

# A COMPARATIVE STUDIES ON THE CHEMICAL AND PHYSICAL ATTRIBUTES OF WILD FARMED NILE TILAPIA (OREOCHROMIS NILOTICUS)

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**ABSTRACT:** The research was directed towards the study of the fish species *Oreochromis niloticus* (Trewavas), formerly *Tilapia nilotica* (Linnaeus) in order to comparing the chemical composition and fish body weight characteristics of its farmed with their natural counterpart (collected from Nile River). Forty nine assorted fish species of each group (*Tilapia niloticus*) were randomly collected fresh from Sudan University Fish Farms and Nile River. For two groups the filleting yield (head, skin, viscera, fins and skeleton and fillet were taken) and chemical analysis were performed. The sequence percentage variation of fish body weight components in each fish was varied among studied species. Thus the order tend to decrease from fillet, head, fins and skeleton, viscera and skin in farmed fish and from fillet, head, fins and skeleton, skin and viscera in wild fish. Concerning the chemical analysis of major body constituents of studied fish whose main elements moisture, dry matter, ash, protein, fat and NFE were determined. Protein and fat content level was found to be significantly different ( $P < 0.05$ ) while moisture, dry matter, ash, NFE was insignificantly different ( $P > 0.05$ ) in the farmed and wild fish species.

**Keywords:** Chemical, physical attributes, wild, farmed Nile tilapia, *Oreochromis niloticus*

## INTRODUCTION

From nutritional point of view fish composite of very high nutritional quality, it is rich in most of vitamins, proteins, minerals, fats and essential amino-acid and a nutritious part of human diet an idea which had been justified by some biological experiments that it is nutritionally equivalent to those of meat, milk, eggs (FAO, 1995a). This properly placed fish in an especially important category of food.

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).

The state of world fisheries and aquaculture 2006, review total capture fisheries production globally in 2004 reached 95.0 million tones, an increase of 5% in composition with 2003, when total catch had declined to 90.5 million tones (Non, 2006).

Preliminary estimates for 2005 global capture production indicate that in land water catches have increased by almost 0.4 million tones and marine catches have decreases by over 1.5 million tones (Non, 2006). However, less than one third of the marine captured production last in 2005 in comparison with 2004 can be attributed to be high variability of Peruvian anchoveta, as total catches of all over marine species combined were reduced by about 1 million tones (Non, 2006).

Aquaculture production contribution to global supplies of fish, and other aquatic animals continued to grow, increasing from 3.9% of total production by weight in 1970 to 27.1% in 2000 and 32.4% in 2004 (Non, 2006). Africa and Asia continue to contribute about 90% of the world total and their shares are fairly stable (Non, 2006).

Fish production and management in Sudan fisheries resources is endowed with enormous aquatic and fisheries resources (Non, 2002). The fish potential in the Sudd Region has been estimated at 75000 year/tons while the reported landings have not exceeded 3000 tons per year (Non, 2002). 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).

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).

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 (Malcolm, 1977) 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. The chemical composition of fish varies greatly from species to one individual to another depending on age, sex, environment diet, and season.

Concerning comparison on the proximate chemical composition and physical characteristic and filleting yield between cultured and wild Nile Tilapia (*Oreochromis niloticus*) little work has been carried out in Africa in general and almost nothing in Sudan in particular (FAO, 1992 and 1995a).

The main Objective of this study is to show a comparison on the chemical composition, physical attributes and filleting yield between cultured and wild Nile Tilapia (*Oreochromis niloticus*).

## MATERIALS AND METHODS

### Locality

The study was conducted at Sudan University of Science and Technology college of Veterinary Medicine and Animal Production Department of Fisheries and wildlife science 10km east of Khartoum.

### Samples and Experimental trial

A total of ninety nine of commercially fish (Wild) and farmed samples of (Trewavas, 1982), formerly *Tilapia nilotica* (Linnaeus, 1957) of Nile Tilapia (*Oreochromis niloticus*) belonging to family Cichlidae (Local name: Bulti), were selected for this study. Standard and total lengths of the each sample group were determined and recorded (in cm) using measuring board (100 cm in length) and total body weights were recorded in gam. Then, fishes were filleted, eviscerated, de-headed and skinned using sharpen knives. The weight of viscera, fillets (with ribs), head, skin, skeleton and fins (with some adhesive meat) weighed separately using weighing balance (10 kg).

The whole fish body each of each fish group of wild and farmed *Oreochromis niloticus* species were trimmed and ground homogenously using blending machine (Maframa) and placed in insulated plastic bags and chilled in refrigerator, then the samples were taken to laboratory of central veterinary research laboratories centre (Soba) South of Khartoum for proximate analysis following the procedure given by AOAC (1980).

### Statistical analysis

The data of this study were analyzed statistically, using computer statistical package (SPSS version 10) as described by Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

Tables 1 and 2 show summary of filleting yield, chemical composition and statistical analysis of wild and cultured Nile tilapia (*Oreochromis niloticus*).

The finding of the present study showed some stark fact on the manifesto of the popular cultured fish emphasizing on chemical composition between wild and farmed *Oreochromis niloticus* which serves as the principle basis in evaluating the nutritional and economical value of the fish.

The proximate chemical composition analysis clearly revealed that, a distinct variation on the chemical composition of the studied fish. The protein and fat percentage level of *Oreochromis niloticus* from Nile river site was found to be 22.70 and 7.78 and from fish farms was 21.05 and 7.32. This agree with Agab and Babiker (1987), they 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), they indicated that protein and fat was ranged between 6-28% and 0.1-67% as reported by El Taly (1994), Eyo (1991) and Mgawe (1991).

However these results were clearly revealed that wild fish had its better than farmed species in accordance with the percentage of protein and fat content, this might be, interpreted by the fact that since the fish collection took place during May (Autumn) the wild fish might has already stored body fats and protein during the its feeding period, whereby it tends to have higher protein and fat levels. Also this might be due to natural geographical distribution as the fish exclusively inhabit a wider range of ecosystems evolved as riverine fishes living in marginal waters, flood, plain, and pools and, they are adopted to Lacustrine conditions and different feeding habits and patterns as tilapia are generally herbivorous and omnivorous Pike and Brown (1967).

**Table 1 - Shows summary of mean yields of different body parts of Nile Tilapia (*Oreochromis niloticus*) collected from different sites**

Parameter	Total Weight (g)	Total Length (cm)	Standard Length (cm)	Head (%)	Skin (%)	Viscera (%)	Fins & Skeleton (%)	Fillet (%)	Inedible parts (%)	Edible parts (%)
Wild Fish	288.2 $\pm$ 47.97	23.7 $\pm$ 1.30	19.67 $\pm$ 1.30	28.0	8.2	7.8	16.5	32.2	60.5	32.2
Cultured Fish	365 $\pm$ 161.70	21.7 $\pm$ 2.74	17.50 $\pm$ 3.08	25.4	5.8	6.2	18.6	37.1	56.0	37.1

Values are the mean of 49 fish samples for each. SD=Standard Deviation

**Table 2 - Shows summary of statistical analysis and chemical composition components of wild and cultured Nile Tilapia (*Oreochromis niloticus*) collected from different sites (mean $\pm$ SD)**

Parameter	Total Weight (g)	Total Length (cm)	Standard Length (cm)	Moisture (%)	Dry Matter (%)	Ash (%)	Protein (%)	Fat (%)	NFE (%)
Wild Fish	288.2 $\pm$ 47.97	23.7 $\pm$ 1.30	19.67 $\pm$ 1.30	72.5 $\pm$ 4.35	26.7 $\pm$ 5.14	2.80 $\pm$ 0.26	22.70 $\pm$ 82	7.78 $\pm$ 0.12	28.96 $\pm$ 4.18
Cultured Fish	365 $\pm$ 161.70	21.7 $\pm$ 2.74	17.50 $\pm$ 3.08	74.08 $\pm$ 3.08	25.96 $\pm$ 3.11	2.98 $\pm$ 0.36	21.05 $\pm$ 64	7.32 $\pm$ 0.17	32.70 $\pm$ 2.87
Standard Error	24.53	0.48	0.42	0.77	0.85	6.58	0.22	5.68	0.82
Significance Level	-	-	-	N.S.	N.S.	N.S.	**	**	N.S.

Values are the mean of 12 fish samples for each. SD=Standard Deviation. NFE=Free nitrogen Electron

The lower percentage level of fat and protein content in farmed fish might be due to insufficient and less nutritive value of the artificial supplement feeds, less digestibility, poor water quality and mis-management.

The chemical and biological characteristics of water in artificial aquaculture pond are extremely complex neither natural water. There is a close interaction between chemical equilibrium and various physical, biological and edaphic factors. These factors affects and are affected by changes in the chemical equilibria and the cycle in the pond which reflects in the fish species as described by Borgstrom (1962).

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 fishes on the open sea and in inland waters. Fishes 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 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 fat were to be more obvious in fishes feeding on lower trophic levels, as appeared in this study. The major physico-chemical and biological characteristics of each site starkly effective on the chemical composition and physical characteristics of each fish differently and indirect. The level of oxygen, together with temperature, consequently play a great role in the water quality and hence food consequently production. These factors could be played a major role in chemical constituent's variation in our studied species.

The dry matter showed a slight variation between the two treatment studies 26.7 and 25.9 as well as the nitrogen free electron (NFE) 28.9 and 32.7 respectively. Ash content was found to be of 2.8 and 2.9. In all the treatments the moisture percentage level increases while the percentage of total fat level decreases and vice versa. The protein percentage also increases with the decrease in fat percentage, and ash percentage show a little variation than the rest of the constituents of the fish flesh.

The proximate chemical composition results of body constituents were showed protein and fat were significantly different ( $P < 0.05$ ) while moisture, dry matter, ash and nitrogen free electron (NFE) were insignificantly different ( $P > 0.05$ ) between the studied species.

The fillet was found to be 32.3 and 37.1% in wild and farmed species respectively this was disagreed with the findings of Hassan (1996) who mentioned that the edible parts is ranged between 45–50% and percentage levels differ according to the shape and body size of fish. These findings in the line of Obanuand Ikeme (1988), and agrees with Omer (2000) who found that the fillet percentage ranged between 32.8%–42.92.

This lowest fillet yield might also be attributed to large head, viscera and method and techniques of filleting. Also the results showed a decreasing order of fillet, head, fins and skeleton, viscera and skin for cultured fish and decreasing order of fillet, head, fins and skeleton, skin, and viscera for wild fish respectively. This in agreement with the findings of Mac (1992) and Mac (1996) who carried out study on meat yield and nutrition value determination of Nile Tilapia (*Oreochromis niloticus*) and *S. gallaenous* he found that the physical characteristics of the species has a decreasing order of fillet, head, fins and skeleton, viscera and skin for Tilapia and this in agreement with the findings of Abanuand and Ikeme (1988) who reported that the weight of whole fish and weight of fillets were highly significant difference to each other. It also agrees with Reay et al. (1943) and Vanwyk (1944), they reported that the amount of fish flesh varies with size, age, sexual status and season of captures, this disagree with the findings of Remijo (1992). The result of the fish body weight characteristics has clearly revealed that the percentage of fillet, head, fins and skeleton, viscera and skin between the studied species differ significantly this variability might to attributable to differences of food intake, diet, size, age, sex, season of capture and environmental conditions.

It could be concluded that there was slightly differences between the wild and cultured tilapia species in term of chemical composition and physical characteristics, but the percentage of edible parts was recorded a higher in wild than cultured species.

The detailed analysis of fish chemical composition coupled with feeding intake relevance to different environmental condition and seasons should be targeted as the basis of comparing fish proximate chemical composition and grading in further studies

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