Sudan University of Science and Technology

College of Graduate Studies

A study on Biodiversity of Fish in Al-rahad Turda-North Kordofan State with Emphasis on *Hetrotis spp*

دراسة عن التنوع الحيوي للاسماك في تردة الرهد بشمال كردفان بالتركيز علي أسماك أمكورو

Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in (Fish Science and Technology)

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الآية

قال تعالى:

(وَهُوَ الَّذِي سَخَّرَ الْبَحْرَ لِتَأْكُلُواْ مِنْهُ لَحْمًا طَرِيًّا وَتَسْتَخْرِجُواْ مِنْهُ حِلْيَةً تَلْبَسُونَهَا وَتَرَى الْفُلْكَ مَوَاخِرَ فِيهِ وَلِتَبْتَغُواْ مِن فَضْلِهِ وَلَعَلَّكُمْ تَشْكُرُونَ)

صدق الله العظيم

سورة النحل آية (14)

DEDICATION

To the soul of my late father

To my mother

To my sweetheart

To my lovely hero and my little flowers

To my beautiful sisters and brothers

ACKNOWLEDGEMENT

First I thank the Almighty God who gave me the aptitude and patience to conduct and finish this study so it is my grateful to give sincere thanks to my supervisor ***Dr. Haram Hassan Abbas*** *for her supervision, and assistances in this research. My sincere gratitudes to all the staff members in Sudan University of Science and Technology Faculty of Animal Production. My thanks are extended to the staff of Ministry of Agriculture and Animal Resources, North Kordofan State, Elrahad Locality. I would like to every person who supported me, and to my colleagues.*

ABSTRACT

This study was conducted in the area of Alrahad , North Kordofan State during summer (March, 2017), it aimed to find out the biodiversity of fish in the Turda and to determine the physiochemical parameters of the water (pH, temperature, dissolved oxygen, ammonia and water transparency) of Alrahad Turda, and the body weight composition of the fish species which is found in the Turda in an attempt to find out the impact of water parameters on the fish and to determine the nutritional value of the fish *Hetrotis spp.* Water analyses were done using water analysis devices (Appendix 12- 16). A total of 50 fish samples were collected, ten fishes from five different species found there. The total length, standard length (in centimeters) and total weight (in grams) were determined and body weight composition was done using measuring board (100cm) and normal balance (10kg) (Appendix 1). Chemical analysis of five fish samples (*Hetrotis spp)* was performed to determine the percentages of (protein, fat, ash and moisture) in the fish flesh was done using (AOAC. 2005). Statistical analysis was done using One Way ANOVA Test followed by least significant difference (LSD).

Results of biodiversity indicated that just five species were jn Alrahad Turda, namely (*Oreochromis niloticus, Clarias gariepenus, Lates niloticus, Bagrus baged* and *Hetroti sspp*). Results of water analysis were (0 mg/l) for ammonia, pH (8.5), dissolved oxygen 7.5mg/l, temperature $23^{o}C^{0}$ and Transparency 68/cm). They were in normal range of water for fish in aquaculture. Results showed that *Hetrotis spp* (Omkoro) fish had the most edible parts (66%), followed by *Oreochromis niloticus* and *Lates niloticus* (50%) while *Bagrus bayed*gives (49%) and catfish gave only 44%, proximate composition of *Hetrotis spp* (Omkoro) fish were in Average DM% (83.58), Ash (1.68), CP (27.35), EE (7.41), CF (2.75) and NFE was 46.23. The results

proved that *Hetrotis spp* (Omkoro) presents high amount of flesh and high nutritive value.

المستخلص

أجريت هذه الدراسة في محلية الرهد ولاية شمال كرفان في فصل الصيف (مارس 2017م) وهدفت لمعرفة التنوع الحيوي للاسماك ومعرفه الخصائص الكيميائية والفيزيائية لمياه تردة الرهد (وهي درجة الحموضة والقلوية، الحرارة، الأوكسجين الذائب، نسبة الأمونيا، درجة نقاء المياه) وكذلك لمعرفة التركيب الوزني لأنواع الأسماك المتواجده في مياه التردة. وذلك لتحديد أثر البيئة المائية على نمو تلك الأسماك الموجودة وتحديد القيمة الغذائية لسمكة أم كورو ***Hetrotis spp***. تم تحليل المياه باستخدام اجهزة التحليل الفيزيائي (ملحق 12–16) وكذلك جمع عدد 50 عينة سمك من الأسماك المذكورة بمعدل 10 سمكات لكل نوع. وتم تحديد متوسطات الطول الكلي والطول المعياري (بالسنتيمترات) والوزن الكلي (بالجرامات) مع تحديد التركيب الوزني باستخدام قياس (100سم) والميزان العادي 10كجم (ملحق رقم 1) أما التحليل الكيميائي لأنواع الأسماك الخمسة فقد تم تحديد النسبة المئوية (للبروتين، الدهون، الرماد، الرطوبة) بإستخدام جهاز (AOAC 2005). أما التحليل الإحصائي فقد تم بإستخدام إختبار ANOVA ذو الإتجاه الواحد باتباع طريقة الفرق المعنوي الأقل. أظهرت نتائج التنوع الحيوي وجود خمسة أنواع من الأسماك وهي أسماك البلطي *(Oreochromis niloticus)*، أسماك القرموط *(Clarias gariepenus)*، أسماك العجل *(Lates niloticus)*، أسماك البياض *(Bagrus baged)* وأسماك أم كورو ***(Hetrotis spp)***.

أما نتائج التحليل المائي فقد أظهرت النسب الآتية: (الأمونيا صفر ملغ/ لتر، الحموضة 8.5، الأوكسجين الذائب 7.5، الحرارة 23 درجة مئوية، نقاء المياه 68/سم) وهي تعتبر المستوى الطبيعي وأثبتت الدراسة أن مياه تردة الرهد صالحة للاستزراع السمكي ، وأثبتت أن سمكة أم كورو تمتلك نسبة أعلى من الأجزاء المأكولة 66% وتليها سمكة البلطي والعجل بنسبة 50% والبياض بنسبة 49% بينما سمكة القرموط بنسبة 44% ونتائج التحليل التقريبي لاسماك أم كورو *(Heterotis spp)* أظهرت معدل الرطوبة 83.58% والرماد 1.68%، البروتين27.35% ومستخلص الإيثر 7.41، الألياف الجافة 2.75 والـ NFE 46.23 وأثبتت نتائج الدراسة أيضاً أن أسماك أم كورو لها كمية لحم أكبر وذات قيمة غذائية عالية.

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CHAPTER ONE

1. INTRODUCTION

Fish is one of the most important sources of animal protein available in the tropics and has been widely accepted as a good source of protein and other vital nutrients for the maintenance of healthy body **(Andrew, 2001).** In Sudan fish is distributed over an area of 100.00 km^2 of fresh water and 760 km^2 of marine. The total sustainable production amount to 114-100 tones/year and human consumption estimated at only 1.4kg/year **(Meske, 1985).**

Alrahad Locality is one of North Khordofan localities. Its geographical location adds to its strategic importance because, it's a cross road conjunction linking numerous parts of Sudan, its capital represents a commercial center and a variety of natural resources. All the aforesaid facts make of it a place of strategic aspects (Ministry of Aquaculture and Animal Resources, Northern Kordofan State).

Alrahad is located between longitudes of 18°:30´ and 21°:31´ east and latitudes 45°:12´ and 42°:13´ north. From the north it is adjacent to the locality of Umdam Haj Ahmed and the localities of South Khordofan State southwise, its east border Um Rawaba locality and its westward Shekan Locality. It has an area of about 6,320 km^2. (Ministry of Aquaculture and Animal Resources, Northern Kordofan State).

The population of Alrahad Locality is about 167,838 approximately. The Turda is a permanent water source of 14 km long and 3 km wide with an average depth of 4 meters and a storage capacity of $64X10^6$ m^3, fed by two creeks Um Tkrkr and Abu Habil in the fall season. The city's population for depend on Alrahad Turda as a source of water for drinking and growing vegetables and fruits. Fishing is practiced and it which became a source of

food and income for the local people and the State, as well. The Locality enjoys the satisfactory fish resources which are available in Alrahad Turda. Prior to introduction of fish farming in 2010, the presence of small Tilapia fish has been observed together with mackerel fish and absence of other species such as catfish, calf, and trevally fish. Fishing was unfairly used, where inappropriate fishing nets and mosquito nets were used, and fishermen were not organized in associations and fishing practice was considered as a secondary profession and fish meat was sold only inside the city at low prices. In 2010 other fish species were introduced in Alrahad Turda through a project funded by the Western Sudan Resource Management Program (IFAD), where the quantity of 33,000 fishes of tilapia, calf, catfish and trevally fish were introduced. Fishing in Alturda was organized to be practiced at certain area, called Almashare, (plural of Mushr'a), which are five mashare, namely: Albarageet Mushr'a, Wad Elhindi, Almarwaha, Southern Mushr'a and Samaha Mushr'a and the last is the main Mushr'a. The area is a tourist area for visitors. The overall production of Alrahad Turda in 2013 reached about 306.5 tons. The estimated total fish stocks is about 1000 tons/year, meaning that off take is only about 30%.

Fish of Omkoro (*Heterotis spp*)

Scientific classification:

Family*: Protopterade*

Order*: Lebidosireniformes*

Phylum: *Chordate*

Genus*: Protopterus*

Sp: *Protopterus aethiopicus P. amphibious, P. annetenus, P. dolloi*

Source: (https://www.iucnredlist.org).

The Aims of This Study Were:

- To evluate the biodiversity of fish inAlrahadturda (North Kordofan)
- To determine the physiochemical characteristics of water (pH, temperature, dissolved oxygen, ammonia and water transparency) in Alrahad Turda (North Kordofan State)
- To identify the filleting yield characteristics the fish species which are found in the Turda
- To determine the nutritional value of *Hetrotis spp* fish.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Water Characteristics:

Water is the home of the fish and its quality is one of the most overlooked aspects of pond management until affects fish production. Water quality generally means the component of water which must be present for optimum growth of aquatic organisms (Ehiagbonre and Grundiran, 2010). Water quality is made of physical, chemical, biological factors which influence the use of water for fish culture purposes. The factors include dissolved oxygen, pH, hardress, turbidity, and alkalinity. Ammonia and temperature, and other parameters such as biological oxygen and oxygen demand indicate the pollution level of given water body (Ehiagbonre and Grundiran, 2010).

2.1.1 Water Temperature:

The relative changes of temperature degrees in water bodies are due to the fact that water is highly thermal capacity as compared to the other liquids (Elsuadi, 1986). Many aquatic organisms are affected by temperature degree of the water in which they live from its impact on some bioactivities which like place under certain temperature (Elsuadi, 1986).

2.1.2 Water Transparency:

Transparency, refers to how clean the water, is the major source of the low transparence cause in the open water zone of the most lakes is typically phytoplankton, but closer to the shore line erosion. Also the flood water and too many bottom feeing fish may stir up bottom sediment and increase the clouding of water (Asma, 1984 and Michaud, 1991).

2.1.3 pH .values:

The pH of natural water depends on several factors**:** the carbonate system, type of rock, type of soil, and nature of discharged pollutant. The concentration of carbonates ($CO_4 2HCO_3^{-1}$) **and** carbon dioxide (CO_2) in the main influence on the pH of clean water. High concentration produces alkaline water (pH high) while low concentration usually produces acidic water i.e low pH (Kreger, 2004).

2.1.4 Dissolved Oxygen:

In water, oxygen is available in dissolved state; it is in microscopic bubbles mixed in between water molecules can inter to the system through direct diffusion as by product of photosynthesis. This means then the level of dissolved oxygen in the water can be increase through the mechanical erosion it is removed through respiration and decomposition (Lawson, 1995)**.**

2.1.5 Ammonia NH_3:

Ammonia (NH_3) is by product from hydro carbonate industry. It is gas at normal atmospheric pressure easy to liquefy and readily dissolved in water and usually available at every high degree of purity (99.0%). Storage in liquid statute requires container able to resist high pressure. Ammonia hydroxide (NH_4OH) is solution of ammonia and has a concentration of 2050 g/kg of ammonia (FadelElseed, *et. al.*, 2003).

2.2. Fish Body Weight Composition:

Filleting implies removal is of bones and fins from the flesh. Filleting and trimming are important for logistics economics and has added value along the marketing chain and in separation of inedible part from the edible ones, filleting can be done either by machine or hand. Hand filleting is laborious and time consuming (Rora, *et. al.*, 2001).As many animals' products fish and

fishery water, proteins and other nitrogenous compound, lipids carbohydrate, minerals and vitamins. However, chemical composition of fish varies greatly from one species and one individual fish to another, depending on age, sex environmental and season (Huss, 1995).

The fish has skeletal or cartilaginous structure which provides support for the body. The muscles which from the edible part account for most of the weight of the fish. The skin forms from cover often with an outer layer of scales, and secret slimy mucus, which lubricates the fish and seals, the surface. The gills are the main part of the breathing mechanism and take up oxygen from the water. The organs in the abdominal cavity, including the stomach, intestine and liver are known as the guts. The removal of the guts is normally the first step in handling and preservation.

Weis (1953) reported the edible fraction of the different fish species varies wildly between 30%- 50% total weights.

Furthermore Finne, *et. al.*, (1980) found that the yield of deboned flesh of some of the fish species from Gulf of Mexico varied from a maximum of 31-3% to a minimum of 20- 0%.

The lipid contents of the fillets from lean fish are low and stable whereas that from fatty species varies considerably (Huss, 1995). However, the variation in the percentage of fat is reflected in the percentage of water, since fat and water normally constitute around 80% of the fillet. As a rule of thumb, the amount of fat can be estimated from an analysis of water content in the fillet (Huss, 1995). Obonu and Ikeme (1988) carried out studies on processing characteristics and yield of some fish of the river Niger. They mentioned that the fillet, head, viscera and bones were in the range 33.5-68%, 11-31%, 3.89-9.8% and 1.32-15.3%, respectively.

Eye (1991) studied carcass composition and filleting yield of ten fish species from Knjilake. He reported that the weight of whole fish and weights of fillets were highly significantly different to each other ($p<0.01$).

Mac (1992) carried out studies on meat, yield and nutritional value determination of *O. niloticus* and *S. galiaeous*, and found that the processing characteristics of this species have decreasing order of fillets, head skeleton, viscera and skin.

Remijo (1992) reported that the *Labeo spp* exhibit the decreasing order of fillets, head viscera and skin. Ali, *et. al.*, (1992) studied body characteristics yield assessment and proximate chemical composition of commercial fish species namely, *Lates niloticus, O. niloticus, Sarotheradeom galilaeous, Labeo niloticus* and *Labeo horie*. The result of characteristics and yield indices revealed clearly percentage decrease in the order of fillets, heads, skeleton, viscera and skin for *Tilapia spp*. compared to order of fillets, skeleton, viscera, head and skin for *Labeo spp.*

Adebona, (1981) pointed that the percentage of bone and gut for Chrysihys was (47.87%) and for Bagus (46.2%) whereas, that of Tilpia was (35%). Ognia, (1991) studied the estimated catch and percentage composition remove about 40% fillet. Thus leaving about 60% carcasses, (skeleton and gut), with about 15-38% flesh still attached. Jock, (1996) revealed in his study on the percentage of fillet, head, viscera and skeleton of four different fish species (*Bagarus bagarus*, *Bagarus domak*, *Barbus bynn* and *Synodontis spp*) at Nuba lake was as follows: 49.86% 5%, 4.78 and 20% - 45.17%, 11.40, and 18.43%, respectively. Siham (1999) showed that the percentage of head viscera, skin, skeleton and fillet of *Protopterus aethiopicus, Malapaterunus electicus* and *Tetradon fahak* bought them from Elmorada fish market were as follows: 16.59 – 10.88%, 28.99%, 10.26% and 29,2-19.26%, 17-9%, 16.02%-

13.35% and 27.29%-5%, 24.58%, 13.76%, 21.66%, 6.61% and 30.56%, respectively. Abdel Raheem, (2010) reported that percentage of protein, lipid, ash and moisture of three fish species (*Distichodus niloticus, Labeo niloticus* and *Claris spp*) were as follows: 21.30%, 21.30% and 21.30-1.20% and 1.07% - 19.33%, 19.33% and 18.60% - 78.66 and 72.33%, respectively. Moreover, he studied the body weight composition of three fish species (*Distichodus niloticus, Labeo niloticus* and *Claras spp*) and average of total length (cm), standard length (cm) and total weight (g). His findings were as follows: (39.75g), (33.25g) and (676.33g) for *Distichodus niloticus*. (29.33g), (23.33g) and (251.50g) for *Labeo niloticus* and (41.25g), (37.17g), (497.33g) for *Claras spp*. Salih (1995), studied the body structure yield indicators and physical analysis of *Labeo niloticus* from commercial fish landing at Khartoum and mentioned that fillets yield of this species was about 37% of the total weight.

2.3 Chemical Composition:

Fish is wildly accepted because of it s highl palatability. Low cholesterol and tender flesh (Onyi, *et. a.,l* 2010). However less number of consumers eats fish because of its nutritional value. It is therefore necessary to raise the awareness of consumers and fishery on the nutritional contribution of some fish species in their diets (Adewoue, *et. al.,* 2005). Zaitsev, *et. al.,* (1969) conducted studies on fish curing and processing. They mentioned that the food value is normally estimated only approximately according to amount of edible material (flesh) and its content of the basic nutrient (protein and fat). Fish species with low levels of fat are suitable for processing fat content increases, while water content decreases correspondingly. Heating undoubtedly causes oxidation of lipid in fish (Autken, 1979). The food value of fish species is determined by balance between relative amounts of these main components, protein, fat, moisture and mineral present in flesh (**Asia**, 2003).

Dirar (1993) reported that the proximate composition of *Hydrocynus spp* was 34% moisture, 8.7% protein 6.7 fats and 16.6% ash. Romijo (1992) reported that the moisture of fresh *Labeo spp* fish was (70.4-71.2%). Clucas (1996) reported that the crude protein of fresh fish ranges between 14-20% and higher levels are obtained during winter season. Ali, *et. al.,* (1996) studied body characteristics yield and chemical composition of *Labeo spp*. They found that the results of the proximate chemical composition were 76.7%, 19.3%, 2.1 and 1.6% for moisture protein, fats and ash, respectively. Siham (1999) study on the chemical composition of three different fish species (*Protopterus aethiopiacus, Malapaterurus electricus and Tetradon fahakh*), from Almawrada Fish Market revealed that the protein percentage of the three fish species whereas follows: 20.89%, 20.4% and 20.6%, respectively. The fat content was 0.15% and 0.36%. respectively. Ash content was 2.89%, 1.56% and 0.51%, respectively.

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Study Site:

This study was conducted in Alrahad Turda, North Kordofan State, in summer March, 2017.

3.2 Water Analysis

Water samples were taken in the study area and examined for (pH, temperature, and dissolved oxygen, ammonia and water transparency) using water analysis devices.

3.3 Fish Samples:

Fish were caught using gill nets from different site of collection in order to find out all species found there consequently fifty fish samples of five fish species (*Oreochromis niloticus, Clarias gariepenus, Lates niloticus, Bagrus bayed ,Hetrotis spp).* Which were found in the Turda Were used for body weight composition, ten fish from each species, The total length and total weight of individual species were taken using measuring board (100cm) and normal balance (10kg) (Appendix 1). Five samples of *Hetrotis spp* were chosen for chemical analysis.

3.4 Experimental Procedure

Total length, standard length, total weight and filleting yield indices were determined using different materials (sharp knives, a balance and a measuring board) and recorded in separated tables. The fish sample were washed thoroughly with tap water and weighed individually and degutted, headed and filleted using sharp and clean knives. The fillets of *Hetrotis spp* fish have been frozen and packed in a thermos and sent to the Department of Animal

Nutrition, Faculty of Animal Production, University of Khartoum, to determine chemical composition parameters (moisture, protein, fat, dry matter and ash), as described by (AOAC 2005).

3.5 Measurements of Fish Length and Weights

3.5.1 Total Length: Is a maximum length of the fish, with the mouth closed and the tail Fin pinched together.

3.5.2 Standard Length

Is the measurement taken from the tip of the lower jaw to the posterior end of the hyporal bone (Anderson and Gutruter 1983).

3.5.3 Fork Length

Is the Measurement taken from the anterior most point of the fish to the end of the median caudal fin rays (Anderson and Gutruter 1983).

3.6 The Weight Measurement:

The weights were taken using measuring normal balance (10kg).

3.7 Chemical Compositions

Moisture content, crude protein, fat and ash were determined for wet samples according to standard methods of Association of Official Analytical Chemists. (AOAC, 2005) Fillets were minced and chilled prior chemical analysis using standard method of to determine proximate composition. **(**Deng, *et. al.*, 2016). For each size group, 5 g of homogenised samples were weighed out in triplicate into pre conditioned moisture dishes. The dishes with samples were placed in oven and dried for 16 hours at 98 °C, as this temperature avoids losses of volatile food components. After the 16 hr of drying, the dishes were cooled down in desiccators and the moisture content of the samples calculated accordingly (Kasozi *et. al.*, 2014).

3.7.1 Moisture Content

The moisture content was determined according to the standard methods of the Association of Official Analytical Chemists (AOAC, 2005).

Procedure:

A sample of 5 g was weighed into a pre-dried and tarred dish. Then, the sample was placed into an oven (kat-nr.2851, Elektrohelios, Sweden) and left to dry at 105 ºC until a constant weight was obtained. After drying, the covered sample was transferred into a dessicator and cooled to room temperature before reweighing. Triplicate results were obtained for each sample and the mean value was reported two decimal points according to the following formula:

Calculation:

Moisture content %

$$\text{Moisture content \%} = \frac{(w1-w2)}{W1} \times 100$$

Where:

W1= original weight of sample.

W2= weight of sample after drying.

3.7.2 Protein Content

Crude protein was determined by the Kjeldahl methods using sulphuric acid for sample digestion. Total nitrogen was quantified by titrating the distillate against 0.05 M hydrochloric acid. Methylene blue and methyl red mixture was used as indicator. Crude protein was determined by multiplying the nitrogen value by the conversion factor of 6.25.

Procedure:

0.5g of the sample was accurately weighed and transferred together with 2-3 glass pellets, Kjeldahl catalyst and 20 ml of concentrated sulphuric acid into

Kjeldahl digestion flask. After that, the flask was placed into a Kjeldahl digestion unit for about 3 hours, until a colorless digest was obtained. Following, the flask was left to cool to room temperature. The distillation of ammonia was carried out in 30 ml boric Acid (2%) by using 40 ml distilled water and 60 ml sodium hydroxide Solution (33 %). Finally, the distillate was titrated with standard solution of 0.1N HCL in the presence of 2-3 drops of indicator (Bromocreasol Green and Methyl Red) until a brown reddish color was observed. The total nitrogen and protein were calculated using the following formula:

$$N\% = \frac{\text{Volume of HCl} \times N \times 14}{\text{Weight of Sample} \times 1000} \times 100$$

P%= N% X 6.25 (Factor)

Where:

N% = crude nitrogen (%).

P% = crude protein (%).

N = normality of HCL.

14 = equivalent weight of nitrogen.

3.7.3 Fat Content

Fat content of each sample was determined according to Soxlet method by ether extract using 2 gm of fish samples. Extraction continued for 5 hours at 100°C before finding the weight of the extract fat.

Procedure:

A sample of 5g was weighed into an extraction thimbles (30 100 mm) and covered with cotton that previously extracted with petroleum ether. Then, the sample and a pre-dried and weighed Erlenmeyer flask containing about 100ml petroleum ether were attached to the extraction unit (Electro thermal,

England) and the temperature was adjusted to produce about 150 to 200 drops of the condensed solvent per minute for 16 hours. At the end of the distillation period, the flask was disconnected from the unit and the solvent was redistilled. Later, the flask with the remaining crude ether extract was put in an oven at 105 ºC for 3 hours, cooled to room temperature in a dessicator, reweighed and the dried extract was registered as crude fat according to the following formula:

Calculation:

$$\text{Fat \%} = \frac{(W2-W1)}{W} \times 100$$

Where:

W1 = weight of empty flask.

W2 = weight of flask with oil.

W = weight of sampling.

3.7.4 Ash Content

The ash content was determined by burning the samples for about 6 hour at 400-600ºC in a muffle furnace. Crude ash was determined by incineration in a muffle furnace at 550°C for 10 hours. Ash was determined by heating 1 gm at 550°C in muffle furnace until a constant weight was obtained.

Procedure:

A sample of 5g was weighed into a pre- heated, cooled weighed in porcelain crucible. Before ashing, the sample was pre-washed on an electrical pre-asher and placed into a muffle furnace (Carbolite, Sheffeild, England) at 550 ºC. After complete ashing, the crucibles with ash were transferred directly to a dessicator, cooled, weighed and the ash content was calculated as percent of the original weight of sample:

$$\text{Ash content \%} = \frac{(W1-W2)}{W} \times 100$$

Where:

W1 = weight of crucible with ash.

W2 = weight of empty crucible.

W = sample weighting.

3.8 Statistical Analysis:

The obtained results were analyzed using One Way ANOVA. Test followed by least significant difference (LSD) and using SPSS V.16 program. Also person correlation and simple regression analysis was fitted using S. Growth, compound mathematical models.

CHAPTER FOUR

4. RESULTS

4.1 Water Analysis:

The physiochemical parameters of the water of Elrahad Turda (ammonia, pH, dissolved oxygen, temperature and transparency) were in normal range for fish.

Table (1): Shows physiochemical characteristics of water from Alrahad Turda for different three days

Parameters	Days		
	1st	2nd	3rd
Ammonia (mg/l)	0	0	0
pH	8.5	8.5	8.5
Dissolved Oxygen (mg/l)	7.5	8.2	8
Temperature (°C)	23	24.4	22.9
Transparency (cm)	68	63	58

Table (2): Shows body weight compositions (gm) of the five fish Species found in the Turda (Mean+SD)

Fish species	Total wt	Head wt	Viscera wt	Skin wt	Skeleton wt	Fillet wt.	Clearance ratio
Oreochromis niloticus	372.20^{b}	96.40^{a}	28.10^{b}	13.20^{b}	53.30^{a}	185.00^{b}	50%
Clarias gariepenus	744.00^{ab}	195.70^{a}	54.60^{b}	22.90^{ab}	69.40^{a}	430.60^{ab}	44%
Bagrus bayed	378.80^{b}	110.10^{a}	16.70^{b}	12.80^{b}	42.50^{a}	165.50^{b}	49.%
Lates inloticus	458.30^{ab}	112.60^{a}	34.20^{b}	14.80^{b}	53.00^{a}	229.00^{b}	50%
Hetrotis spp	989.40^{a}	137.70^{a}	133.70^{a}	42.90^{a}	28.90^{a}	649.10^{a}	66%
Sig.	0.04	0.2	0.001	0.03	0.4	0.01	0.00
	**	*	**	**	*	**	**

^{abc}Means in the same column without common letter are significantly different at P<0.01

* Significant

** Highly significant

Table (3): Shows the Total and Standard Length of the Studied Fish Species (cm).

Fish species	Total length (cm)	Standard length (cm)
Oreochromis niloticus	25.10[c]	14.70[c]
Clarias gariepenus	42.60[b]	28.50[b]
Bagrus bayed	39.60[b]	24.90[b]
Lates niloticus	30.40[c]	16.50[c]
Hetrotis spp	58.30[a]	45.80[a]
Sig	**	**

[abc]Means in the same column without common letter are significantly different at P<0.01

** Highly significant

Table (4): Shows the Approximately Analysis of Chemical Composition of Omkoro Fish (*Heterotis spp*).

Sample number	Parameter					
	DM%	**Ash**	**CP**	**EE**	**CF**	**NFE**
1	83.87	1.02	32.55	7.63	2.51	40.16
2	83.50	1.04	31.50	7.60	2.53	40.83
3	83.47	2.50	26.20	7.31	0.00	47.46
4	83.52	2.60	26.26	7.33	0.00	47.33
5	83.48	2.00	26.25	7.30	2.44	45.49

CHAPTER FIVE

5. DISCUSSION

The result of this study should shed a light to acknowledge of the biodiversity of fish in the Alrahad Turda and the physiochemical characters of the water it has found the degree of temperature 23°C is suitable for growth of five species in the Turda, and the pH is about 8.5 it alkaline due to the nature of amount minerals in the soil and the wasted of chemical materials from boat activities, therefore the transparency about 63 is not clear. The dissolved oxygen is available in acceptable amount.

The fillets yield results indicates that the body weight composition revealed significant differences $P<0.01$ in head, viscera, skin, skeleton, and fillets of five fish (*Oreochromis niloticus, Clarias gariepenus, Lates niloticus, Bagrus bagrus, Hetrotis spp*) This result is in disagreement with Eyo (1991). Who studied carcass composition and filleting yield of ten species from Kanjilake And Obonu and Ikem (1988) in their studies on processing characteristics and yield of some fishes of the river Niger mentioned that the fillets, head, viscera, and bones were in the range 33.5-68%, 11-3.89%- 9.8% and 1.32-15.3% respectively. The results obtained disagreed with Mac (1992). Generally, the filleting yield of the studied fishes were reflection of another anatomy, species with large head, skin, and skeleton, relative to musculature lower filleting yield than those smaller head, skin and skeleton. Few considerations head and skeleton are used as by product.

The result of proximate chemical composition disagreed with Clucas and Ward (1996). They reported that the crude protein of fresh ranges between 14-20% and higher levels are obtained during winter season and also disagreed

with Dirar (1993) whose reports of the proximate composition of *Hydrocyanus spp*. were 34% moisture, 8.7% protei , 6.7% fat and 16.6% ash. Remigo (1992) reported that the moisture of *Labeo spp* fish was 70.4- 7.2%)

CHAPTER SIX

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion:

- From the results just five fish species were found in Alrahad Turda namely (*Oreochromis niloticus, Clarias gariepenus, Lates niloticus, Bagrus bagrus, Hetrotis spp*).
- The study addresses the characteristics of water in the Elrahad Turd , the final findings shows the potentiality for fish aquaculture, while the water alkalinity (pH 8.2) stands as challenge.
- The *Heterotis spp* shows the highest edible meet percentage compared with the other four species, so that we can recommend being additional choice for consumers.
- *Heterotis spp* was found that it has a high nutritional value according to the proximate composition.

6.2 Recommendations:

- Further studies should be conducted in this field regarding the unusual fish species as human consumption.
- Omkoro fish can be filleted and processed in order to be introduced to human feeding besides using the rest of its parts as byproduct for animal feed.
- Conserving fisheries stock and initiation of other reservoirs for fish to cover the local community needs is highly recommended.
- Further studies and analysis of the water of Alrahad Turda in different seasons are needed.

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APPENDICES

Appendix 1: Weighing a studied fish with a balance.

Appendix 2: Measuring fish using a measuring tape.

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Appendix 3: Omkoro (*Hetrotis spp)*.

Appendix 4: *Lates niloticus* fish from Alrahad Turda.

Appendix 5: *Clarias lazera* fish from Alrahad Turda.

Appendix 6: *Hetrotis spp* from Alrahad Turda.

Appendix 7: *Hetrotis spp* from Alrahad Turda.

Appendix 8: *Lates niloticus* from Alrahad Turda.

Appendix 9: *Hetrotis spp* from Alrahad Turda.

Appendix 10: *Hetrotis spp* from Alrahad Turda.

Appendix 11: pH meter used for water analysis.

Appendix 12: HI 96700Ammonia LR used for water analysis.

Appendix 13: Dissolved Oxygen meter used for water analysis.

Appendix 14: Measuring pH in Alrahad Turda.

Appendix 15: Measuring oxygen in Alrahad Turda.

Appendix 16: View of water at Alrahad Turda.

Appendix 17: Alrahad Turda.