Effects of chopping and salting on the properties of pre-rigor silver carp muscle: Metabolic process, protein functionality, and ultrastructure

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Introduction

- Shortly after the fish are slaughtered, a series of complex biochemical changes occur in the muscle during rigor development. In surimi production, live or very fresh fish are typically used. Therefore, the biochemical changes occurring during rigor development in fish muscle are highly relevant.
- The surimi processing procedures include chopping, salting, and the addition of exogenous substances. These procedures, particularly chopping and salting, are known to affect the functional properties of surimi protein. The changes during rigor development can be influenced by the chopping and salting process, ultimately affecting the quality of the meat product.

Results & Discussion

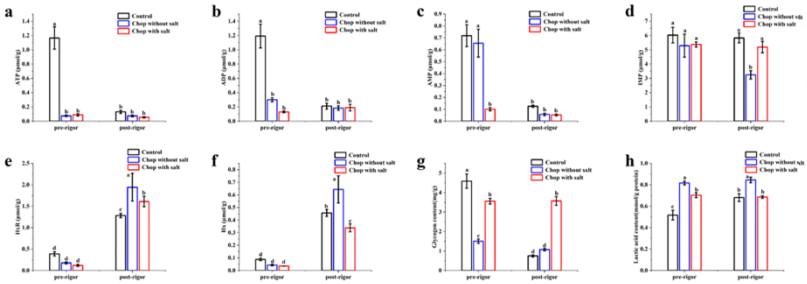

Figure 1. Changes of ATP(a), ADP(b), AMP(c), IMP(d), HxR(e), Hx(f), glycogen (g) and lactic acid (h) in the muscle of silver carp after chopping and salting. [a-d]Different letters on the bar indicate significant differences ($P < 0.05$).

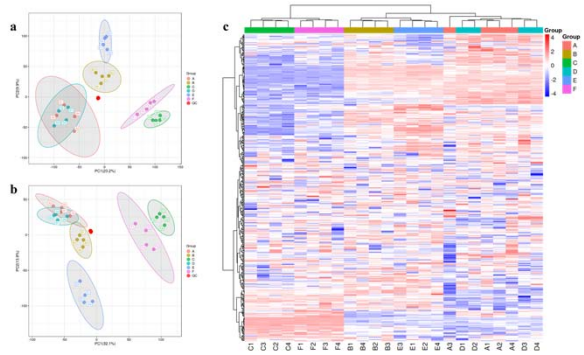

Figure 2. Multivariate statistical analysis of metabolite in the muscle of silver carp after chopping and salting. PCA scores plot (a: positive ion mode; b: negative ion mode) and heat map (c). A and D samples were fish meat pieces as the control group, B and E samples were meat chopped without salt, C and F samples were meat chopped with salt; A, B and C were in the pre-rigor stage, while D, E and F were in the post-rigor stage. QC in the PCA score plots was quality control sample.

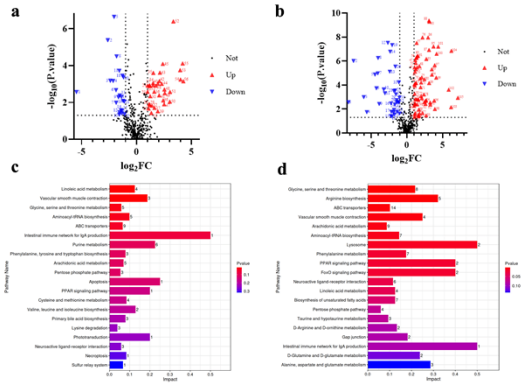

Figure 3. Volcano diagrams (a: D vs E; b: E vs F) and pathway analysis (c: D vs E; d: E vs F) of differential metabolites in the muscle of silver carp after chopping and salting. A and D samples were fish meat pieces as the control group, B and E samples were meat chopped without salt, C and F samples were meat chopped with salt; A, B and C were in the pre-rigor stage, while D, E and F were in the post-rigor stage.

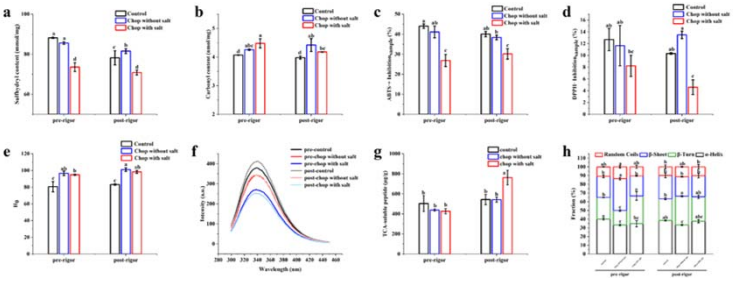

Figure 4. Changes of sulfhydryl content (a), carbonyl content (b), ABTS free radical scavenging capacity (c), DPPH free radical scavenging capacity (d), surface hydrophobicity (e), intrinsic fluorescence spectroscopy (f), TCA-soluble peptide (g) and secondary structure of myofibrillar protein (h) in the muscle of silver carp after chopping and salting. [a-d]Different letters on the bar indicate significant differences ($P < 0.05$).

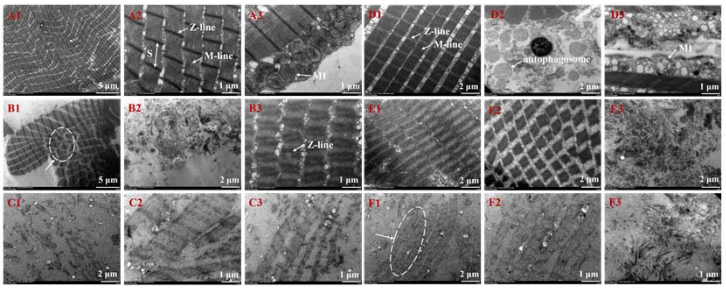

Figure 5. Changes of TEM (A and D samples were fish meat pieces as the control group, B and E samples were meat chopped without salt, C and F samples were meat chopped with salt; A, B and C were in the pre-rigor stage, while D, E and F were in the post-rigor stage.).

Conclusions

- Chopping accelerated the metabolism of ATP and glycogen; however, ATP levels equalized post-rigor, and glycogen breakdown was inhibited by the presence of salt. Metabolic profiling revealed that both chopping and salting altered metabolic processes, particularly in amino acid, fatty acid, and purine metabolism.
- Chopping led to marginal changes in the physicochemical properties of proteins post-rigor, while chopping with salt promoted protein oxidation, denaturation, and proteolysis.
- The ultrastructure of fish muscle was similar between pre-rigor and post-rigor stages after chopping or

Acknowledgement

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