

Morphological Characterization as a Foundation for DNA Barcoding in Nile Tilapia

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Structured Abstract

Background: Tilapia fish are globally recognized for their economic and ecological significance, serving as a vital protein source and a cornerstone species in aquaculture. Their adaptability and high yield have made them integral to food security, particularly in developing regions. However, traditional morphological methods for species identification are no longer reliable due to the overlapping traits among species and widespread hybridization. This has caused significant confusion in distinguishing members of the tilapiine genus, highlighting the urgent need for more precise identification techniques to ensure effective management and conservation efforts.

Methods: This study focuses on the morphological and meristic characterization of *Oreochromis niloticus* (Nile tilapia) and the isolation of genomic DNA from collected samples. Morphometric measurements, including body depth, dorsal fin length, and snout length, were used to study species variability. Additionally, DNA barcoding was utilized to enhance identification through the analysis of genetic sequences, specifically targeting the mitochondrial cytochrome c oxidase subunit I (COI) gene. By integrating traditional morphological methods with modern molecular approaches, this study aimed to improve the accuracy of tilapia species classification.

Results: The morphometric analysis identified significant differences in body depth, dorsal fin length, and snout length, shedding light on species variability within *O. niloticus*. However, morphological methods alone were insufficient for definitive species identification, particularly in distinguishing hybrids. The incorporation of DNA barcoding addressed this limitation, providing a more precise approach to identifying species. This integration of traditional and molecular methods enhances the understanding of tilapia diversity, supporting both conservation efforts and sustainable aquaculture practices.

Conclusion: This study underscores the importance of combining morphological characterization with DNA barcoding for accurate species identification. The findings contribute critical knowledge for fisheries management, biodiversity conservation, and the aquaculture industry. By improving species identification tools, this research lays the foundation for future studies on sustainable fish farming practices and the preservation of genetic diversity in tilapia populations.

Keywords: Tilapia, *Oreochromis niloticus*, DNA barcoding, morphology, aquaculture

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