Sudan University of Science and Technology
College of Animal Production Science and Technology

Department of Fisheries and Wildlife Science

Effect of adding different level of LIPIDOL on growth performance and chemical composition of adult *oreochromis niloticus*

اثر اضافة مستويات مختلفه من اللبيدول علي مستوي النمو والتركيب الكيميائي لاسماك البلطي النيلي البالغه

A Thesis Submitted in Partial Fulfillment of the Requirement of the B.Sc. Degree in Fisheries and Wildlife Science (Honor)

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Dedication

To our mother and father whom helped and motivate us

To our lovely brothers , sisters, friends, and all people We grateful for all that

With our love.

Acknowledgment

All our greatest thank first to Allah, the most merciful who gave us the health strength and patience to conduct this study .Grateful thanks to our supervisor; Ustaz. Fouzi Ali Mohammed College of Science and Technology of Animal Production Department of Fisheries and Wildlife Science for his guidance and provision of scientific knowledge. Finally our thanks to all people whom helped us to finish these research.

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Abstract

The methodology was conduct at the fish hatchery at Department of Fisheries Science and Wildlife, College of Animal Production Science and Technology, Sudan University of Science and Technology for a period of 45 days from (17/ January/2017 to 24/ February/2017).The aim of this study was to determine the effect of different level of LIPIDOL on growth performance and chemical composition of adult Nile tilapia (*O. niloticus*). Fourteen adults Nile tilapia average weight **255**g.The experiment contained four treatment (control C $_0$%LIPIDOL, D1 10%LIPIDOL, D2 25%LIPIDOL and D3 40%LIPIDOL).Fish was distributed randomly in four ponds 10 fish / pond. Fish were fed 10% of body weight daily twice (11 am and 4 pm).Fish were weighed and measured every 7 days. Results were expressed as means ± standard deviation (SD). Data were statistically analyzed using ANOVA one-way analysis of variance. Comparisons among means was made by (LSD) when significant F- values were observed ($P < 0.05$), using SPSS version (21). The growth performance analysis of daily weight gain and fillet yield data using the ANOVA one way indicated that daily weight gain and fillet yield increased up to 1% and 2.5% and 4% g of Lipidol /kg, respectively Also the results obtained from the present study showed significance difference in chemical composition of fish between all treatments. Furthermore water quality parameters measured during this study showed significance difference at the level ($P<0.05$) between the four treatments.

Keywords: *lipidol,diets,growth performance, O.niloyicus.*

الخلاصة

اجريت التجربة الحاليه بمفرخ الأسماك قسم علوم الاسماك والحياة البرية, كلية علوم وتكنولوجيا الإنتاج الحيواني ,جامعة السودان للعلوم والتكنولوجيا لمدة خمس واربعون يوما في الفتره من (17 / يناير / 2017 إلى 24 فبراير 2017) . الهدف من هذه الدراسة تحديد تأثير مستويات مختلفه من الليبيدول في مستوي النمو والتركيب الكيميائي لاسماك البلطي النيلي البالغه (*O.* .*niloticu*). أربعة عشر عينه من البلطي النيلي متوسط وزنها 255 جرام. احتوت التجربة على اربعة معاملات (ليبيدول C 0٪ و D1 10٪ ليبيدول و D2 25٪ ليبيدول و D3 40٪ ليبيدول) وتم توزيع الاسماك عشوائيا في اربعة احواض اسمنتيه بمعدل عشره اسماك لكل حوض. تم تغذية الأسماك بنسبة 10٪ من وزن الجسم مرتين يوميا (11 صباحا و4 مساء)، وتم وزن الأسماك وقياسها كل 7 أيام. البيانات المتحصل عليها تم تحليلها احصائيا بواسطة تحليل التباين والنتائج تم عرضها في جداول واشكال عن طريق المتوسط والانحراف المعياري عند مستوي معنوية ($p \leq 0.05$). وأظهرت النتائج تحسن في مستوي النمو .أيضا النتائج التي تم الحصول عليها أظهرت وجود فرق معنوي في التركيب الكيميائي للأسماك بين جميع المعاملات. كما أظهرت مقاييس جودة المياه التي تم قياسها خلال هذه الدراسة فرق معنوي عند مستوى ($P<0.05$) بين المعاملات الأربعة.

كلمات البحث: ليبيدول، الغذاء، وأداء النمو،البلطي النيلي.

CHAPTER ONE

INTRODACTION

1.1 Background

Aquaculture is the farming of freshwater and saltwater organisms as finfish, mollusks, crustaceans and aquatic plants. It is also known as aqua farming. Aquaculture involves cultivating aquatic populations under controlled conditions, and can be contrasted with commercial fishing, which is the harvesting of wild fish. Commercial aquaculture supplies one half of the fish and shellfish that is directly consumed by humans (**FAO, 2009**).

Aquaculture was heralded as the perfect protein production technique for developing countries during the 1960s and 1970s. Aid organizations promoted aquaculture as a means of improving food security with low grain to feed conversion rates, and minimal environmental impacts (**Canonico *et al*. 2005**).

Nile tilapias have been farmed for centuries. Depictions on an Egyptian tomb (dated at 4000 years) display the fish in ornamental ponds. The culture of the tilapia genus on a global scale, primarily Oreochromis mossambicus, began in the 1940s. However, it was not until the 1960s that O. niloticus was exported worldwide (**FAO, 2012**).

Worldwide harvest of farmed tilapia has now surpassed 800,000 metric tons, and tilapias are second only to carps as the most widely farmed freshwater fish in the world. The Nile tilapia (*O. niloticus*) one of the first fish was species cultured. Illustrations from Egyptian tombs suggest that Nile tilapia were cultured more than 3,000 years ago, Tilapia have been called saint Peters fish in reference to biblical passages about the fish fed to the multitudes. The Nile tilapia is still the most widely cultured species of tilapia in Africa (**Thomas Popma and Michael Masser1999**).

Fish farming business also needs knowledge and techniques for its successful execution and harvest. The business potentiality alone can result in successful harvest if the farmer has limited technical skills (**Mkoka, 2007**).

1.2 study problem

Feed is one of the primary factors influencing cost efficiency of their farming operation (**Gonzalez-Rodriguez and Abdo de la Parra, 2004**)

1.3 Justification

Lipidol is a porotin

Objectives:

1. To determine the effect of different level of lipidol on growth performance of adult Nile tilapia (*O. niloticus*).
2. To determine the effect of different level of (lipidol) in chemical composition of adult Nile tilapia (O. niloticus).
3. To determine some water quality parameters of different ponds treatments.

CHAPTER TOW
LITERATURE REVIEW

2.1 Aquaculture:

Global aquaculture production has been steadily increasing over the last decade. The global production of farmed fish and shellfish (**according to FAO categorization**) increased from 10.64 million metric tonnes (mt) in 1987 to 26.83 million mt in 1996, indicating an increase of 148%. The corresponding increase in value was 110%, from 16.38 billion to US $ 41.55 billion. The boom in aquaculture production is reflected in the production figures for India as well which shows an increase from 0.78 million mt in 1987 to 1.77 million mt in 1996 (126%), and the corresponding value increase was from 0.83 billion to US $ 1.98 billion (139%). This estimate by FAO might appear conservative when, according to Marine Products Export Development Authority of India (MPEDA), the export earnings from shrimp alone exceeded one billion dollars consecutively for the last four years. Asian countries claim the lion's share (91%) of global aquaculture production, adopting a spectrum of different culture systems and intensities, from the traditional to the most modern, with other continents trailing behind, some excelling however in production of certain categories of fishes (diadromous fishes), such as salmonids. In 2004, the total world production of fisheries was 140.5 million tonnes of which aquaculture contributed 45.5 million tonnes or about 32% of the total world production. The growth rate of worldwide aquaculture has been sustained and rapid, averaging about 8 percent per annum for over thirty years, while the take from wild fisheries has been essentially flat for the last decade.

As defined by the United Nations Food and Agriculture Organization (FAO), aquaculture is the "farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Farming implies some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators; etc.Farming also implies individual or corporate ownership of the stock being cultivated...” Aquaculture is fastest growing sector of the world food economy, increasing by more than 10% per year and currently accounts for more than 30% of all fish consumed. While the world community has only recently viewed aquaculture as a potential solution to the dilemma of depleted oceans, it is by no means a new practice. In fact, the advent of aquaculture dates back millennia, though its exact origins are unknown. It most likely grew out of necessity –foraging and hunting were not sufficient to provide stable source of food to local communities. While there are many parallels to agriculture, the development of aquaculture has progressed more slowly than terrestrial farming because of the unfamiliar nature of the ocean terrain and characteristics of aquatic organisms.55A large proportion of organisms that humans rely on for protein and sustenance come from the sea. Currently, approximately 16 percent of animal protein consumed by the world’s population is derived from fish, and over one billion people worldwide depend on fish as their main source of animal protein.

Worldwide consumption of fish as food has risen from 40 million tons in 1970 to 86 million tons in 1998.Once thought of as an abundant, inexhaustible resource, the world ocean faces a significant loss of essential diversity. This loss is occurring at an alarmingly rapid rate, due to the combined effects of overfishing, habitat destruction, pollution, and profound ecological and biotic change caused by global warming as well as the human-mediated transfer of marine organisms. According to the FAO “About 47 percent of them tailstocks or species groups are fully exploited and are therefore producing catches that have reached, or are very close to, their maximum sustainable limits. Clearly, additional means of producing fish must be developed in order to maintain a sufficient supply of food for an ever-growing population. Aquaculture offers one way to supplement the production of wild capture fisheries and it will continue to increase in importance as demand increases in the future. It was not until after World War II that aquaculture gained much attention as a potentially large-scale industry. A shift in economic conditions in developed nations of the world led to an increase in the demand for fish such as salmon, shrimp, eels, and sea basses, all of which can be produced profitably through aquaculture.9In the 1960's, aquaculture became significant commercial practice in Asia where it had mainly been used as a small-scale means of local community food production for thousands of years.10In the last few decades, worldwide aquaculture production has increased significantly. In 1970 aquaculture oprations composed 3.9 percent of all fish production, compared to 27.3 percent in2000. Worldwide, total fish production from aquaculture operations has increased steadily at a rate of9.2 percent per year.11But; aquaculture has not yet become the large-scale global food replacement for the numerous food-poor areas of the world, as many thought it would be. (ref)

2.2 Tilapia

2.2.1Taxonomy of Nile tilapia

Species: Oreochromis niloticus (Linnaeus 1758)

Family: Cichlidae

Order: Perciformes

Class: Actinopterygii

The Nile tilapia Oreochromis niloticus is a deep-bodied fish with cycloid scales. Silver in colour with olive/grey/black body bars, the Nile tilapia often flushes red during the breeding season (Picker & Griffiths 2011) . It grows to a maximum length of 62 cm, weighing 3.65 kg (at an estimated 9 years of age) (FAO 2012). The average size (total length) of O. niloticus is 20 cm (Bwanika et al. 2004).

2.2.2Natural distribution and habitat

O. niloticus is native to central and North Africa and the Middle East (Boyd 2004). It is a tropical freshwater and estuarine species. It prefers shallow, still waters on the edge of lakes and wide rivers with sufficient vegetation (Picker & Griffiths 2011).

2.2.3Environmental tolerance ranges

The Nile tilapia will reportedly thrive in any aquatic habitat except for torrential river systems and the major factors limiting its distribution are salinity and temperature (Shipton et al. 2008). The survival limits for O. niloticus are reported to lie between 11 and 42°C (FAO 2012). The concentration of dissolved oxygen is not a major limiting factor for Nile tilapia, as they can tolerate levels as low as 3-4 mg/l (Boyd 2004).

2.2.4Growth

Nile tilapia can live longer than 10 years (GISD 2012). Food availability and water temperature appear to be the limiting factors to growth for O. niloticus (Kapetsky & Nath 1997). Optimal growth is achieved at 28-36°C and declines with decreasing temperature (Teichert-Coddington et al. 1997, FAO 2012). The ability to vary their diet may also result in variation in growth (Bwanika et al. 2007). In aquaculture ponds, O. niloticus can reach sexual maturity at the age of 5-6 months (FAO 2012).

2.2.5Diet and mode of feeding

Nile tilapia are known to feed on phytoplankton, periphyton, aquatic plants, invertebrates, benthic fauna, detritus, bacterial films (FAO 2012) and even other fish and fish eggs. Depending on the food source, they will feed either via suspension filtering or surface grazing (GISD 2012), trapping plankton in a plankton rich bolus using mucus excreted from their gills (Fryer & Iles 1972). O.niloticus have been observed to exhibit trophic plasticity according to the environment and the other species they coexist with (Bwanika et al. 2007).

Once a quality feed is processed, stabilized and packaged it is of little value if it is not properly applied. Proper application of feeds in not an easy task and it goes hand in hand with proper stocking procedures, regular sampling for growth and health as well as the maintenance of suitable water quality parameters. Improving the economic return from the feed should be one of the primary goals of the farm manager,although it is far from an easy task In previous research (see Davis et al.,2006) we have demonstrated a number of feed management concepts. One of the first consider ations when planning feed management is to choose a nutrient density of the feed. When se lecting a feed and applying it to a production system, one must understand that nutrient requireme nts are actually daily intakes. Hence nutrient density of the diet (e.g. protein and energy content) will affect how much you should feed as well as the feed conversion. Hence, feed inputs must be adjusted for the nutrient density of the diet; that is to say if we have higher concentrations of a nutrient in the feed we would offer less feed.As an example, a well balanced diet containing 40 % protein and fed at 75 % of the ration will deliver the same protein as a diet containing 30 % protein and offered at a 100 % ration. If the lower protein diet meets the nutritional requirements of the animal under a given set of conditions, increasing protein intake by increasing the daily ration (for this example 110%) does not lead to better growth. However, this overfeeding will in turn increase feed conversion ratios (feed offered per unit biomass gained) and increase pollution loading of the system. Similarly, if one chooses to increase the level of protein in the diet and feed the same quantity of feed (for this example feeding 100% ration of the 40% protein diet), growth would not improve, and feed conversion would stay the same. However, the efficiency of using the protein decreases and nitrogen waste (the metabolic by-product of protein metabolism) will increase. Of course over feeding any diet also reduces the economic returns from the feed(Tacon, A.G.J. and U.C. Barg. 1998).

Once a nutrient density of the diet is selected one must properly apply the feed, which is one of the biggest challenges to the commercial farmer. There are no set feeding rates that work on all farms as there are too many factors influencing growth rates and hence nutrient requirements. This means that each farm should use their own production data and experience to establish feed tables and feeding protocols that are appropr iate for their conditions. Quite often when evaluating feed inputs we find that producers with poor feed conversion ratio's (FCR > 1.4 with a 35% protein diet) are overfed during the later portion of production. As feed conversions can only be determined after the fact there is no way to absolutely know what to do during a production cycle. However, if one knows historical results for growth and FCR, as well as current growth and a reasonable estimate of survival one can easily check if feed inputs are "reasonable". For example, if we know that the best FCR we have seen on the farm is 1.2, then we have a target FCR. Similarly, if historic averages for growth is 1.5 g/week then we have a target for growth. Remember, growth will vary from year to year so quite often we use both historical averages as well as current growth per week (averaged over at least two weeks) as guide(Davis, A., Roy, L. and D. Sookying 2008).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study area

The experiment was conduct at the fish hatchery at Department of Fisheries Science and Wildlife, College of Animal Production Science and Technology, Sudan University of Science and Technology for a period of 45 days from (17/ January/2017 to 24/ February/2017).

3.2 Experimental design*:*

40 adults Nile tilapia average weight **255.** gm. The experiment contained four treatment (control C $_0$%lipidol, D1 10%lipidol, D2 25%lipidol and D3 40%lipidol).Fish was distributed randomly in four ponds 10 fish / pond. Fish were fed 10% of body weight daily two times (11 am and 4 pm).Fish were weighed and measured every 7 days.

Table 1: Formula and proximate analysis of the experimental feeds supplemented with various levels of Lipidol and control.

Ingredient (%)	Experimental diets			
	control	**D1**	**D2**	**D3**
Fishmeal	30	30	30	30
Wheat bran	20	19	19	18
Ground cake	21	21	21	21
Bread floor	10	10	8.5	8
Starch	10	10	10	10
Veg.oil	5	5	5	5
Min-mix	4	4	4	4
Lipidol	-	1	2.5	4
Total	100	100	100	100
Chemical composition	**Experimental diets**			
	control	**D1**	**D2**	**D3**
Dry matter (%)	96.0±0.00	94.50±0.74	96.50±0.71	96.50±0.71
Crude protein (%)	29.55±0.07	29.80±0.07	29.80±0.00	30.80±0.14
Crude fat (%)	2.86±0.06	2.64±0.04	2.44±0.01	2.34±0.06
Ether extract (%)	3.60±0.14	4.05±0.07	3.90±0.14	3.80±0.14
Ash (%)	15.50±0.71	14.00±1.49	13.50±0.71	16.50±0.71
Nitrogen free extract (%)	45.07±0.31	43.96±0.95	46.86±1.25	43.86±1.62

3.3 Growth and feed utilization

Initial body weight (IBW), final body weight (FBW), specific growth rate (SGR), feed intake (FI), feed conversion ratio (FCR), survival rate, protein efficiency ratio (PER), protein productive value (PPV) and energy retention (ER) were measured using the following equations:

SGR = [In final body weight - In initial

Body weight/time (days)] X 100

FI= fish weight x feeding level /100,

FCR= Feed consumed / Weight gain

WG = FBW (g) - IBW (g)

PER = Weight gain (g) / protein fed (g)

PPV= [Protein gain (g) / protein fed (g)] x 100

ER (Kcal/kg) = [Energy gain (g) /Energy fed (kcal)] x 100

3.4 Determination of Chemical composition

The proximate composition for experimental diets and fish carcass were measured according to AOAC (1990). As follows:

3.4.1 Moisture Content Determination:

The samples were first weight (Initial weight) then dried in an electric oven at 1050C for 24-30 hours to obtain a constant weight. The moisture content was calculated as follows:-

$$\textbf{Moisture content (\%)} = \frac{\text{Initial weight} - \text{Dry weight} \times 100}{\text{Initial weight}}$$

3.4.2 Crude Protein Determination:

The Kjeldal method for estimation of nitrogen was applied. Nitrogen content was converted to protein percentage by multiplying by 6.25 as follows:

$$\textbf{Protein \%} = \frac{(Va - Vb) \times N \times 14 \times 6.25}{1000 \times Wt} \times 100$$

Whereas:

Va = volume of HCL used in titration

Vb = volume of sodium hydroxide of known normality used in back titration

14 = conversion factor of ammonium sulfate to nitrogen

6.25= conversion factor of nitrogen to protein

Wt= weight of sample

N= normality of NaoH

3.4.3 Crude Fat Determination:

Fat content of each sample was determined according to Soxhlet method by ether extract using 2 gm of fish samples. Extraction continued for 5 hours at 100 0C before finding the weight of the extract fat. Fat percentage was then calculated as follows:

$$\textbf{Fat \%} = \frac{\text{Extracted fat weight x 100}}{\text{Sample weight}}$$

3.4.4 Ash Content Determination:

Ash was determined by heating 1 gm at 5500C in muffle furnace until a constant weight was obtained. Ash content percentage was given by the following formula:

$$\textbf{Ash \%} = \frac{\text{Ash weight x 100}}{\text{Sample weight}}$$

3.5 Water quality

PH, Nitrate, Nitraite and ammonia were estimated by aqua sol kits during the experimental period according to APHA (1995). Physico-water as follows:

3.5.1. PH:

1. Fill a clean test tube with 5 ml of water to be tested (to the line on the tube).

2. Add 5 drops of High Range pH Test solution, holding dropper bottle upside down in a completely vertical position to assure uniformity of drops.
3. Cap the test tube and invert tube several times to mix solution.
4. Read the test results by comparing the color of the solution to the appropriate High Range pH Color Card (choose either freshwater or Saltwater). The tube should be viewed in a well- lit area against the white area of the card. The closest match indicaters the pH of water sample. Raise the test tube with clean water after use.

3.5.2 Nitrate (NO_3^-):

1. A clean tube with was filled with 5 ml of water to be tested (to the line tube).
2. 10 drops from Nitrate Test Solution Bottle #1 was added, holding the dropper bottle upside down in a completely vertical position to assure uniform drops.
3. The test tube was capped and inverts tube several times to mix solution.
4. Vigorously shake the Nitrate Test Solution Bottle #2, for at least 30 seconds. This step is extremely important to insure accuracy of test results.
5. Now add 10 drops from Nitrate Test Solution Bottle #2, holding the dropper bottle upside down in a completely vertical position to assure uniform drops.
6. Cap the test tube and shake vigorously for 1 minute. This step is extremely important to insure accuracy of test results.
7. Wait 5 minutes for the color to develop.
8. The test results were read by comparing the color of the solution to the appropriate Nitrate Color Card (use the fresh water color card). The tube should be viewed in a well – lit area against the white

area of card. The closest match indicates the ppm (mg/l) of Nitrate in the water sample. Rinse the test tube with clean water after use.

3.5.3 Total ammonia (NH_3/NH_4)

1. A clean tube was filled with 5 ml of water to be tested (to the line tube).
2. 8 drops from Ammonia Test Solution Bottle #1 were added, holding the dropper bottle upside down in a completely vertical position to assure uniform drops.
3. Add 8 drops from Ammonia Test Solution Bottle #2, holding the bottle upside down in a completely vertical position to assure uniform drops.
4. The test tubes capped and shaked shake vigorously for 5 seconds.
5. Wait 5 minutes for the color to develop.
6. The test results were read by comparing the color of the solution to the appropriate Ammonia Color Card (use the fresh water color card). The tube should be viewed in a well – lit area against the white area of card. The closest match indicates the ppm (mg/l) of ammonia in the water sample. The test tube was rinsed with clean water after use.

3.6 Statistical Analysis

Results were expressed as means ± standard deviation (SD). Data were statistically analyzed using ANOVA one-way analysis of variance. Comparisons among means was made by (LSD) when significant F-values were observed ($P < 0.05$), using SPSS version (21).

CHAPTER FOUR

RESULT

Table (4.1): Growth performance of different testaments fed with difference Lipidol levels				
Parameters Treatments	**Initial weight (g/fish)**	**Final weight (g/fish**	**Weight gain (g/fish)**	**Growth percent %**
D1	39.00±3.48^{c}	45.20±6.32^{c}	6.20±0.37^{b}	116.43±17.51^{b}
D2	81.09±5.36^{b}	85.16±12.08^{b}	4.00±0.53^{c}	105.23±15.54^{c}
D3	36.67±3.59^{d}	44.04±11.38^{c}	7.37±0.69^{a}	120.14±28.48^{a}
Control	95.05±4.65^{a}	99.83±19.11^{a}	4.78±0.53^{c}	105.24±21.38^{c}
^{a,b,c,d}Means values in the same column with superscripts are significantly different at level (P<0.05)				

Table (4.2): Growth performance of different testaments fed with difference Lipidol levels

Treatments	ADWG	SGR	Survival rate%
D1	0.138±0.14^{b}	0.140±0.14^{c}	90
D2	0.090±0.28^{d}	0.640±0.15^{a}	90
D3	0.164±0.23^{a}	0.210±0.20^{b}	90
Control	0.106±0.43^{c}	0.030±0.24^{d}	90

Table (4.3): proximate Composition of fish fed with difference Lipidol levels

T	**Parameters**						
	Moisture %	D.M%	Ash %	C.P%	C.F%	E.E%	N.F.E%
Control	76.50±0.71^{a}	23.50±0.71^{b}	3.50±0.71^{b}	32.25±0.71^{a}	0.00	6.70±0.14^{a}	33.80±1.98^{b}
D1	74.50±0.71^{b}	25.50±0.71^{a}	4.50±0.71^{a}	31.95±0.07^{b}	0.00	6.70±0.14^{a}	31.40±0.28^{c}
D2	71.50±2.12^{c}	26.50±0.71^{a}	4.00±0.00^{a}	31.55±0.07^{b}	0.00	6.50±0.00^{a}	31.45±0.64^{c}
D3	76.00±1.41^{a}	24.00±1.41^{c}	4.50±0.71^{a}	31.00±0.14^{b}	0.00	6.45±0.07^{a}	34.05±2.19^{a}
^{a,b,c}Means in the same column are significant different at the level (p<0.05).							

Table (4.4): Some water quality parameters of different treatments.

Parameters Treatments	Temperature	pH	No_2	No_3	NH_4
D1	21.25 ± 0.50^c	8.05 ± 0.10^a	6.25 ± 2.50^b	0.25 ± 0.00^a	0.25 ± 0.00^a
D2	22.00 ± 0.82^b	8.10 ± 0.20^a	7.50 ± 2.89^a	0.19 ± 0.13^b	0.05 ± 0.13^b
D3	23.00 ± 1.83^a	8.15 ± 0.19^a	6.25 ± 2.50^b	0.19 ± 0.13^b	0.06 ± 0.13^b

^{a,b,c}Means values in the same column with superscripts are significantly different at the level ($P<0.05$)

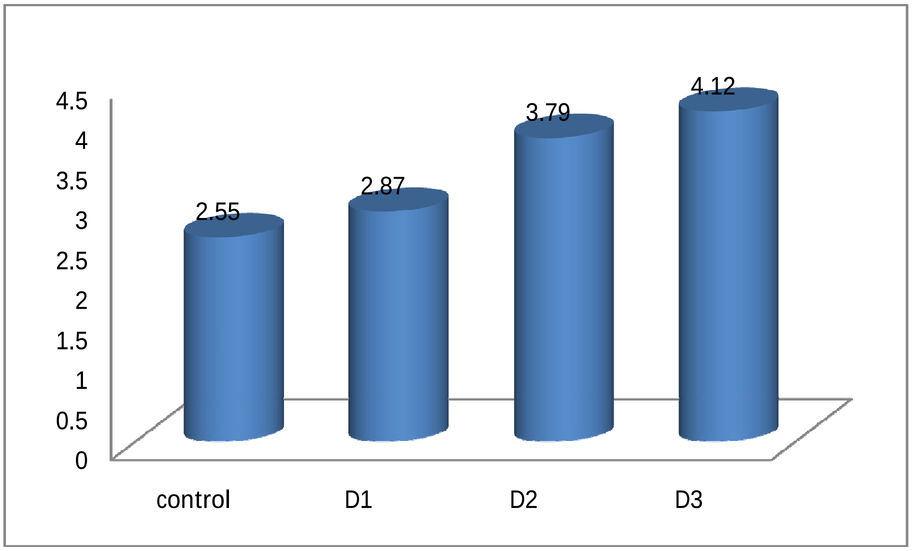

Figure (4.1): Food conversion ratio (FCR) of different ponds fed with difference Lipidol level.

CHAPTER FIVE
DISCUSSION

The levels of supplementation of Lipidol did not affect ($P>0.05$) the feed conversion ratio and protein deposition rate of fish, but they affected the chemical composition of fish, which increased linearly, and fillet yield, which increased linearly. The growth performance analysis of daily weight gain and fillet yield data using the ANOVA one way indicated that daily weight gain and fillet yield increased up to 1% and 2.5% and 4% g of Lipidol /kg, respectively (Table 2).

The digestible Lipidol influenced ($P>0.05$) daily weight gain in the fish of the present study, close to the values obtained by Santiago & Lovell (1988) and Furuya et al. (2001a) for Nile tilapia, of 9.00 and 10.50 g methionine + cystine/kg, respectively. On the other hand, Jackson & Capper (1982) determined the requirement of 12.70 g of methionine + cystine/kg for tilapia mossambica (*Oreochromis mossambicus*) for maximum weight gain.

The proportion of Lipidol can also affect the weight gain of fish, as described by Nguyen & Davies (2009), who observed the best weight gain of Nile tilapia fed diets containing 0.50:0.50, 0.60:0.40 or 0.70:0.30 of methionine: cystine ratios. In the present study, the proportion of methionine to cystine estimated for weight gain and fillet yield production were approximately 0.60:0.40 and 0.70:0.30, respectively.

The result obtained for the feed conversion ratio from this study differs from those found by several authors, who determined the effects of dietary methionine + cystine on feed conversion for juvenile rainbow trout (Kim et al., 1992),channel catfish (Burtle & Cai, 1995), yellow perch (Twibell et al., 2000) and Nile tilapia (Furuya et al., 2004).

Also the results obtained from the present study showed significance difference in chemical composition of fish between all treatments. Furthermore water quality parameters measured during this study showed significance difference at the level ($P<0.05$) between the four treatments.

CHAPTER SIX

conclusion and recommendation

6.1Conclusions

The best supplementation of Lipidol level requirements for weight gain and fillet yield of adult Nile tilapia from 4% g/kg, in this study. Diet 3 which contain 4% Lipidol give higher weight gain and Diet2 which contain 2.5% Lipidol give lower weight gain.

6.2Recommendation

- Further work is needed to study enzyme digestibility of fish fed with feed Containg difference Lipidol level.
- Further studies for evaluation of immune response of fish fed with feed Containg difference Lipidol level.

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