins and frames. These byproducts of the fish processing industry can be a great source of value added products such as proteins and amino acids, collagen and gelatin, oil and enzymes Esteban et al(2007) Disney et al(1977). These wastes contain proteins (58%), ether extract or fat (19%) and minerals. Also, mono saturated acids, palmitic acid and oleic acid are abundant in fish waste (22%).Hamza et al (2017) analyzed fish waste collected from Port Sudan fish market and reported that the chemical composition of fish waste was as follow moisture 84, ash 18.56%, protein 62.39%, lipid 6.44%, fiber 3.39% and high digestibility of waste due to low fat to protein ratio.

2.7 Effect of feeding fish meal on growth performance and carcass characteristic:

Fishmeal has been a popular poultry feed ingredient for many decades. The literature describing the use of fish meal has been reviewed Ghanim (2009) reported that feeding elevated levels of Tilapia replacing soybean meal on weekly feed intake resulted in significant differences ($p<0.001$) in broiler feed consumption from 7 to 42 d of age . Birds on diets contained 75 and 100% tilapia by-product fish meal had significantly lower feed consumption as compared to those fed 0, 25 and 50%. Karimi (2006) clarified that feed intake during 11-20d, 21-32d and 0-42d had significantly increased with fishmeal inclusion rate increased, he stated that the beneficial effects of fishmeal on broiler performance become most evident at higher inclusion level and during the mid points of the growth period, mainly via stimulation of feed intake rather than improvement in feed conversion ratio of diets. Studies results using fish meal in broiler diets (Ponce and Gernat, 2002) showed no significant differences in body weight feed consumption and feed conversion ratio on broiler Ghanim (2009) reported that weekly weight gain were almost similar in all treatments when fishmeal was added up to the 3.5% level but the higher inclusion (5%)

represents the lowest weight gain. Ahmed (2006) studied of the effect of five different locally produced fish meals on broilers performance, the results indicated the superiority of Synodontis whole fish meal, Synodontis gutted whole fish meal and semi spoiled Nile perch whole fish meal over fish entrails meal and fish scrap meal in all production parameters , except feed intake. Fish scrap and fish entail meals though inferior in terms of feed intake and body weight gain, but their effects on FCR and PER were almost similar, if not better than that of the commercial super concentrate. The overall result indicated the superiority of the locally manufactured concentrate. Al-Marzooqi, et al (2010) study of the effect of feeding different levels of sardine fish silage on broiler performance under closed and open-sided housing systems and reported that fish silage can replace up to 20% of soybean meal in broiler diets without affecting either growth performance or the sensory quality of broiler meat. Khatun, et al (2003) reported similarity in weight gain when feeding diets contained fish meal and silk warm caterpillar meal (SCM).Many studies citing appositive correlation between dietary salmon protein concentrate and growth performance of broiler chickens. Feeding corn-soybean meal based diet containing 11.5% condensed salmon protein concentrate (SPC) compared to control diet, whereas dried SPC did not appear to elicit similar growth performance enhancements compared with that of control diet or menhaden fish meal diet(Lowa state University. Animal Industry Report (2007).On other study by Maigualema and the Gernat(2003) concluded that Tilapia by-product Meal (TBM) can be substituted with Soybean meal (SBM) without negatively affecting bird performance or carcass quality.Y.Yu (2004) said substitution of fish meal with either meat or bone meal and poultry by-product meal should substantially cause noticeable decline in weight gain.Jamsang (1988) found that body weight gain was markedly improved when fishmeal included at 6% compared with 4%. Awoniyi et al (2003), Salih (2009) stated that fishmeal could be used at different levels up to 8% in broiler diets without adversely effecting weight gain, feed consumption and efficiency. Replacement of soybean meal (SBM) with tilapia by product meal (TBM) resulted in significant differences ($p<0.001$) in broiler feed conversion ratio from 7 to 42 d of age. Birds on diets containing the 75 and 100% TBM had significantly poorer feed conversions ratio as compared to the 0, 25 and 50% treatments. Schumaier and McGinnis (1969) reported that adding 4.8 to 12% additional protein from fish meal to a basal diet improved growth of chicks up to 30%. Scott et al. (1957) observed similar growth responses, but when using fish meal as the sole source of protein chick growth was poor. However, Harms et al. (1961) reported that the addition of 3% fish meal practical broiler diets had no significant effect on any of the measured production parameters. Waldroup, et al (1965) obtained similar results when 25 to 50% of SBM protein was replaced with fish meal protein. Rojas et al (1969) also reported no significant changes in body weight, feed consumption, or feed efficiency when SBM was replaced at various levels with protein from Peruvian fish meal. Avila and Balloun (1974) found that different levels of Anchovy meal in broiler diets had no significant effect on body weights or feed efficiency, except when fish meal replaced all of the soybean protein. They detected a significant growth depression when 100% of the soybean protein was replaced. Wu et al (1984) fed four different hydrolyzed fish meal to broiler chicks up to 7 week of age and observed no significant differences among treatments for live body weight and feed conversion. Hulan, et al (1989) using red fish meal at levels up to 12% in the ration found no significant effects on overall mortality or feed efficiency, but reductions in body weight and feed consumption occurred, increasing dietary levels of RFM or RFO resulted in a linear decrease in body weights. When substituting up to 50% of the crude protein contributed by SBM with crude protein from TBM, Ponce and Gernat (2002) observed that TBM could partially replace the use of SBM in broiler diets without adversely affecting performance or carcass quality. Carcass weights were significantly higher (p <

0.001) for 0, 25, and 50% substitution of TBM for SBM, which was undoubtedly related to higher live weights detected for these treatments. They concluded that tilapia meal agreed with other studies that have shown that different types of fish meal can successfully replace SBM up to a certain concentration without causing adverse effects on broiler production parameters.Because of the potential economic losses from undesirable off-flavored meat (Waldroup et al. 1965) and growth depression effects caused by adding high levels of fish meal in broiler diets, the inclusion of fish meal is usually limited. However,In conclusion, TBM could partially replace the use of SBM in broiler diets up to 50% without negatively affecting growth performance or carcass quality.The similarity in weight gain indicated that the diets were equally efficient with no superiority of fish meal over silkworm caterpillar meal (SCM). This result agreed with the findings of Ichhponani and Malik (1971), Khatun et al (2003) and Loselevich et al (2004). Y.Yu (2004) reported that substitution of fish meal with either meat or bone meal and poultry by-product meal resulted in Lowfeed efficiency. Mukhtar and Tabidi (2014) replaced imported concentrate by local concentrate contained high level of fishmeal (20%) with synthetic amino acids mainly synthetic lysine (12%) and methionine (4.3%) and plant protein sources (groundnut cake and sesame cake) in broiler diet they found that chicks performed significantly better. Jaffer (2010) study effect of using local fish meal (Liza abu) as protein concentration in broiler diet, he reported that in all fish meal fed levels, chicks obtained similar body weight, feed consumption, feed conversion and mortality to those of control group. On the other hand, Asrat et al (2009) studied the effect of partial substitution of plant protein with fishmeal prepared out of cooked and sun dried fish offal on feed intake and carcass traits of Rhode Island Red chicks they concluded that fish meal inclusion into diets of growing RIR chicken up to the levels of 16.6% of the DM of the diet did not affect health or performance traits; however, best results were obtained at 9.96%. Al-Marzooqi et al., (2010) produced evidence that fish silage can replace up to 20% of soybean meal in broiler diets without affecting body weight, weight gain, FCR, feed intake and sensory quality of broiler meat. Hulan et al (1989) fed red fish meal at levels up to 12% in broiler diet they found no significant effects on overall mortality or feed conversion ratio. Ponce and Gernat (2002) observed no significant differences between treatments in mortality or carcass yield when broiler fed tilapia by product meal. Awoniyi et al (2003), reported that fishmeal could be used at different levels up to 8% in broiler diets with no significant differences among treatments on mortality. The study conducted by Asrat (2008) indicate that the mean daily bodyweight gain of groups fed with rations containing fish meal is significantly higher ($p \leq 0.05$)than the control and the highest daily body weight gain was achieved at 9.96% fish meal inclusion however, further increasing the level of fish meal depressed growth rate. Negussie and Alemu (2005) suggested rations containing fish meal have best assortment of high levels of amino acids and is used to balance rations of plant protein sources that are severely limited in critical amino acids. Donald and William (2002) suggested that fish meal levels up to 8%will usually induce productive performance in broilers. Karimi (2006) explained further increasing the level of fish meal depressed growth rate. Sex and age had also affected daily body weight gain and final weight gain (Tagene and Asrat, 2010; Yoseph, 2013). Maigulema and Gernat (2003) reported significantly higher body weights up to 6 weeks of age in broilers and Binda et al (2012) also reported the highest weight gain were attained ate 7 weeks of age for meat strain chicken. Another study conducted by Asrat et al., (2008) pointed out that cooked and sun dried fish offal, can be incorporated up to 16.6% of the diets of growing RIR chicken without affecting health, feed intake and nutrient retentions.

In areas where there are fishing and meat processing operations, there is good potential for using offal for poultry feeding, in either fresh form or after processing. For example, the edible flesh of most types of fish represents only 40 percent of their total weight, leaving 60 percent for use as a protein feed resource. Scrap fish and fish wastes or residues (heads and offal) can be dried and processed into a meal, or be preserved as silage. Studies by Al-Marzooqi *et al*. (2010) on feeding different levels of fish silage waste (guts and gills) on broiler performance showed that diets had significant effects on feed intake at 1st to 3rd weeks. Birds on diet 10% and 20% fish silage waste consumed high and mean weight gain for the overall period (0-35 days) was considered, birds fed diets containing 10% and 20% fish silage gained more than the other groups whereas there was no significant effects on feed conversion ratio, similar results were reported by (Espe *et al*., 1992) who included up to 50% of fish wastes (offal and intestine) in broilers diet .Replacement of soybean meal with tilapia by-product meal at various levels (up to 50% of soybean meal) in broiler diets resulted in significant differences in body weight, feed consumption and feed conversion without negatively affecting performance or carcass quality (Maigualema and Gernet, 2003). The study conducted by Asrat (2008) indicate that Groups fed with rations containing fish meal were significantly superior ($p< 0.05$) to the control group in the carcass parameters. (Yoseph, 2013) reported that effect of sex on most carcass were significant in which male is superior to female. Carcass percentage, Proventriculus, pancreas, spleen, heart and abdominal fat pad weights as a percent of live weight were not affected by the different diets

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Experimental site and duration:

This experiment was conducted at the Animal Production Research Center ,Poultry Farm, in Khartoum north during the period between 6 of May to June during which the temperature ranged between 32-36 ^{0}C to study the effect of feeding red sea fish waste meal (RSFWM) on performance, carcass characteristics, internal organs weight and gut micro flora of broiler chicks.

3.2 Experimental house:

The experiment was conducted in a semi closed poultry house (45 *10squ.m) and 3m height, with concrete floor and corrugated iron sheet, the house extended East West and it was constructed from red brick covered by soft cement at East West side and netting at South and North side .The house equipment were cleaned and disinfected before starting the experiment using formalin (10%) and black phenol (2%). The house was divided into 12 equal units (1*1m) each; the floor was covered by 2 inches deep wood shaving as litter. Each unit provided with one tubular feeder and 5 nipples drinker.

3.3 Experimental Birds:

Ninety six, seven days old chicks (Hubbard classic) were selected randomly from five thousands chicks purchased from Dagan Poultry Company (MICO). The chicks were randomly divided into four treatments groups (24 chicks per each group) and each group was furthered replicated three times given 8 birds per replicate. The treatment was distributed in completely randomized design (CRD).

3.4 Experimental diets:

3.4.1Red sea fish waste collection and preparation:

Red sea fish waste(RSFWM) (head ,fin , belly content) was collected in garbage plastic bags from the local market in Sigala area at Port Sudan state during May 2017, The waste was then boiled in a local made aluminum bowl covered by tap water and covered by a heavy weight bowl coverage. The bowl with its sample was then heated up to the boiling point for fifteen minutes using charcoal fire. The boiling water was drained and the fish waste was oven dried at 80^0C for 24 hours to obtain a well dried waste which was ground in a powdery form using Apex® Hammer Mill. The product was subjected to microbiological examination to determine the presence of Salmonella and E.Coli according to the methods described by McCapes, et al (1989).The red sea fish waste was subjected to proximate analysis according to the methods outlined by AOAC (1990) (Table 1).

3.4.2 Diets formulation:

Four iso-nitrogenous, is caloric experimental diets were formulated. All diets were compounded to meet the requirements for broiler chickens according to the recommendations reported by NRC (1998). Diet 1(T1) serve as control diet formulated without the inclusion of RSFWM. In Diets 2(T2), 3 (T3) and 4(T4) RSFWM was incorporated at 2.5%, 5% and 7.5%, respectively. All diets were also supplemented with feed grade methionine and lysine. Table 2 show the composition and calculated analysis of the experimental diets.

3.5 Birds Husbandry and Experimental Design:

A total of 96 day-old broiler chicks of the Hubbard Classic a heavy strain were purchased from Dagan Poultry Company. All chicks were electrically brooded on a deep litter floor at Animal Production Research Center poultry farms. They were fed a 24% crude protein broiler pre starter commercial ration ad libitum during the first 5 days after arrival from the hatchery prior to the commencement of the experiment. Water was also provided ad libitum with appropriate antibiotics and anti-stress particularly after arrival. The experimental birds were divided into four treatment groups of 24 birds per group. Each treatment group was further replicated three times consisting of 8birds per replicate. The groups were then randomly allotted to the 4 dietary treatments in a Completely Randomized Design (CRD). Feed and water were offered ad libitum. The experiment lasted for 42 days. Chicks were vaccinated against Newcastle (ND) and infectious bronchitis (IB) on arrival by spraying, all other vaccines Gumboro vaccine (IBD) at 14 and 28 days, Newcastle (ND) at 17 and 24 days old were administrated through drinking water. Vitamins (1gm/ liter) were added after each vaccination for three consecutive days.

3.6 Performance traits:

3.6.1 Live Body weight:

Body weight was measured for all chicks at the beginning of the experiment; it was repeated on weekly basis weekly at the end of each week at the same time.

3.6.2 Body Weight gain:

Body weight gain was calculated by subtraction the live weight at the beginning of each week from live body weight at the end of the same week.

3.6.3 Feed intake:

Feed intake is the amount of feed consumed every week; it was calculated for each treatment on weekly basis. At the end of the week the residual amount of feed was weighed and subtracted from the known weight of feed at the beginning of the week. The product was divided by the total number of bird.

3.6.4 Feed conversion ratio:

Feed conversion ratio (FCR) was calculated on weekly basis by the following equation: Feed conversion ratio (FCR) = feed consumed (g)/Weight gain (g) (Naji, 2006)

3.6.5 Mortality Rate:

Mortality was recorded when occurred.

3.7 Internal Organs weight:

At the end of the 6th weeks, birds were weighed and fasted overnight (except for water). Two birds (male and female) from each replicate were randomly selected and slaughtered without stunning, then scalded, manually plucked, washed and allowed to drain on wooden table. Evisceration was performed by a ventral cut and visceral as well as thoracic organs were removed. Spleen, Liver, Heart, and Gizzard weight were recorded.

3.8 Carcass characteristics.

Eviscerated carcasses were weighed and then chilled for 12 hours, cold carcasses weights were recorded and dressing percentage was calculated. Carcass cuts weights (Wing, Back, Breast, Drum stick and thigh) were recorded.

3.9 Microbial Analysis:

After slaughtering, two birds from each replicate were selected. The ileum and cecum contents were collected. Contents were gently removed in sterile sampling tubes and immediately transferred on ice to the laboratory. The contents of mentioned segments were used for microbial analysis.

3.10 Statistical analyses and experimental design:

Data generated from the experiment were subjected to analyses of variance (ANOVA) according to general linear model procedure of SPSS software (SPSS 2001). The significant differences among means were determined by LSD test (Steel et al,1997).

Table (1) Proximate Analysis of Red Sea Fish Waste meal (RSFWM)

Nutrient	**(%)**
Moisture	3.2
Dr matter	96.1
Crude protein	32.9
Lysine	8.5
Methionine	2
Fat	5.72
Ash	23.8
Calcium	5.3
Phosphorus	1.9
ME (Kcal/kg)*	2827

*ME was calculated according to the equation of lodhi et al(1976)

Table (2): Composition and calculated analysis of the experimental diets

Treatments / Ingredients	Red sea fish waste meal inclusion (%)			
	0.0	2.5	5	7.5
Sorghum	66	65.1	64	62.95
GNC	26	24.4	22.8	21.25
Concentrate	5	5	5	5
RSFW	0	2.5	5	7.5
DCP	0.5	0.5	0.5	0.5
lime stone	1.5	1.5	1.5	1.5
Lysine	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1
Nacl	0.3	0.3	0.5	0.3
Oil	0.3	0.3	0.3	0.6
Antitoxin	0.2	0.2	0.2	0.2
Calculated analysis				
ME/Kcal/kg	3158	3151	3154	3152
C P %	22.0	22.03	22.01	22.01
C F %	4.9	4.7	4.5	4.3
Ca %	1.12	1.10	1.10	1.09
$P_{av.}$ %	0.59	0.57	0.56	0.54
Methionine %	0.48	0.50	0.54	0.57
Lysine %	1.07	1.14	1.22	1.29

*concentrate (NUTRISTAR) contained:CP38 % ,CF4 %, Ca 10%,Av.P 6.5%, lysine 12%, Methionine4%,ME2090kcal/Kg ,Sodium 2.45%, Nacl 7.40%

CHAPTER FOUR

4.0 RESULTS

4.1 Proximate Analysis of Red Sea Fish Waste meals (RSFWM):

The proximate chemical composition of red sea fish waste is shown in table (1). On average the (RSFW) contained, DM 96.1%, CP 32.9%, Fat 5.72%, Ash 23.8%, Ca 5.3%, av.P1.9%, and 2827 Kcal/Kg calculated metabolic energy.

4.2 Effect of feeding red sea fish waste meal on weekly body weight (g/bird):

Feeding (RSFW) at various levels resulted in significant differences ($P < 0.05$) for weekly body weight (Table 3). Chicks fed 7.5% RSFW had higher BW compared to other treatments during the 1^{st}, 2^{nd},4^{th} and the 6^{th} week, in the 5^{th} week the birds fed 5% RSFW had a similar body weight as the group fed 7.5% RSFW.

4.3 Effect of feeding red sea fish waste meal on weekly weight gain (g/bird):

The effect of feeding red sea fish waste on weekly weight gain is shown in table (5).the result revealed that feeding red sea fish waste resulted in significant differences in weekly weight gain during 1^{st},2^{nd},3^{rd} ,5^{th} and the 6^{th}week, no significant differences were observed in week 4^{th}.highly significant differences were observed when the birds fed(7.5%) red sea fish waste. in the 1^{st},2^{nd} and the 3^{rd} week of the experiment .

4.4 Effect of feeding red sea fish waste meal on weekly feed intake (g/bird):

Table (6) showed the weekly feed intake when broilers fed different levels of red sea fish waste. Feed intake was significantly ($p<0.05$) higher during the 1^{st}, 2^{nd}, $5^{th}$and the 6^{th} week when chicks fed 7.5% RSFW compared to other treatments. On the other hand, birds fed 2.5% RSFW had significantly higher feed intake during the 3^{rd}, 4^{th} and the 6^{th} week.

4.5 Effect of feeding red sea fish waste meal on weekly feed conversion ratio (FCR) (g/feed/g/gain):

The effect of feeding fish waste on weekly feed conversion ratio is shown in table (3).The effect of fish waste on weekly feed conversion ratio of broiler chickens had showed a highly significant differences during the 1^{st} ,3^{rd} , 5^{th} week , significant differences ($p<0.05$) the 2^{nd} week . No significant differences were noted during the $4^{th}$and 6^{th} week.

4.6 Effect of feeding red sea fish waste meal on internal organs weight (gm):

The effect of feeding red sea fish waste on internal organs weight is shown in table (7).The result on internal organs weight the pancreas was not significant differences($p > 0.05$) ,spleen , liver, gizzard were significant ($p<0.05$) and the heart highly significant ($p<0.05$).

4.7 Effect of feeding red sea fish waste meal on dressing percent and carcass cuts:

The effect of feeding red sea fish waste on dressing percent and commercial cuts weight are shown in table (8).Result revealed that feeding RSFWM had no significant effect on dressing percent and wing weight wing, on the other hand, back , breast and thigh weight significant differences ($p<0.05$) during in the carcass weight and drum stick .

4.8 Effect of feeding red sea fish waste meal on performance of 6 weeks old broiler chicken:

Feeding RSFWM at tested levels resulted in significant differences ($P <0.05$) for BW, body weight gain and feed consumption but feed conversion ratio was not significant (Table 3). Chicks fed 7.5% RSFW had higher BW, body weight gain and feed consumption compared to other treatments.

4.9 Effect of feeding red sea fish waste meal on gut micro-organisms:

The result of sample microbial analysis for *Salmonella* and *E.coli* were negative for all treatments group. this result was similar with the findings of Ghanim (2009) who reported that roasting of the locally disposed fish meal can suppressed the activity of its' fatal microorganisms.

Table (3): Effect of feeding red sea fish waste on weekly feed conversion ratio (g feed/g gain)

Treatments / Weeks	Red Sea Fish Waste Meal Inclusion (%)				Sig. level
	0.0%	2.5%	5%	7.5%	
Wk1	1.55[a]±0.07	1.51[ab]±0.05	1.46[b]±0.02	1.38[c]±0.03	**
Wk2	2.05[a]±0.11	1.86[b]±0.07	1.86[b]±0.02	1.85[b]±0.03	*
Wk3	2.24[a]±0.07	2.04[b]±0.07	2.16[a]±0.06	1.93[c]±0.06	**
Wk 4	1.78[b]±0.011	1.89[a]±0.31	1.69[c]±0.02	1.80[b]±0.78	*
Wk5	1.98[c]±0.21	2.34[a]±0.17	2.11[b]±0.06	2.28[a]±0.12	**
Wk6	2.31[c]±0.16	2.39[b]±0.26	2.75[a]±0.23	2.44[b]±0.10	*

[a,b,c]Means in the some row with different subscript letter are significantly different.

*Significant (P< 0.05)

**Highly Significant (P < 0.01)

Table (4): Effect of feeding red sea fish waste meal on weekly live body weight (g/bird)

Treatments / Weeks	Red Sea Fish Waste Meal Inclusion (%)				Sig. level
	0.0%	2.5%	5%	7.5%	
Wk1	342.9^{c}±17.51	360±^{b}21.65	366^{b}±8.98	386.7^{a}±14.7	*
Wk2	645.0^{c}±24.09	712.5^{b}±43.84	711.5^{b}±14.21	748.8^{a}±31.92	*
Wk 3	1034.0^{d}±39.22	1183.7^{c}±61.22	1131.3^{b}±8.86	1208.8^{a}±36.14	**
Wk4	1439.0^{c}±52.71	1614.3^{a}±47.78	1583.1^{b}±16.12	1639.5^{a}±30.41	**
Wk5	1783.9^{c}± 45.74	1920.2^{b}±45.07	1953.8^{b}±19.33	1984.8^{a}±26.39	*
Wk6	2131^{d}±104.99	2329.3^{b}±19.79	2286.2^{c}±41.88	2381^{a}±28.82	*

^{a,b,c,d}Means in the some row with different subscript letter are significantly different.

*Significant (P< 0.05)

**Highly Significant (P< 0.01)

Table (5): Effect of feeding red sea fish waste meal on weekly weight gain (g/bird)

Treatments / Weeks	Red Sea Fish Waste Meal Inclusion (%)				Sig. level
	0.0%	2.5%	5%	7.5%	
Wk1	177.3^{c}±6.26	193.1^{b}±18.41	199.6^{b}±9.02	220.9^{a}±10.82	*
Wk2	302.1^{c}±18.24	352.5^{b}±22.19	345.4^{b}±8.53	362.1^{a}±19.38	*
Wk3	389.0^{c}±21.07	471.2^{a}±43.99	419.8^{b}±17.07	460.0^{a}±4.72	*
Wk 4	405.0^{c}±37.64	430.6^{b}±52.38	451.8^{a}±12.59	430.7^{b} ±17.48	*
Wk5	344.9^{b}±47.16	305.9^{c}±4.24	370.4^{a}±7.63	345.3^{b}±7.50	*
Wk6	347.7^{b}±23.52	409.1^{a}±32.72	332.7^{b}±23.01	396.5^{a}±5.29	*

^{a,b,c}Means in the some row with different subscript letter are significantly different.

*Significant (P< 0.05)

Table (6): Effect of feeding red sea fish waste meal on weekly feed intake (g/bird)

Treatments / Weeks	Red Sea Fish Waste Inclusion (%)				Sig. level
	0.0%	2.5%	5%	7.5%	
Wk1	275.5^{b}±2.93	273.2^{b}±49.80	291.0^{a}±11.73	304.4^{a}±9.82	*
Wk2	616.5 ^{b}±21.04	655.2 ^{a}±30.98	641.5 ^{a}±11.04	671.0 ^{a}±33.49	*
Wk3	863.5^{d}±6.69	959.0^{a}±84.71	905.8^{b}±13.25	886.9^{c}±25.53	*
Wk 4	721.2^{c}±26.34	^{a}807.0±31.12	763.9^{b}±25.85	776.5^{b}±1.81	*
Wk5	676.2^{d}±23.37	717.1^{c}±8.79	781.9^{b}±19.97	888.5^{a}±58.23	**
Wk6	803.6^{c}±84.60	975.5^{a}±42.39	871.4^{b}±142.23	967.5^{a}±36.97	*

^{a,b,c,d}Means in the some row with different subscript letter are significantly different.

*Significant (P< 0.05)

**Highly Significant (P< 0.01)

Table (7): Effect of feeding red sea fish waste meal on internal organs weight (gm)

Parameters	Red Sea Fish Waste Inclusion (%)				Sig. level
	0.0%	2.5%	5%	7.5%	
Spleen	8.0.±0.0	9.0±0.0	7.0±.0.01	7.0±0.01	NS
Liver	30.5±0.015	27.9±0.162	30.5±0.015	28.7±0.112	NS
Heart	7.9±0.053	7.0±0.034	7.8±0.042	8.1±0.052	NS
Gizzard	20.7±0.084	19.4±0.061	21.7±0.10	20.5±0.112	NS

a,b,cMeans in the some row with different subscript letter are significantly different.

NS: Not significant

Table (8): Effect of feeding red sea fish waste meal on carcass weight, dressing percent and commercial cuts weight (gm)

Treatments / Parameters	Red Sea Fish Waste Inclusion (%)				Sig. Level
	0.0%	2.5%	5%	7.5%	
Carcass Weight (gm)	1563^{c}±27.42	1808^{a}±108.81	1681^{b}±31.65	1702^{b}±181.89	*
Dressing percent %	71.11±2.42	72.07±2.12	69.79±3.21	68.31±1.79	NS
Wing (gm)	91.67±7.64	102±2.5	97.50±5.00	98.33±7.64	NS
Back (gm)	340.0^{c}±29.47	409.2^{a}±41.26	402.5^{a}±33.82	378.3^{b}±31.26	*
Breast (gm)	499.2^{c}±22.68	584.2^{a}±63.70	559.2^{b}±21.26	566.7^{b}±70.06	*
Drum stick (gm)	124.2^{c}±11.81	146.7^{a}±11.55	133.3^{b}±8.4	133.3^{b}±10.10	*
Thigh (gm)	140.0^{c}±9.01	165.0^{a}±6.1	152.5^{b}±6.61	158.3^{b}±24.28	*

^{a,b,c,d}Means in the some row with different subscript letter are significantly different.

*Significant (P < 0.05)

NS: Not significant

able (9): Effect of feeding red sea fish waste meal on overall performance of 6 weeks old broiler chicken

Treatments / Parameters	Red Sea Fish Waste Inclusion (%)				Sig. Level
	0.0%	2.5%	5%	7.5%	
Initial body wt(g/bird)	165.6±2.72	166.9±3.24	166.5±1.57	165.8±2.95	NS
Body weight (g/bird)	2133^{d}±126.18	2329^{b}±19.79	2286^{c}±41.88	2378^{a}±28.82	*
Feed intake (g/bird)	3957.3^{d}± 144.9	4387^{b}± 198.1	4255.7^{c}± 152.4	4394.8^{a}± 92.7	*
Weight gain (g/bird)	1966.1^{d}± 133.2	2162.5^{b}± 17.2	2119.8^{c}± 43.0	2215.7^{a}± 25.3	*
FCR (g feed /g gain)	2.01 ± 0.06	2.03± 0.08	2.0± 0.09	1.98± 0.05	NS

^{a,b,c,d} Means in the same row with different subscript letter are significantly different.

*Significant (P< 0.05)

NS: Not significant

FIGURE (1): Effect of feeding red sea fish waste meal on internal organs weight (gm)

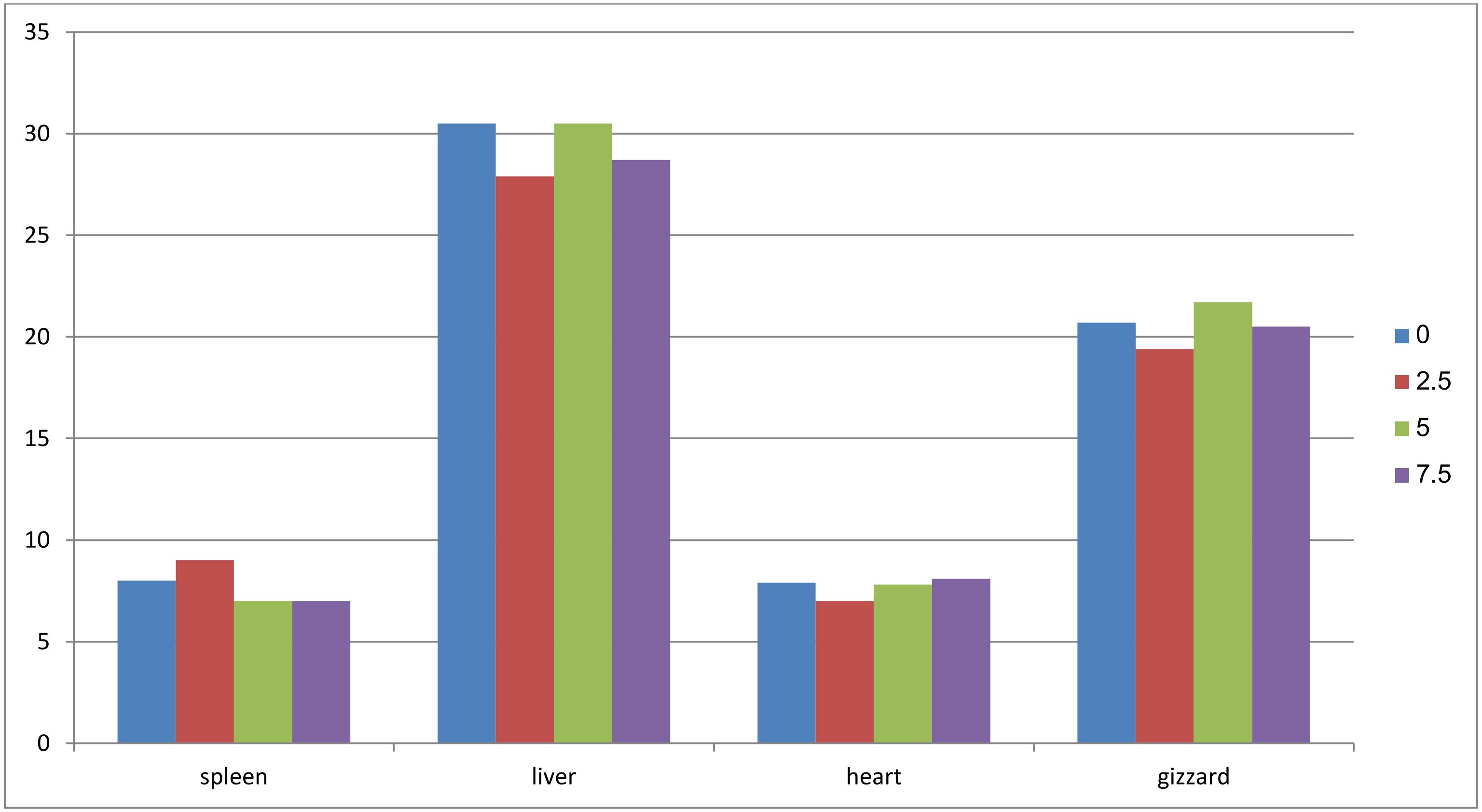


FIGURE (2): Effect of feeding red sea fish waste meal on carcass weight, dressing percent and commercial carcass cuts weight (gm)

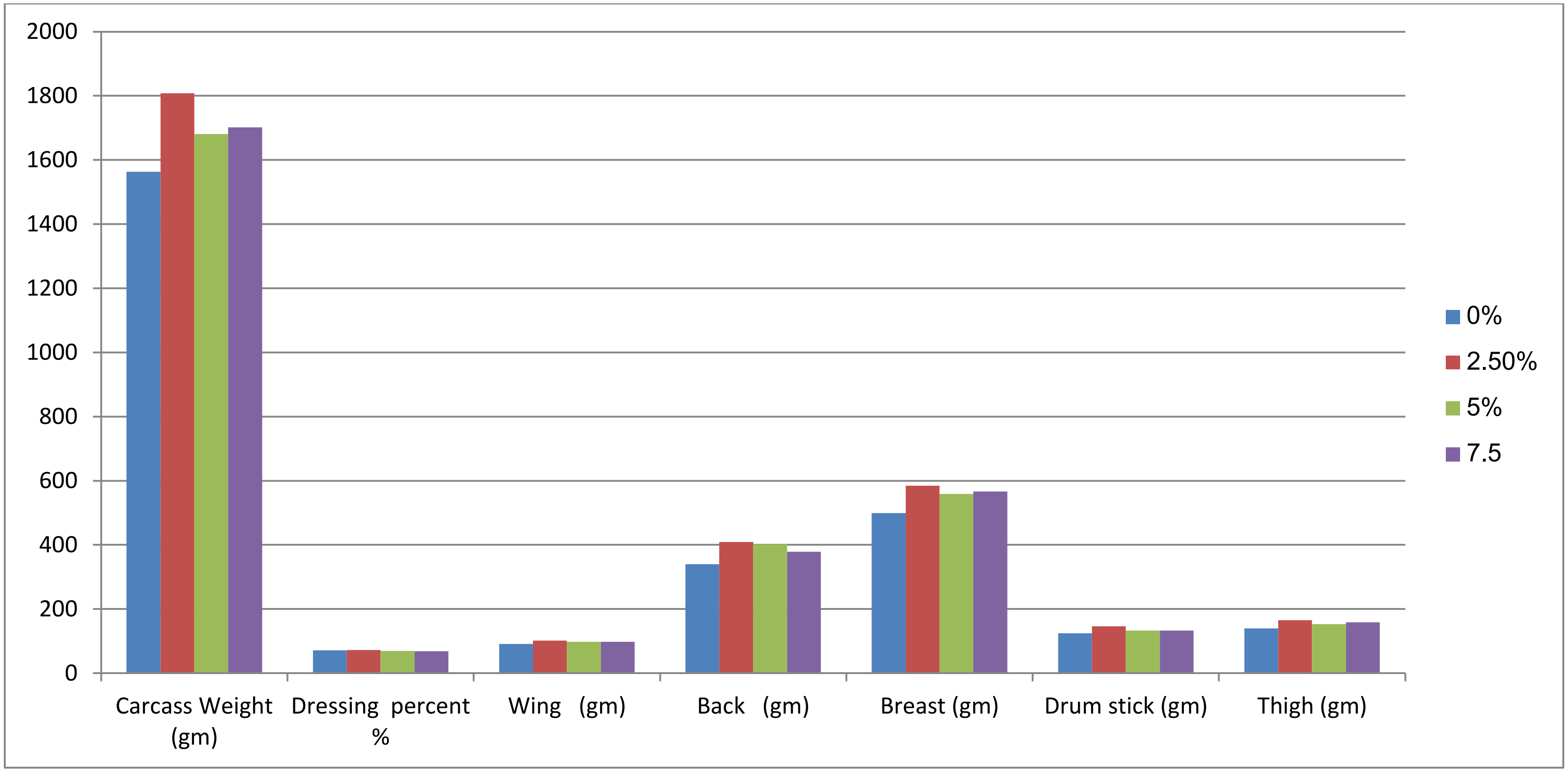
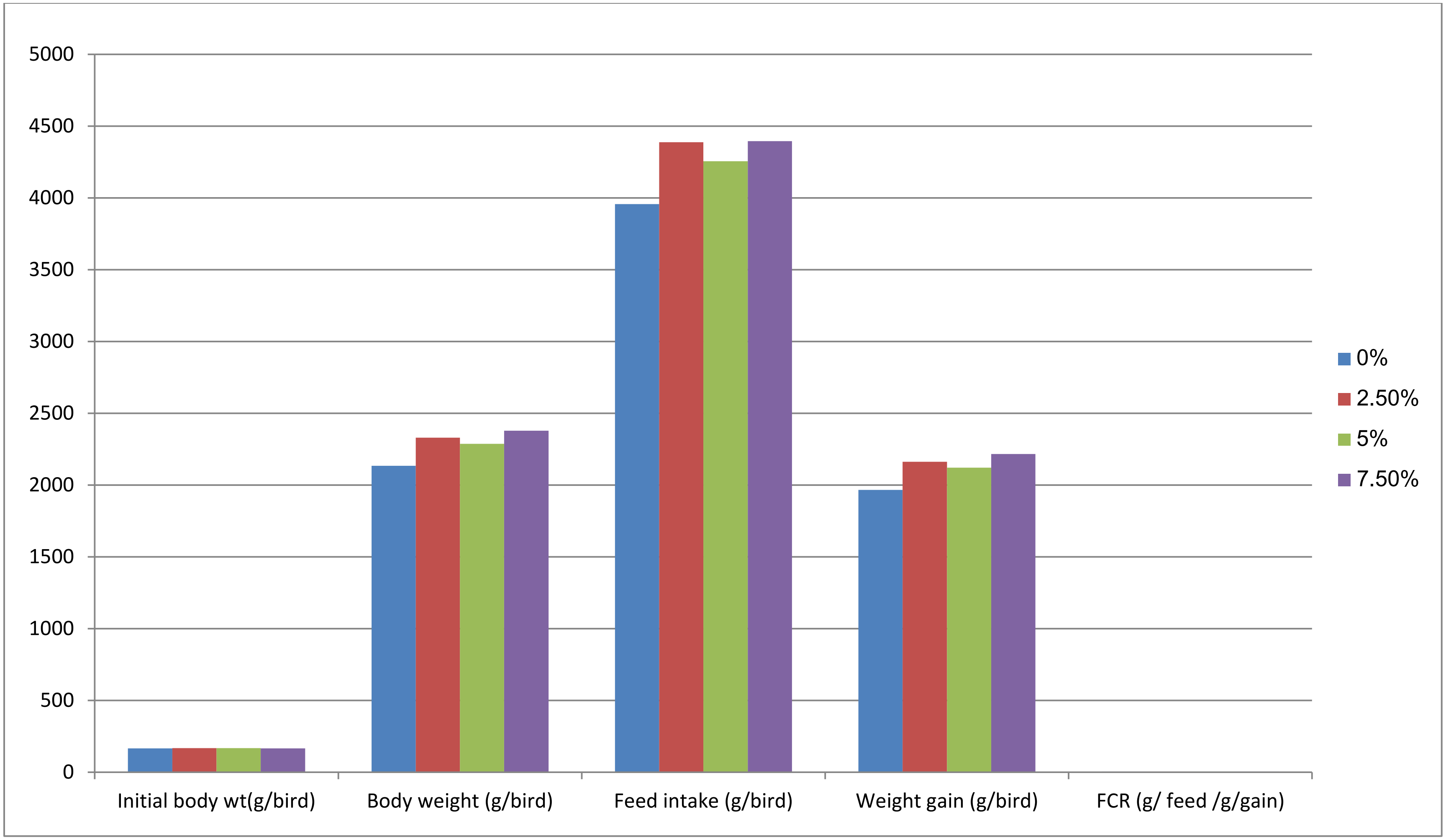


FIGURE (3): Effect of feeding red sea fish waste meal on overall performance of 6 weeks old broiler chickens


5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Initial body wt(g/bird)
Body weight (g/bird)
Feed intake (g/bird)
Weight gain (g/bird)
FCR (g/ feed /g/gain)
0%
2.50%
5%
7.50%

CHAPTER FIVE

5.0 DISCUSSION

5.1 Proximate Analysis of Red Sea Fish Waste meals (RSFWM):

The proximate chemical composition of the RSFWM showed that RSFWM contained, DM 96.1%, CP 32.9%, Fat 5.72%, Ash 23.8%, Ca 5.3%, P 1.9% and 2827 Kcal/kg calculated metabolizable energy. The CP content of cooked and sun dried FWM has been reported to be 44.7 % (Asrat *et al.* 2008). Biazen (2010) and Hamza et al (2017) also reported values of 62,4% and 48.75 % for fish byproducts , and both are higher than the present value. A value of 41.2 % and 40.48% CP was also reported for locally processed FWM (Ojewola *et al*. 2005; Alemayehu, 2015) which is slightly higher than the present value. Windsor (2001) noted that fish meal made mainly from filleting offal usually has slightly lower protein content and a higher mineral content, which is the case in RSFWM used in the present experiment, reasons for the observed differences could be due to processing, type of fresh fish, duration of heating, type of dryer used, temperatures and storage period which vary in their crude protein value. Moghaddam *et al.* (2007) recorded higher EE (22.9%) for the Kalka fish meal from which fat was not removed. Asrat et al.

(2008) and Biazen (2010) reported values of 21.6% and 21.37% for locally produced FWM, respectively which are by far higher than recorded in the present study this could be explained by the method of processing used to turn the fish waste to a meal as each method leaves different quantity of residual oil in the meal. Alemayehu1et al (2015) and Asrat et al. (2008) reported 2982.04 and 3160 Kcal/kg ME for locally produced FWM, which was slightly higher than the present findings. Similarly, Biazen (2010) reported 3987.3 Kcal/kg for locally produced fish byproduct meal, which was very much higher than the present findings. Ponce and Gernat (2002) have reported a value of 2600 Kcal/kg of feed for tilapia by product meal samples which was considerably lower than the present results these contradicted results may be due to residual oil in the meal. Biazen (2010) and Asrat et al. (2008) reported a value of 27.32% and 24.76% total ash, respectively for FWM obtained from local processors at rift valley lakes. Dale et al (2004) reported a value of 25.5% for eight tilapia byproduct meal samples. The ash content of RSFWM obtained in the present experiment was slightly lower than the values reported by these previous authors. This may be because the composition of fish waste meal can vary depending upon species of the fish and the method used to prepare the meal.

5.2 Effect of feeding red sea fish waste meal on overall performance of 6 weeks old broiler chickens.

The performance characteristics of broiler chickens fed red sea fish waste meal showed that the initial weight of broiler chickens were statistically similar at the commencement of the experiment. The final live weight, feed intake and total weight gain were affected by the different levels of RSFWM ($P < 0.05$).Birds fed 7.5% RSFWM have significantly ($P<0.005$) higher final live weight (2378g) and final weight gain (2215g) this result might be due to the unidentified growth factors in RSFWM. Oliveira (2003) also obtained similar result. Feed intake was affected by the levels of RSFWM ($P< 0.05$), diet contained 7.5% RSFWM had the highest value (4394.8g). In this regard RSFWM is a high value supplement and provides most of the essential amino acids required by monogastric animals, there by stimulating appetite and feed intake (Jassim,2010).Santana *et al*. (2008) and Jose' *et al.* (2016) reported that the inclusion of dried fish waste meal silages did not affect feed intake. However, other related studies observed higher feed intake in broilers when fish waste was added in the diets (Ochetim, 1992 and Mbamba, 2000). The contrasting results might be associated with various factors that modulate feed intake in birds such as genetic variation between strain, environmental temperature, energetic content of the diet, texture and palatability of the feed (Abdullah *et al*., 2010 and Siegel, 2014)..Final body weight gain followed the same trend being relatively higher for birds fed 7.5% RSFWM which is an indication of better and optimum feed intake. Feed conversion ratio values were statistically similar with all diets; this may be due to the similarity in quality and suitability of the diets

5.3 Effect of feeding red sea fish waste meal on carcass weight, dressing present (%), carcass cuts and internal organs weight:

Carcass characteristics of broiler fed graded levels of red sea fish waste meal revealed that The dressing percentage obtained in the present study (68.31% to 72.07%) was within the range that was reported by (Ochetim, 1992) but was different from the higher dressing percentage and carcass weight results reported by (Mbamba, 2000) in birds fed diets containing fish wastes. The contrasting results between the two studies might be associated with type of fish waste used and length of experimental period. The breast muscles and drumsticks are the most economically important portion of the carcass and also provide the greatest portions of edible meat in broilers (Smith and Teeter, 1987). The relative weights of these two cuts were significantly different which is in contracts with the findings of (Rosenfeld et al., 1997). The sizes of the liver and gizzard, heart and spleen did not differ significantly between treatments similar results were reported by

(Fanimo, et al., 1996; Mohammed, et al., 2009; Al-Marzooqi, et al., 2010). The results of the previous study carried out by Ologhobo et al. (2012) on carcass characteristics of broiler finishers fed poultry offal and Cray fish waste meal as replacement for fishmeal revealed that the chickens fed Cray fish waste meal had the best eviscerated weight.

5.4 Effect of feeding red sea fish waste meal on gut micro-organisms.

The results of microbial analysis for the prevalence of *Salmonella* and *E.coli* were negative, which mean that all treatments fed the red sea fish waste meal were free of salmonella and E.coli. This result was similar with the findings of Ghanim (2009) who reported that roasting of locally disposed fish meal can suppress the activity of its' fatal microorganisms.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 conclusions:

1- The proximate chemical composition of red sea fish waste meal was DM 96.1%, CP 32.9%, Fat 5.72%, Ash 23.8%, Ca 5.3%, av.P1.9%, and 2827 MJ/Kg calculated metabolizable energy (ME).

2- Feeding red sea fish waste meal up to 7.5% improved final body weight, weight gain and increased feed intake.

3- Feed conversion ratio was not affected by the inclusion of red sea fish waste meal.

4- Red sea fish waste meal had no significant effect on some pathogenic bacteria (*Salmonella and E.coli)*.

6.2 Recommendation:

Study with different levels and types of fish waste meal and if any off-odor or flavors would carry over in broiler meat need to be conducted.

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MEGA-TERM
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