

Characterization of Nutritional Composition and Filleting Yield of Commercial Fresh Water Fish from Elmawrada Market, Khartoum State

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Submitted: 2 Jan 2026; Accepted: 17 Jan 2026; Published: 3 Feb 2026

Citation: Abbas Bakhiet, H. H., & Mohamed Ahmed, F. A. (2026). Characterization of Nutritional Composition and Filleting Yield of Commercial Fresh Water Fish from Elmawrada Market, Khartoum State, Khartoum State. *J N food sci tech*, 7(1):1-4. DOI : <https://doi.org/10.47485/2834-7854.1055>

Abstract

Fish is a vital source of high-quality protein and essential nutrients, contributing significantly to human health by preventing cardiovascular diseases, cancers, and neurodegenerative conditions. This study investigates the proximate composition and filleting yields of four commercial freshwater fish species—Nile Tilapia (*Oreochromis niloticus*), Catfish (*Clarias spp.*), Bagrus (*Bagrus spp.*), and Nile Perch (*Lates niloticus*)—from El-Mawrada Fish Market, Khartoum, Sudan. Analyses revealed significant variations in moisture, protein, fat, and ash content among species. The fillet yield was highest in Nile Perch (*Lates niloticus*, 49.67%), while Nile Tilapia (*Oreochromis niloticus*) exhibited the lowest (40.97%). Catfish (*Clarias spp.*) showed the highest percentage of viscera (12.58%), and Nile Perch had the lowest (6.12%). Moisture content ranged from 72.9% to 81.92%, and protein content varied between 18.9% and 20.5%. Statistical analyses confirmed significant differences ($p \leq 0.05$) in carcass yields and proximate composition among the species. These findings underscore the nutritional and industrial value of these fish species, providing critical data for their use in food production and market enhancement. The study highlights the necessity of periodic evaluations to monitor the impact of environmental and industrial changes on fish composition.

Keywords: Fish Composition, Industrial Changes, Protein, Ash.

Introduction

Due to its high value protein, the majority percentage of population in the world consumes fish. It contains most of the important nutritional components and acts as a source of energy for human beings (Sutharshiny & Sivashanthini K, 2011). The majority of the nutrition lists recommend that human beings should consume fish every day (Balk et al., 2004). The regular consumption of this antioxidant decreases the risk of colon, breast, and prostate cancers, (Sidhu, 2003) the risk of Dementia and Alzheimer's diseases, Grant WB 19977; and prevents the cardiovascular diseases. Knowledge of the proximate composition is an important way to understand the energy value and to plan appropriate industrial and commercial methods of processing. Normally, the composition of live-weight, whole fish consists of 70 to 80% water, 20 to 30% protein, and 2 to 12% lipid (Love, 1980). However, the composition of fish can differ under different environmental conditions, since different conditions of water, feeding, sex, phase of life, and catch may be quite different (Javaid et al., 1992). Insufficient supply of protein is among the most prevalent nutritional deficiencies in many tropical countries (Eyo, 2001). Fish meat contains all the amino acids needed for good protein nutrition. Besides, the

protein content in fish is of great relevance when the quality and texture of fish meat are considered (Majid et al., 2011).

Fish store energy in lipid forms, which considered an indicator of their quality as well. The oil derived from fish is composed of polyunsaturated fatty acids, which are attributed to reducing serum cholesterol levels which in turn lower the risk for certain coronary heart-related diseases. Fish flesh is also a significant source of minerals, where Zn, Fe, and Cu are the most abundant micro-elements present according to Saadettin, et al., (1999). Considering the tremendous change in the climatic condition, seasonal alteration, and industrial growth, wide difference may be observed in the biochemical constituents of fishes. The proximate composition, therefore, needs to be documented periodically in a region.

The proximate and filleting yield of four freshwater fish species from Elmawrada fish market, Khartoum State, was determined in order to assess their energy values and the possibility of different value-added food products due to their compositional differences.

Materials and Methods

Study Location

This study was conducted at the Central Laboratory of Fish Biology, located at the Sudan University of Science and Technology, Sudan.

Sample Collection and Preparation for Proximate Analysis

Fourteen fresh fish samples, representing Nile Tilapia (*Oreochromis niloticus*), Catfish

(*Clarias sp.*), Bagrus sp., and Nile Perch (*Lates niloticus*),

were obtained from El-Mawrada Fish Market in Omdurman. The samples were promptly stored in an ice container to ensure preservation during transportation to the Soba Laboratory Center in South Khartoum State. Upon arrival, the samples were prepared and processed following standard protocols to determine the proximate composition of fish muscle and carcass tissues.

Proximate Composition Analysis

Moisture content, crude protein, fat and ash were determined for wet sample according to standard methods of Association of Official Analytical Chemists (AOAC) (1990).

Statistical Analysis

Statistical analysis was performed using the Analysis of variance one way (ANOVA) and Duncan's multiple Range Test, to determine differences between treatments means at significance rate of $P < 0.05$. The standard deviation of treatment means was also estimated. All statistics will carry out using Statistical Analysis program (SPSS, 16).

Results

Tables (1, 2 and 3) represent the body weight characteristics and the caloric value of the selected species analyzed. The varied values of their presence in the body of the fishes analyzed were recorded.

Table 1: illustrate condition factor of four commercial species in Sudan.

Species	Parameters				
	T.L	S.L	T.B.W	H.L	(K)
<i>L. niloticus</i>	37.58±4.3 ^a	31.50±4.0 ^a	616.67±26.0 ^a	10.91±1.0 ^a	1.1619 ^a
<i>Clarias spp</i>	46.33±2.0 ^b	40.83±1.7 ^b	650.0±60.9 ^b	10.58±0.3 ^a	0.6536 ^b
<i>O. niloticus</i>	30.33±7.4 ^c	24.58±5.8 ^c	601.66±49.3 ^a	7.91±1.6 ^c	2.1564 ^c
<i>Bagrus spp</i>	48.91±3.9 ^b	35.91±2.9 ^d	530.83±15.6 ^d	11.0±1.04 ^a	0.4536 ^b

$K=100*w/l^3$

Whereas: T.L = Total length, S.L = Standard length. T.B.W = Total body weight, H.L = Head length, K= condition factor.

Table 2: illustrate body weight characteristics for four commercial species.

Species	Parameters			
	Head weight (g)	Viscera weight (g)	F+ sk weight (g)	Fillet weight (g)
<i>L. niloticus</i>	135.83±51.3 ^a	39.17±19.8 ^a	118.33±47.8 ^a	304.17±16.6 ^a
<i>Clarias spp</i>	134.16±17.7 ^a	81.67±12.5 ^b	115.0±16.4 ^a	319.17±41.1 ^a
<i>O. niloticus</i>	126.67±86.9 ^a	63.33±44.9 ^c	148.33±13.3 ^b	260.0±23.0 ^b
<i>Bagrus spp</i>	111.67±28.2 ^b	36.67±9.8 ^d	95.83±17.5 ^c	263.33±70.1 ^b

a, b,c and d; means within the same column followed by the different superscript are significantly different ($P < 0.05$)

Table 3: comparison of percentage carcass yields of four commercial species.

Species	Parameters			
	Head (%)	Viscera (%)	F+ sk (%)	Fillet (%)
<i>L. niloticus</i>	21.94±0.59 ^a	6.12±1.24 ^a	19.13±2.16 ^a	49.67±2.49 ^b
<i>Clarias spp</i>	20.61±1.50 ^a	12.58±1.87 ^b	17.64±1.43 ^a	49.01±2.74 ^b
<i>O. niloticus</i>	22.45±2.60 ^a	11.45±2.50 ^b	22.89±4.14 ^b	40.97±3.55 ^a
<i>Bagrus spp</i>	20.94±1.11 ^a	6.90±1.08 ^a	18.19±1.12 ^a	49.32±4.78 ^b
<i>P - value</i>	NS	*	*	*

a, b,c and d; means within the same column followed by the different superscript are significantly different ($P < 0.05$).whereas: NS = no significance different, * = significantly different

Discussion

This study highlights the nutritional and industrial importance of freshwater fish species in the El-Mawrada Fish Market, underlining the variations in the proximate composition and filleting yield. The results of this study improve the understanding of the potential to maximize fish as an alternative food source in Sudan and similar regions.

Nutritional Composition

The proximate analysis revealed significant interspecies differences in moisture, protein, fat, and ash content. Moisture content ranged from 72.9% to 81.92%, consistent with global averages for freshwater fish, which typically range between 70% and 80% (Ahmed et al., 2022).

High moisture levels necessitate effective storage and processing to minimize spoilage, a critical consideration for tropical markets.

The protein content (18.9–20.5%) highlights how important these species are in our diet. This matches recent findings that fish is a better protein source because it is easy to digest and has a good amino acid profile (Fontanillas et al., 2022; Abraha et al., 2018). The observed variability reflects environmental influences, including diet and water conditions, as reported in recent reviews on fish nutrient profiles (Ahmed et al., 2022). Fat levels, a key determinant of energy value and flavor, also varied among species. Recent studies emphasize the role of lipids in health, highlighting omega-3 fatty acids' importance in reducing cardiovascular and neurological disease risks (Golden et al., 2021). These findings validate the health benefits associated with freshwater fish consumption and their potential for targeted nutritional interventions.

Filleting Yield and Industrial Implications

The filleting yield varied significantly, with Nile Perch achieving the highest yield (49.67%) and Nile Tilapia the lowest (40.97%). High-yield species like Nile Perch are economically advantageous for value-added processing and export markets (Ahmed et al., 2022; González-Fernández et al., 2021).

Meanwhile, the lower yields in Nile Tilapia can be offset by exploring sustainable by-product utilization, such as producing fish oil, gelatin, and biofertilizers, as advocated by recent circular economy approaches (Hosseini et al., 2022). The variation in viscera percentages (highest in Catfish, 12.58%; lowest in Nile Perch, 6.12%) has implications for processing costs and waste management. Innovative processing technologies can convert these by-products into high-value resources, supporting a zero-waste approach and enhancing profitability (Fontanillas et al., 2022).

Environmental and Seasonal Influences

Environmental factors such as water temperature, pollution, and feeding conditions significantly affect fish composition. Recent studies underscore the need for continuous monitoring to assess the impacts of climate change and industrial activities on fish habitats and nutrient profiles (Ahmed et al., 2023). Seasonal variability, a factor well-documented in fisheries science, further influences proximate composition and yield. Studies suggest integrating adaptive strategies to mitigate these fluctuations, ensuring stable fish production and quality year-round (Fontanillas et al., 2022; González-Fernández et al., 2021).

Conclusion and Future Directions

This research provides essential insights into the nutritional and industrial potential of freshwater fish species in Sudan. Recommendations include:

Enhanced Processing Techniques

Invest in technologies for efficient filleting and by-product utilization.

Regular Monitoring

Periodic assessments of fish composition to address environmental impacts.

Value Chain Optimization

Encourage sustainable practices to maximize the economic and nutritional value of fisheries.

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