Sudan University of Science and Technology

College of Graduate Studies

Nutritional Composition Of Wild and Hormone Sex Reversed Nile Tilapia *(Oreochromis niloticus)*

التركيبة الغذائية لاسماك البلطى النيلى من المصادرالطبيعية والمعالجة بالهرمون

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Dedication

Dedication of this study;

To my father;

To my mother;

To my Brothers and Sisters,

To my beloved husband Mr. Tariq Hassan to my kids (Mohammed Elmujtaba, Mohammed Elmustafa, Mohammed Alamin and Mohammed Elmozamel) for theirs times, for encouragement and standing behind me throughout this thesis;

To all my colleagues; friends and relatives.

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ABSTRACT

The study was conducted to evaluate the nutritional composition through analysis of wild and hormone treated Nile Tilapia, *Oreochromis niloticus*. The fifteen samples of each wild and sex reversed were measured. The mean weight of wild species samples were (225.9 $\pm$ 19.9 g), while sex reversed samples were (169.9$\pm$46.3 g) with, significant difference ($p < 0.05$).

The result of chemical composition presented was as mean percentage to moisture, Fat, Crude protein and Ash all which considered determined parameters of fish quality and nutritive value of each fish group.

The dried samples of wild and sex reversed fishes has significant difference ($p < 0.05$) in moisture as (50.49 and 18.20 %), crude protein as (86.16 and 65.2 %), Fiber such as (62.26 and 18.28 %) wild and sex reversal, respectively . No %),and Ash (17.69 and 16.62 %) for both samples.

From the obtained result ,it is preferable to encourage farming will fingerlings of separation or selective breeding to improve of fish farmed stock instead of using hormonal treatment.

الخلاصة

صممت الدراسة لتقييم مقارنة القيمة الغذائية التقريبية لاسماك البلطي النيلي من المصادر الطبيعية والمعالجة هرمونيا فى المزارع استنادا على الوزن والتركيب الكيميائى كاساس للمقارنة .تم تجميع خمسة عشر عينة من كل نوع حيث تم تحديد المتوسط الوزنى لكل مجموعة والتركيب الكيميائى على اساس الوزن الجاف . اظهر متوسط الوزن فرقا معنويا ($P<0.05$) بين النوعين. حيث سجلت قيمة (225,9 ± 19,9 جم) للاسماك المستجلبة من النيل وقيمة(169,9± 46,3 جم) للاسماك المعاجة بالهرمون وكانت هنالك فروق معنوية ($P<0.05$).

نتائج التحليل الكيميائي عرضت كمتوسطات للرطوبة ,الدهون ,البروتين ,والرماد كمقياس لجودة الاسماك و القيمة الغذائية للمجموعتين.

العينات الجافة للاسماك الطبيعية و المعالجة هرمونيا اظهرت اختلافات معنوية بدرجة ($P<0.05$) للرطوبة (50,49 و18,20 %) ,البروتين (86,16 و 65,2 %) ,الالياف (62,26 و 18,28 %) للاسماك الطبيعية و المعالجة هرمونيا على التوالي.

بينما لم توجد فروق معنوية ($p> 0.005$) للدهون (14,51 و 15,41 %) و الرماد (17,61 و 16,62 %) للاسماك الطبيعية و المعالجة هرمونيا على التوالي.

من النتائج المتحصل عليها من الدراسة تحض على استخدام اصبعيات اسماك البلطى النيلى المستزرعة المستجلبة من المصادر الطبيعية وذلك بعد فرزها يدويا لتحسين فرص النمو بدلا من الاصبعيات المعالجة هرمونيا بغرض اقلاب الجنس .

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CHAPTER ONE

1-NTRODUCTION

The study background

Tilapias are very important in world fisheries, and are the second most important group of food fish in the world. Nile tilapia, *Oreochromis niloticus* accounted for a harvest of nearly 2.54 million tones in 2009 **(FAO, 2011)**, second only to carp as a warm water food fish and exceeding the harvest of Atlantic salmon, Salmo salar, although, the value of the Atlantic salmon catch is more than twice that of the tilapia catch **(Maclean et al., 2002)**.

Although, native to Africa, tilapias are cultured in Asia and the Far East, and occupy two rather separate market niches, being a poor man's food fish in countries such as Israel and the Southern United States **(Maclean et al., 2002).** Flesh quality has gained importance among consumers and in the aquaculture industry because it is directly related to human health and nutrition. Flesh quality comprises several different characteristics. Due to the large number of traits involved and the ensuing complexity, genetic improvement for flesh quality has been almost neglected in breeding programs for aquaculture species.

The Study Problems

Quality traits can usually be recorded only on dead fish, and therefore family selection must be practiced in a breeding program **(Gjedrem, 1997).** In order to meet the increase in human fish demand, aquaculture is increasing along the necessity of supplying fish products of high quality and also diversified product **(Queméner et al., 2002).** Generally, an important success factor is that consumers accept farmed fish to be equivalent or superior to the wild fish (**Olsson et al., 2003**).

Quality terms and how they are perceived differ from the fish farmer, processing industry and consumer. While growth and feed conversion are of great importance to the aquaculturist, these parameters are unlikely to be of indirect interest to the latter. However, producing fish that are positively received by processors and consumers alike is naturally of major concern to the fish farming industry **(Rasmussen, 2001)**. The quality of farmed fish has occasionally been reported as being lower than that of wild fish (**Sylvia *et al.,*1995**). Although, contradictory results have also been obtained **(Jahncke *et al.,* 1988).**

Hernandez *et al.,* (2001) reported that wild fish acceptability is greater than that of farmed fish. The term fish quality is all encompassing and its study is difficult owing to the fact that specific parameters that are recognized as being vital in one part of the world are judged to be less important elsewhere. Salmonid aquaculture has focused for many years on enhancing the quantity of fish produced. However, optimization of the quality of salmonids may lead to improvement of consumer acceptance and higher price for the farmed product **(Rasmussen, 2001).**

Significance of the Study

In these connections, **Sahu *et al.* (2000)** reported that among the commercial characteristics of fish, flesh quality is becoming more important to the aquaculture industry. The consumer dictates the flesh quality and it is a very complex characteristic. An attempt has to be made to define and analyze flesh quality and its relation to carcass characteristics. Carcass quality traits must be defined precisely and should be able to be measured with a high repeatability. Some of the quality traits vary within the carcass.

Therefore, a very precise carcass evaluation is necessary to arrive at any useful conclusion. To have an efficient program for improving growth and flesh quality traits of fish, it is necessary to test 10 to 15 fishes from each family for carcass evaluation each year and to compile a database. The genetic gain will increase when more families are tested in each generation. Not exceeding 3000 tons per year **(Non, 2002).**

The variations in the chemical composition of fish are closely related to the environment of rearing in ponds or nature and completely depend on feed intake.

During periods of heavy feeding, at first the protein content of the muscle tissue will decrease very slightly and then the lipid content will show a marked and rapid increase. Fish will have starvation periods for natural and physiological reasons **(Bendall, 1962).**

Fresh water, fish culture started in Sudan in 1953, with the establishment of the experimental demonstration fish farm within the premise of the fisheries research centre in Khartoum production from these farms has been extremely low, with a maximum of 1000 ton per year. Fresh water fish culture has not developed, due to serious handicaps including limited skilled personnel, inadequate research extension and infrastructure facilities and limited operational funds **(Non 2002).**

Objectives

1. The main objectives of this studes were to compare the physical characteristics of wild and sex reversed tilapia (*Oreochromis niloticus*).
2. Determine the chemical composition of wild and hormone trcated tilapia as a farmed fish.

CHAPTER TWO

LITERATURE REVIEW

2.1-1 Back ground

Tilapia species are perhaps best known because of their potential as an easily raised and harvested food fish. Their commercial advantages include fast growth, a diet of readily abundant algae and zooplankton and they are more resistant to viral, bacterial and parasitic diseases than other commonly cultured fish, especially at optimum temperatures for growth.

Many types of the tilapia products are available in the world markets. Today, fresh or frozen Tilapia fillets are available in different sizes and packages, as skin-on, skin-off, deep skinned, individually quick frozen, smoked and sashimi grade, and are treated by carbon monoxide or ozone dipped.

2.1-2Classification of *Oreochromis Niloticus*

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 *Oreochromis niloticus* is 20 cm **(Bwanika et al. 2004).**

Fish Fillets is one of such products according to **Clucas and Sutcliffe (1981)**, flesh cut from a whole fish parallel to the line of backbone, it could be block or single fillet of which it is in high demand in developed world, intensive, yet can be a means of providing livelihood support to a large number of people living in the coastal areas and many commercial culture systems in many developing countries. **Lupatsch *et al.* (2001).**

2.2 Fish Uses and Food Value:

People in the developing countries are in generals much more dependent on fish as a part of their daily diets than people lining in the developed world, it may be used fresh, frozen, canned, cured salted, dried or smoked. Fish meal and fish flour are two products of the fishing industry used for the dairy animals and poultry feeds and so odd the world's supply of protein rich food.

Fish is an important and highly desirable food for people suffering from protein, energy and malnutrition which is a leading cause of infont mortality in developing world. It could be a good source against endemic goiter caused by lack of dietary iron and iodine.

Each 100grames of lean or white fish flesh contains less than 1% of fat, about 18% of protein and an energy value range of 50-80K.cal. Oily fish contains 8 - 15% of fat and so has a higher energy value (80 - 160 Kcal \ 100/g), **(Mohamed.Y.1999),** When processed, preserved and cooked properly, fish retains most of its high nutrient contents. However this can be lest during poor handling and storage.

Fish protein has a high biological value similar to the protein of land animals but the contents of protein are somewhat less than meat, and there is often a large waste in the scales and bones.

2.3 Chemical Composition

Fish has an important role in food security and poverty alleviation in both rural and urban areas of Sudan, but little is known about the nutritional value of the Nile fish that are normally utilized either fresh or preserved dried, salted or smoked.

better knowledge of their nutritional value, which is expected to be closely associated with fish species, could contribute to the understanding of variability in meat quality of different species of the Nile fish. Moreover, the measurement of some proximate profiles such as protein contents, lipids and moisture contents is often necessary to ensure that they meet the requirements of food regulations and commercial specifications (Waterman, 2000).

The percentage proximate composition was determined chemically according to the method of analysis described by the Association of Official Analytical Chemists (AOAC, 2000).

The study of chemical composition of fish is an important aspect of fish flesh quality since it influence both keeping quality and the technological characteristics of the fish **(Huss, 1988).**

Data on chemical composition of many of the freshwater fishes of our country is not available and hence an attempt has been made to analyses as many as thirty-six species. The chemical composition of fish varies widely from species to species and season to season.

There is also individual variation in the same species. Knowledge of chemical composition is essential in order to compare its value as food with other protein foods. **Stansby (1954)** has elaborated on the importance of chemical analysis.

Various studies have examined the effects of temperature, light, salinity, pH and oxygen concentration on the proximate composition of fish but these factors would seem to have very limited effects. On the other hand, endogenous factors are genetic and linked to the life stage, age, size, sex and anatomical position in the fish **(Huss, 1995).**

The variations in the chemical composition of fish are closely related to the environment of rearing in ponds or nature and completely depend on feed intake.

The relationship between total lipids and moisture, and total lipids and total protein contents were determined and the caloric value of each species was calculated. Amino acids composition was determined with an automatic amino acid analyzer (LKB 4151 plus, Biochrom Ltd., Cambridge, UK) according to Bidlingmeyer et al. (1987).

The degree of variability in different groups of amino acids (according to type of side chain) was expressed as percentages of total amino acids in each species and the ratio of essential amino acid was determined. Seasons, and geographical localities (Zenebe et al., 1998b).

It was also found to influence post-harvest processing and affect the shelf-life of the fish (Clement and Lovelli, 1994). Changes in fatty acid and amino acids concentrations were found to be useful as an index of freshness and decomposition of marinated fish in storage (Özkan, 2005).

Likewise, different cooking methods affect the quality of fish meat (Prapasri, 1999).

Orechromis niloticus has historically been rated by consumers as grade 2 in a scale of four grades, but there was no scientific basis behind this grading. **Karrar (1997)** designed a research programme that considered the comparative biochemical composition of representatives of the four grades including *O. niloticus*.

The purpose was to see whether or not this arbitrary grading found a scientific back ground when the nutritive values were compared. The investigation addressed the fillet composition in general, fillet composition changes with sex and with season in addition to mineral content percentages moisture, protein, fat and ash contents changes during the different maturing stages.

2.4-1 Moisture Content

Moisture retention in seafood is normally associated with the water holding capacity and ph of the protein (Rainer .2000).After harvest these muscle proteins readily denature and may lose up to 80 % of their water binding capacity within 5 days at normal refrigerated storage (4 ^{0}C). Further substantial losses of natural juices, vitamins and minerals also occur during thawing and cooking (Rainer, 2000).

In balancing the ration it is essential to know the water content of each component, also ,moisture in prepared feed must be monitored because levels over 8% favours the presence of insects, and over 14% there is the risk of contamination by fungi and bacteria (cockerel et al ., 1971).

Remijo (1992) reported that, the moisture content of fresh Labeo fish spp. was (70.4 -71.2 %).

Ali et al., (1996) stated that, the moisture content in deep frozen fish of Labeo species was 76.7 % Clucas and Ward (1996) reported that, flesh from healthy fish contained 70 – 80 % water.

Ahmed (2006) carried out comparison of nutritive value of fesseikh using hydrocynus species and Schilbe species, he mentioned that, the moisture content of the fresh fish was in the range of 72.9-81.92%.

2.4.2 Crude protein

Protein provides amino acids in the diet , which are required in the body to regulate growth , repair , maintenance and replacement of tissues . Essential amino acids are required in adequate amounts in the daily diet, because they cannot be synthesized in the human body. Quality evaluation amino acid scoring procedure is considered to be more accurate than animal assays used for predicting protein quality of food**(Dillon. 1992).**

The protein in fish muscle tissue can be divideded into the following three groups:

1. Structural protein (actin, myosin ,tropormyosin and Actomyosin) which constitutes 70-80% of the total protein content .

2. Sarcoplasmic proteins (myoalbmin, globulin and enzymes). This fraction constitutes 25-30% of the protein.

3. Connective tissues protein (collagen), which constitute approximately 3% of the protein. (Suzki ,1981).

The majority of indrcoplasmic proteins are enzymes participating in cell metabolism , such as the anaerobic energy conversion from glycogen to ATP. If the organelles within the muscle cells are broken , this protein fraction may also contain the metabolic ezymes localized inside the sndoplasmatic reticulum , mitochondria and lysosomes **(Huss ,1995).**

The fact that the protein composition of the sarcoplasmic protein fraction changes when the organelles are broken was suggested as a method for differentiating fresh from frozen fish, under the assumption that the organelles were intact until freezing.

However, it was later stated that these methods should be used with great caution as some of the enzymes are liberated from the organelles during iced storage of fish as well **(Huss ,1995)**.

The proteins in the sarcoplasmic fraction are excellently suited to distinguishing fish species ,as each species has a characteristic band pattern when separated by the isoelectric focusing methods **(Huss ,1995).**

Remijo (1992) reported that , the protein content in fresh Labeo fish species was 20 – 21 %,while Johnson (1994) found 15.2 % in frash fish .

Clucas and Ward (1996) reported that flesh from healthy fish contained 15-24b% protein. **Ahmed (2006)** reported that, the protein content was in the range between 18.9-20.5 %.

2.4-3 Fat content

Among the elements contained in fish, lipids vary the greatest. Fish are classified as lean, semi-fatty or fatty. These categories are distinguished by terming fish that store lipids only in the liver as lean and fish storing lipids in fat cells distributed in other body tissues as fatty **(Huss,1995)**.

Typical lean species are bottom dwelling ground fish like cod, saithe, and hake. Fatty species include pelagic such as herring, mackerel and sprat. Some species store lipids in limited parts of their body tissues only, or in lower quantities than typical fatty species, and are consequently termed semi–fatty species (e.g. barracuda. mullet and shark) **(Huss,1995).**

The lipids present in body fish species may be divided into two major groups: The phospholipids and the triglycerides.

The phospholipids make up the integral structure of the unit membranes in the cells, thus they are often called structural lipids.

The triglycerides are lipids used for storage of energy in fat depots, usually within special fat cells surrounded by a phospholipids membrane and a rather weak collagen net work **(Ackman, 1980).**

Remijo (1992) reported that, the fat content in fresh labeo fish species as 3.5 – 5.4%. Johnson (1996) found that, fresh fish fat content varied widely from species to species and from season to another, it was 5.6% in lean fish.

Clucas and Ward(1996) reported that, flesh from healthy fish contained 1 -- 2.2% fat. **Ahmed (2006)** found that, fat content in *hydrocynus spp*. And *Schilbe spp*. Ranged between 1.4 – 2.2 %.

2.4-4 Ash content

Most of the known inorganic elements or minerals can be detected in the human and fish body , but only fifteen of those known to be essential to man need to be derived from food Clucas and Ward (1996) .

According to **Ahmed (2006)** the ash content of the fresh fish ranged between 1.1-1.7 .

Nile Tilapia exhibits sexual dimorphic growth where males grow significantly faster, larger and more uniform in size than females. Males and females had significantly different final weights owing to supplementations of three different oils (**Biro *et al.*, 2009**).

Johnston (1994) found that fresh fish fat content varied widely from species to species and from season to another. It was 5.6% in lean fish.

2.5.1 Natural Distribution and Habitat

Oreochromis 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).**

Native (green) and introduced (red) ranges of *Oreochromis niloticus* globally (Data source: GISD 2012). Please note this map does not indicate country wide presence, but merely that the species is categorised as an alien within that country.

2.5.2 Diet 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).**

Oreochromis niloticus have been observed to exhibit trophic plasticity according to the environment and the other species they coexist with **(Bwanika et al. 2007).**

2.5-3 Growth

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).**

2.5.4 Reproduction

Male fish initiate breeding with the creation of a spawning nest, which is fiercely guarded. When the water temperature increases above 24°C, a female will lay her eggs into the nest. These are then fertilized by the males before the female collects them in her mouth (known as mouth brooding). The eggs and the fry which then hatch are incubated and brooded in this manner until the yolk sac is fully absorbed two weeks later **(FAO 2012).**

The number of eggs a female will produce is dependent on body size. This can range from 100 eggs (produced by a 100 g fish) to 1500 eggs (spawned by a 1 kg fish). The females will not spawn while brooding. Males on the other hand fertilise the eggs of multiple females continuously given optimal environmental conditions **(FAO 2012).**

2.5.5 Environmental 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 *Oreochromis 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).

2.5.6 -History of Domestication

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 *Oreochromis niloticus* was exported worldwide (FAO 2012).

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).**

This global popularity has led to a number of important developments in culture techniques. Initially, tilapia was allowed to breed freely. However, farmers and scientists observed that this led to the production of smaller fish. In the 1960s, attempts were made to produce male mono sex populations through hybridization between different tilapia species **(Hickling 1963).**

This proved problematic and gradually females reappeared in the progeny **(Wohlfarth 1994).** Major technological developments in the 1970s allowed for the successful production of all-male populations through the use of sex-reversing hormones which resulted in higher returns from tilapia farming. Following this, and further research into culture processes, the industry boomed **(FAO 2012).**

Today, tilapia is often farmed with multiple species in the same pond, such as shrimp and milkfish. This not only optimises the financial return if space is limited, but also helps prevent the growth of harmful bacteria and serves to remove excess organic matter in the water **(Troell 2009).**

Genetic modification of the species has also been undertaken to maximise farming efficiency. For example, the Genetic Improvement in Farmed Tilapia (GIFT) project in the Philippines created strains of *O. niloticus* that grew up to 60% faster than their relatives **(Eknath & Acosta 1998).**

However, in Africa, the use of improved stock lines is rare due to concerns regarding genetic modification. As a result, many tilapia farms use brood stock which underperforms by 20-40% relative to wild individuals. There is great scope for improvement in this regard, either by rotational mating or the introduction of improved strains (Brummet & Ponzoni 2009).

CHAPTER THREE

MATERIALS AND METHODS

3.1 The Experiment Site

The study was conducted at fisheries and wildlife science laboratory, college of Animal Production Science and Technology, Sudan University of Science and Technology.

3.2 Fish sampling

Thirty samples of each *Oreochromis niloticus* wild and hormone trited samples were obtained from different environments and divided equally. The wild were collected from the fish landing site in Jebel Aulia in early hours of morning and care was taken to ensure that all fishes used for analysis were in fresh condition, while the hormone trited samples were brought from fish farm in Jebel el Tena (Elgitana area).

3.3 Physical analysis

The samples were first properly cleaned in the laboratory and then total length, standard length were measured by measuring tape (100cm) and weight of each fish was determined by sensitive balance.

After careful examination, each individual were insert in oven (Muffle Furnace) at 50 C° for 48 hours for complete dryness and weighed again. After that the samples was taken to lab for determination of chemical analysis.

3.4 Chemical analysis

The proximate composition, chemical analysis were determined for above mentioned fishes which include moisture, protein, fat, ash by using the standard methods **(AOAC, 1990).**

3.5.1 Protein content determination:

One gram of each sample was weighed for the analysis procedure, the protein content was determined by Kjeldhal method (AOAC, 2000), **calculated as follows:-**

Nitrogen (%) = T × 0.1 × 0.014 × 20 ÷ Weight of sample × 100.

Crude protein % = N × 6.25 = CP%

Whereas: T = titrated volume of HCl

N = Protein nitrogen

3.5.2 Moisture determination:

Moisture was analyzed through weighing 5 gm of the sample (flesh) into a weighed tarred silica or porcelain dish. Dry in the oven at 105 C for 24hrs, allow cooling in a desiccators and weight loss in weight (represents moisture).

The moisture % was calculated as follow:

$$\text{Moisture \%} = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100.$$

Moisture was expressed as percentage of wet weight according to the standard methods. Total lipids were determined following the method of Folch et al. (1957).

3.5.3 Ash determination

Total ash was measured by weighing out 5 gm of the sample into silica dish which has previously been ignited and cooled before weighting then the dish and contents were ignited first gently and consequently at 550 C until the Ash got a grey / white color. The dish was cooled at room temperature and by subtracting the weight before and after aching, the ash % will determine as:

$$\text{Ash \%} = \frac{\text{Fresh weight} - \text{Ash weight}}{\text{Fresh weight}} \times 100.$$

3.5.4 Fat determination

Fat content determination was done by drying the samples at 100˚C in an oven and then extracting the crude fat with petroleum ether in a Soxhlet extractor for 4 hours.

3.6. Statistical analysis

The data were statistically analyzed using computer statistical package of social science (SPSS version 21), ANOVA TEST. The mean values and the difference between replicate were determined.

CHAPTER FOUR

RESULT

4.1 Biometry

The hormone treated samples showed significantly difference from the wild species samples in term of total body weight **(225.93± 19.89)** and **(169.87± 46.33)** ($P < 0.05$) and average total length from farm (hormone treated group wild fish) varied as **(23.087± 0.80)** and **(20.50± 1.815)** also is differed significantly, ($P < 0.05$) table (1).

Conditional factor there was no significant difference ($P > 0.05$) between farm (sex reversal) and wild all are in a good condition showed in table (3).

Table 1: Mean Biometry of *Oreochromis niloticus* sex reversal and wild.

Fish	Parameters		
	T.L	S.L	T.B.W
Sex reversal	23.087± 0.80 [a]	18.63± 0.87 [a]	225.93± 19.89 [a]
Wild	20.50± 1.815 [b]	16.91± 1.50 [b]	169.87± 46.33 [b]

Whereas:

T.L= Total length,

S.L= Standard length,

T.B.W= Total body weight.

a, b Means within each comparison in the same column with the different superscripts differ significantly ($P < 0.05$)

Table 2: Mean illustrate condition factor of *Oreochromis niloticus* sex reversal and wild.

Fish	T.L	T.B.W	(K)
Sex reversal	23.09	225.93	1.835
Wild	20.50	169.87	1.972

Whereas:

T.L= Total length,
T.B.W= Total body weight.
K= condition factor
W= weight
L= length

$$K=100*w/l^3$$

4.2 Proximate chemical compositions

The results of chemical composition of different tilapia *(Oreochromis nilticus)* on dry matter basis are show N in table (3).

The crude protein value was the highest in wild population **(80.16±10.60)** differenced significantly ($P < 0.05$) to those collected from farm as hormone treat meant **(65.2±11.08).**

More over high moisture content was obtained from wild population samples **(50.49±15.036)** which differenced+ significantly ($P < 0.05$) to those obtained from farm as treated with hormone **(18.20 ± 5.05).**

Fat content hormone treat meant samples showed high variation in a sense of **(15.41± 1.88)** compared to those obtained from wild **(14.51±2.67)** with no significantly difference between them ($P > 0.05$).

Ash content was **(16.62±3.69)** in farm hormone treat meant samples in comparing to **(17.09±4.15)** in wild, with no significant different ($P > 0.05$) variation in ash content was found between hormone treat meant samples and wild samples of *Oreochromis niloticus.*

Nitrogen free extract (NFE) was the highest in wild samples **(62.26±20.15)** compared to sex reversal **(18.28±8.36)** with difference significance($P > 0.05$).

Table 3: Mean illustrate proximate chemical composition of *Oreochromis niloticus* hormone treat meant samples and the wild samples.

Fish	Parameters				
	Protein	**Moisture**	**Fat**	**Ash**	**N.F.E**
Sex reversed	**65.2± 11.08 ^{a}**	**18.20±5.05 ^{a}**	**15.41±1.88 ^{a}**	**16.62±3.69^{a}**	**18.28±8.36 ^{a}**
Wild	**80.16±10.60 ^{b}**	**50.49±15.03^{b}**	**14.51±2.67 ^{a}**	**17.09±4.15^{a}**	**62.26±20.15 ^{b}**

a,b Means within each comparison in the same column with the different superscripts differ significantly ($P < 0.05$).

CHAPTER FIVE

DISCUSSION

Fish is a highly protein food consumed by the populace; A larger percentage of consumers do eat fish because of its availability, flavor, palatability while fewer percentage do so because of its nutritional value. Therefore, studies on the proximate composition and elemental composition of the freshwater fish have not really caught attention of researchers in fisheries; Hence the consumer and fishery workers are left with limited or paucity of information's on the importance of particular fish species in their daily diets **(Adewoye et al., 2003).**

The present work was planned to study the proximate composition of *Oreochromis niloticus* hormone treated and wild through estimating their major biochemical components such as crude protein, moisture content and lipid content in the dry basis of body of each sample.

The high percentage crude protein of wild samples (**80.16±10.60**) than those individual collected from farm as hormone treated(25.2±11.8) could be attributed to the fact that; fish in natural are good source of pure protein, but the differences observed with hormone treat meant samples **(65.2± 11.08)**, in the obtained values may also be attributed to fish absorption capability and conversion potentials of essential nutrients from their diet or their local environment into such biochemical attributes needed by the organisms body the result with in agree with **(Burgress, 1975, Adewoye and Omotosho, 1997, Fawole, et al 2007, and Aitken 1967).**

(50.49±15.03) differ significant with sex reversal ($P <$ 0.05). The result is in agreement with **Agab and Babiker (1987),** who reported that the range of protein and fat content level in fish flesh, lies in between 18.12 - 28.5% for protein and 10.6–22.5% for fat, while **Karrick et al. (1956)** and **Remijo (1992),** indicated that protein and fat ranged between 6–28% and 0.1–67% as reported by **El Taly (1994), Eyo (1991), Mgawe (1991) , waterman, J.J(1970) and Samy et al (2012).**

Lipids content (fat) showed no significant differ among sex reversed and wild *Oreochromis niloticus* however the percentages of content is in agreement with **Samy et al 2012, Boutos,J.Z 1970, Clement 1994).**

The total average content of ash in the sex reversed and wild *Oreochromis niloticus* is not so different and it doesn't show any significant difference ($P > 0.05$).

The total ash content (which represents the content of inorganic elements and mineral salts in the analyzed edible portion) greatly depends on the size and the samples weight, and also from the sexual maturity, food source and external environment is agree with many reported **Eyo, A.A (1991), Samy et al (2012), Watanabe et al. 1997; Roy & Lall 2006; Ye C.X. et al. 2006; Santaella (2011), El Tay 1994), waterman, J.J(1970).**

As demonstrated above, the proximate analysis data of the same fish species showed a significant variation. This is due to several environmental conditions, dietary and physiological factors, seasonal variation, sexual maturation, size, feeding cycle **(Borgstrom, 1962).**

These factors are observed in wild, free-living fish on the open sea and in inland waters. Fish raised in aquaculture may also show variation in chemical composition, but in this case several factors are controlled, thus the chemical composition may be predicted.

Factors such as feed composition, environment, fish size, and genetic traits all have an impact on the composition and quality of the aquaculture D fish.

From ecological part, this fish species belong to the same trophic levels, *Oreochromis niloticus* is a vegetarian **(Abu Gidiri 1982).** The effects of environmental condition on fish major chemical constituents especially protein and fat were to be more obvious in fish feeding on lower trophic levels, as appeared in this study. The level of oxygen, together with temperature, consequently play a great role in the water quality and hence food consequently production. These factors could to play a major role in chemical constituent's variation in our studied species.

CONCLUSION AND RECOMMENDATIONS

6.1. CONCLUSION

This study concluded that there was slightly differences and significantly expired between the wild and hormone treat meant fish as cultured tilapia species in term of proximate chemical composition but the percentage of protein , fat and moisture contents were recorded higher in wild than hormone treat meant fish as farmed species.

The wild fish is intensively rich in term of nutritional values and physiological benefits to human's health for consumption, and also it good to cultivate wild fry without adding hormone to separate sex so we can identify sex through the natural fry and fingerlings.

6.2. RECOMMENDATION

1. Better use the natural breeding and manual identifying of sex in ponds than hormone application.

2. Encourage consumption of farm based fish and also oriented the consumers about the quality and its nutritional value.

3. The hormone should be adjusted in scientific ways not to affect the quality of fish.

CHAPTER SIX

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Appendix

(1): Proximate chemical composition of *Orochromis niloticus* sex reversal.

S/No	Ash content	Crude Protein	Moisture content	Fat content
1	13.6	63.69	15.93	18.5
2	11.31	77.435	16.66	16
3	14.97	76.935	16.97	13
4	13.12	61.273	17.11	16.5
5	18.47	61.655	14.97	12.3
6	16.3	69.855	15.2	13.8
7	14.9	30.9	18.71	14.9
8	17.69	62.235	16.7	12.89
9	25.08	70.50	14.8	15.28
10	22.72	68.845	17.63	16.3
11	18.73	68.07	21.29	16.16
12	18.69	65.47	26.83	15.72
13	14.61	66.79	29.79	16.45
14	14.01	75.455	21.3	18.7
15	15.8	58.95	9.0	14.7

(2): Biometry of *Orochromis niloticus* sex reversal

S/No	Total length	Standard length	Weight
1	24	21	238
2	23.2	18.2	214
3	23.2	18.3	195
4	22.6	18.3	250
5	22.3	17.6	233
6	24.5	19.6	247
7	21.4	17.6	193
8	23.3	18.2	247
9	22.9	18.5	219
10	22. 6	18.3	224
11	23.4	18.8	222
12	23.3	18.8	216
13	23.2	18.5	226
14	24.2	19.6	257
15	22.2	18.1	202

(3): Proximate chemical composition of *Orochromis niloticus* wild.

S/No	**Ash content**	**Crude Protein**	**Moisture content**	**Fat content**
1	16.07	76.61	31.6	18
2	16.58	90.01	45.7	16
3	16.47	65.10	41.1	13
4	17.67	69.88	64.06	17.5
5	18.45	59.25	35.5	11.9
6	18.64	88.91	65.3	12.5
7	15.85	75.48	39.7	15.88
8	17.06	85.72	44.31	14.55
9	17.12	86.59	72.36	15.40
10	11.88	84.29	37.37	9.47
11	16.17	86.59	38.70	14.82
12	29.91	90.01	42.96	17.88
13	18.78	89.13	51.76	17.31
14	12.24	64.45	71.86	11.28
15	13.17	87.37	75.19	12.15

(4): Biometry of *Orochromis niloticus* sex reversal

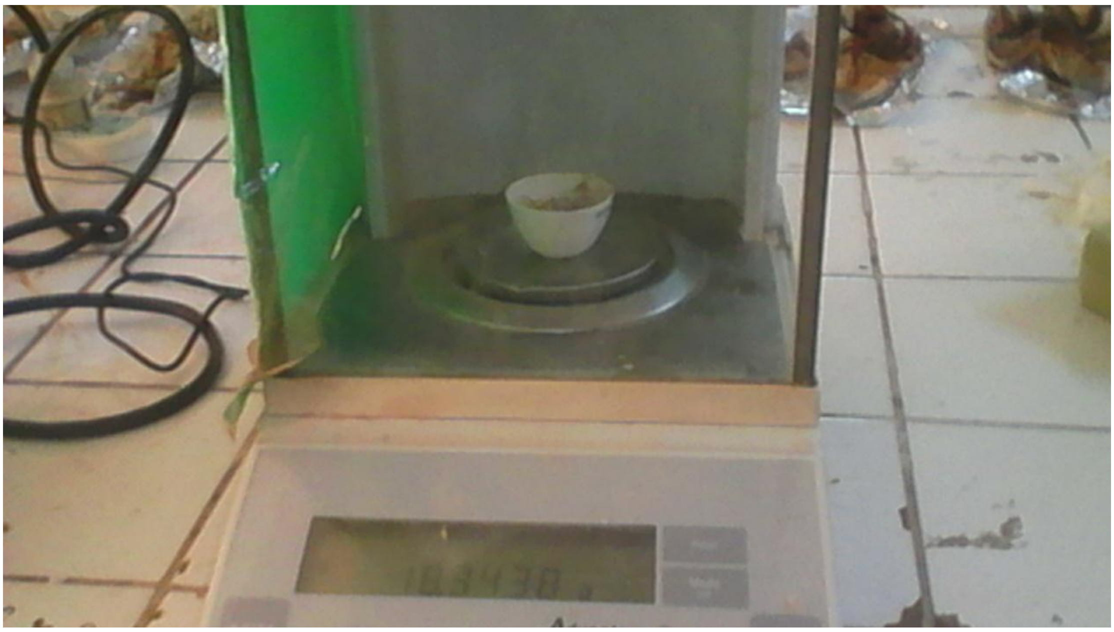
S/No	Total length	Standard length	Weight
1	20	17	163
2	23	19.4	221
3	19.1	15.8	125
4	24.2	19.5	288
5	21	17.5	186
6	21.4	17.3	202
7	20.5	16.8	172
8	20.5	17	168
9	20.7	17	161
10	17	14	99
11	20.1	16.5	155
12	21.5	18	182
13	21.5	17.9	181
14	18	15	118
15	19	15	127

(5): Illustrate S the drying oven machine.

(6): Sensitive balance and samples of wild fish after drying.

(7): Illustrate samples of sex reversal fish after drying in oven

(8): Illustrate weighed of sample for Ash.



(9): Bruise machine for powder specimens.

(10): Illustrate process of Ash samples in the oven machine

(11): Process of extraction of moisture content machine