The quality of cold smoked salmon: Influence of raw material and technological parameters

The objective of this Ph. D. thesis was to study the liquid holding capacity/liquid loss of raw and smoked salmonids as affected by raw material and chill storage of the cold smoked product. The liquid holding capacity is an important quality parameter for cold smoked salmon. This study has shown that the liquid holding capacity in raw and cold smoked salmon is influenced by several factors. The size of the fish affected the liquid holding capacity as large fish had lower liquid holding capacity than smaller fish. The salt content influenced the liquid holding capacity in smoked fish as it was found that high salt content gave higher liquid holding capacity. The salt uptake of the fillets was affected by the lipid content as a high lipid content lead to a lower salt content. It was also found that the lipid content increased with the size of the fish. The lipid content affected the liquid holding capacity in raw salmon, as high lipid content gave lower liquid holding capacity. Thus, the lipid content is an important parameter regarding the liquid holding capacity as it can influence the liquid holding capacity directly or indirectly by affecting other factors e.g. the salt content which influences the liquid holding capacity. During the chill storage period of smoked salmon, the liquid holding capacity decreased. It was found that the large smoked salmon lost more liquid than the small smoked salmon did during chill storage. At the same time the lipid fraction of the liquid loss increased while the water fraction remained at a constant level. The decrease in the liquid holding capacity during chill storage of the smoked product was related to changes in the water distribution. Three water pools were found in raw and smoked salmon samples. An exchange of water from pool II to pool I was seen during chill storage of smoked salmon. The microstructure of the fish muscle was affected by the smoking process and the subsequent chill storage. An indication of lipid droplets being released was observed during the chill storage period, which could indicate denaturation of the collagen structure in the muscle. Several methods for measuring the liquid holding capacity in fatty fish have been used. A comparison of two of the methods, a centrifugation method and a liquid leakage test, was made. The investigation showed that the two methods measure different parameters, and that the two methods cannot substitute each other and the methods may have different applications. Both methods are highly dependent on experimental conditions. It is recommended that both types of methods are used in order to get a detailed picture as possible of the liquid holding capacity. NMR relaxation curves were used to investigate the relation between the centrifugation method and the liquid leakage test. A high correlation was found between NMR relaxation curves and the liquid holding capacity measured by the centrifugation method for both rainbow trout and salmon. Thus, the low-field NMR technique has potential as a fast and non-destructive method to measure liquid holding capacity in fatty fish. In conclusion, this study has shown that the ability of the salmonid muscle to hold liquid is a complex property influenced by many factors. The experiments in this thesis have shown that raw material and chill storage of the smoked product affected the liquid holding capacity. Thus, the producers of cold smoked salmon should be aware of this and should have a careful control of the raw material especially regarding the lipid content.

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