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# Evaluation of Chemical and Physical Properties of Fish in Different Water Nile in Khartoum State

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## Abstract
This study was conducted in Khartoum State -Sudan to evaluate the effects of fish species *Malpetrauselectriccus* (A) , *Tetradonfahaka*( B) and water environment on chemical, physical properties of fish patties. Fish species samples were collected from three different water environments, River Nile(R.N), White Nile(W.N) and Blue Nile(B.N). Patties were formulated after collection of the fresh fish as two groups(A and B) . The chemical analysis showed that, the protein, moisture, ash content and ether extract (E.E) were significantly different($p< 0.05$), among samples in the two groups(A and B) as the highest protein content(31.30 ±0.232)was shown in A in R.N and the lowest one (29.37±0.175) reported at B in W.N. Group A in W.N reported the highest content of ether extract(6.37±0.21) ,however the lowest content was found in B in R.N. The pH showed no significant difference between the two groups ($p>0.05$) in the three water environments ,while samples of the two groups(A and B) were significantly different ($p< 0.05$) in cooking loss that B in B.N reported the highest percentage ( 38.00±2.48),in reverse to A in W.N that recorded the lowest percentage (28.00±2.48 ).The difference in fish species and water environments affected significantly on chemical composition and cooking loss of fish patties.

**Keywords:** Fish patties, *Malpetrauselectriccus* , *Tetradonfahaka*. Sudan.



## Introduction
Fish has been one of the main human foods for many countries ,and still constitutes an important part of the international trade, currently worth more than 50 billion $US, indicating increasing consumer interest in the commodity since 70% of the Earth's surface is covered by water ,there are plenty of sources to harvest(Samakupa,2003).

About 96% of fish captured in Sudan, comes from fresh water fisheries, of which 55% is from the White Nile, Blue Nile, Atbara River and Nubia Lake (Carleton and Pena,1982). Sudan is endowed with diversified surface, underground water sources and resource and arable lands suitable to support vigorous capture fisheries and aquaculture industry y. Currently, capture fisheries activities are centered around the River Nile and its tributaries, and the territorial waters of Sudan on the Red Sea(FAO, 1999).

Fish has been recognized as a high quality protein and fat that are completely digested and assimilated in the body than that of any other proteins and fat. Fish oils are a rich source of ω3fatty acids those have beneficial health effects in the prevention of a number of diseases such as coronary heart diseases, inflammation, autoimmune disorders and cancer (Sahena *et al*., 2010). However, there is substantial evidence that fish and seafood are high on the list of foods associated with outbreaks of food borne diseases (Huss, 1997). Increasing seafood is being used as the dish of choice owing to its healthy image and delicious taste.

Proximate composition of fish involves the determination of moisture, lipid, protein and ash content. Carbohydrate is determined by difference. The proximate composition of fish is affected by a diversity of factors such as: size, sexual maturation, temperature, salinity, exercise, ration, time and feeding frequency, starvation, type and amount of dietary ingredients (Shearer, 1994).

Physico-chemical characteristics are important determinants reflecting the condition of freshwater fish assemblages. It has been established that habitat variables such as water temperature, velocity, substrate, conductivity, depth and width, altitude and distance from the source influence river fish composition (Li *et al*., 2012). Generally fish is made up of 70-84 percent water, 15-24 percent protein, 0.1-22 percent fat and 1-2 percent minerals and 0.1-1 percent carbohydrate(Holma *et al*.,2013, Suganthi *et al.,* 2015,Tidwell *et al*.,2001 ) . Fats from fatty fish species contain poly unsaturated fatty acids (PUFAs) namely, EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) (omega 3 fatty acids) which are essential for proper growth of children and prevent the cardiovascular diseases such as coronary heart disease ( Hantoush *et al*.,2014, Marta,2015, Suganthi *et al.,* 2015). The nutritional value of fish used as a source of food is obtained from its chemical composition, which varies widely from species to species and within the same species can affect the chemical composition in fish, Akinneye *et al*.,(2010). However, in different environmental conditions, the composition of the fish may differ in relation to the differences in water quality, feeding conditions, sex, and state of maturity, (Brett *et al.*,1969, Javaid, *et.al*.,1992).

In recent years, the increase of the world's population as well as various socioeconomic changes has caused to an increase of the consumer's preference for ready-to-eat foods. Fish paste products are of the most preferred ready-to eat foods by consumers around the world and many studies have been conducted on the production, quality, and stability of these foods (Çaklı 2008; Cakli *et al*., 2005).

The principle fish processing methods in Sudan are smoking ,salting ,sun –drying, fermentation, grilling and frying. The predominant type of fishery products in any particular country are closely related to the food habits and purchasing power of the population. Specific types of fishery products are best suited as the local staple food. Furthermore, due to the lack of a good transport infrastructure for the transportation of fresh fish to towns and villages, lack of (modern) preservation techniques cured fish is the most convenient in which fish can be sent to such areas(Ali,1994).

Fish industry has been developing processed or minced fish products such as fish burgers, fingers and sausages, which add cooking convenience to nutritional benefits (Mohammed *et al*., 2007).

The objectives of this study were to increase the current economic value of fishes which have cheapest price or un preferred by consumers , and investigate the suitability of patties processing from flesh of *Maleptruruselectricus* and

*Tetrodonfahaka*, and their physical, chemical properties in different water environments i.e. River Nile, White Nile and Blue Nile.

## Materials and Methods

This study was carried out in Khartoum state –Sudan using the meat Technology laboratory facilities of the College of Animal Production Science and Technology, Department of Meat Science andTechnology.Two fish species *Malapterus electric s*and *Tetrodonfahaka* were collected from River Nile, White Nile and Blue Nile .

Patties Formulation

Fish Preparation

Fresh fish meat 3Kg of each species *Malapterus electricus*(A) and *Tetrodon fahaka*(B), from three different water environments (River Nile, White Nile and Blue Nile), were collected after fish deboning. Three replications for each species were done during the experimental period .

River Nile samples were collected from River Nile (Shampat), White Nile samples were collected from Jubal Awliaa Dam , Blue Nile samples were collected from East Blue Nile (ElGerief Market). Fresh fish were preserved in an insulated box contained crushed ice at 5c$^{o}$ during transportation. Fish was filleted thoroughly with proper methods and after that washed and chilled prior to processing which was done under good hygienic condition.

**Patties Preparation**

fish flesh( one kg) from each species (A and B) were taken from the three different environments (River Nile, White Nile and Blue Nile) used in patties preparation .The fish flesh was ground through 0.25 inch plate of electrical meat grinder Plate 3. Each batch was chopped separately. The chopper was started after fish meat mincing, then boiled potatoes were added and chopped, half of the recommended ice water was added and uniformly dispersed, then the binder (skimmed milk) and seasoning( Cinnamon, Mace, Cardamom, Coriander and Black pepper ) were added together with the remainder of the recommended ice water(Table 1) . Then the patties were manually formulated in cylindrical shape about 4 inches in length. After that the product immediately stored in refrigerator at (4$^{o}$c) waiting different tests .Three patties link were taken randomly from each treatment sample for approximate analysis in the Central Veterinary Research Laboratory (Soba). Three replicates were done.

**Table 1: Ingredients of the Fish Patties Recipe**

| Ingredients | Quantities / g | Percentage ( %) |
|---|---|---|
| Fish meat | 1000 | 66.05 |
| Bread crumbs | 100 | 06.61 |
| Ice-water | 150 | 09.91 |
| Garlic paste | 5 | 0.33 |
| Coriander | 3 | 0.20 |
| Cinnamon | 3 | 0.20 |
| Salt | 18 | 1.19 |
| Potato | 200 | 13.21 |
| Mace | 2 | 0.13 |
| Skimmed milk | 30 | 1.98 |
| Cardamom | 2 | 0.13 |
| Black pepper | 1 | 0.06 |

**Chemical Analysis**

The determination of dry matter ,ash, crude protein and fat were performed according to A.O.A.C(2002) for fish patties.

**Moisture Determination**

The samples were weighted at first (initial weight), then dried in electric oven at 105 $c^0$ between 24 – 30 hours to obtain a constant weight. The moisture content was calculated as following :

Moisture %

$$= \frac{\text{Initial weight – dry weight}}{\text{initial weight}} \times 100$$

**Crude Protein Determination**

The Kjeldahl method for estimation of nitrogen was applied . Nitrogen content was converted to protein by multiplying 6.25 as follow

$$\text{Protein \%} = \frac{(V_a - V_b) \times N \times 14 \times 100 \times 6.25}{1000 \times wt}$$

Where :

$V_a$= volume of HCL used in titration

$V_b$ = volume of NaoH of known normality used in back titration.

0.014 = conversion factor of ammonium sulfate to nitrogen .

6.25 = conversion factor of nitrogen to protein

Wt = weight of tissue sample .

**Fat Determination**

Fat content (ether extract) of each sample was determined according to Soxhlet method, using 2g of fish sample. The extraction continued for 5 hours at 100 c˚.

$$\text{Fat \%} = \frac{\text{Extraction fat weight}}{\text{initial weight}} \times 100$$

**Ash Determination**

Ash was determined by heating 1g at 55 c˚ in a muffle furnace until a constant weight was obtained. Ash content percent was calculated by the following formula :

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

**Nitrogen –free extraction**(NFE)

NEF % = 100 – (Dry matter

or (moisture% + protein% + fat% + ash%)

**Physical Determination**

**pH Determination**

The pH was determined by blending 5g of fish patties sample with 40ml of distilled water at high speed stirrer for one minute. The pH was determined by using ph meter (microprocessor pH meter-HANNA model pH 210)that had been calibrated with standard buffers (pH 7.0 ).

**Cooking loss% Determination**

Cooking loss was calculated by the difference in known sample before and after cooking as percentage .

$$\text{Cooking loss} = \frac{\text{Wt.of sample before cooking – wt.of sample after cooking}}{\text{wt.of sample before cooking}} \times 100$$

**Statistical Analysis**

The data of this study were analyzed statistically using computer statistical package for Social Science (SPSS version 21). General Linear Model - Two - way analysis of variance (ANOVA) and regression line as described by Zar (1984).

**Results**

The study included processing of sample of patties from two species *Maleptrurus electricus* (A)and *Tetrodon fahaka*(B)in different water environments River Nile ,White Nile and Blue Nile and the chemical, physical evaluation of the above samples were conducted.

Protein, ash, moisture content and ether extract (E.E) percentage showed significant differences ($p< 0.05$) among treatments of the samples within the two groups A and B ( table 2) while group (A)in R.N have the highest protein content(31.30±0.232) compared with other groups in different environments( Figure 1)while group,(B) have the highest ash percent other than group A which recorded the lowest ash percent in the same river

( Figure 2) ,also moisture content in group B in Blue Nile is higher compared with that in River Nile and White Nile .On other hand group A in W.N recorded the highest ether extract (6.37±0.21)compared to the same group and group B in the other environments.

**Table 2: Means and their standard deviation values for chemical composition of fish patties from *Maleptrurusel ectricus* and *Tetrodon fahakain* in (River Nile, White and Blue Nile) in Khartoum State**

| Water supply | Species | Moisture% | Protein% | Ash% | D.m% | E.E% | N.F.E% |
|---|---|---|---|---|---|---|---|
| River Nile | Group(A) | 77.33±4.04$^{a}$ | 31.30±0.232$^{b}$ | 1.76±0.25a | 21.66±2.52$^{b}$ | 6.13±0.23$^{b}$ | 38.77±3.270$^{a}$ |
| | Group(B) | 79.66±1.52$^{b}$ | 30.5±4.175a | 2.56±0.67$^{b}$ | 20.33±1.53$^{a}$ | 5.84±0.21$^{a}$ | 40.73±1.935$^{b}$ |
| | Mean | 78.50±3.02$^{b}$ | 30.39±.468$^{a}$ | 2.10±2.0$^{b}$ | 21.00±2.00$^{a}$ | 5.985±0.26$^{a}$ | 37.75±2.635$^{a}$ |
| White Nile | Group(A) | 78.00±1.00$^{b}$ | 30.74±.402$^{b}$ | 2.50±0.50$^{a}$ | 22.00±1.00$^{a}$ | 6.37±0.21$^{a}$ | 38.59±1.330$^{b}$ |
| | Group(B) | 76.33±2.52$^{a}$ | 29.37±.175$^{a}$ | 2.50±0.44$^{a}$ | 23.67±2.52$^{b}$ | 6.34±0.31$^{a}$ | 37.66±2.315a |
| | Mean | 77.17±1.9$^{a}$ | 30.19±.474$^{a}$ | 2.50±0.42$^{b}$ | 22.33±1.94$^{b}$ | 6.35±0.23$^{b}$ | 38.13±1.175$^{b}$ |
| Blue Nile | Group(A) | 74.00±3.61$^{a}$ | 30.65±.410$^{a}$ | 1.83±0.21$^{a}$ | 26.00±3.61$^{b}$ | 6.26±0.15$^{b}$ | 35.30 .0661$^{a}$ |
| | Group(B) | 80.0±0.10$^{b}$ | 31.13±.132$^{b}$ | 2.00±0.02$^{b}$ | 20.00±1.00$^{a}$ | 5.93±0.12$^{a}$ | 40.33±1.119$^{b}$ |
| | Mean | 77.00±.40$^{a}$ | 30.86±.468$^{a}$ | 1.92±.20$^{a}$ | 23.00±4.05$^{c}$ | 6.10± 0.20$^{b}$ | 37.90±3.724$^{a}$ |

a ,b,c mean superscript within the same column are significantly different at level ($p<0.05$).

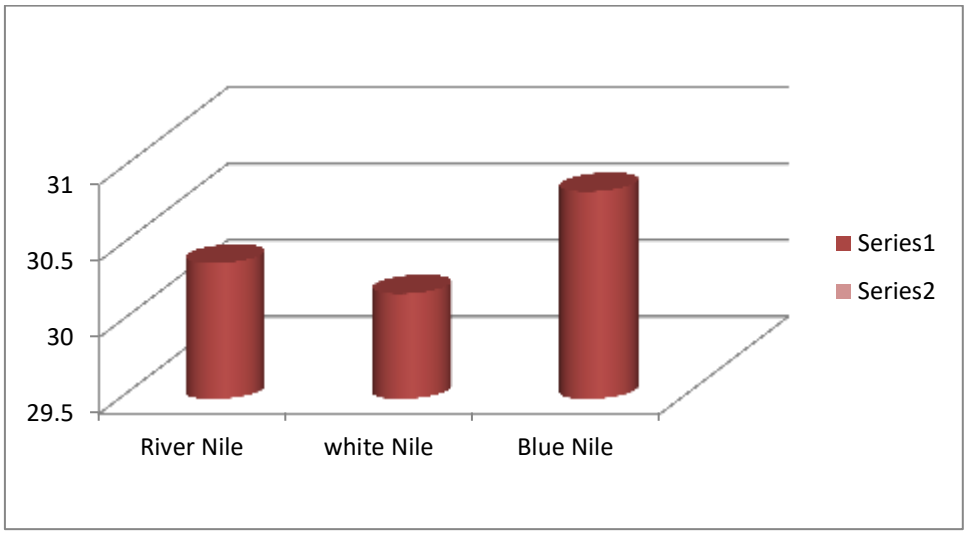


Figure 1:Protein contents in River Nile,White Nile and Blue Nile

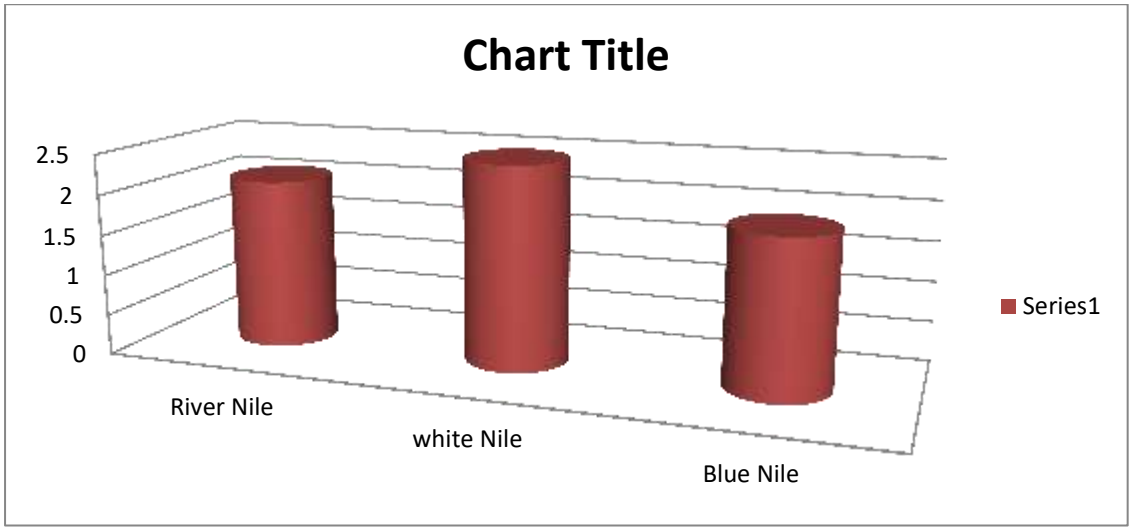


Figure 2: Ash contents in River Nile, White Nile and Blue Nile

**Physical analysis**

The results of pH recorded no significant difference among the treatments ($p>0.05$)of the samples within the three environments as in(Table 3) (Figure3), although group B revealed the highest percentage(6.16±0.057) in W.N and lowest percentage was reported in group A in R.N .

As for Cooking loss there was significant difference among the treatments ($p<0.05$) (Table 3) that the highest percentage was shown in group B in (B.N)while the lowest content of cooking loss(28.00±2.48)appeared in group A in W.N( Figure4).

**Table 3: Means and their standard deviation for pH and cooking loss of fish patties from *Maleptrurus electricus*(A) and *Tetrodon fahakain*(B) in (River Nile, White Nile and Blue Nile)in Khartoum State**

| Environment | Species | Ph | Cooking loss |
|---|---|---|---|
| Rive Nile | Group A | 6.03±0.057[a] | 36.00±2.48[b] |
| | Group B | 6.06±0.017[a] | 32.00±2.48[a] |
| | Mean | 6.05±0.055[a] | 34.66±2.70[b] |
| White Nile | Group A | 6.13±0.0577[a] | 28.00±2.48[a] |
| | Group B | 6.16±0.057[a] | 35.00±2.48[a] |
| | Mean | 6.150±0.035[a] | 31.83±6.40[a] |
| Blue Nile | Group A | 6.11±0.011[a] | 33.00±2.48[a] |
| | Group B | 6.230±0.054[a] | 38.00±2.48[b] |
| | Mean | 6.10±0.022[a] | 35.00 ±5.78[c] |

a,b,c mean superscript within the same column are significantly different at level ($p<0.05$)

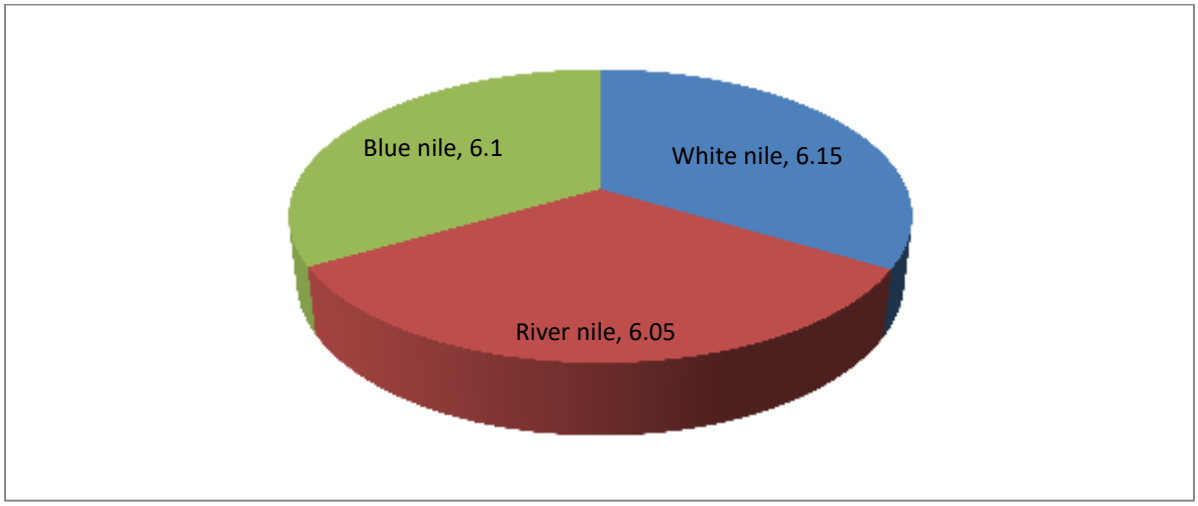


Figure 3: pH means in River Nile, White Nile and Blue Nile.

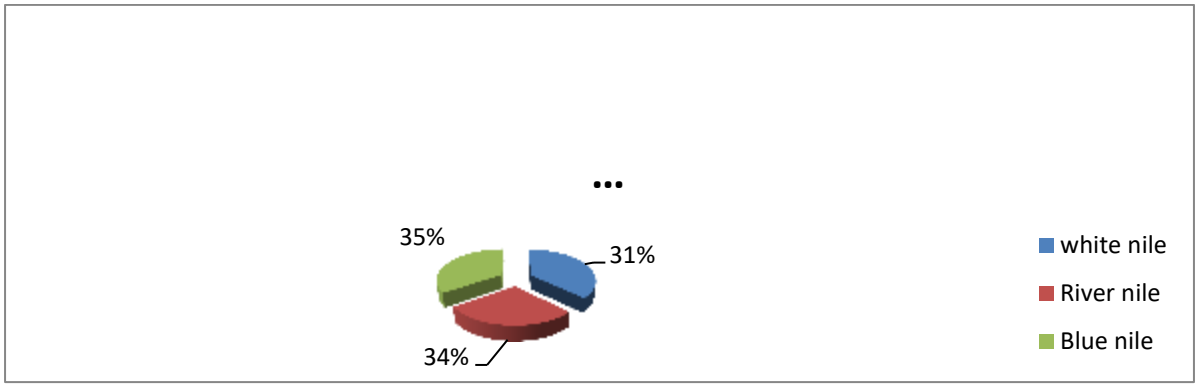


Figure 4: Cooking loss contents in White Nile, River Nile and Blue Nile.

## Discussion

Fish is a source of high quality proteins, essential minerals, vitamins and polyunsaturated fatty acids. Some recent works concerned with the development of new products that ideally retain all the nutritional properties of fish, but not its typical odor, so they can be included, meat-based preparations (Mohamed *et al*., 2011). Several methods exist to assess the quality of seafood. However, there is much variation in the chemical, bacteriological, and sensory changes, between species and different fish products, depending on whether the product is fresh or processed and the type of processing that is carried out. Therefore, the acceptable limits for each quality criteria may vary greatly for each type of product (Huss, 1988; Botta, 1995; Köse and Uzuncan, 2000).

The result of chemical composition determined protein, moisture, dry matter and ash. There was significant difference ($p<0.05$)between group A and group B table 2 as Khater and Farag (2016) who reported significant difference among three fish paste products from( Salmon ,Herring and Anchovy) species except for the protein which was not significantly different .On the other hand the results were not in agreement with these obtained by Elminshawi,(2007) who clarified no significant difference between burgers and fish loaves processed from Bagrus sp And Clarias sp for protein,moisture,dry matter and ash. . Protein was not conformable with that in study conducted by(Abdelmajid, 20 08) who reported protein in kofta as (19-22%),and also it was differ from that in the study which conducted by Rafiaa (2008) who found the protein percentage was (18-28%) in the chemical composition of sausage processed from *T.fahakaand* . This disagreement may be due to the difference in products formulation.

Moisture content in group A and B recorded( 74-78)%,(76-80)% respectively .This result agreed with the study which conducted by Alaa (2013) who studied the chemical composition of sausage from *T.fahaka* and found moisture content (77.60%) and also agreed with the study conducted by Abdelmajid (2008)who found the moisture content in kofta range (71-73%).

As for ash content there were significant different ($p<0.05$) between the two groups 2.50% which agreed with Ahmed ,(2011), who found ash percentage in sausage (2.5-3.2)%.

For the result of pH there were no significant difference ($p>0.05$) between the two species among the different water environments (Blue, River and White Nile) , which was similar with the result obtained by Khater and Farag (2016), who showed no significant variation ($p >0.05$) for pH values among the three fish paste products, for Salmon paste, Herring paste and Anchovy paste . Also the result agreed with the study conducted by Sourkaty (2012),who found the pH in minced meat and burger at the same range .Also it is similar to Elminshawi (2007) whose results for the pH clarified no significant difference($p>0.05$) between burgers and fish loaves processed from *Bagrus* sp and *Clarias* sp .Shetty *et al.,*(2015),who studied water quality impact on coastal river fishes reported the same result.

As for cooking loss there was high significant difference ($p<0.05$) between the two groups A and B in different water environments which may be due to the variation in water environments which were affecting in moisture content of fish flesh. This result disagree with Elminshawi(2007), who found cooking loss of burgers and fish loaves processed from *Bagrus* sp and *Clarias* sp.were not significantly different ($p>0.05$).

## Conclusion

The fish species, *Maleptrurus electricus* and *Tetrodon fahaka*, which were considered as low fish grade (grade three)

and un favored by consumers, could be compete with high grades after processing of their flesh as patties due to their high nutritive value .

More studies are needed about other un preferable species of fish, and should be used in meat processing as sausages, burger ,…ect.

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## تقييم الخصائص الكيميائية والفيزيائية للاسماك في ميالا النيل المختلفة في ولاية الخرطوم

**مها مبارك محمد و ايناس ضيف الله هاشم**

جامعة السودان للعلوم والتكنولوجيا– كلية علوم وتكنولوجيا الانتاج الحيواني

**المستخـلص**

أجريت هذه الدراسة في السودان(ولاية الخرطوم) لتقييم تأثيرنوع الأسماك والبيئات المائية المختلفة علي الخصائص الكيميائية و الفيزيائية للكفتة المصنعة من سمكتي البردة ( أ ) والتامبيرة ( ب) اللتان استخدمتا في التجربة ، وجمعتا من ثلاثة بيئات مائية نهر النيل ،النيل الأبيض والنيل وبعد جمع الأسماك الطازجة تم تصنيع الكفتة من المجوعتين(أ)و(ب) ، حيث أوضح التحليل الكيميائي أن هنالك فروقاً معنوية في كل من البروتين ,الرماد,الرطوبة و الدهون في البيئات المائية المختلفة للمجموعتين (أ)و(ب).حيث ان اعلي محتوى للبروتين ظهر في (أ)فى نهر النيل (31.30 ±0.232) (29.37±0.175) تم تسجيله في (ب) عند النيل الابيض .سجلت المجموعة (أ) اعلي محتوى لمستخلص الايثر (6.37±0.21) بينما وجد اقل محتوى عند (ب) في نهر النيل. لايوجد فرق معنوي في الأس الهيدروجيني بين المجموعتين(أ)و(ب) في البيئات المائية الثلاثه بينما اختلفت العينات في القروبين اختلاف معنوي في فاقد الطهي (p< 0.05 حيث ان المجموعة (ب) في النيل الازرق سجلت اعلى نسبة ,(38.00±2.48) عكس المجموعة (أ) في النيل الابيض التي سجلت اقل نسبة .(28.00±2.48) .الاختلاف في نوع الاسماك والبيئات المائية يؤثر معنويا في التركيب الكيميائي وفاقد الطهي للكفتة المصنعه من اسماك التامبيرة والبردة.