

Title:**Low Field NMR Study on Wild and Farmed Cod (*Gadus morhua*)****Authors & affiliations:**

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Abstract:

The production of farmed cod has increased fast in the last years due to increased market demands of cod and at the same time decreased quota of wild cod available. Studies have shown that the properties of farmed cod are though different from the properties of wild cod and that farmed cod can not be used as a raw material for all cod products. The first aim of this study was to investigate the physical, chemical, sensory and microbial differences between wild and farmed cod filleted pre rigor or post rigor mortis, with or without salt injection and stored chilled (0-4°C) or superchilled (-2°C) for up to 15 days. The second aim of the study was to find which characteristic differences between groups can be predicted by Low Field Nuclear Magnetic Resonance (LF-NMR).

A 20 MHz Bruker Minispec bench top LF-NMR instrument was used for the NMR measurements. Proton relaxation times of the samples were measured with Carr-Purcell-Meiboom-Gill (CPMG) and Inversion Recovery (IR) pulse sequences at 2°C. The transverse relaxation times measured by CPMG were processed with a bi-exponential model and the longitudinal relaxation times with a mono-exponential model.

The results indicated large differences in the physical and chemical properties of wild and farmed cod. Wild cod had higher water content than farmed cod as well as higher water holding capacity, pH and larger extracellular space. The relaxation times measured by NMR were found to correlate very strongly to these factors, and the longer transverse relaxation time, T_{22} , relating to extracellular water in particular.

Longer longitudinal relaxation times, T_1 , were found in wild cod than farmed cod, which may be related to a softer and juicier texture of the wild cod. Longitudinal relaxation times were then significantly larger in brine injected wild cod than unsalted wild cod (both pre and post rigor), but the effect of brine injection to the mobility of water in the farmed cod was small. The NMR measurements though indicated that water diffused from the cells to the extracellular space to a greater extent in the farmed cod than in the wild cod when salt was injected to the muscle. Only small differences were found in the relaxation times due to storage temperature.

The study showed that low-field NMR is a useful tool in the evaluation of the quality and properties of wild and farmed cod.

Key words: Low field Nuclear Magnetic Resonance (LF-NMR), wild cod (*Gadus morhua*), farmed cod, salt injection, chilling, superchilling, pre rigor, post rigor.