Structural and Microstructural Mechanisms Underlying Texture Deterioration in Grass Carp (*Ctenopharyngodon idellus*) During Storage

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Outline

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Abstract

Textural deterioration is a major limiting factor for the quality and marketability of grass carp (*Ctenopharyngodon idellus*) during chilled storage, and recent studies have demonstrated that this process is governed by the coordinated degradation of intramuscular connective tissue (IMCT) and key myofibrillar proteins. Early postmortem softening is driven predominantly by rapid IMCT disruption, characterized by extensive collagen solubilization and weakening of extracellular matrix architecture. Insoluble collagen decreases dramatically from 69.69% to 34.04% within the first days of storage, while microscopy reveals collapse of the connective-tissue honeycomb network, indicating structural failure preceding declines in myofibrillar integrity. In contrast, myosin heavy chain and actin remain relatively stable, whereas larger myofibrillar proteins such as titin and nebulin exhibit progressive degradation during mid–late storage, contributing to sarcomere destabilization and continued textural weakening. Endogenous protease profiling further indicates that matrix metalloproteinases (MMP-2 and MMP-9) are the principal drivers of IMCT degradation, while cathepsins and calpains initiate and accelerate myofibrillar protein hydrolysis. Correlation analyses reveal strong associations between decreasing shear force and reductions in insoluble collagen or nebulin, reinforcing their roles as key structural determinants of firmness. Collectively, these findings indicate that grass carp undergoes a two-stage softening mechanism during chilled storage: rapid IMCT degradation that dictates early texture loss, followed by myofibrillar destabilization that governs later-stage quality decline. Understanding these sequential biochemical and structural events provides a scientific foundation for developing strategies to control enzymatic activity, stabilize connective tissue, and extend the storage quality of freshwater fish.

Yang, F., Teng, J., Liu, J., Yu, D., Gao, P., Yu, P., Jiang, Q., Xu, Y., & Xia, W. (2024). Texture maintenance and degradation mechanism of ice-stored grass carp (*Ctenopharyngodon idella*): A scope of intramuscular connective tissue. *Food chemistry, 432*, 137256.

Shen, J., Zhong, B., Xia, W., & Xu, Y. (2024). Action of structural proteins in textural deterioration of grass carp (*Ctenopharyngodon idellus*) fillets during refrigerated storage. *International Journal of Food Science and Technology, 59*, 2659–2666.