Low field NMR study on seven dry salting methods of cod

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The objectives of this study were to study the differences in the water behaviour in cod fillets, while using seven different dry salting processes, i.e. where the fillets were, prior to dry salting for a month, injected with 22% brine and brined for 2 days in a 10% NaCl brine (method 1), injected with 22% brine, 2.5% polyphosphates and brined for 2 days (2), injected with 22% brine, 2.5% polyphosphates, 1% carboxylmethylcellolose (CMC) and brined for 2 days (3), injected with 22% brine, 2.5% polyphosphates, proteins and brined for 2 days (4), brined for 2 days (5), pickle salted for 3 days (6) or dry-salted only (7).

Low-field Nuclear Magnetic Resonance (LF-NMR) was used to evaluate the changes in water behaviour throughout the salting process by measuring the proton relaxation times in minced samples at all process stages, i.e. in the raw material, after brining or pickle salting, after dry salting and finally in rehydrated fish. Proton relaxation times of the samples were measured with Carr-Purcell-Meiboom-Gill (CPMG) and Inversion Recovery (IR) pulse sequences. The measurements showed that the relaxation times increase during brining, indicating a decrease in the mobility of the water molecules. After pickle and dry salting, the relaxation times, except T_{22}, fall, due to protein denaturation and dehydration. After rehydration of the samples, the relaxation times increased again, as the water holding capacity and water content of the samples increased. A significant difference in relaxation times was found between the samples that had been brine injected (method 1-4), brined (5) and pickle and dry salted (6-7) at all process steps, showing the longest relaxation times for brine injected samples and the shortest for the pickle and dry salted samples. Addition of polyphosphates did not lengthen the relaxation times significantly, neither when used solely with salt (method 2) nor when combined with CMC (3) or proteins (4). LF-NMR gives good indication of the WHC, water activity, water, salt and protein content, which all are factors that strongly affect the quality of the product. LF-NMR can therefore be used in the evaluation and optimization of dry salting processes of cod.

Key words: Low field Nuclear Magnetic Resonance (LF-NMR); dry salting; brine injection; cod (Gadus morhua); transverse relaxation; longitudinal relaxation; water populations; salt; polyphosphates; water holding capacity (WHC).