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Comparative Study in the Chemical Composition of Wild and Farmed Nile Tilapia *Oreochromis niloticus* (Trewavas 1982)

A thesis submitted in partial fulfillment of the requirement's for the Degree of B.Sc. in animal production (fishers and wildlife)

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بِسْمِ اللّهِ الرَّحْمَنِ الرَّحِيم

الإستحلال

قال تعالى ﴿أُحِلَّ لَكُمْ صَيْدُ الْبَحْرِ وَطَعَامُهُ مَتَاعًا لَّكُمْ وَلِلسَّيَّارَةِ وَحُرِّمَ عَلَيْكُمْ صَيْدُ الْبَرِّ مَا دُمْتُمْ حُرُمًا وَاتَّقُوا اللَّهَ الَّذِي إِلَيْهِ تُحْشَرُونَ ﴾

صدق الله العظيم

[المائدة : 96].

DEDICATION

TO OUR MOTHERS AND FATHERS

TO OUR FAMILIES

TO OUR TEACHERS

TO OUR COLLEAGUES

TO CANDLES THAT BURN TO LIGHT UP FOR OTHERS

TO EVERYONE WHO TAUGHT ME CHARACTERS

I DEDICATE THIS HUMBLE RESEARCH TO THE LORD ALMIGHTY TO FIND ACCEPTANCE AND SUCCESS.

ACKNOWLEDGMENT

Our greatest thanks to Allah Almighty, the most merciful who gave us the health, strength and patience to conduct this study.

The words are racing and the phrases are crowded to organize the thanksgiving, which is only worthy of you, to you, who has made a head start in the science and education, to you who made and did not wait tender.

FOR YOU **DR.SARRA BUSHRA**

ABSTRACT

The experiment was designed to study chemical composition of farmed and wild fish species *oreochromis niloticus* collected from White Nile and from kuku hatchery .A total number of six fish with different weights were (230-280). Three fishes were collected from Jebal Awlia Dam at the White Nile, and another fish were collected from the hatchery of the Sudan University for Science and Technology. Chemical analysis was carried out for the two group to determined Moisture, protein, fat. The data was analyzed by one –way analysis of variance. Result shows no significant difference between the two groups in the protein, fat.

Difference was noted in the moisture, dry matter contents.

Key words: ***oreochromis niloticus*** **chemical composition Jebal awlia kuku hatchery Proximate Analysis.**

الخلاصة :

أجريت هذه الدراسة لمعرفة الإختلاف في التركيب الكميائي لأسماك البلطي النيلي بين الاسماك المستزرعة والأسماك المتواجد في الطبيعة. عدد الأسماك التي أجريت عليها هذه الدراسة كان ست سمكات ثلاث منها أخذه من مفرخ جامعة السودان للعلوم والتنكنولوجيا(مجمع كوكو) والاخريات من منطقة خزان جبل أولياء بالنيل الأبيض.

الدراسة شملت تحليل البروتين والدهون، اثبت التحليل الاحصائي انه لا توجد إختلافات معنوية في البروتين والدهون بين المجموعتين وهنالك فرق معنوي في درجة الرطوبة والمادة الجافة بين المجموعتين.

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CHAPTAER ONE

INTRODUCTION

The chemical composition important success factor is that consumers accept farmed fish to be equivalent or superior to the wild fish ,Quality terms and how they are perceived differ for the fish farmer, processing industry and consumer (Olsson et al., 2003).

The processor, the nutritionist, the cook and the consumer all have a direct interest in the composition of fish. The processor needs to know the nature of the raw material before he can apply correctly the techniques of chilling, freezing, smoking or canning.

The nutritionist wants to know what contribution fish can make to the diet and to health, and the cook must know for example whether a fish is normally lean or fatty.

The consumer is interested not only in whether a particular fish tastes good, which is a matter of opinion, but also in whether it is nutritious.

To compare the chemical analytic composition of farmed fish with their natural counter parts is complex study, should be emphasized with more specialized geographical influence with diet playing an important role culture fish tend to be deficient in body protein and ash and that they almost always contain more lipid than do wild fish, such lipid being the more saturated (Malcolm, 1977).

The chemical composition of fish varies greatly from individual to another depending on age, sex, environment diet, and season.

Concerning comparison on the proximate chemical composition between cultured and wild Nile Tilapia (*Oreochromis niltoicus*) little work has been carried out in Africa in general and almost nothing in Sudan in particular (FAO, 1992 and 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. 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. The majority of data from literature which compare quality of wild and farmed fish deals with chemical composition, nutritional value and other physical-chemical parameters (Alasalvar et al., 2002; Grigorakis et al., 2003 and Grigorakis, 2007).

Moreover, the O. niloticus has many outstanding advantages such as easy to culture, high growth rate, easy breeding high quality protein, good taste, white cotton meat like sea bass fish, high nutrition and having more Omega-3than other wild freshwater fishes and wild estuarine fishes. (Aquatic Animal Research Centre Charoenpokphand, 1999).

Recently, the demand of Tilapia (*Oreochromis niloticus*) consumption has increased continuously because O. niloticusis of low price with high nutrition value . The whole fish and fillet are admirable for consumers.

As a result, the production of farmed tilapia has increased from 383,654 mt in 1990 to 1,505,804 mt in 2002, representing about 6% of total farmed finfish in 2002 (FAO, 2004).

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, 2002).

Farmed fish is offered with nutrient rich foods couple with the natural productivity in the pond unlike the wild fish that has to depend completely on natural food production for its sustenance. (BAZ *ET AL.*1972)

Tolerance and adaptability to changing environmental parameters have made Nile tilapia a hardy and desirable aquaculture species.

These traits have also enabled this fish to become a highly successful invasive species into temperate and subtropical aquatic environments. (Linnaeus, 1758).

Tilapia have many attributes that make them an ideal candidate for promoting aquaculture and provide sustainable development in sudan . these include: fast growth, tolerance to a wide range of environmental conditions, resistance to stress and diseases, ability to reproduce in captivity, feeding on low trophic levels and good sensorial proprieties of flesh (Boari et al., 2008 and Dergal et al., 2013).

The composition of a particular species often appears to vary from one fishing ground to another, and from season to season, but the basic causes of change in composition are usually variation in the amount and quality of food that the fish eats and the amount of movement it makes. For example, fish usually stop feeding before they spawn, and draw on their reserves of fat and protein. Again, when fish are overcrowded, there may not be enough food to go round; intake will be low and composition will change accordingly.

Importance of the work?

As consumers awareness increased there is a need to access the quality, enhance safety and nutritional value in fish and in particular cultured fish in line with international requirements. Therefore, this work was performed to compare compositions among the farmed and wild *Oreochromis niloticus* fish flesh.

The aim of work:

- To know the chemical composition of farmed Nile Tilapia (O. niloticus).
- To know the chemical composition of wild Nile Tilapia (O. niloticus).
- to compare the chemical composition between them .

CHAPTAER TWO

LITERATURE REVIEW

Tilapias are a hardy species produced by several culture methods under a wide range of environmental conditions. They are tropical and subtropical species, but they have been cultured at temperate sites by using geothermal water, greenhouses, or other means of providing warm water during winter.

Contrary to some aquaculture species, tilapias are important in both local and export markets. They also are produced as food fish by rural farmers. The popularity of tilapias with consumers is increasing in western countries and Japan, and exports are expected to increase for years to come. Production methods are highly variable, and less attention has been given to identifying good practices for tilapia production than has been done for shrimp, salmon, and channel catfish.

However, experience with other species will be useful in evaluating production practices and suggesting important issues for tilapia certification.

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).

In these connections **(**Sahu 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.

(Abdel-Aziz 2006) found that the highest mean value of moisture content (80.32 ± 0.39%) was shown by cultured population and differ significantly (P≤0.05) from those of the other populations studied.

Moreover, the highest mean value of protein (58.14±0.51%) was achieved by cultured population, but did not differ significantly (P≤0.05) from that of Nile River population.

Lipids content showed higher mean (23.52 ± 0.40%) by Edku Lake population, but did not differ significantly (P≤0.05) from that of Manzalah Lake population.

Nile tilapia (O. niloticus) from River Nile contains about 80.08% moisture. The same results were obtained by Abo-Raya (1975) and ElAkel (1983). Galhom (2002) reported that.

A work done by (Saleh, 1986; Salama, 1990; El-Ebzary and El-Dashlouty, 1992; Keshk, 2004). in fish obtained from various water sources and different fishing season shows a general trend towards increasing the percentage of moisture in cultured as compared wild fish distribution of fat in the carcass is an important economic trait.

It is very difficult to ascertain the optimum level of fat in a carcass. Generally, it is felt that fat percentage of 16 to 18% in a fillet is too high. Excessive fat deposits reduce the quality of the fish. Increase in fat depots increases waste in processing.

There are several other methods available to measure fat content in a fish carcass (Wold and Isaksson, 1997; Sahu et al., 2000). Moreover, Sahu (2000) reported that protein content and composition are stable during development. The wide variability in the characteristics of muscle and connective tissues in commercial fish is related to their mode of development.

Chemical composition differences among Nile tilapia O.niloticus populations may be due to some environmental factors.

In these connections, Svàsand (1998), Favalora et al. (2002) and Flos et al. (2002), reported that the quality of fish is affected by parameters such as feed type, level of dietary intake and growth. Feed composition has a major influence on the proximate composition of salmonids.

In particular, whole body lipids as well as the lipid content in the edible fillet are directly related to dietary fat content, while the fatty acid composition of the fish flesh is also strongly influenced by the dietary fatty acid profile.

Fish body composition appears to be largely influenced by feed composition. An increase in other parameters such as feeding rate and fish size also result in enhanced adipose deposition and decrease water content in the fish body.

The protein content, however, remains more or less stable. An increase in body fat content is generally accompanied by reduction in slaughter yield, owning to an increase in the weight of viscera in relation to body weight.

The levels of proximate constituents in the whole body as well as the fillet are readily manipulated by feed composition and feeding strategies, whereas the sensory parameters are less affected by these variables.

Different rearing systems generate products having variable quality level which differ from wild fish in color. Fish can form a very nutritious part of man’s diet; it is rich in most of the vitamins he requires, it contains a good selection of minerals, and the proteins contain all the essential amino acids in the right proportions.

Although the amount of protein in fish varies a little from species to species and, on occasions, within a species, the protein content for meat and for fish is roughly comparable.

Tilapia culture is also one of the fastest growing farming activities, with an average annual growth rate of 13.4% during 1970–2002.

They are widely cultured in about 100 countries in the tropical and subtropical regions.

2.1 Structure of fish muscle:

The blocks of muscle, which form the individual flakes in the cooked fish, are separated by thin sheets of what is known as connective tissue; these are curved within the fillet and run from the backbone to the skin.

In fresh fish the muscle blocks are firmly attached to the connective tissue, and the surface of a cut fillet is smooth and continuous. There are also tiny blood vessels running through the muscle.

The connective tissue accounts for only a small percentage of the total weight of the muscle, smaller than for example in beef muscle; this is one reason why fish is generally less tough to eat than meat. In fatty fish such as herring and mackerel the strips of dark muscle are much larger in proportion and contain higher concentrations of fat and certain vitamins. Since it is not usually practicable to separate the dark, fatty muscle from the light muscle when preparing fish for cooking, as one might trim fat from beef for example, the values given in the tables for composition of flesh are for the total muscle, taking light and dark together.

2.2 The principal components of fish muscle:

2.2.1 Water:

The main constituent of fish flesh is water, which usually accounts for about 80 per cent of the weight of a fresh white fish fillet. Whereas the average water content of the flesh of fatty fish is about 70 per cent, individual specimens of certain species may at times be found with a water content anywhere between the extremes of 30 and 90 per cent.

The water in fresh fish muscle is tightly bound to the proteins in the structure in such a way that it cannot readily be expelled even under high

pressure. After prolonged chilled or frozen storage, however, the proteins are less able to retain all the water, and some of it, containing dissolved substances, is lost as drip. Frozen fish that are stored at too high a temperature, for example, will produce a large amount of drip and consequently quality will suffer. In the living fish, the water content usually increases and the protein content decreases as spawning time approaches; thus it is possible, with cod for example, to estimate the condition of the fish by measuring the water content of the muscle.

In cod, the water content of the muscle is slightly higher at the tail than at the head; this slight but consistent increase from head to tail is balanced by a slight reduction in protein content.

2.2.2 fat:

Content may vary from one individual to another.

2.2.3 Protein:

The amount of protein in fish muscle is usually somewhere between 15 and 20 per cent, but values lower than 15 per cent or as high as 28 per cent are occasionally met with in some species.

All proteins, including those from fish, are chains of chemical units linked together to make one long molecule. These units, of which there are about twenty types, are called amino acids, and certain of them are essential in the human diet for the maintenance of good health. Furthermore.

2.3 Flesh quality:

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. Quality traits can usually be recorded

only on dead fish, and therefore family selection must be practiced in a breeding program (Gjedrem, 1997).

These differences have direct effects on body composition, health status as well as growth of fish. The feeding habits and type of food availability is a true reflector of fish body composition.

CHAPTAER THREE

MATERIALS AND METHOTDS

3.1 Description of the study area:

The study was conducted at the Central veterinary research laboratories (Soba) South of Khartoum . Three fishes were collected from Jebal awlia Dam at the White Nile located 45 km south Khartoum. Other fishes are collected from the hatchery of the Sudan University of Science and Technology. Department of Fisheries and wildlife science ,college of animal production10 km east of Khartoum .

3.2 Materials and methods :

six fresh samples of *Oreochromis niloticus* (Trewavas, 1982) from the wild and farmed were chosen randomly for body chemical analysis were selected for this study. Standard and total lengths of the each sample group were determined and recorded table (4.1) and total body weights were recorded in table (4.2) by using (ruler, sensitive balance, metric bar, scissor). The samples were placed separately in clean sterile plastic bags and transferred in an insulted ice box.

3.3 Sampling procedures:

2 grams of each fish wild and farmed *O. niloticus* species were trimmed and taken to the central veterinary research laboratories (Soba) South of Khartoum in this sample analysis were conducted for moisture, crude protein and crude fat using A O A C (1990) methods.

3.4 Proximate composition determination:

The proximate composition for 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 105 C for 24-30 hours to obtain a constant weight. The moisture content was calculated as follows:-

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

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:

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

Where as:

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 gram 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:

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

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:

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

3.5 Statistical analysis:

The data were analyzed by one-way analysis of variance (ANOVA, F test) and LSD for significantly different means at a significance level of 0.05 using SPSS version 16.

CHAPTAER FOUR

RESULT

Table (4.1) **Information on O. niloticus is taken from Jabel Awlia Dam.**

Name	T.L	S.L	T.W
A	27	22	231.3
B	25	20.5	252.6
C	28	22.5	279.6

Table (4.2) **Information on O. niloticus is taken from Kuku hatchery**.

Name	T.L	T.S	T.W
A1	26.5	20.5	232
B1	28.6	22.3	255.6
C1	29	23.5	274

Where as:

T.L: total length.

S.L: stander length.

T.W: total weight.

Tables (4.3) **A summary of the chemical composition of the O. niloticus the Jabel Awlia Reservoir for different weights.**

Name	M	D.M	C.P	E.E	N.F.E	ASH
A	77 76	23 24	30.6 30.45	6.2 6.0	35.2 34.35	5.0 5.2
B	78 77	22 21	31.5 31.6	5.8 6.0	35.8 36.6	4.9 4.8
C	75 77	25 23	30.2 30.27	6.4 6.2	33.4 35.23	5.0 5.3

Tables (4.4**) A summary of the chemical composition of the O. niloticus the Kuku hatchery for different weights.**

Name	M	D.M	C.P	E.E	N.F.E	ASH
A1	74 73	26 27	29.9 30.0	5.7 5.5	34.4 33.2	4.0 4.3
B1	71 72	29 28	30.1 30.14	6.0 5.8	29.9 30.56	5.0 5.5
C1	75 74	25 26	30.5	5.6 5.9	33.9 32.6	5.0 4.8

Where as:

M: moisture.

D.M: dry matter.

C.P: crude protein.

E.E: ether extract.

N.F.E: nitrogen free extract.

Tables (4.5) **The average chemical composition results for the O. niloticus Jebel Awlia.**

Name	M	D.M	C.P	E.E	N.F.E	ASH
A	76.5	23.5	30.525	6.1	34.775	5.1
B	77.5	21.5	31.55	5.9	36.2	4.85
C	76	24	30.235	6.3	34.315	5.15

Tables (4.6) **the average chemical composition results for the O. niloticus Kuku hatchery.**

Name	M	D.M	C.P	E.E	N.F.E	ASH
A1	73.5	26.5	29.95	5.6	33.8	4.15
B1	71.5	28.5	30.12	5.9	30.23	5.25
C1	74.5	25.5	30.6	5.75	33.25	4.9

Where as:

M: moisture.

D.M: dry matter.

C.P: crude protein.

E.E: ether extract.

N.F.E: nitrogen free extract.

Tables (4.7)

The result of Chemical Composition of farmed and wild fish

Parameters	Jebel Awlia	Kuku hatchery	Significant
Moisture	76.67±1.03	73.17±1.47	**
DM	23.00±1.41	26.83±1.47	**
CP	30.77±0.62	30.22±0.31	NS
EE	6.10±0.21	5.75±0.19	*
NFE	35.10±1.12	32.43±1.82	*
Ash	5.03±0.19	4.77±0.54	NS

N=6 fish

*= Significant at P<0.05, **= Significant at P<0.01, NS= No Significant differences

CHAPTA FIVE

DICUSSION

Table (4.5) and (4.6) shows a summary of chemical composition of wild and farmed Nile tilapia (*Oreochromis niloticus*).

Table (4.7) statistical analysis Show protein and fat contents of wild and farmed fish is as flows is (30.77) and (6.10)for the wild and (30.22) and (5.7)for the cultured there are no significant difference between the wild and farmed fish.

this differ from the result given by (SULIMAN 1.et al 2011).

Statically analysis showed that the wild fish is not superior to farmed and there are no significant difference between the wild and farmed fish.

fish in the proximate chemical analysis according to the availability of protein and fat.

From this result the difference found between wild and farmed fish might be due to the type of food given to the fish.

In this study we may say that food given to the fish is similar to the natural food.

CHAPTER Six

6.1 Conclusion:

The chemical composition of Nile tilapia Slight differences between farmed and wild species, it implies that farmed and wild is a Similar in nutritional value.

6.2 Recommend:

- More work should be carried to compare fish from the culture butting in mid the type of food given to fish and compare it with fish from the wild.
- To analysis the chemical composition of Nile Tilapia fishes from different environments.
- Performed chemical composition for farmed fish with differ type of fed.

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