

Effects of Pulsed Electric Field Pretreatment on Salt Diffusion and Textural Properties of Fish Meat

Yuri Kominami¹, Aberham Hailu Feyissa², Lucas Sales Queiroz²

¹The University of Tokyo, ²Technical University of Denmark

Summary

Pulsed electric field (PEF) technology, a non-thermal processing method, is potentially applicable to raw fish products such as sushi and sashimi. In this study, we investigated the effects of PEF treatment on the texture, microscopic tissue structure, and salt diffusion rate of fish meat, with the aim of controlling and simplifying the seasoning process. Seawater-farmed rainbow trout (*Oncorhynchus mykiss*) was used as the test material.

To optimize PEF treatment conditions, rainbow trout meat was treated with bipolar pulses (pulse width: 10 μ s; frequency: 10 Hz; gross time: 2.5 s/50 pulses) at pulse strengths ranging from 0.125 to 0.5 kV/mm. Among these conditions, no visible sparking was observed at or below 0.125 kV/mm, suggesting that this pulse intensity is appropriate for treating rainbow trout meat. Accordingly, a pulse strength of 0.125 kV/mm was adopted for subsequent experiments.

When the number of pulses was varied from 0 to 300 at this fixed intensity, a linear, pulse-dependent increase in meat temperature was observed. However, texture analysis of samples treated with 0, 100, 200, and 300 pulses showed no significant differences. Similarly, histological examination revealed no obvious structural changes between untreated and 300-pulse-treated samples. These results indicate that, under the present conditions, PEF treatment has minimal impact on the texture and tissue integrity of rainbow trout meat. Nonetheless, higher pulse counts may result in texture softening or structural alterations.

Investigation of salt diffusion revealed that PEF treatment significantly enhanced NaCl penetration into the fish meat. This is presumably due to the formation of irreversible micropores in the cell membranes. Similar findings have been reported in beef, where PEF pretreatment before marination improved mass transfer. Our results confirm that PEF also facilitates substance diffusion in rainbow trout meat.

In conclusion, this study demonstrates that optimizing PEF parameters allows for enhanced diffusion of seasoning agents such as salt without compromising the texture of raw fish meat, suggesting its potential utility in the processing of high-quality, fresh seafood products.