Sudan University of Science and Technology

College of Graduate Studies

Incorporation Of Dietary Palm Date Pits in All-Male Nile Tilapia (*Oreochromis Niloticus*) Diets

إضافة نوى البلح في تركيب علائق أسماك البلطي النيلي وحيد الجنس

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الآية

قال الله تعالي:

(إِنَّا كُلَّ شَيْءٍ خَلَقْنَاهُ بِقَدَرٍ)

سورة القمر آية (49)

(وَالنَّخْلَ بَاسِقَاتٍ لَهَا طَلْعٌ نَضِيدٌ)

سورة ق الآية 10

DEDICATION

I dedicate this thesis to
The soul of my father
Mohammed siddig swar
to my beloved mother
Shama Ibrahim Swar
To my sisters
Tamador, and her kids.
Tahany,and her husband.
Nada Swar ,
To my aunt ,
Nadia Ibrahim Swar.
And to all my family members who stand beside me
throughout my life.

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ABSRACT

A 45- days randomized factorial design 3×2 (Three levels 25,50 and 75%) of palm date pits, three level (Non, with and without) of 3% bakery yeast (*Saccharomyces cerevisiae)* and three replicates. The experiment was conducted in twenty one plastic aquaria .The all-male Nile tilapia (Orechromis niloticus) fingerlings were placed in each aquaria. Each aquarium supplied with well-aerated and precipitated dechlorinated tap water with an average weight 1.9±1.11 g/fish (10 fish/aquaria) and total length 5.18±0.69 cm/fish. Fish were fed three times/day (10 days, at 8.30-11.30 - 3.30 A.M) at a rate of 12, 8 and 4% of body weight, to study the Effect of partial replacement of animal protein (fish meal) in the diet on growth performance, carcass composition, feed utilization, condition factor(k) and feed cost . Seven experimental diets were prepared; control diet (T0, CP 36.84) contained 45% (fish meal) as animal protein and 0% (palm date pit meal) plant protein. Tested diets (T1, T2 and T3) contained 25, 50, 75% with 3% bakery yeast (CP 35.71, 35.53, 34.74) and 25,50,75% without yeast(CP36.01, 36.27 and 35.57) respectively ; in order to substituting about 75, 50, and 25 of fish meal diet respectively. The results revealed that, tilapia fed on T1 , T2 and T4 diets (25, 50 and 25%) replacement with and without yeast respectively recorded the best growth performance, feed and protein utilization than other experimental as compared to control diet, also they represent the highest condition factor(K) values which indicate that the fish are in good health. Tilapia fed on diet T3 (25%fish meal) T5,T6 (50 and 25%fish meal) with and without yeast respectively had poor growth and differ significantly ($p<0.05$) from the rest diets . Diet composition significantly affect carcass composition. These data suggested that Palm date Pit with and without yeast *Saccharomyces cerevisiae* can partially replace fish meal (animal protein) in fingerlings all-male Nile tilapia diet at level up to 50 and 25% with and without yeast respectively, without any adverse effect on growth performance. Moreover, fish meal partially replacement with 3% yeast, gave superior growth performance than other diets under the present experimental condition. This study revealed that there is an economic efficiency of incorporating palm date pit (plant protein) as partial substitution of fish meal (animal protein) with and without yeast in all-male Nile tilapia (Oreochromis niloticus) it could reduce the cost of feeds .

الملخص

تم تصميم تجربة معامليه بالنظام العشوائي لمدة 45 يوم تتكون من 3×2(ثلاثة مستويات25 , 50 و75%) من مسحوق ﻧ ى البلح , ثلاثة مستويات (صفر, توجد و لا توجد) بنسبة 3% من مسحوق خميرة الخبز *Saccharomyces cerevisiae* لثلاث مكررات. أجريت التجربة في 21 حوض بلاستيكي(aquaria) مزود كل على حدة بإمداد ماء مرسب و معقم بالكلور بالإضافة إلى الأوكسجين لأصبعيات ذكور أسماك البلطي النيلي(Oreochromis niloticus) التي وضعت بمتوسط أوزان 1,11±1,9جم وطول كلى 0,69±5,18سم/سمكة (10 سمكات/ حوض) وغذيت بثلاثة معدلات 12, 8 و4% من الوزن الكلى ولثلاثة فترات (لمدة 10 أيام , الساعة8,30 ,11,30 و 3,30 صباحا") لدراسة إمكانية الإستبدال الجزئي لمسحوق الأسماك(البروتين الحيواني) في العليقة بمسحوق النوى (البروتين النباتي) وأثره في معدلات النمو,التركيب الكيميائي, الكفاءة التحويلية للغذاء, معامل الحالة وتكلفة العليقة. لقد تم تصميم 7 علائق هي الكنترول (0,00% نوى بلح و محتوى بروتين 36.84) بمحتوى 45% بدرة سمك وصفر% بروتين نباتي (مسحوق نوى البلح) T 1 ,T2., T3   (25, 50 و 75 %نوى بلح مع اضافة3%خميرة الخبز (محتوى بروتيني 35,5,35,71 و34,74) و T6,T5,T4(25,50 و75% نوى بلح لا تحتوى على خميرة الخبز(محتوى بروتيني 36,01 ,36,27 و35,5) علي التوالي. وذلك لإحلال75 ,50 و25% من بدرة السمك. أظهرت النتائج أن إضافة مسحوق نوى البلح للعلائق له اثر ايجابي في التركيب الكيميائي النهائي للأصبعيات وأن إضافة 25 و50 % من مسحوق نوى البلح و مسحوق خميرة الخبز بالإضافة إلى 25% من مسحوق نوى البلح في العليقة التي لا توجد بها خميرة الخبز بمستوى المعنوية (P<0.05) يعطى نتائج جيدة بمعدلات النمو والكفاءة التحويلية للغذاء مقارنة بعليقة الكنترول. كما انه يعطى قيم عالية لمعدل الحالة(k الذي يبين أن الأصبعيات في حالة صحية جيدة) دون اى آثار سلبية على نمو ذكور أسماك البلطي النيلي , أما العلائق T3, T5و T6 أعطت معدلات نمو متدنية.كذلك إضافة 3% من مسحوق خميرة الخبز كمادة إضافية يعزز من قدرة ذكور

أسماك البلطي من الاستفادة من الغذاء وبالتالي من رفع معدل النمو مقارنة بتلك العلائق الأخرى المستخدمة التي تخلو من الخميرة.كما أظهرت أيضا النتائج أن هذه النسب المحققة(25, 50و25%) أعلاه لها كفاءة اقتصادية عالية تؤدى إلى تقليل تكلفة علائق ذكور البلطي النيلي .

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CHAPTER ONE
INTRODUCTION

1.1 Background

Feed production is the major problem facing aquaculture practice, At present feed accounts for about 60-85% of the variable operating cost in fish farm NRC (1993), therefore the potential use of cheap unconventional indigenous feedstuffs, such as plant protein and their extracts has been increasing, There have many published studies that have confirmed that the addition of plants or their extracts (e.g aquatic plant, Alfa Alfa , cotton seed, ground nut and sesame cake, etc) in the diets has a beneficial effect in improving growth parameters and protection from diseases in aquaculture (Temesgen, 2004; Shalaby, 2004; Sasmal et al., 2005; Johnson and Banerji, 2007; Ebrahim et al., 2007; Abd el Hakim et al ., 2008; Tartiel et al., 2008; Khan et al., 2013; Labib et al.,2015).

The high content of Nitrogen Free Extract (NFE) in date pits has attracted the attention of a number of researchers to evaluate its Potential utilization in animals feed, with promising results. Dietary inclusion of date pits significantly improved the growth and feed utilization of sheep, calves and Sudanese desert lambs and poultry (Tag El- Din and Nour, 1993; Elgasim et al. 1995; El Hag et al. 1996; El Hag and El Khanjari 2000; Yagoub and Alamam, 2011; Sulaiman, 2014). Further, for rats (Ali et al. 1999; Vandepopuliere et al. 1995; Hussein et al. 1998), and for fish such as Mullet, carp and tilapia species diets (Yousif et al. 1996a; Belal and Al-Owafeir 2004).

About 50-70% of tilapia growth in fed ponds is due to natural food web, the rest comes from either of using supplementary, completely ,commercial and therapeutic feeds it depends on the system of aquaculture used Tingtin (2003), The feeding habit of fish can change when the environment changes, we can artificially change the feeding habits of the fishes and make the best use of them if we can understand the biological, Physiological Characteristics of Growth and Digestion of Fish, feeding patterns of fishes and further understand the nutritional requirement by the fishes, Yosif (2004).

The main approaches of feed formulations are to bring the local conditions into consideration, utilize the locally –and available materials, implement integrated utilization, and try the best to develop feed sources.

The selection of raw material for diet should develop and utilize economic and Sustainable raw material to keep formula comparatively. Raw materials Granularity must be fine enough to ensure easy digestibility and absorption. Proper processing facility must be selected and reasonable processing methods must be adopted to guarantee the homogenous and the diet quality. The granularity of smashed ingredients of feed should be fine (100 <40 mesh, 90 < 60 mesh).

Prepared diet for fish must be in the form of pellet, granule, crumbles or sticky paste. Fish live in water and diet needs good stability in water after applied to hold up for at least 20 to 30 minutes without being in order to avoid disorganization, dissolution and loss. Diet should not pollute the environment (Zero-pollution release is required), Tingting (2003).

Few studies were done on evaluating palm date pits as replacement of fish meal in Nile tilapia diet globally and nothing done in Sudan. For those reasons this study was conducted in the Fisheries Laboratory and hatchery of the Sudan University Science and Technology to assess the growth performance, carcass composition, feed utilization, condition factor(k) and feed cost of All-Male Tilapia nilotica fingerlings, fed diets containing different levels of date pits meal as partial replacement of fish meal protein such as 25, 50, and 75 % ; 75, 50, and 25% with and without bakery yeast(for the purpose of making the date pits fiber easily digested by tilapia fingerlings) respectively. Also to maximize the beneficial returns from the local materials which is considered as by- products that may caused socio economics and environmental problems in order to reduce the cost of feeds.

1.2 Problems

High cost of fish meal which have the great priority in fish feeds.

Excess amount of by-products(can easily recycling).

1.3 **Justification**

High cost of fish feeding especially animal protein sources, Availability and varieties of the resources not studied, Some resources have negative impacts (by-products), but in the same time it could be usefully adopted for other purposes providing new plant protein act as partial substitution for animal protein in fish feeding .

1.4 Objectives

1- To find- out the effect of incorporation of date palm pits levels (25,50 ,75 ;25,50 and 75%) with and without yeast respectively in all-male Nile tilapia (Oreochromis niloticus) diets in the growth performance, end carcass composition, feed utilization , condition factor(K) and feed cost . If result is good it could encourage the scientists and researchers to innovate studies, searching new sources that reducing the feed cost, adding new taste for cultured species , solving the problems caused by by-products , improving fish diets , fish farming revenue in Sudan and thus improve food security.

2- To find- out the effect of incorporation of date palm pits levels (25,50 ,75 ;25,50 and 75%) with and without yeast respectively in all-male Nile tilapia (Oreochromis niloticus) diets in total length and water quality parameters during the trial.

CHAPTER TWO

LITRETURE REVIEW

2.1 Date Palm Future in Sudan

Palm is the oldest horticultural tree introduced in the Sudan. That has happened more than 3000 years in the north of the country which represents a natural extension of palm cultivation areas stretching from North Africa to South Asia between latitude 35.10 degrees north . It is noted that this area include all Arab countries and most areas of the Sudan. In Sudan the palm is concentrated in three states such as Northern , River Nile and North Darfur (81.4%) , the rest is distributed in the states of Khartoum, Al Jazeera, Kassala and the Red Sea, Osman (2013), which represent the most important regions of the world suitable for palm cultivation and production of dates where minimal rainfall, relative humidity and high temperature are in optimal range.

Palm gained importance of which offer multiple benefits since that man knew how to take advantage of the various parts (flesh, leaves, pits, roots, etc) in addition to the Palm fruit that made the tree of life in arid areas. Dates were fully known since ancient times as a fruit food and medicine for humans and animals as other plants. This has been confirmed with the latest analysis, where dates are concentrated with energy food item as in Table (2.1) below.

Table (2.1) : The nutritional value of 100 g. Dates.

Item	**CH**	***H2O***	***CF***	***CP***	***EE***	***P (Mg)***	***Ca (Mg)***	***Vit Niacin (Mg)***	***Vit B2 (mg)***	***Vit A (Unit)***
Date	75	20	2.4	1.8	0.5	72	65	2.2	0.05	60

Source: http://www.aghapack.com/

CH=carbohydrate, H_2O=water, CF=crude fiber, CP= crud protein,

EE=crude fat, P= phosphorus, Ca= calcium, vit= vitamin.

Sudan won the eighth rank, globally in the cultivation and production of harvest dates by 425 thousand tons per year, the dry varieties and half dry is almost the only varieties cultivated in the Sudan. Because of the introduction of new varieties of date palm to the Sudanese market and the lack of modern factories for processing and canning dates, just two small factory Karima, Abo Alama in addition to family projects for the local consumptions; And the production industries transformative for harvest dates is not complete probably as it is potentiality of good environment , soil , qualified , and expertise labors. the future promise (new species and modern technologies such as tissue cultivation was adopted) of spread of palm cultivation in most part of Sudan from north to south and even in the unsuitable area for agriculture, which is good signs for production industries transformative(e.g. pasts, stoned, syrup, wine, sugar, etc) and abundant of by-products (In fact, typically this apparent waste product of date production is either discarded or on occasion used as animal feed) which helpful in animals feeds ,productions and other industries Osman (2013).

Date seeds are the by-product of date stoning, either for the production of pitted dates or for the manufacture of date, the growing demand of dates enhanced their production which reached 7.2 million tons in 2010 FAO(2011) and approximately 720,000 tons of date–pits could be produced annually (*i.e.* considering 10% of the total fruit mass).

2.1.1 Description of Date Pits

2.1.2 Common Name

Date seeds, dates pits, date kernels, date stones, date pips

2.1.3 Species

Phoenix dactylifera *L.arecaceae*.(heuzé v, et al, 2012)

2.1.4 Local name

Meshrik Wad lagai. (used in this study)

Food waste was "one of the great paradoxes of our times", and it is wasting resources to produce food (Scott–Thomas, 2013). Recent research trends are to explore the use of waste from food industry, and the waste utilization could provide economic gain to the farmers, industry, food security, environmental safety and sustainability. The date seed is a hard coated seed with a small embryo, usually oblong, ventrally grooved, that makes the seed components difficult to digest. It is necessary to process the seeds before feeding them to livestock. Date pits weigh 0.5 g to 4 g and represent 6 to 20 % of the fruit weight and the values depend on maturity, variety and grade. Date by-products are available in countries of production and where dates are packed or processed.

2.1.5 The nutritive values

Date seeds are a low protein feed, with about 5-11% DM crude protein. Oil content about14 types of fatty acids (table 2.2.1) is in the 4-14 %, crude fiber 16-51 % NFE 58-90 %, all amino acids essential for fishes except methionine (23 with 2.3-5.6%), 15 salts and minerals table (2.2), six vitamins And contains growth hormones, also those component above looks like or similar to mother milk, and its energy similar to that found in corn, barley and wheat bran, etc. In Indonesia and Malaysia, PKM was found to contain 20-25% crude protein Gohi (1975).

TABLE (2.2) : Fatty Acids in Date Pits.

F/A%	Capric	Carpinic	Myristic	Palmitic And Oleic	Linoleic	Stearic	Loric
	2	3	5	6	7	3.2	4

F/A= Fatty Acids

TABLE (2.3) : Minerals in mg/100g Powder Seeds

Type	K	Cl	Ca	P	Mg	So4	Na	Fe	Cu	Br
	625-750	160-270	60-68	55-76	50-60	43-52	4-5	1.3-3	0.15-2.3	2.36-3.24

Source: www.hyah.cc/forum/t16578.html.

K=botasium.Cl=Chloride.Ca=Calsium.p= Phospores. Mg=Magnesium

So4= Cabritat. Na=Sodium.Fe=Iorn.Cu=Cubalt.Br=Brome.

2.1.6 Potential Constraints

The nutritive values of date seeds reported by the literature are variable. And it is very low due to low protein content and to very high fiber content, resulting in metabolizable energy levels as low as 2.9 MJ/kg. The lower feed efficiency that is sometimes observed may make using date pits not profitable. Maximum inclusion rates should be 5 % in young animals and 10 % in grower-finishers. Higher inclusion rates could be acceptable in slow-growing animals; it is an excellent slow release energy feed for camels during long desert journeys. The protein and energy balance of the diet should always be established carefully.

Seeds are traditionally used for animal feed, recent study in UAEU that date pits degraded by fungi were as effective as synthetic antibiotic in inhibiting a range of pathogenic bacteria in chickens – holding out the future possibility of treating pathogens such as Salmonella, Campylobacter, Shigella and E-coli,. They can also be used as a source of oil, polyphenol content of the date seeds was higher than in the edible flesh which has antioxidant properties valuable in cosmetics, nutraceutical, pharmaceutical, and medicinal products (Al–Farsi and Lee, 2008) and is largely related to their contribution to human health through their multiple biological effects such as Antioxidant activity, antimutagenic and anticarcinogenic activities, and anti-inflammatory actions Habib(2013), as a coffee , cocoa substitute, functional foods for human (e.g. Increasing the fiber content of bakery products) (Habib et al 2008), as a raw material for activated carbon or as an adsorbent for dye-containing waters and as a conventional soil fertilizer (Vandepopuliere *et al.*, 1995).

Date byproducts are usually distributed to animals as complementary feed during winter, though they can also be used year round..The presence of steroid compounds in date pits, notably estrogen, progesterone and ostriol, has been known since the 1950s, though the actual effects of these compounds on sheep growth and reproduction have yet to be clearly demonstrated Still, treatments with hexane and diethyl ether combined in some cases with germination have been proposed in order to decrease the amount of steroids.

2.2 Biology Of *Oreochromis niloticus*

2.2.1 Historical background

The Nile tilapia (*Oreochromis niloticus*) is a species of tilapia, a cichlid fish native to Africa from ancient Egyptian times as depicted on bas-relief from an Egyptian tomb dating back over 4000 years, which showed the fish held in ornamental ponds, south to East and Central Africa, and as far west as Gambia. It is also native to Israel, and numerous introduced populations exist outside its natural range. The distribution occurred during the 1960s up to the 1980s. In 1974 Nile tilapia was introduced to Bangladesh from Thailand(Wikipedia) and in 1978 to China from Sudan 22 of them, which leads the world in tilapia production and consistently produced more than half of the global production in every year, FAO (2015), it is also commercially known as mango fish, *nilotica*, or *boulti*.

2.2.2 Scientific Classification

Kingdom: Animalia

Phylum: Chordata

Class: Actinopterygii

Order: Perciform

Family: Cichlidae

Genus: Oreochromis

Species: Oreochromis niloticus

Binominal name: Oreochromis niloticus (Linnaeus. 1758)

2.2.2.2 Description

The Nile tilapia has distinctive, regular, vertical stripes extending as far down the body as the bottom edge of the caudal fin, with variable coloration, the Body compressed; caudal peduncle depth equal to length. Scales cycloid. A knob-like protuberance absent on dorsal surface of snout. Upper jaw length showing no sexual dimorphism. First gill arch with 27 to 33 gillrakers (figure2.4.3) . Lateral line interrupted. Spinous and soft ray parts of dorsal fin continuous. Dorsal fin with 16 - 17 spines and 11 to 15 soft rays. Anal fin with 3 spines and 10-11 rays. Caudal fin truncated. Color in spawning season, pectoral, dorsal and caudal fins becoming reddish; caudal fin with numerous black bars FAO (2015). Adults reach up to 60 cm (24 in) in length and up to 4.3 kg (9.5 lb). It lives for up to 9 years. It tolerates brackish water and survives temperatures between 8 and 42 °C (46 and 108 °F). In recent research done in Kenya, this fish has been shown to feed on mosquito larvae, making it a possible tool in the fight against malaria in Africa.

Figure (2.1) :The image of Nile tilapia (Oreochromis niloticus)

Source: FAO (2015)

2.3 Global Aquaculture and Fish Meal

As the global population continues to grow and forecasts exceeding 8 billion by the year 2030. The seafood consumption is predicted to reach between 150-160 million tons per year in 2030 FAO (2005). The decline in wild fish catches due to overexploitation of our fisheries resources; aquaculture will be called upon to fill this gap. In the last three decades (1980–2010), world food fish production of aquaculture has expanded,(fish farming business increases more than other animal production enterprise) by almost 12 times, at an average annual rate of 8.8 percent at 60 million tons (excluding aquatic plants and non-food products), with an estimated total value of US$119 billion. Global aquaculture production has continued to grow, when farmed aquatic plants and non-food products are included, world aquaculture production in 2010 was 79 million tones, worth US$125 billion, Freshwater fishes dominate global aquaculture production 56.4 percent, 33.7 million tones.

About 600 aquatic species are raised in captivity in about 190 countries for production in farming systems of varying input intensities and technological Sophistication. These include hatcheries producing seeds for stocking to the wild, particularly in inland waters FAO (2012). Global production of farmed Nile tilapia was 1.66 million metric ton (MMT) and 2.54 MMT in 2005 and 2009, respectively, including other cichlids the production was 3.1 MMT out of global aquaculture production of 55.1 MMT FAO (2010). Thus tilapia and other cichlids totally contribute about 5.6% of total aquaculture production. With the amount of sales for year 2000, 2005 and 2010 are 1.744.000, 457.312.000,>5.000.000.000 U$ respectively Antony (2010). According to the Fishery Statistical Yearbook of Bangladesh, tilapia production was 136,000 metric tons in 2012. It appears that tilapias are likely to be higher rank in global aquaculture production next to carp production, According to El-Sayed (2006), requires minimum fish meal, suitable for different culture system either in marine or fresh water Fitzsimmons (2010).

The major problems in using fish meal in formulation of fish feed are its rising cost, the price has increased more than two fold in recent years FAO (2013). In Asia alone, the production of fish feed increased from 40% in 2000 to 60% in 2008 while the fishmeal consumption for tilapia increased from 0.8 million tons to 1.7 million tons during same period (Tacon and Metian, 2008), Within the animal husbandry subsectors, aquaculture is the largest user of fishmeal and fish oil (figure 2.5), uncertain availability, currently up to 36% of the world's total fisheries catch each year is ground up into fishmeal and oil to feed farmed fish, livestock, chicken and pigs (Jacquet et al., 2010), variation in quality and its high inclusion 40-70% in fish feed and it is expensive.

However, the amount of whole fish converted into fishmeal is declining due to the increases of the consumption rate of fish as human food, currently, the by-products and trimmings used and it made up of 35% of total fishmeal production (fishmeal has been shifting from a mere commodity to become a more specialized ingredient) Malison (2013). replacing fish meal which is being used globally as dietary protein in formulated fish feeds, by alternative locally available and cheaper plant feedstuffs sources in aqua-feeds is proved to be very essential for the future development of aquaculture sector and challenging task (Tacon et al., 2006).

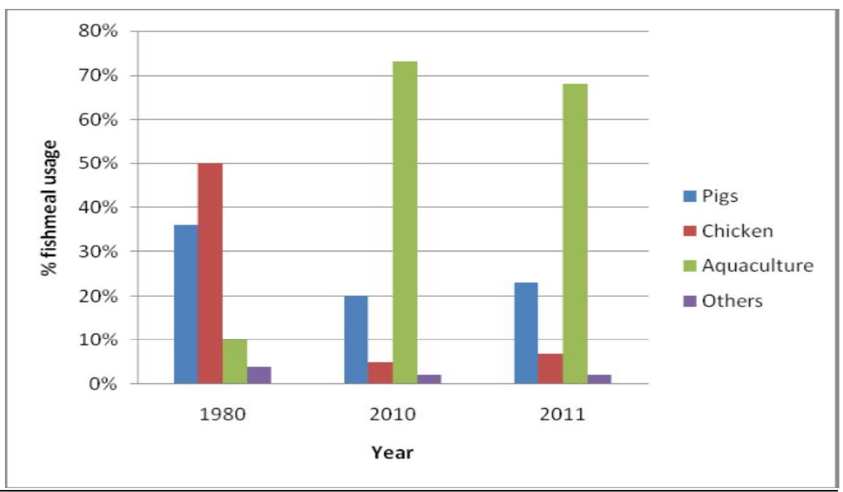

Figure (2.2) : Percentage of fishmeal usage among diets for pigs, chicken, aquaculture and other animals between 1980 and 2011. (Adapted from FAO 2006)

2.4 Fish verse animal

Fish lives in the water and belong to lower poikilothermal animal. Due to the special living environment, it is different from land higher homoeothermic animal. It does not need to consume energy to keep body temperature. It is easier to keep balanced in the water than in the land (The body temperature of fish is usually 0.5ºC higher than environment temperature, which is much lower than those of land livestock and poultry). All phases of metabolism [includes the storage of energy (anabolism) as fat, protein, and carbohydrate, and the transformation of those storage products into free energy (catabolism), require energy which is the result of all the chemical and energy transformations that occur within a living organism, animal obtain it from food. Energy is expended for the maintenance of life and for growth and reproduction; however, fishes with different feeding habits have quite different ratios of various components in energy Miller, (2009).

Fish also releases wastes from protein metabolism in the form of NH_3. Fish has lower requirement for energy than land animal (whose metabolism wastes are mainly urea and uric acid). Therefore, the energy fish need for growth is approximately half to 2/3 of that of land animal. The growth efficiency of Fish has high requirement of protein nutrient which has the prioritized in the diet, e.g., 2 to 4 times for livestock and poultry since fish lacks the capability turning fat or carbohydrate into protein, but fish has low food conversion ratio 1.25-1.5, 2.25, 3.3, 8, for Fish, Poultry, Swine and Beef cattle respectively. Scientists said the plentiful fish could be a good candidate for clinical use, but collagen from mammals like cows and pigs has been found to be dangerous because it can pass on infections from animal to human. However, tilapia collagen is 'benign', Collagen-rich fibers from the tilapia fish were found to boost skin growth on wounds faster than normal dressings (encouraged the growth of fibroblasts and increased the expression of genes involved in wound healing).

2.5 All-Male Tilapia

The plentiful fish, nicknamed 'the chicken of the sea' as it can be cooked and prepared in so many different ways, is found naturally in sea and fresh water and is successfully farmed in all climates. It is fast replacing varieties of fish whose numbers are becoming scarce in the wild, particularly in America where it is now one of the top five fish dishes in the country. Tilapia has numerous advantages as an aquaculture species (Teichert-Coddington et al., 1997) such as rapid growth, omnivorous fish can use high proportion of inexpensive plant sources in their feeds, stands well in wide range of environmental conditions (Such as temperature, salinity, low dissolve oxygen, etc.), resistance against stress and diseases, short generation interval and low supplementary feed require in natural environment and can take the Commercial feed immediately after yolk-sac absorption, El-Sayed (2006).

Unfavorably, the uncontrolled breeding of tilapia in ponds (Early sexual maturity 3-4month) which led to excessive recruitment about 70% , as a result competition in space and food within the target fattening species (Yosif et al ,2010), stunting and a low percentage of marketable-sized fish, dampened the initial enthusiasm for tilapia as a food fish, Has resulted in various techniques being developed to control unwanted reproduction, Under favorable conditions they will continue to reproduce, the offspring competing with the initial stock for food (Phelps and Popma, 2000). There are a number of ways to control reproduction in mixed sex population so the development of hormonal sex-reversal techniques in the 1970s represented a major breakthrough that allowed male mono-sex populations to be raised to uniform, marketable sizes.

According to FAO (2015), all male culture of tilapia is preferred because of their faster growth. Several techniques have been adopted for production of mono-sex (all male) tilapia: Manual sexing Guerrero (1982); hybridization Hickling (1960); genetic manipulation (Pandian and Varadaraj, 1988); and sex reversal through sex hormone administration (Shelton et al., 1978; Guerrero, 1982). Sex reversal by oral administration of feed incorporated with 17ɤ methyl testosterone is probably the most effective and practical method for the production of all male tilapia (figure 2.6), which consistently grow to a larger, more uniform size than mixed sex or all-female tilapias. This is the most common method of sex reversal in most countries (Cagauan et al., 2004).

Hormonal sex reversal has been particularly effective in cichlids because the gonadal differentiation takes place early in the life history. Tilapia species that have been successfully sex reversed are mouth brooding species where hormone treatment begins within a few days after hatching (Phelps and Popma, 2000). In addition, research on nutrition and culture systems, along with market development and processing advances, led to rapid expansion of the industry since the mid 1980s. Several species of tilapia are cultured commercially, but Nile tilapia is the predominant cultured species worldwide FAO (2015).

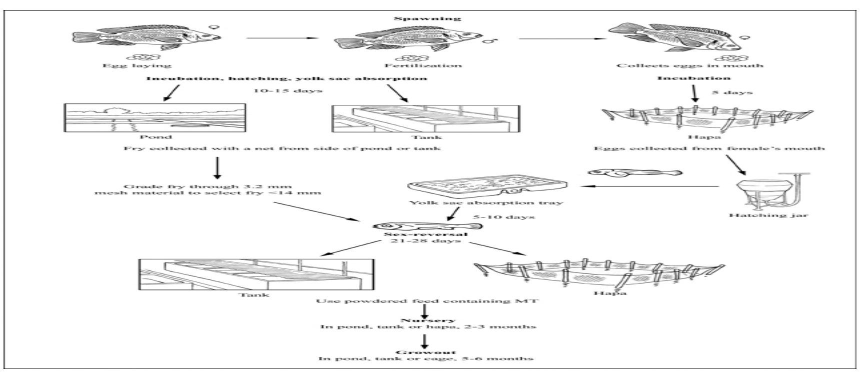

Figure (2.3) : Production cycle of Mono-Sex Nile tilapia (*Oreochromis niloticus*)

Source: FAO (2015)

2.6 Food and feeding habits

One of the key factors to successful fish culture is the understanding of some Biological fundamentals especially food and feeding behavior. Nile Tilapia is an omnivore, feeding on plankton as well as on higher plants, the Juvenile and adult Nile tilapia is reported to filter phytoplankton (Northcott *et al.* 1991). Since Nile tilapia use algal protein raising tilapia for food at lower trophical level can be a cost-efficient culture method. Fish food consumption might be influenced by many environmental factors such as water temperature, food concentration, stocking density, fish size and fish behavior (Houlihan *et al*. 2001).

The feeding behavior of Nile tilapia begins at sunrise continues during the daytime and becomes most active during sunset. The grazing behavior is varied from size to size, time to time, and actually it positively correlated to the occurrence and the richness of nature food components. So, the Fullness degree insignificantly differed. On the other hand, plankton is quickly digested and passed to the mid-gut and subsequently to hind-gut. Also, evacuation time (rate) may affect the composition percentage of phytoplankton in fish stomach.

In this concern Yada (1982) reported that Nile tilapia could change its feeding periodicity according to the fluctuation of phytoplankton concentrations. Moreover, Focken *et al*, (2000) reported that the natural food is ingested for 4-5 hours in the morning and 5-7 hours in the afternoon, and the flow of natural food from the stomach is low and fast. Subsequently, it could be supposed that each phytoplankton organism has its own evacuation rate.

2.7 Feeding rates and Growth

It has been evident from several studies that feeding rate and meal frequency can influence the production performance of tilapia. The feeding rate relative to the body weight decreases as fish size increases; however, the rate of food consumed increases per individual (Wang *et al*. 1989). (Brummett, 1995; Saha and Dewan, 1979) observed that the amount of phytoplankton in Nile tilapia stomachs decreased as fish size increased. Study with polyculture farming of tilapia, common carp and silver carp showed that growth performance, body fat and gross energy gain increased as feeding rate 0 to 5% and to apparent satiation increased (Abdelghany and Ahmad, 2002a).

Tambaqui showed better outcome using 10% feeding rate and 3 meals per day at growth phase (Silva et al., 2007). Research from pikeperch (6.4 g) give enhanced growth at 2% feeding rate and 3 meals/day (Wang et al., 2009).

Yuan et al. (2010) found increased growth performance, protein and lipid contents with increasing feeding rate. And Riche et al. (2004) reported that growth efficiency of tilapia increased if they are allowed for four hours satiation feeding. Increased daily feeding rates from 30 to 60% of body weight for juvenile tilapia (12 mg body weight) gave significantly higher growth (Santiago et al., 1987). A study with red tilapia showed that best growth can be achieved near satiation feeding rate (Clark et al., 1990). According El- Saidy et al. (2005), tilapia with average weight 61.9 g showed cost effective and affordable feed strategy at 2% feeding rate. Similarly, Storebakken and Austreng (1987) found that Atlantic salmon showed increased growth by increasing the ration level from 0.5 to 1.0 of expected appetite level, but further increase in ration doesn't support for the growth. Increased meal frequency provided better carbohydrate utilization for hybrid tilapia (Tung and Shiau, 1991). Imageperiod also influences the growth of tilapia and El-Saidy and Kawanna (2004) stimulated the growth of tilapia by using longer Imageperiod.

2.8 Length- Weight relationship

Tilapia growth can generally be broken into three distinct phases such as :-

1. Exponential or Accelerating Phase : In this phase the young fry is ravenous eaters and they can consume feed that is equivalent to up to 25% of their body weight daily. As a result, the fish grow very fast when measured in percent of body weight per day. However, since the fish are initially very small, the total weight gain is initially low. This rate of weight gain (in grams per day) increases until the fish weigh

approximately 100 grams, at which point they enter the Linear Phase of growth.

2. Linear Phase : In this Phase, Tilapia eat approximately the same amount each day and the growth remains fairly linear. Their feeding rate does not change drastically during this period because, although the fish are growing, they eat less feed as a percent of their body weight as they grow. The duration of the linear growth phase differs dramatically with the species and strain of tilapia. Some inferior strains may show growth deceleration at sizes of less than one pound.
3. The Plateau Phase : At this point(When fish growth begins to decelerate) it begins to take more food and time to achieve a given amount of growth, this can be very frustrating for the aquaculturist who is trying to get fish to market. Cheaper fingerlings often become more expensive in the long run due to poor genetics.

In fishes, generally the growth pattern follows the cube law Beverton and Holt (1957) stated that major deviations from isometric growth are rare. Such cubic relationship for fishes will be valid when Fish grows isometrically . But in reality, the actual relationship between the variables, length and weight, may depart from this, either duet to environmental conditions or condition of fish (Le Cren, 1951). According to Martin (1949) the value of the exponent ‘b’ in the parabolic equations usually lies between 2.5 and 4. Depending upon the deviation of ‘b’ values from ‘3’ fishes can be classified into three groups (i) b= 3 where the body form of fish remains constant at different lengths (isometric) (Allen, 1938), (ii) b<3 when fish becomes more slender as the length increases and (iii) b>3 (allometric) when fish grows more stouter with increase of length (Growner et.al., 1976).

2.9 Nutritional Requirement

2.9.1 Protein

Riche et al (2004) reported that, the appropriate range of protein requirement in diet is from 22% to 55%, e.g., 22% to 30% for herbivores, 30% to 40% for omnivores and 38% to 55% for carnivores and increased if they allowed for four hours satiation feeding. The optimum protein requirement of Nile tilapia depends on size, age, dietary protein source, energy content, and water temperature. Several studies have been estimated that protein requirement for fry tilapia varies from 32 - 50% and decreases with increasing fish size so for juvenile ranges from 30 to 40%, and for maximum performance of larger tilapia 25 to 30% (Hafedh, 1999; Nguyen, et al., 2009; El-Saidy et al., 2005; Ali et al., 2008; Abdel-Tawwab et al., 2010; Gunasekra et al., 1996; NRC., 1993). On the other hand, tilapia broodstock require 35-45% dietary protein for optimum reproduction, spawning efficiency, and larval growth and survival (Gunasekera *et al.*, 1996a and b; Siddiqui *et al.*, 1998; El-Sayed *et al.*, 2003).

2.9.2 Amino Acids

Despite that tilapia require the 10 essential amino acids (arginine, lysine, histidine, threonine, valine, leucine, isoleucine, methionine, phenylalanine, and tryptophan). Few studies have considered EAA requirements of Nile tilapia, *O. niloticus*, and *0. Mossambicus.* The EAA requirements of tilapia may depend on the species and amino acid source (e.g. crystalline AA vs. casein/gelatin). For example, the performance of tilapia fed crystalline EAA based diets was lower than those fed casein or casein/gelatin diets (Jackson and Capper, 1982; Teshima *et al.*, 1985), presumably due to the low pH of the AA-based diets. More work is needed in this area, since other studies indicated that lowering food pH enhanced the appetite of *Tilapia zillii* for food (Adams *et al.*, 1988). Tilapia requirements for sulfur–containing AA can be met by methionine or a methionine/cystine mixture. Recent studies recommended a methionine: cystine ratio of 50:50 for the best performance of Nile tilapia (Abdelghany, 2000b). Similarly, the requirement of tilapia for phenylalanine (aromatic amino acid) could partially be met by tyrosine (NRC, 1993).

2.9.3 Lipid

The optimum dietary lipid requirement for tilapia is 5 to 12% (Lim et al., 2011), and Han et al. (2010) found significantly better growth by increasing dietary lipid from 55 to 85 g per kg diet.

According to Lim et al. (2011) tilapia require linoleic (n-6) series fatty acids (18:2n-6 or 20:4n-6) and it can enhance the growth better than the n-3 series (18:3n-3, 20:5n-3 or 22:6n-3). Fish have a high (above 90%) digestibility of lipids. They are not only source of energy and essential fatty acids, but also carrier of fat-soluble vitamins (vitamins A, D, E and K).Different fishes has different requirements for essential fatty acids. The appropriate requirement of fatty acids is different due to the differences in feeding habit, age, and water temperature.

2.9.4 Carbohydrate

Fish's requirement of carbohydrates and their function in nutrient are still in disagreement. It is generally believed that the optimum level of carbohydrates in diet is 30 % and 21% for warm and cold water fish respectively, and for Tilapia is about 25-36%. Tilapia utilize starch efficiently from 22 to 46% dietary starch while 22% considered as optimum level for juvenile tilapia (Wang et al., 2005).

2.9.5 Minerals

The biggest metabolic difference between fish and mammal in mineral requirement, in fish are essential in minute amounts 2-3% because fish can absorb some minerals from waters such as calcium ion and small amount of microelements (Mg, Fe, Cu, Zn, I). However, fish have to get the phosphorus provided in feed since they cannot utilize it in the water Miller (2009).

2.9.6 Vitamins

Vitamins are kind of low-molecular organic compounds consist of fat-solubleA, D, E, K and water-solubleB1, B2, B6, and B12 as well as pantothenic acid, nicotinic acid, cyclohexanehexol, folic acid, bilineurine and biotin are essential in minute amounts 1-2% to the maintenance of animal health and promotion of growth and development. Long lack of a certain kind of vitamin can cause metabolism disorder and pathological state and fish might have suffered from hypovitaminosis so In general, fish either cannot compose or can only compose very little amount of their essential vitamins in their own body, and their requirement cannot be met and their feed have to be fortified with vitamins. The growth of tilapia can be enhanced by using optimum protein, lipid, carbohydrate and other nutrients (balance diet) also has Similar type influence on growth performance of tilapia Miller (2009).

2.10 Feedstuff

2.10.1 Animal Protein

2.10.1.1 Fishery by-products

A wide variety of fishery by-products have been evaluated and used in Aqua feeds, including fish silage and fish protein hydrolysate, shrimp head meal, krill meal, and squid meal. the development of commercial aqua feeds or complete formulated diets for these species has usually been based upon the use of fishmeal as the main source of dietary protein; the nutritional characteristics of fishmeal protein approximating almost exactly to the nutritional requirements of cultured finfish, is also a good source of essential fatty acids, digestible energy, macro and trace minerals, vitamins, and generally acts as a feeding stimulant for most finfish species (Tacon, 1993). Moreover, experimental aquafeeds containingfinfish species were reported to have very good water stability and low nitrogen loss irrespective of the binder used (Fagbenro and Jauncey, 1995). Furthermore, during feeding trials, excellent apparent digestibility for dry matter.

2.10.1.2 Terrestrial animal by-products

It have been tested as fishmeal replacers within tilapia feeds have included poultry by-product meal (PBM), hydrolyzed feather meal (HFM), blood meal (BM), and meat and bone meal (MBM). Despite their usually high crude protein content, these fishmeal replacers are usually deficient in one or more essential amino acids (EAA); the limiting EAAs generally being lysine (PBM, HFM), methionine (MBM, BM, HFM), and isoleucine (BM) (NRC, 1993; Tacon and Jackson, 1985). However, these imbalances can be overcome to a large extent by -mixing complementary protein by-product meals so as to obtain the desired EAA profile (Davies et al., 1989).

In fact, diets containing MBM or high MBM/BM ratios (3:l and 2:3) were found to be superior to FM even at a 100% substitution level; when BM was used a total replacement for FM, fish growth was still comparable to the control diet (Davies *et a/.* 1989). Falaye (1982) and Bishop *et al.*, (1995) reported that HFM could replace up to 50% and 66% of the FM or FM: MBM within diets for *O. niloticus* fingerlings and fry with no loss in growth performance, respectively; growth of fish fed these rations being comparable with that of fish fed the FM control ration Terrestrial animal by-product silage has been successfully used as a protein source for tilapia. Belal *et al.* (1995) fed *O. niloticus* fingerlings (10.8 g) test diets containing 0-20% chicken offal silage (COS), made from chicken viscera, as a replacement of FM. They found that the growth and body composition of fish fed COS up to 20% level were similar to that of fish fed a FM based diet. High inclusion levels of COS should be tested in order to determine the proper inclusion level.

2.10.1.3 Meat meal

The quality of meat meal as a protein supplement depends on its production process as well as raw material used. Good quality meat meal is low in fat and mineral content. Meat meal is frequently used as an animal protein source in compound fish feed manufacture although its feed value is generally considered inferior to that of soybean meal and fish meal. Fats in meat meal although poor in the PUFA's required by cold water species, are good energy sources for both carp and rainbow trout. Slaughterhouse wastes are best used in combination with dry feed ingredients to make moist feeds. Heat processing may be necessary and the material used immediately if refrigeration facilities are not available. Because meat meal is usually an imported item, its cost is usually high. Slaughterhouse waste, on the other hand, is inexpensive when available FAO (2014).

2.10.1.4 Blood Meal (BM)

BM is an animal waste product readily available in abattoirs and can be used as an alternative high quality and cheap protein source in fish feed formulation, It may be used fresh, or processed into blood meal before using., its amino acid content is not as well balanced as that of muscle tissue. Fresh blood may be used to enrich commonly available feedstuffs such as rice bran and wheat bran in fish diets. The bran also soaks up the excess moisture in the production of moist pelleted feed. In combination with rumen contents, fresh bovine blood has successfully substituted fish meal in channel catfish diets .Because animal blood is widely available in most countries, often at little or no cost, its use in aquaculture diets can help lower feed cost. Blood meal is superior to meat meal in test-diets for salmon FAO (2014).

BM products can effectively replace marine proteins in grow-out rations for shrimps (*Pannaeus vannamei*) when supplemented with methionine (Dominy and Ako, 1988). Davies et al. (1989) fed Mozambique tilapia (*O. mossambicus*) fry for seven weeks using BM and found that up to 75% of the FM in the diets could be effectively replaced. However, Otubisin (1987) conducted a 120 day experiment with caged *O. niloticus* fingerlings using BM and concluded that dietary BM inclusion levels above 50% of the FM protein significantly reduced fish performance. El-Sayed (1998) also found that BM used as a sole protein source in practical diets for Nile tilapia reared in outdoor concrete tanks for 150 days resulted in reduction of fish performance.

It is important to realize that management factors such as feeding frequency, rearing condition and other environmental factors are equally important. Agbebi et al. (2009) reported that fish meal can be replaced completely by BM with no adverse effect on growth, survival and feed conversion of Nile tilapia and *Clarias gariepinus* juveniles. The studies of Aladetohun and Sogbesan (2013) showed that inclusion of BM in the experimental diet improved the growth performance of Nile tilapia.

2.10.1.5 Bone meals

Bone meals are made by heat processing of animal bones followed by grinding to produce a fine powder. Contrary to common belief, bone meal is not all calcium and phosphorus. Depending on the processing method employed, bone meal can contain up to 36 percent protein. Much of this protein is, however, of low quality since it is mainly collagen, the substance extracted industrially from bones to produce gelatin and glue. With the development of fish diets containing ever-decreasing content of animal protein such as fish meal and meat meal, bone meal may become more prominent as a dietary source of calcium and phosphorus FAO (2104).

2.10.1.6 Hydrolyzed poultry feather meal

Feather meal is a by-product from poultry production, contains a complex protein (keratin very rich in the non-EAA cystine (as high as 25 percent). Threonine and arginine, has high level of pepsin digestible protein (Fowler, 1990). The amino acid profile of it is similar to those of FM and soybean meal (Fowler, 1990). This can be hydrolyzed to improve bio-availability (Munguti et al., 2014). Hydrolyzed poultry feather meal is more commonly used as a nitrogen source in ruminant feeding. This is due mainly to its deficiency in most of the EAA's, thus making it unsuitable as a source of animal protein for other livestock. Unless properly hydrolyzed, feather meal is not very digestible for non-ruminants. Fish diets will not be improved by its inclusion unless they already contain other high quality protein sources. However, the utilization in fish diets is limited due to a complex protein called keration (Steffens, 1994). The utilization of hydrolyzed FM protein in tilapia feeds could be economically feasible. However, studies conducted to evaluate the use of hydrolyzed feather meal in fish diets recommend low substitution levels due to poor digestibility and sub-optimal levels of essential amino acids (Steffens, 1994; Mendoza et al., 2001). Arunlertaree and Moolthongnoi (2008) concluded that fermented FEM could be used at 25 % up to 50 % as the replacement of FM for 30 % CP Nile tilapia diet. Feather meal is available in those countries that have a highly developed and integrated poultry industry (FAO 2014).

2.10.2 Plant protein Meals and Oils

2.10.2.1 **Plant Protein Meals**

commonly used in aqua feeds include soybean meal, wheat gluten meal, corn gluten meal, rapeseed/canola meal, cottonseed meal, sunflower seed meal, groundnut/peanut meal, mustard oil cake, lupin, kernel meal, and broad bean meal; and plant oils include rapeseed/canola oil, soybean oil, and palm oil.

Plant proteins represent the major dietary protein source used within feeds for lower-trophic-level fish species and the second major source of dietary protein and lipids (after fishmeal and fish oil) for marine shrimps and European high-trophic-level fish species (e.g. salmons, trouts, marine fishes, and eels). Other species and species groups that use substantial amounts of plant protein meals and oils include milkfish, mullets, freshwater prawns, and freshwater crayfishes.

The inclusion levels of plant protein meals and oils vary widely depending upon species and species group, Soybean meal is the most common source of plant protein used in compound aqua feeds and the most prominent protein ingredient substitute for fishmeal in aquaculture feeds, with feeds for herbivorous and omnivorous fish species and crustaceans usually containing 15–45 percent soybean meal, with a mean of 25 percent in 2008. In global terms, and based on a total compound aqua feed production of 29.3 million tons in 2008, it is estimated that the aquaculture feed sector consumes about 6.8 million tons of soybean meal (23.2 percent of total compound aquafeeds by weight).

Other plant proteins that are being increasingly used include corn products (e.g. corn gluten meal), pulses (e.g. lupins and peas), oilseed meals (rapeseed meal, cottonseed and sunflower), and protein from other cereal products (e.g. wheat, rice and barley). Currently, plant protein and/or oil choice and selection are based upon a combination of local market availability and cost, as well as their nutritional profile, their palatability is hindered by presence of anti-nutritional factors(such as gossypol, glucosinolate, saponins, trypsin inhibitors etc.) and low bioavailability (Francis et al., 2001). Some plant proteins contain phosphorus phytate, which binds phosphorus, reduces palatability and interferes with the bioavailability of divalent trace elements which limit their use in compound feeds or require removal/inactivation through specific processing (such as heating, cooking etc) (Gallagher, 1994).

With the continued rise in the fishmeal price, plant protein concentrates (soybean protein concentrate, canola protein concentrate, and pea protein concentrate and corn/wheat gluten meals) will gain increasing prominence over regular plant protein meals within aquafeeds for high-trophic-level cultured species and crustaceans. For example, the demand for soybean protein concentrates within aquafeeds is projected to exceed 2.8 million tons by 2020. However they contain many anti-nutritional factors (FAO 2014).

2.10.2.2 Plant Oil Seeds

Limited attention has also been given to the use of other oilseed meals and byproducts as sources of dietary protein for tilapia, including groundnut, sunflower, rape seeds, sesame seeds, and copra, macadamia, and palm kernel. For example, Jackson et al., (1982) evaluated the use of groundnut cake, sunflower meal, rapeseed meal, and copra meal within diets containing 30% crude protein for O. mossambicus over a seven to nine week rearing period.

They found that 25%, 75%, 75% and 50% of these protein sources, respectively, could effectively replace FM protein in the control diets without a significant retardation in fish performance. El-Sayed (1987) studied the effects of replacing a casein: gelatin protein mixture with sesame protein within experimental diets for T. zillii fingerlings, and found that fish fed sesame seed-based diets exhibited poor growth performance and displayed disease symptoms including haemorrhage and red spots in the mouth and at the bases of the fins even at the lowest sesame seed level tested (25%). Since sesame seeds were known to be deficient in Lys and zinc (Zn), the diets were re-evaluated after dietary supplementation with Lys and Zn. Interestingly, fish growth increased and disease symptoms disappeared when either Lys or Zn was added to the diets; indicating that either Lys or Zn met the requirement of the other, and in turn supported the thesis that EAA deficiency may not be the limiting factor in tilapia feeds.

2.10.2.3 Groundnut Oil Cake

Groundnut oil cake is a safe feed for fish **.** It has been demonstrated that in India that diets consisting of 50 percent of the material as the principal protein source can be used in complete feeding of carps. Its high polyunsaturated fatty acid (PUFA) content also makes further addition of fats to such diets unnecessary. Because groundnut protein is especially low in methionine, the oilcake should be used with methionine-rich protein supplements or with synthetic methionine to achieve a proper balance of essential amino acids in the diet.

Quality in groundnut oilcake depends on whether the material is made from decorticated nuts. Removal of the fibrous hulls yields a better quality product with higher protein content. This will also depend on the amount of residual oil in the cake. In a few countries there are two varieties of groundnut oilcake: the mill produced and the 'country' produced. The former is an industrial product with generally lower residual oil content (less than 7 percent), whereas the latter is produced on often a very small scale in villages and may contain as much as 13 percent oil. The principal (and often very serious) contaminant of groundnut cake is aflatoxin. Aflatoxin is a group of highly toxic substances produced by the mould *Aspergillus flavus*. The most prominent of these are aflatoxins B_1, B_2 and G_1. The toxins are produced only when the mould exists as a pure culture. Aflatoxin is a hepatotoxin and mortality among afflicted animals and fish invariably results from severe liver damage. Small doses over an extended period of time produce cancer of the liver in humans.

The half lethal-dosage or LD_{50} for trout weighing 100 g is 0.5 ppm in the diet. Improper post-harvest handling of nuts is usually blamed for the presence of aflatoxin in groundnut although pre-harvest infestation has also been documented. Aflatoxin is not destroyed by heat. The LD_{50} dosage at which mortality occurred among animals consuming the contaminated feed is 50 percent according to (FAO 2014).

2.10.2.4 *Soybean meal* (SBM)

Soybean meal (SBM) is generally considered to be one of the best readily available plant protein sources in terms of its protein quality and EAA profile (with the exception of Methionine), like most other plant proteins it does contain a wide variety of endogenous antinutrient which require removal or inactivation through *processing* prior to usage within aqua feeds (Tacon,1 995a). The dietary inclusion of SBM in tilapia feeds is affected by the dietary protein level. numerous studies have been conducted using *processed* SBM as a67% to 100% of the dietary protein could be supplied in the form of SBM; the inclusion level depending upon a variety of different factors, including fish species and size, SBM source and processing method, aqua feed processing and manufacturing method, and culture system employed. For example, pre pressed solvent extracted or full-fat SBM, with or without Met supplementation successfully replaced up to 75% of FM within diets fed to *O. niloticus* fry (Pantha, 1982; Tacon *et al.,* 1983), *O. mossambicus* (Jackson, Capper et al, 1982).

***2.10.2.5 Cottonseed meal* (CSM) *and cake* (CSC)**

Cottonseed meal (CSM) and cottonseed cake (CSC) have been widely used within tilapia feeds, although with conflicting result. For example, Ofojekw and Ejike (1984) and Robinson *et al.,* (1984) reported lower growth rates and feed efficiency in *O. niloticus* and *O. aureus* fed CSC and CSM-based diets than with fish fed FM based diets. The poor response was attributed to the antinutrients gossypol and cyclopropionic acids contained within glanded and glandless CSM, respectively. Moreover, glandless CSM was found to be better utilized than glanded CSM (Robinson *et al.,* 1984).

2.10.2.6 Cereals and cereal by-products

Grown primarily for human consumption, cereal grains are no less important as feed for efficient animal production. Present-day high energy diets for monogastrics farm animals often contain up to 80 percent cereal grains and their by-products. The use of grains is somewhat restricted in fish diets because of generally lower tolerance for dietary carbohydrates by fish. This effect appears to be more pronounced among cold-water species such as the trout than among warm-water species. While cereal grains are considered mainly as a source of dietary energy, their byproducts represent a fairly rich source of protein and polyunsaturated fatty acids (PUFA). It sometimes constitutes a significant percentage of fish feed processed into pellets. Starch present in cereals act as good, natural binders when gelatinized under normal pelleting conditions, giving products that have high water stability. Consequently, cereal grains are indispensable in the manufacture of floating-type pelleted feed (FAO 2014).

2.10.2.7 Wheat Meal

Although primarily a crop of temperate countries, wheat is also grown in parts of the tropics where there is a long period of relatively cool weather. Where it is not grown, it is imported for flour production. Wheat products are, therefore, available in practically every country. Wheat, often used as an ingredient of compound fish feed in temperate countries is seldom used in the tropics because of its high cost. Damaged grain is, however, frequently available and when fed to fish is at least equivalent to maize in feed value ,Milling of wheat produces three major by-products, two of which are almost exclusively used as feed for livestock. These are: wheat bran and wheat middlings (or fine bran). The third, wheat germ, has higher commercial value as a food item for humans. Occasionally, damaged flour is also available as feed.

2.10.2.8 Wheat bran Meal

Wheat bran is the primary coat of the wheat grain. It has fairly high protein content and polyunsaturated fatty acids (PUFA). . Because it is also high in fiber, it has a laxative effect when fed at excessive levels to animals. Such an effect, however, will be more difficult to determine in fish. Nevertheless, wheat bran has been successfully fed at fairly high levels to various species of fish without adverse effects on growth.

Too much wheat bran in a formulation results in pellets with poor water stability due to the water absorption characteristics of fiber, and it is grown primarily for human consumption. The use of grains is somewhat restricted in fish diets because of generally lower tolerance for dietary carbohydrates by fish. This effect appears to be more pronounced among cold-water species such as the trout than among warm-water species (FAO 2014).

2.10.2.9 Aquatic plants Meal

Relatively few studies have been conducted concerning the use of aquatic plants as feed ingredients within tilapia feeds. The results of feeding trials using aquatic plants often vary considerably and sometimes yield conflicting results. A good example can be seen concerning the use of the freshwater fern *Azolla* sp.; the latter having a unique symbiotic relationship with a nitrogen fixing cyanobacteria *Anabaena azollae.* Duckweed *Lemna* sp also has considerable potential for use a fishmeal replacer within tilapia feeds (Mbagwu *et al.,* 1990) or as a complete diet in its live form (Edwards, 1987; Journey *et al.,* 1990; Wee, 1991). Appler (1985) found that up to 20% of FM could be replaced by *Hydrodíctyon retículatum* without any adverse effects on the growth performance *of O. niloticus* and *T. zillii.* Chiayvareesajja *et al.,* (1990).

2.11 Single Cell Protein (SCP)

2.11.1 Probiotic (Bakery- Yeast)

In the recent past, biosynthesis and utilization of SCP, which are a group of microorganisms including unicellular algae, fungi, bacteria, cyanobacteria and yeast; by tilapia within culture systems has attracted the attention of aquaculture nutritionists (El-Sayed, 1999; Avnimelech, 2007). The use of live yeast(non-hormone growth promoter) is one of the most important probiotics in animal feeds has a long history . According to Jouany in 2000, the number of published papers on probiotic yeast for ruminants increased rapidly from 1950 to 2000 resulting in around 80 papers published per year in peer-reviewed journals from 1950 to 1980. Further research efforts gave a better insight on the understanding of basic mechanisms and modes of action in the 90's. It is any of various unicellular fungi of the genus *Saccharomyces* ,especially*S. cerevisiae*, reproducing by budding and from as cospores and capable of fermenting carbohydrates.

Ruminants represent perhaps the best-developed market for live yeast usage. Available products vary widely in both the strain of *Saccharomycescerevisiae* used and the number and viability of yeast cells present. Not all strains of the yeast are capable of stimulating digestion in the rumen e.g. Effect of addition diet probiotic with tow levels of protein content ration on some growth parameter of common carp, results showed that growth was good when 5 % of probiotic was added to a low levels protein diet (5 % protein), this finding is very essential since the price of the diet declined.

SCP contains more than 38% protein, 3% lipid, 6% fiber, 12% ash and 19 K J g-1 energy, which is just sufficient for tilapia production (Azim and Little, 2008).Indeed these values are far much better than most commercial pellet feeds used in aquaculture farms today (Ogello et al., 2014). Fish fed with 20% CP of SCP based diet significantly performed better than those fed commercial 30% FM diet). The active recirculation of proteins by microorganisms is credited for the increased protein utilization in fish reared in SCP fed systems (Ogello et al., 2014). This is definitely positive information to farm managers who may even aim at increasing further recycling of proteins.

2.12 Formulated Feeds

High quality formulated feeds are used to achieve high yields and large sized fish (600-900 g) within a short period of time. The maximum size at harvest of Nile tilapia reared in ponds that are only fertilized is generally less than 250 g after 5-6 months of on growing. Under semi-intensive farming systems, most tilapia farmers in Asia fertilize their ponds and use formulated feeds. However, in intensive pond and tank culture systems or in cages, tilapia farmers mainly depend on commercial pelleted feeds. The nutrient inputs used and the yield and weight of tilapia at harvest in several Asian countries are summarized by Dey (2001). In terms of pond yields, Dey (2001) reported that overall, the average yield of pond farming in Taiwan, Province of China is very high (12 to 17 tones/ha) while ponds in Bangladesh, China, the Philippines, Thailand and Viet Nam produce around 1.7, 6.6, 3.0, 6.3 and 3.0.

2.13 Inclusion of Date Pits in Fish Diet

Fish meal (FM) has been partially or completely replaced by plant proteins though some conflicting results were evident in a review study by (Tacon et al., 2010). Recent study usingFour iso-nitogenous isocaloric diets containing 0, 100, 200 and 300 g kg^{-1} DF(date fiber) as replacement of wheat bran, They were fed to *O. niloticus* fingerlings (0.65 g). Further increase in dietary DF to 300 g kg-1 resulted in significant retardation in all parameters. Body fat was reduced while protein, ash and moisture were increased by increasing DF level. Increasing dietary DF level caused changes in tilapia's intestinal villi, reduced dietary microbial activity and bacterial population of selected species, and produced stronger pellets Belal et al (2015).

Four levels 0, 15, 30, and 45% of wet Date (WD),two levels (0 and 0.03%) of Digestarom (D)Instead of yellow corn in Nile Tilapia Diet, studded by Gaber et al., (2014) .The results revealed that, mean final weight (g/fish), SGR (%/day), feed conversion ratio, PPV and PER, were significantly ($p \leq 0.05$) affected by the levels of WD and level of D. And the best diet achieved which containing 30% WD supplemented with 0.03% D.

Yousif, (2012) reported that using of Dehydrated *Entromorpha, Prosopis cineraria* pods and date pits meals, as substitution of the wheat flour at 0, 10, 20 and 30%. Diets supplemented with date pits achieved the best ($P<0.05$) survival rate.The carcass protein contents were similar for all treatments. The moisture content was inversely related to fat content, irrespective of treatments. The ash content was high (P<0.05) in the groups fed the control diet.

Mabrouk et al (2011),said that using of two forms of palm cull date and date pits as energy sources, supplemented with feed additives (Phytogenics), to be partially replaced (13.5%) yellow corn(iso-nitogenous (30.43% crude protein), isocaloric (436.43 kcal GE 100g-1)) in feeding Nile tilapia fingerlings, increased the fish specific growth rate and feed utilization. However, replacement either DCD or DP decreased tilapia performances; meanwhile DP recorded the worst values. On the other hand, DG supplementation improved fish performances either fed WCD-based diets or control diets (YC). It could be concluded that wet cull date may be cost-effective when partially replaces yellow corn in tilapia diets as energy source, and improves fish performances when supplements with 0.03 % Digestarom.

Khadr, (2006), reported that the use of date stone meal (DSM) as unusual energy source instead of yellow corn inMale of Nile tilapia dietsat level 0, 25, 75% respectively, on body weight, body weight gain, weight gain %, feed intake, feed conversion, carcass characteristics, feed cost and histopathological. showed that cumulative feed consumption was affected by feeding date stone meal. The diet containing 75% date stone meal exhibited better growth performance as unusual energy source.The best dressing percentage was recorded with diet containing 75% date stone meal as compared with other groups. On the other side from the economical point of view the tilapia fed diet containing 75% DSM showed the nearly economical results in comparing with control.

In Saudi Arabia, Al Amoudi et al., (2001), was tested local Palm Kernel Meal (LPKM) as a partial or a total replacement of fish meal on tilapia *(Oreochromis spillurm)* . The replacement percents of fish meal with LPKM were 0, 7.6, 15, 22, 30.2, and 100 in diets I, II, HI, IV, V and VI respectively.. The lowest increase in weight was observed with fish fed100% (LPKM) .

The best food conversion rate (FCR) was noticed with fish fed on control (1.73). While the worst FCR (4.4) was with100%. Ash, dry materials, water, protein and fat contents in *0. Spilurm* carcass muscles, showed no differences among experimental diets. On the contrary, fat and protein contents were significantly lower in muscles of fish fed on diet100%, and their moisture and ash contents were relatively high compared to other diets tested.

Five iso-nitogenous (40% CP) and isocaloric (19 MJ/kg) diets were formulated to investigate the utilization of acid treated date pits as carbohydrate source for tilapia fingerlings *(Oreochromis niloticus)*. Diet was replaced by 50% (15% of the total diet) and 100% (30% of the total diet)for treated and untreated date pits, respectively. Growth performance, feed conversion ratio and protein productive value were significantly (P<0.05) higher in fish fed 50% treated date pits. Carcass analysis showed significantly (P<0.05) lower crude protein content In fish received treated date pits compared to the groups received untreated. Date pits. Dry matter and ash content were not affected Osman et al (2001).

Omoregie and Ogbemudie,(1993) shows that the best growth and food utilization indexes were recorded in Nile Tilapia when fed 15% palm kernel/25% fishmeal diet (28.56% dietary crude protein and 13.49% dietary crude fiber), while the poorest growth and food utilization indexes were recorded with the 30% palm kernel/10% fishmeal diet (27.86% dietary crude protein and 18.99% dietary crude fiber). The high crude fiber present in palm kernel meal reduced digestibility in test diets with higher inclusion level.

Chapter Three

Material and Methods

3.1 Experimental Diets

Diet ingredients were obtained from the local market (Koko market).Seven experimental diets incorporated with different levels of fresh wet date pits (MeshriK Wad Lagai) 0, 25, 50, and 75% for diets T0,T1, T2, T3, T4, T5 and T6 respectively which got from Abu Alama date packaging Factory (local market). All feeds were formulated with ingredients commonly used, including fish meal, groundnut Cake, wheat bran, bread flour, starch, yeast, mineral mix and vegetable oil , were presented in Table 3.4 . The experiments of this study were conducted in the fresh water Fisheries Laboratory and hatchery. Sudan university of Science and Technology The duration of the experiments was one month and half, start from 19 August to 2 October 2015.

The date pits were cleaned and soaked in tap water for three days, dried and some were milled in the home blender others in the central Khartoum market by coffee grinder in to powder. Chemical Analysis of date pits were presented in Table 3.1 below .

Table (3.1): Chemical Composition of Date Pits (% DM)

Type	Moisture	DM	CP %	EE %	CF %	Ash	NFE
Date Pits	1.5	98.5	6.27	2.9	3.5	2	83.83
Gross Energy/kcal/100g	398.609						
Digestible Energy/kcal/100g	225.11						

Nitrogen-free extract(NFE) = 100 - (moisture + crude protein + crude fat + crude fiber + ash).

Gross energy (kcal/100g), based on 5.7 kcal/g protein, 9.5 kcal/g lipid, and 4.0 kcal/g carbohydrate.

Digestible energy (kcal/100g), based on 5.0 kcal/g protein,9.0 kcal/g lipid, 2.0 kcal/g carbohydrate.

DM= Dry Matter. CP= Crude Protein. EE=Either extract. CF= Crude Fiber.

The additional additive yeast were inclusion in the experimental diets in a rate of 3 gram (by replacing 2g of starch) For diets T1, T2 , T3 respectively, in dry form. The chemical analysis of the yeast presented in Table 3.2 below.

Table (3.2): Chemical Composition (% DM) of Yeast

Type	Name	Moisture	DM	CP	EE	CF	Ash	NFE
Saccharomyces *cerevisiae*	Bakery - Yeast	9.2	90.8	51.5	6.3	1.8	6.8	24.4

DM= Dry Matter. CP= Crude Protein. EE=Either extract. CF= Crude Fiber. NFE= Nitrogen-free extract

The chimecal compostion of fish meal use in the experimental diets were presented in Table 3.3 below.

Table (3.3): Chemical Composition (% DM) of Fish Meal

Type	Moisture	DM	CP%	EE%	CF%	Ash	NFE
Fish Meal	7.85	92.15	61.29	8.15	0.6	9.5	12.61

DM= Dry Matter. CP= Crude Protein. EE=Either extract. CF= Crude Fiber. NFE= Nitrogen-free extract.

3.1.1 Method of preparation

Dry ingredients presented in Tables 3.4 , with the percentage that presented in Table 3.5 ; they were first sieved to be very fine particles then they were weighed by using electrical balance (ModeL: 2003, Max:200g, cl:0.001g, AC:220W/50HZ, S/N:11g, SF:400) and thoroughly all dry matters were mixed well for homogeneity and the vegetable oil were added to the mineral and vitamins and then mixed with the previous component. Tap water were boiled and additional starch (10g/100g) were added for making gelatinized binder, an excess water added (depend on the ingredient) to obtain an excellent paste with about 10% moisture content. Pellets were obtained by using manual meat grinder with 0.6mm- diameter and later were dried in the lab for 24h and subsequently broken into crumbled form and each diet packaged in plastic bag and kept under the ambient room temperature until starting the experiment. Sample from each diet were taken for the chemical analysis Table 3.4.

Table (3.4): The Ingredients and Chemical Composition of the Experimental Diets*/100g*

Ingredient	Treatment						
	Control	With (group A)			Without (group B)		
	0.00%	25%	50%	75%	25%	50%	75%
Fish -meal (60cp)	45	33.75	22.5	11.25	33.75	22.5	11.25
Date-pits (6.27cp)	0	11.25	22.5	33.75	11.25	22.5	33.75
Groundnut Cake (34.5CP)	21	21	21	21	21	21	21
Wheat bran (15.7CP)	10	10	10	10	10	10	10
Bread Flour	10	10	10	10	10	10	10
Starch	5	2	2	2	5	5	5
Yeast	0	3	3	3	0	0	0
Mineral Mix	4	4	4	4	4	4	4
Vegetable Oil	5	5	5	5	5	5	5
Chemical composition (% DM)							
Moisture	6.5	8.5	6.0	12.5	7.5	6.0	6.50
DM	93.5	91.5	94.0	87.5	92.5	94.0	93.5
CP	36.84	35.71	35.53	34.74	36.01	36.27	35.57
EE	3.85	3.55	3.45	3.40	3.95	3.70	3.60
CF	3.03	2.97	2.96	2.90	2.80	2.90	2.92
Ash	15.0	13.5	8.50	12.50	9.50	7.50	9.50
NFE	34.79	35.78	43.57	33.97	40.24	43.64	41.92
G /Ekcal/100g	385.70	380.34	409.53	366.18	403.74	416.40	404.60
D/Ekcal /100g	288.42	282.025	295.805	272.23	296.08	301.90	294.10
P Energy	54.44	53.51	49.45	54.08	50.84	49.65	50.11
ERE	1.883	2.71	1.61	2.17	3.81	4.86	2.16

DM=Dry Matter. CP=Crude Protein. EE=Ether Extract. NFE=Nitrogen free Extract's\E= Gross Energy. D/E=Digestible Energy. Protein Efficiency Ratio (PER) =wet weight gain (g)/Amount of protein given (g). Protein productive value (PPV %) = (P2 – PI) ×100 / Protein intake (g) where: P2: Protein content in fish carcass at the end; P1: Protein content at the start. Protein energy = (energy in protein/gross energy) X 100. Energy retention efficiency ERE(EU %) = [Final body energy (Kcal) – Initial body energy (Kcal) ÷ Dietary energy consumption (Kcal)] X 100.

Table (3.5) : Nutritional Percentage: (2×3×3+3 (control) Factorial =21

Plant protein	**Date pits %+Yeast (g)**			**Total**	**N- Ex –D**
1- D-P with (group A)	25+ 3g	50+3g	75+3g	3	3
2- D-P without (group B)	25	50	75	3	3
3-Control (Non)	0	0	0	1	1
Animal Protein %	75	50	25	-	-
Total	-----	-------	--------	7	7

D-P-with-Y = Date pits with Yeast.

D-P-without- Y= Date Pits without Yeast.

N-Ex-D =Number of experiments Diet

3.1.2 Experimental Fish

Fingerlings of All-Male *Oreochromis niloticus* used in the study were Purchased from Aljwariss private farm (south Jebel Awliaa dam) at age of approximately 2 month old and average weight 0.5-2.0g (these Fish were stocked in a high densities and feeding them just to keep them life without growing till they sold) they hold them in oxygenated plastic bag. About 500 fingerlings ; after receiving they were acclimatized for about 30 minutes in the surface of the plastic tanks which filled by tap water and then those Experimental fish were kept in plastic tanks(Aquarium) in fisheries laboratory and fed on a basal diet for 18 days(from 1- 18 august) for the reasons of acclimatization period, and once the adaptation period was completed some initial sample was taken to the laboratory of the institution research center of animal resources (Soba) for the chemical analysis presented in Table 3.6 below.

Table (3.6) : Carcass Composition (% DM) of All-Male Nile tilapia (*Oreochromis niloticus*)

Type	**DM**	**Moisture**	**CP**	**EE**	**ASH**	**NFE**
Caracas	78	22	17.35	6.125	1.325	53.2
G/E (kcal/100g)	369.8825					

Nitrogen-free extract(NFE) = 100 - (moisture + crude protein + crude fat + crude fiber + ash).
Gross energy (kcal/100g), based on 5.7 kcal/g protein, 9.5 kcal/g lipid, and 4.0 kcal/g carbohydrate.
DM= Dry Matter. CP= Crude Protein. EE=Either extract. CF= Crude Fiber.

3.1.3 Experimental Design

The experimental Fish (10/Aquaria) were distributed randomly in to 21 plastic tanks (Aquarium) 36L (36×34×31 cm) according to the complete randomization (Using papers method), they filled with precipitated tap water (in hatchery), Fish were bulk weighed, and their initial weights, and total length (from the tip of the mouth till the end of the caudal fin) for random sample were recorded, with average 1.9±1.11g, 4.9± 0.77cm respectively, using Digital scale (electronic kitchen, auto zero, power 1.5v*2.AA battery, 5000g*1g/177oz*0.10z) and ruler respectively.

The fish in each aquarium were fed on the experimental diets according to the feeding regime, three time /daily (at 8.30-11.30 -3.30 o'clock) ,10 days at rations 12% of body weight for the first 20 days, and then was reduced to 8% in third 10 days and 4% in the last 10 days for 45 days. The daily feed allowance was adjusted every 10 days (sampling) after bulk weighing the fish, and also at the end of the feeding trial each fish were weight individually by using electrical balance and the total length were measured for some sample randomly, also some fish sample taken from each treatment and kept in freezer for the chemical analysis.

All plastic tanks were siphoned twice (accessories and personal hygienic Adopt, no disease appears during experiment), before feeding daily in order to prevent accumulation of fecal matter and waste, also they were brushing during the week according to the situation of the aquarium. and then cleaned, fresh water was added approximately 10% (2-3 litter/one times) to reset water volume and also they were cleaning at each sampling and filled again with completely new water. During day of sampling no feed provide for fish. All plastic tanks were provided with aerations nets using air blower, Water Quality parameters, oxygen, temperature, total ammonia, nitrites and nitrates (water sample was stored in freezer till the end of the trial), and pH were measured by using Dissolved oxygen meter (Model: DO-5509), manual thermometer, kits , Eco Tester PH1(Range 0.0-14.0, power 4*1.5"VA76" micro alkaline batteries') respectively. They were measured at each sampling.

3.2 Growth Performance Parameters

1-Weight gain(WG%) = $w_{2/W1 \times 100}$

2-Average daily gain (ADG) (g/fish day-1) = total gain / duration period(days).

3-Average daily feed intake (ADF/IN)=Total feed intake/duration period.

4-Specific growth rate (SGR) % day-1) = 100 × (Ln W2 - Ln WI)/n.

Where: Ln: Natural logarithms, n: is the duration period.

5-Relative weight gain (RWG %) = Weight Gain / initial weight ×100.

6-Survival Rate(%)=100× (Final Number of Fish/Initial Number of Fish)

7- condition Factor(K)=$100 \times W/L^3$.

Where : W= Weight of the Fish in Gram.

L= Total Length of Fish in Centimeter.

3.2.1 Feeds Efficiency

1-Feed conversion ratio (FCR) = dry matter intake (g) / total gain (%).

2-Protein efficiency ratio (PER) = total gain (g) / protein intake (g)

3-Protein productive value (PPV %) = (P2 – PI) ×100 / Protein intake (g)

Where: P2: Protein content in fish carcass at the end;

PI: Protein content at the start.

4-Energy Retention Efficiency ERE (EU%) = (E2–EI) ×100 / Energy intake (kcal).

Where: ET: Energy in fish carcass (kcal) at the end;

EI: Energy in fish carcass (kcal) at the start.

5-Energy retention efficiency (%) = [Final body energy (Kcal) – Initial body energy (Kcal) / Dietary energy consumption (Kcal)] X 100

3.3 Statistical Analysis

Feed ingredients, experimental feeds and carcasses were analyzed for proximate composition following AOAC standard procedures (2003).

Statistical analyses of data were analyzed by SPSS (version15) 2007(general model multivariate). Duncan's multiple range tests were used to evaluate specific differences between treatment means at (P 0.05). Excel sheet were used to describe the data in figures.

CHAPTER FOUR

RESULTS

4. 1 Growth performance

Result in Table 4.1 show that the overall mean ± SD of the final weight ,(WG%), (WG g/Fish) ,(DWG g/Fish) ,(RWG) and (SGR) of All-Male Nile tilapia(Oreochromis niloticus) fed on diets with partially replaced by palm date pits with and without yeast increased significantly ($p<0.05$) with increasing of date palm pits percentages (with yeast) in T1 and T2 , And also increase significantly ($p<0.05$) with increasing of date palm pits replacement in T4(without yeast). However, the highest values of final weight (36.15±5.22) ,WG% (193.60±25.26) ,WG(g/Fish) (17.48±4.2), DWG(g) (0.39±0.11), RWG% (93.60±25.26) and SGR % (1.45± 0.30) were obtained by fish fed T2 , and the highest values of final body weight(g) (34.76± 6.52), PWG % (181.42±22.76), PWG(g) (15.76± 4.86) , DWG(g) (0.35± 0.13), RWG%(81.42± 22.76) and SGR(1.31 ± 0.29) were obtained by fish fed T4.

Table 4.1: Growth Performance of All-Male Nile tilapia (Oreochromis niloticus) Fingerlings Fed the Experimental Diets (g/Fish)

Items	Treatments							
	Non	With			Without			Sig
	T0(0.0%)	T1(25%)	T2(50%)	T3(75%)	T4(25%)	T5(50%)	T6(75%)	
Initial weight	19.00±1.11							0.23
Final weight**	39.03± 1.79	33.17±2.5	36.15± 5.22	23.41± 13.42	34.76± 6.52	27.92± 13.24	18.02± 4.66	0.00
WG(%)	209.45±6.98[a]	199.12±6.82[b]	193.60±25.26[b]	122.30±85.92[e]	181.42±22.76[c]	149.70 ±68.78[d]	113. 88± 22.72[e]	0.01
WG (g/fish)	20.37±0.69a	16.51±1.43[b]	17.48± 4.20[b]	3.74± 14.37[e]	15.76± 4.86[c]	5.59± 12.91[d]	3.32± 4.09[e]	0.00
DWG (g)	0.45± 0.02a	0.37± 0.04[b]	0.39± 0.11[b]	0.08±0.38[d]	0.35± 0.13[b]	0. 25± 0.34[c]	0.07± 0.11[d]	0.22
RWG (%)	109.45± 7.07a	99.12± 6.82[b]	93.60± 25.26b	22.30± 85.92d	81.42± 22.76c	24.24± 68.78[d]	15.92±22.72e	0.01
SGR	1.64± 0.07[a]	1.53± 0.08[a]	1.45± 0.30[b]	0.24± 2.46[d]	1.31 ± 0.29[b]	0.87 ± 1.62[c]	0.28± 0.57[d]	0.05

Data are represented as mean of three samples replicates ± standard error

Means in the same row with the same letter are not significantly different (P>0.05)

4.2 **The increment weight**

Result in Table 4.2 show that the result of mean ± SD of increment weight of All-Male Nile tilapia (Oreochromis niloticus) fed the experimental diet control,T1,T2%,T3%, and T4%,T5%, T6% \days increase in control (18.76±1.28to39.03± 1.79), in diets contain palm date pits with T1(16.67± 1.28to33.17±2.5), T2(18.67± 1.74to36.15± 5.2) and T4 (19.00± 1.67to34.76± 6.52) without yeast, but these result decrease in T3 (19.67± 0.97 to 23.41± 13.42),T5 (22.33± 0.48 to27.92± 13.24) and T6(21.33± 1.74 to 18.02± 4.66) .

Table 4.2: The Increment Weight of All-Male Nile tilapia (Oreochromis. niloticus) (g/Fish) as Affected with Date Pit Incorporation in Diets/Days.

Diets	Weight of fish (g) at different times					
	0 time	11days	21days	31days	41days	Increment(g)
To(0.0%)	18.67±1.28[d]	24.00±2.21[c]	32.00±1.45[b]	39.00±3.02[a]	39.03±1.79[a]	20.36±1.95
T1(25%)	16.67±1.28[d]	24.00±0.84[c]	28.00±6.32[b]	32.67±4.61[a]	33.17±2.5[a]	16.50±3.11
T2(50%)	18.67±1.74d	24.33±0.48[c]	28.67±1.28[b]	33.67±3.95[a]	36.15±5.22[a]	17.48±2.53
T3(75%)	19.67±0.97[c]	28.33±1.74[a]	24.67±7.12[b]	22.00±12.88[b]	23.41±13.42	3.74±7.20
T4(25%)	19.00±1.67[c]	26.67±5.04[b]	29.00±5.49[b]	32,00±6.03[a]	34.67±6.52[a]	15.67±4.10
T5(50%)	22.33±0.48[c]	31.00±5.09[a]	28.33±7.21[b]	25.67±9.98[c]	27.92±13.24[b]	5.59±6.86
T6(75%)	21.33±1.74[b]	24.00±2.90[a]	21.33±5.44[b]	22.33±5.44[a]	18.02±4.66[c]	3.31±3.20

Data are represented as mean of three samples replicates ± standard error

Means in the same row with the same letter are not significant difference (P>0.05)

4.3 Specific Growth Rate (%)

Result in Table 4.3 show that the mean±SD of specific growth rate(%) of All-Male Nile tilapia (Oreochromis niloticus) fed the experimental diet control,T1,T2%,T3%, and T4%,T5%, T6% \days increase with the incorporated palm date pits none , with and without yeast in the control (2.78±19.41 to 3.61±8.10) , T1(2.80±4.35 to3.49±15.07) ,T2(2.79±13.71 to 3.16±75.52) with yeast and T4 (2.67±13.57 to 3.14±49.41) , T5 (2.67±8.59 to3.31±19.02) and T6(2.74±4.92 to3.33±51.10) without yeast, but these result decrease in T3 (2.93±18.08 to 2.90±108.75), but overall there is no significance difference (p>0.05).This mean that all-male Nile tilapia (Oreochromis niloticus) grow normally when different levels of palm date pits incorporated in the diets .

Table 4.3: Specific Growth Rate of All-Male Nile tilapia (Oreochromis. niloticus) (g/fish) as Affected with Date Pit Incorporation in Diets/Days.

Diets	Weight of fish (g) at different times			
	0 -11 days	11-21days	21-31days	31-41days
To(0.0%)	2.78±19.41	3.33±9.36	3.22±7.96	3.61±8.10
T1(25%)	2.80±4.35	3.29±9.91	3.19±19.02	3.49±15.07
T2(50%)	2.79±13.71	3.20±31.93	2.89±61.13	3.16±75.52
T3(75%)	2.93±18.08	3.00±41.32	2.50±101.40	2.90±108.75
T4(25%)	2.67±13.57	3.06±42.32	2.91±39.10	3.14±49.41
T5(50%)	2.67±8.59	3.27±17.53	3.94±19.61	3.31±19.02
T6(75%)	2.74±4.92	3.27±4.06	3.18±14.47	3.33±51.10
sig	0.29	0.64	0.57	0.79

Data are represented as mean of three samples replicates ± standard error

Means in the same row with the same letter are not significant difference (P>0.05)

4.4 The Weight of Group / Individual (g)

Result in Table 4.4 indicate that the mean ± SD of final weight \ individual (g/Fish) of All-Male Nile tilapia(Oreochromis niloticus) groups control(Non) (4.17±1.61), group A (3.82±1.57) and group B (4.03±1.76) are not significant different ($p>0.05$) and the average weight /fish during 45 days was 4.00 g.These result indicate that the nutritive value of date pit and their hormone –growth content, are more suitable for fish diet.

Table 4.4 : The Weight of All-Male Nile tilapia(Oreochromis niloticus) Group / Individual (g).

Treatment	Control (Non)	Group A (with yeast)	Group B (without east)
	4.17±1.61[a]	3.82±1.57[a]	4.03±1.76[a]
Sig	0.57		

Data are represented as mean of three samples replicates ± standard error

Means in the same row with the same letter are not significantly different ($P>0.05$)

4.5 Feed Efficiency

Results in Table 4.5 indicate that the mean ± SD of feed intake, feed efficiency, food conversion ratio, protein efficient ratio, protein productive value, condition factor(K%) and survival rate. The lower significant value of feed intake(The death fish is not lower values of the mortality rate excluded)was (84.27± 7.9 and 81.10± 10.8) was obtained by fish diet T1(give low FCR)and T6(which give high FCR) . The average values of PER increased in T0, T1,T5and T6 significantly ($p<0.05$) with increasing of palm date pit replacement .

However, the diets T1,T2 and T4 replacement with and without yeast respectively resulted in greater value of FCR (0.42± 0.06, 0.46 ± 0.06 and 0.49±0.04) and the greater value of PER (1.43,1.48 and 1.31) in T1,T2and T4 palm date pits ; T1 and T5 replacement resulted in greater value of PPV(38.65and38.59) for the palm date pit (with and without yeast) respectively. The highest ($p<0.05$)value of the K was(14.68, 13.16,12.95and 11.66) in T0,T2,T1and T4 respectively . The highest survival rate was in T0,T1,T2 and T4 .

Table 4.5 : Growth and Food Utilization Efficiency of All-Male Nile tilapia(Oreochromis niloticus) Fingerlings Fed the Experimental Diets

Item	Treatment							
	Non	With			Without			SIG
	T0(0.0%)	T1(25%)	T2(50%)	T3(75%)	T4(25%)	T5(50%)	T6(75%)	
Feed intake	92.40± 5.72[a]	84.27± 7.9[d]	88.00± 4.1[b]	89.47± 7.1[b]	90.80± 14.7[a]	96.76± 15.7[a]	81.10± 10.8[d]	0.10
FEED/EFF	0.22±0.02[a]	0.20±0.2[a]	0.20±0.0 5[a]	0.035±0.19[d]	0.17±0.34[b]	0.11 ±0.17[c]	0.04±0.60[d]	0. 02
FCR	0.44± 0.04[a]	0.42± 0.06[a]	0.46± 0.06[a]	1.48± 1.64[d]	0.49± 0.04[a]	0.65 ± 0.60[c]	0.71± 0.29[c]	0.18
P:E ratio	1.67[a]	1.43[a]	1.48a	0.35[d]	1.31[b]	0.46[c]	0.28[d]	-
PPV	39.24[a]	38.60[b]	37.29[c]	37.13[d]	37.63[c]	38.59[b]	38.52[b]	-
K(%)	14.68[a]	12.95[a]	13.16[a]	9.87[d]	11.66[b]	11.38[c]	8.86[e]	-
Surviva Rate (%)	93.33[a]	90.00[a]	86.67[b]	66.67[c]	86.67[b]	63.33[c]	50.0[d]	-

Data are represented as mean of three samples replicates ± standard error

Means in the same row with the same letter are not significantly different (P>0.05

4.6 Feeding Rate (Regime %)

Results in Table 4.6 indicate that the mean ±SD of feeding regime % for Hormone-Treated All-Male Nile tilapia(Oreochromis niloticus) fed the experimental diets /Sample decreasing of feeding intake as feed rate decrease , however the initial highest feed intake was in T5 (26.80±0.58),T6(25.60±2.09) and T3 (23.60±1.16) , Although they showed the lower percentage at the final feeding regime (10.00±4.40),(9.60±1.46) and (8.80±5.15) respectively(the differences came here due to electricity problems, losing their appetite and at the end the mortality rate increased) as compare to the rest diets T1(20.00±1.53),T2(22.40±2.09),T4(22.80±2.01)and control(22.40±1.53).

Table 4.6 : Feeding Rate (Regime %) Intake by All-Male Nile tilapia(Oreochromis niloticus) / Sample

Diets	Feed intake(%) at different sample			
	0 (12%)	1 (12%)	2(8%)	3(4%)
Control0.(00%)	22.40±1.53	28.80±2.66	25.60±1.16	15.60±1.21
T1(25%)	20.00±1.53	28.80±1.00	22.40±5.05	13.07±1.84
T2(50%)	22.40±2.09	29.20±0.58	22.93±1.02	13.47±1.58
T3(75%)	23.60±1.16	34.00±2.09	23.07±2.68	8.80±5.15
T4(25%)	22.80±2.01	32.00±6.05	23.20±4.39	12.80±2.41
T5(50%)	26.80±0.58	37.20±6.11	22.67±5.77	10.00±4.40
T6(75%)	25.60±2.09	28.80±3.34	17.07±4.35	9.60±1.46

Data are represented as mean of three samples replicates ± standard error

Means in the same row with the same letter are not significantly different ($P>0.05$)

4.7 Body Composition

The mean± SD of the chemical composition of the whole fish body as affected by partial replacement at the end of the experimental period are illustrated in table 4.7. In all groups including date pits in the diets, fish body dry matter and protein content was improved as compare with control diet which has high protein and lower dry matter. Except fish fed diet containing 50% date pits replacement which are lower body dry matter. Fish fed diet containing 25% and 50% date pits replacement with and without yeast showed the highest significant ($P<0.05$) in protein body content (31.15 and 31.35) respectively. The lowest significant ($P<0.05$) fat (6.40 And 6.55) showed in 75%replacement with and without yeast, and the lowest gross energy body content (376.47 and 377.825) Observed in 50% and 75% replacement in diets with yeast . the higher value of ash body contents in the dry matter (2.40and 2.20)was observed in fish fed diet containing 25% and 75% date pits replacement with yeast.

Table 4.7: The End Carcass Composition (% DM) of All-Male Nile tilapia(Oreochromis niloticus) Fed Experimental Diet.

NO	D.M	Moisture	C.P	E.E	ASH	NFE	G.E/kcal/100g
T0(0%)	73.5	26.5	31.81	6.85	2.15	32.695	377.144
T1(25%)	75.0	25.0	31.15	6.70	2.40	34.75	380.205
T2(50%)	74.0	26.0	30.60	6.70	2.10	34.6	376.47
T3(75%)	75.0	25.0	30.25	6.40	2.20	36.15	377.825
T4(25%)	76.0	24.0	30.90	6.75	2.15	36.25	385.255
T5(50%)	77.0	23.0	31.35	6.75	2.10	36.8	390.02
T6(75%)	74.5	25.5	31.05	6.55	2.05	34.85	378.61

4.8 The Water Quality

The mean±SD values of water quality parameters measured in the rearing plastic tanks (aquarium) are summarized in Table 4.8 The average water temperature was (27.55 oC ± 0.82). This temperature has been reported as the optimum range for tilapia growth and yield (Meske, 1985).The average dissolved oxygen was(5.81ppm± 2.21) Siddiqui et al.(1989) stated that tilapia has a low oxygen demand and can survive at low oxygen levels. Riche and Garling (2003) reported that dissolved oxygen levels should be maintained above 5.0 ppm for best growth. The pH of water affects many water quality parameters and the rates of many biological and chemical processes. Thus, pH is considered important parameters to be monitored and controlled in aquaculture system (Losordo et al., 1998).

In the present study, the average value of pH was (7.64 ±0.36) Pompa and Masser (1999) reported that tilapia can survive at pH ranging from 5 to 10 but they do best at a pH range from 6 to 9. Ammonia and Nitrite are a concern in aquaculture systems and should be monitored regularly. Ammonia production is directly related to feeding and depends on the quality of feed, feeding rate, fish size and temperature (Riche and Garling, 2003). In the present study, ammonia (NH_3) was 0.33±0.43 (optimum0.2ppm), nitrites (NO_2) was 0.24±1.24 (optimum0.3mg/l) and nitrate (NO_3) was(0.99±1.34) (optimum 200-300ppm) concentrations in the rearing tanks are highly significance ($p<0.05$)were not within the safe range for tilapia culture. Growth performance parameters for tilapia fingerlings after the feeding trial are presented in Table 4.1. It is evident that there is a significant effect on tested diets on growth performance of the experimental fish.

Table 4.8 : Show the Water Quality Parameter During the Experiment.

Trt	**T0 0.00%**	**T1 25%**	**T2 50%**	**T3 75%**	**T4 25%**	**T5 50%**	**T6 75%**	**Sig**
Temp	27.58±0.9	27.75±1.0	27.42±0.7	27.58± 0.9	27.5 ±1.0	27.50±0.8	27.50±0.5	0.98
O2	5.41±2.3	5.80±2.1	5.80±2.1	5.60±2.5	5.74±2.5	5.90±2.2	6.40±1.9	0.96
PH	7.60±0.5	7.74±0.4	7.65±0.3	7.64±0.3	7.50±0.4	7.60±0.3	7.73±0.4	0.63
NH3*	0.79±0.9	0.38±0.5	0.15±0.2	0.13±0.1	0.44±0.8	0.27±0.4	0.13±0.2	0.03
NO2	0.00±0.0	0.00±0.0	0.86±1.9	0.42±1.4	0.00±0.0	0.00±0.0	0.42±1.4	0.32
NO3**	0.08±0.3	1.83±2.4	2.50±2.6	2.08±2.6	0.00±0.0	0.42±1.4	0.03±0.1	0.00

Data are represented as mean of three samples replicates ± standard error

Means in the same row with the same letter are not significantly different (P>0.05)

4.9 Length During Experiment

Results in Table 4.9 indicate that mean ±SD of the initial length (cm) and final length (cm) of All-Male Nile tilapia(Oreochromis niloticus) fed control, 25%, 50%, 75%, 25%, 50% and 75% diets there is no significance differences (P>0.05).

Table 4.9 : Length of All–Male Nile tilapia(Oreochromis niloticus) During the Experiment.

Item	T0 0.00%	T1 25%	T2 250%	T3 75%	T4 25%	T5 50%	T6 75%	Sig
IL(cm)	5.03±0.6[a]	4.23±0.4[a]	5.60±0.8[a]	5.20±0.6[a]	5.50±1.6[a]	5.47±0.2[a]	5.20±1. 2[a]	0.59
FL(cm)	6.43±0.3[a]	6.35±0.2[a]	6.50±0.2[a]	6.19±0.1[a]	6.68±0.3[a]	6.26±1.3[a]	5.88±0.2[a]	0.98

Data are represented as mean of three samples replicates ± standard error

Means in the same row with the same letter are not significantly different (P>0.05)

IL=intial length , FL=final length.

4.10 The Economic Evaluation

Results in Table 4.10 indicate that the Prices of experimental diets based on feed ingredients in the local market during the experiment, the diet ingredients, price(Sudanese Currency/kilo gram) ,treatments, food conversion ratio and the total price(Sudanese Currency/kilo gram) , the lower significance price (p<0.05) was (3.38 ,3.70 and 3.95) showed in the 25% , 50% date pits replacement with yeast and 25% without yeast respectively. The highest price was (11.91 and 5.72) in 75% date pits replacement (with and without yeast) respectively; as compare to the control which was (3.54) there is not significantly difference (p>0.05).This result indicate that the incorporation of date pits 25%, 50% and 25% as mentioned above as the partial replacement of fish meal give better economical efficiency results as well as better growth performance and nutrient utilization, this agree with so many works. Mabrouk et al (2011)concluded that wet cull date may be cost-effective when partially replaces yellow corn in tilapia diets as energy source, and improves fish performances when supplements with 0.03 % Digestion. Khadr, (2006), reported that tilapia fed diet containing 75% date stone meal showed the nearly economical results in comparison with control, in this result was 25%, 50% and 25% mentioned above.

Table 4. 10: The Economic Evaluation of the Experimental Diets/Sudanese Currency

Item	Price SDG/kg	Treatments	FCR	Total price \SDG
Fish meal	4.00	T0(0.00%)	0.44	3.54
Date-pits	2.000	T1(25%)	0.42	3.38
Groundnut cake	5.000	T2(50%)	0.46	3.70
Wheat bran	4.000	T3(75%)	1.48	11.91
Wheat bran	6.000	T4(25%)	0.49	3.95
Starch	5.000	T5(50%)	0.65	5.23
Mineral Mix	35.000	T6(75%)	0.71	5.72
Vegetable Oil	18.000			
Yeas	1.500			
Total	80.500			

*The price of date pits according to the price of rejected dates.

CHAPTER FIVE

DISCUSSION

The present study demonstrated the potential of palm date pits for inclusion in commercial All–Male Nile tilapia (Oreochromis niloticus) feeds as fish meal, as well as being of importance for feed production in Sudan. There is little information in the scientific literature concerning the use of it in Nile tilapia feeds, particularly as the level of research and the feeds produced under commercial conditions. most tilapia utilize starch efficiently from 22 to 46% dietary starch while 22% considered as optimum level for juvenile tilapia (Wang et al., 2005). There is considerable benefit related to the partial replacement of the fish meal currently used in feeds. A significant amount of research has been con-ducted on the replacement of Fish meal with plant meal as the protein source in feeds for Nile tilapia (Temesgen , 2004; Shalaby, 2004; Sasmal et al., 2005; Johnson and Banerji, 2007; Ebrahim et al., 2007; Abd el Hakim et al ., 2008; Tartiel et al., 2008; Khan et al., 2013; Labib et al.,2015) .

Gohl (1975) stated that Local Palm Kernel Meal (LPKM) used in Indonesia and Malaysia contains 20 to 25 % crude protein. In the present study, however, analysis of palm date pits indicated that it contains only 6.27% crude protein ; but it significantly affect in the experimental diets (T1,T2,T3,T4,T5 and T6 Table 3.4) and in the growth performance of All–Male Nile tilapia (Oreochromis niloticus) when incorporated in different levels . This suggests that the presence of growth hormone ; steroid compounds , notably estrogen, progesterone and ostriol, which has been known since the 1950s (Barreveld, 1993) would provide fishes with the a substantial amount of growth rates .

Assem et al ,(2014) report that the use of Five isoenergetics–isonitrogenous diets containing 0, 0.5, 1.0, 1.5 and 2.0 g/100 g of fungi Trichoderma reesei-degraded date pits (FDDP) of Nile tilapia Oreochromis niloticus diets as replacement of α-cellelose the Oestradiol increase linearly with FDDP content in diets, which indicates that a FDDP may has phytoestrogenic roll.

The present study clearly demonstrated that as much as 25% ,50% (33.17±2.5 and 36.15± 5.22) and 25%(34.76± 6.52),($p<0.05$) of the Fish meal protein Table 4.1 could be replaced by palm date pits with and without yeast respectively; without reducing the growth rates of All-Male Nile tilapia Oreochromis niloticus, but Further increase in dietary date fiber to 300 g kg-1 resulted in significant retardation in all parameters Belal et al (2015).

This result is in agreement with Omoregie and Ogbemudie,(1993) they report that the replacement of 15% palm kernel /25%fish meal (28.56% dietary crude protein and 13.49% dietary crude fiber), give the best growth and food utilization inversely to the 30%palm kernel 10%fish meals (27.86% dietary crude protein and 18.99% dietary crude fiber) ; this might be due to the high crude fiber , fish age ,size ,environment and low crude protein level . also similar result obtained In Saudi Arabia by Al Amoudi et al., (2001), was tested local Palm Kernel Meal (LPKM) as a partial or a total replacement of fish meal on tilapia (Oreochromis spillurm) they found that the replacement from zero to 32.5 palm kernel increase the weight of Nile tilapia , while 100% replacement give lower weight.

Recent study using Four iso-nitogenous isocaloric diets containing 0, 100, 200 and 300 g kg^{-1} date fiber as replacement of wheat bran, They were fed to O. niloticus fingerlings (0.65 g). Gaber et al., (2014) revealed that the mean final weight (g/fish), SGR (%/day), feed conversion ratio, PPV and PER, were significantly ($p \leq 0.05$) affected by the levels of wet date and level of digestragrom and the best diet achieved by the level 30% wet date and 0.03 ; similar to the present result Table 4.3 and 4.5; digesragrom. Also Yosif, (2012) reported that using of Dehydrated Entromorpha, Prosopis cineraria pods and date pits meals, as substitution of the wheat flour at 0, 10, 20 and 30%. Diets supplemented with date pits achieved the best ($P<0.05$) survival rate. The carcass protein contents were similar for all treatments. Inversely to the all above result that mentioned by Mabrouk et al (2011),he said that using of two forms of palm cull date and date pits as energy sources, supplemented with feed additives (Phytogenics), to be partially replaced (13.5%) yellow corn (YC),(iso-nitogenous (30.43% crude protein), isocaloric (436.43 kcal GE 100g-1)) in feeding Nile tilapia fingerlings, increased the fish specific growth rate and feed utilization. However, replacement either dry cull date or date pit decreased tilapia performances; meanwhile date pits recorded the worst values this is inverse to the result of the present study Table 4.1 and 4.5 ; this is me be due to the high Fiber content Table 3.1; and is usually indigestible to most cichlids mainly because they do not possess the required enzymes for fiber digestion and the flow of natural food from the stomach is low and fast. Subsequently. but Increased meal frequency provided better carbohydrate utilization for hybrid tilapia (Tung and Shiau, 1991). Image period also influences the growth of tilapia and El-Saidy and Kawanna (2004) stimulated the growth of tilapia growth by using longer Image period.

Osman et al (2001) report that the utilization of acid treated date pits as carbohydrate source for tilapia fingerlings (Oreochromis niloticus) the replacement by 50% (15% of the total diet) and 100% (30% of the total diet) for treated and untreated date pits, respectively. Growth performance, feed conversion ratio and protein productive value were significantly ($P<0.05$) higher in fish fed 50% treated date pits .

Khadr, (2006), found that the use of date stone meal (DSM) as unusual energy source instead of yellow corn in Male of Nile tilapia diets at level 0, 25, and 75% respectively. The diet containing 75% date stone meal exhibited better growth performance as unusual energy source. The best dressing percentage was recorded with diet containing 75% date stone meal as compared with other.

The mean ±SD feed intake and feeding regime% values Table 4.5 was taken with death fish tend to be higher in fish fed diets control and T5 (5o%

date pits without yeas) Fish food consumption might be influenced by many environmental factors such as water temperature, food concentration, stocking density, fish size and fish behavior (Houlihan et al. 2001). Khadr, (2006), showed that cumulative feed consumption was affected by feeding date stone meal. The diet containing 75% date stone meal exhibited better growth performance as unusual energy source, inversely to the present result may be due to the different purpose of the inclusions.

The worst value of FCR was T3 and T6 Table 4.5. Al Amoudi et al., (2001) reported that the best food conversion rate (FCR) was noticed with fish fed on control (1.73). While the best FCR (0.42) was 25% with yeast .

The condition factor(K) has been used as an indicator of health in fishing biology studies , such as growth and feeding intensity, it provides information on the variation of fish physiological status and may be used for comparing populations living on certain feeding . Ighwella et al (2011) reported that using of different maltose diet levels(0.0, 20%,25%, 30% and 35%) fed to fingerlings of Nile tilapia (Oreochromis niloticus) give better values of k in all treatment 1.64, 1.77, 1.72 and 1.79 as compared to the present result there is lower significant difference And the mean±SD highest values ($p \leq 0.05$) of factor (k) Table 4.5 was in T0 (control) ,T2 and T4, but all treatment are in good health.

On the other hand, digestgarom supplementation improved fish performances either fed wet cull date-based diets or control diets (YC) Mabrouk et al (2011) it is in agreement with my result when using yeast additives.

Carcass analysis significantly showed ($P<0.05$) lower crude protein content In fish receiving treated date pits compared to the groups receiving untreated Date pits Osman et al (2001) .in the present result the initial carcass analysis was (17.35) Table 3.6 , as compare to the final analysis there is significant difference ($p< 0.05$) . The highest value of ash ($p<0.05$) was 50%

date pit replacement with yeast Table 4.7 , different from Yousif, (2012) who reported that the ash content was higher ($P<0.05$) in the groups fed the control diet . Dry matter and ash content in acid treated date pits were not affected Osman et al (2001). The moisture content was inversely related to fat content, irrespective of treatments Yosif, (2012) , the highest value of moisture was 50% date pit replacement (without yeast) ,while the highest value of fat was 50% date pit replacement (with yeast).

The mean values of water quality parameters measured in the rearing plastic tanks(aquarium) during the trial are summarized in Table 4.8 The average water temperature was (27.55 ^{0}C ± 0.82). This temperature has been

The average dissolved oxygen was(5.81ppm± 2.21) Siddiqui et al.(1989) stated that tilapia has a low oxygen demand and can survive at low oxygen levels. Riche and Garling (2003) reported that dissolved oxygen levels should be maintained above 5.0 ppm for best growth.

The pH of water affects many water quality parameters and the rates of many biological and chemical processes.

In the present study the average value of pH was (7.64 ±0.36) they are in optimum rage of Nile tilapia culture. Pompa and Masser (1999) reported that tilapia can survive at pH ranging from 5 to 10 but they do best at a pH range from 6 to 9. Ammonia and Nitrite are a concern in aquaculture systems and should be monitored regularly. Ammonia production is directly related to feeding and depends on the quality of feed, feeding rate, fish size and temperature (Riche and Garling, 2003). In the present study, ammonia (NH_3) was(0.33±0.43) , nitrites (NO_2) was(0.24±1.24) and nitrate (NO_3) was(0.99±1.34) concentrations in the rearing tanks are highly significant ($p<0.05$) were not within the safe range for tilapia culture for this reasons some treatments showed poor growth performance, decreased the survival rate Table 4.5 . Growth performance parameters for tilapia fingerlings after the feeding trial are presented in Table 4.1; It is evident that there is a significant effect of test diets on growth performance of the experimental fish.

The economic evaluation Table 4.10 indicates that, the lower significant price ($p<0.05$) was (3.38, 3.70 and 3.95) showed in the T1(25%), T2 (50% 0 date pits replacement with yeast and T4 (25%) without yeast respectively. This agrees with so many works. Mabrouk et al (2011)concluded that wet cull date may be cost-effective when partially replaces yellow corn in tilapia diets as energy source, and improves fish performances when supplements with 0.03 % Digestion. Khadr, (2006), reported that tilapia fed diet containing 75% date stone meal showed economical results in comparing with control.

CHAPTER SIX

6.1 Conclusion

The considerable variations in the results recorded previously for optimum dietary protein requirements for maximum growth might be due to variations in fish genetic, size , age, stocking density, raw material, protein quality, hygiene and environmental conditions or other unknown factors, which mask the standardization of the parameters (Ahmad *et al*., 2004).we concluded that the inclusion of 25%, 50% and 25% date pits (Phoenix dactylifera) replacement with and without yeast respectively is a good plant protein source, which could be partially replacing fish meal in All- Male Nile tilapia Oreochromis niloticus for its positive effects in growth performance , feed utilization and economically reducing the feed cost ; At the same time, it could be inferred from the present study generally, that bakery- yeast would serve as a good feed additive in All- Male Nile tilapia feeds.

6.2 Recommendation

1. Further experiment needed to continuous this study to examine the digestibility, vitamins, mineral , microbial, hematology for All-Male Nile tilapia(Oreochromis niloticus).
2. Treatments the non hormone -growth date pits with hexane a diethyl ether, germination or fermentation ….ect ; to enhance the nutritive values and reduce the side effects of hormone .
3. The availability of special feed processing for milling the hard palm date pits (to avoided mixing with other ingredient in market mills).
4. Examine palm date pit for Nile tilapia and other culture species.
5. Application of the experiment in different aquaculture systems(e.g. Earth pond , concrete ….etc) .
6. Application of the experiment in the present of the different fertilizations.
7. The availability of water analyses Kits to mentoring and analyze the parameters during the experiment e.g. ammonia (NH_3) which had the most lethal effect in fish aquaculture system.
8. More research needed to examine good plant resources as fish meal replacement from local material (do not compete with human food) and focusing in the byproduct resources.
9. The researchers should do the proximate analysis by themselves(to increase the accuracy of the result) .

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Appendixes

Fig 4.1 : Growth and Food Utilization Efficiency of All-Male Nile tilapia(Oreochromis niloticus) Fingerlings Fed the Experimental Diets

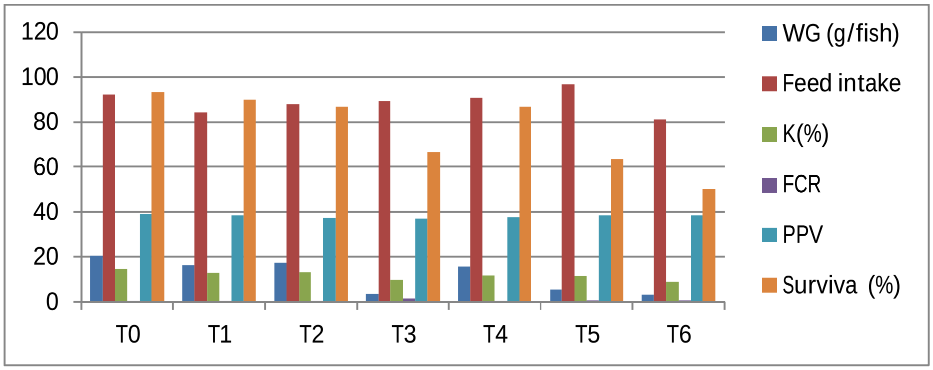


Fig 4.2 : Food Utilization Efficiency of All-Male Nile tilapia(Oreochromis niloticus) Fingerlings Fed the Experimental diets

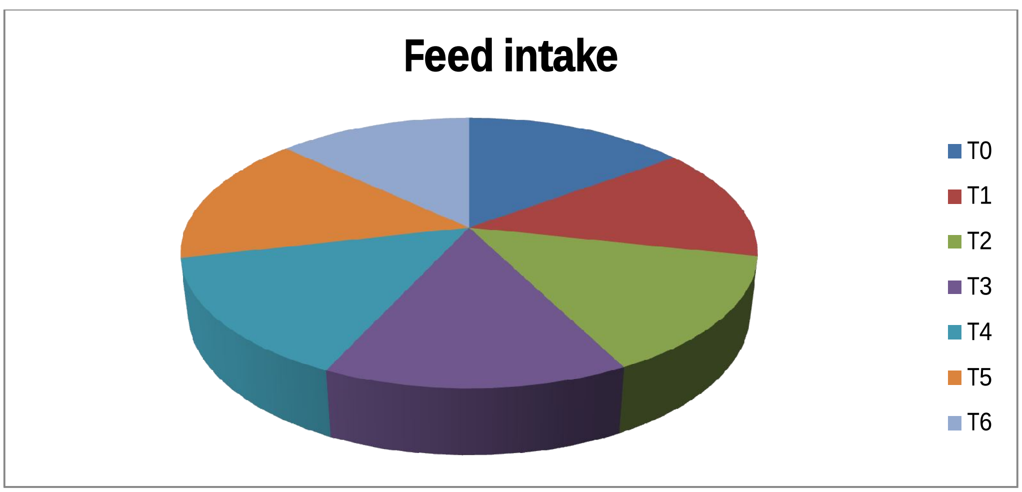


Fig 4.3 : Growth and Food Utilization Efficiency of All-Male Nile tilapia(Oreochromis niloticus) Fingerlings Fed the Experimental Diets

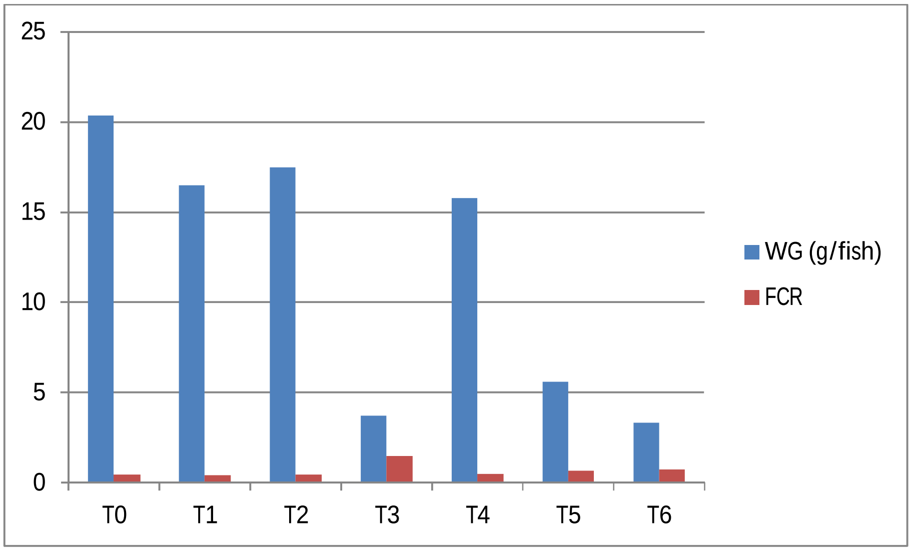


Fig 4.4 : Specific Growth Rate of All-Male Nile tilapia (Oreochromis. niloticus) (g/fish) as Affected with Date Pit Incorporation in Diets/Days

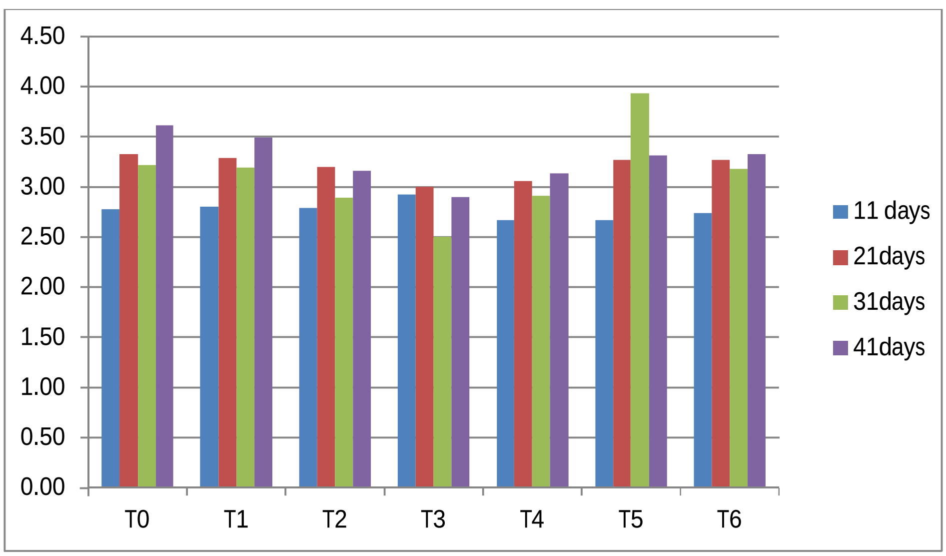


Fig 4.5 : The End Carcass Composition (% DM) of All-Male Nile tilapia(Oreochromis niloticus) Fed Experimental Diet

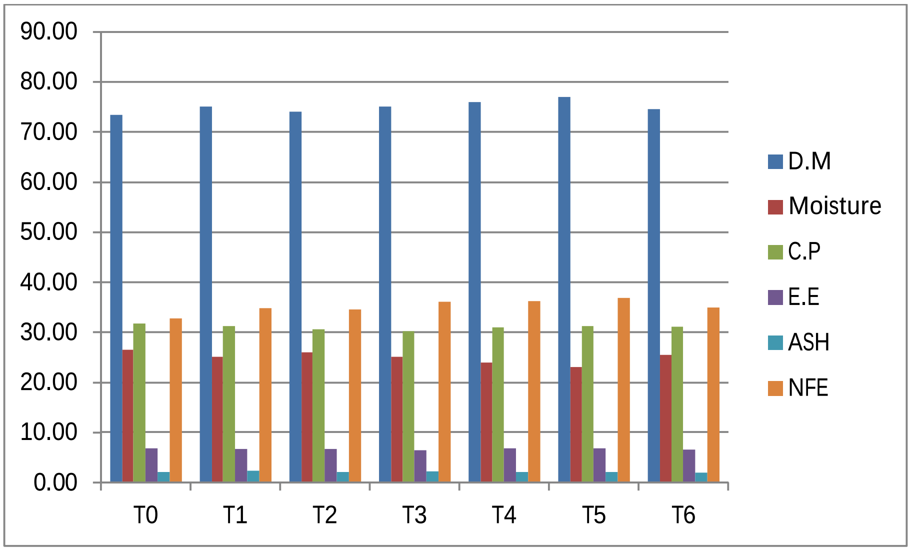


Fig 4.6 : The Water Quality Parameter During the Experiment.

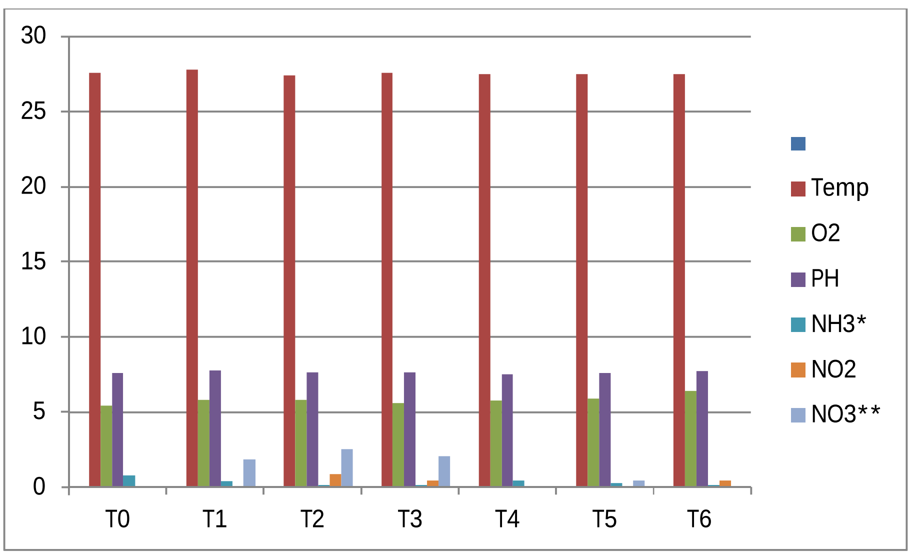


Fig 4.7 : Length of All–Male Nile tilapia(Oreochromis niloticus) During the Experiment.

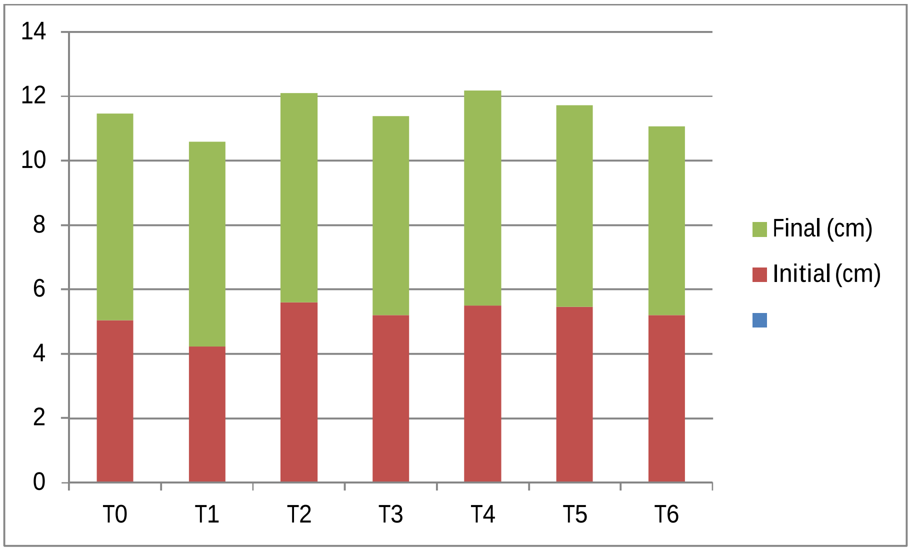
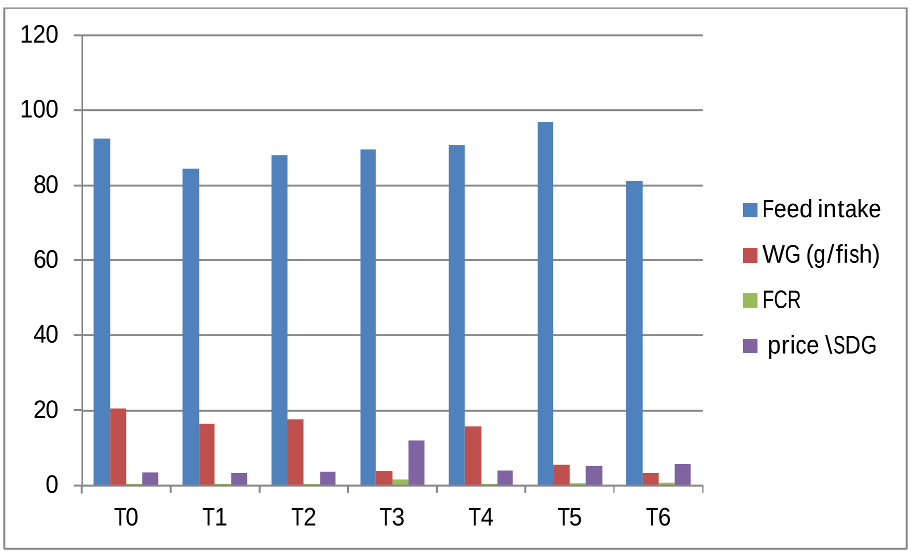


Fig 4.8 : The Economic Evaluation of the Experimental Diets/Sudanese Currency



-(B) Images

Image 3.1: Palme Date (Meshrig Wad Lagai)

Image 3.2 : Date Pits

Image 3.3: The Experimental Diets (Control and Group A)

Image 3.4: The Experimental Diets Group(B)

Image 3.5: The Water Quality Kits, Instruments (O2,PH meter) and Balances Used During the Experiment.

Image 3.6: Transporting of All-Male Nile tilapia(Aljoaris Farm)

Image3.7: The Experimental Plastic Tanks (Aquarium).

Before After

Image 3.8: The All- Male Nile tilapia (Oreochromis niloticus) Before and After the Experiments.