Process analysis and data driven optimization in the salmon industry

Aquaculture supplies around 70% of the salmon in the World and the industry is thus an important player in meeting the increasing demand for salmon products. Such mass production calls for systems that can handle thousands of tonnes of salmon without compromising the welfare of the fish and the following product quality. Moreover, the requirement of increased profit performance for the industry should be met with sustainable production solutions. Optimization during the production of salmon fillets could be one feasible approach to increase the outcome from the same level of incoming raw material. Today a lot of data is gathered in the different links of the value chain regarding raw material characteristics and processing parameters. Yet, even though traceability systems that allow for information transfer are available, this type of information does not follow the fish. This means that valuable information is gathered, but not exploited, and that data from for example the slaughtering companies cannot be included in decision processes related to the further processing of the fish or vice versa. Therefore, the overall aim of the present project has been to investigate if comprehensive collection and analysis of data from the salmon industry could be utilized to extract information that will support the industry in their decision-making processes. Mapping of quality parameters, their fluctuations and influences on yield and texture has been investigated. Additionally, the ability to predict the texture category of the salmon based on protein profile has been explored. The potential effect of the current project was expected to result both in a higher share of products of the highest possible quality, and allocation of products to match raw material to optimal product recipe (for example fillet, portion, smoked etc.). These measures could ensure the industry a higher price for the products, and will have a direct impact on the profit of the filleting companies. The initial work comprised a process analysis of the process line at the collaborating partner Skagerak Salmon A/S where data was gathered on an individual level during filleting. A model was built based on the gathered data enabling prediction of yield after filleting. Moreover, during analysis of the headed salmon it was observed that 78% of the salmon had a larger right side fillet compared to the left side, while all heads had more meat on the left side compared to the right. The heading procedure was identified as the one responsible for the weight difference of the fillets with a potential for increasing the recovery of high value meat i.e. fillet. The difference in fillet size amounted to 23 g per fish, and if recovered 61 tonnes of additional meat a year with a value of 2 million Danish kroner. Furthermore, throughout the project data was gathered covering a total of 11 months in order to investigate the variation in quality parameters. A significant negative correlation between sea temperature at the rearing region and protein content was observed. To the best of my knowledge, no study has reported this previously, and this observation thus segregates from the commonly accepted statement that protein content is a stable parameter in farmed salmon muscle. In the work related to the texture of salmon a model that can predict peak force, and thus texture category, based on protein profile, was built. A total of 16 proteins were required for this prediction, and five proteins; serum albumin, dipeptidyl peptidase 3, heat shock protein 70, annexins, and a protein fragment believed to be titin, were identified. In conclusion, the present project shows how process analysis and extensive data analysis can be used in the salmon industry in the attempt to increase yield. Knowledge of slaughter yield for a certain batch may facilitate optimal planning of the production of salmon fillets by ordering and assigning the right batch to the right product category to obtain an optimal yield and quality. Moreover, it is contemplated that the identification of proteins significant for the measured texture, will contribute to the further understanding of texture. Although more research is still needed in this area, the perspectives extending from the present work may challenge the industry to restructure the information flow of the value chain. This may incorporate an approach that enables all links to receive data that can be used in optimization of processes, and by that achieve an optimal exploitation of the resources in the future.

General information
Publication status: Published
Organisations: National Food Institute, Research group for Food Production Engineering
Contributors: Johansson, G. Ø.
Number of pages: 72
Publication date: 2017

Publication information
Place of publication: Søborg
Publisher: National Food Institute, Technical University of Denmark
ISBN (Electronic): 978-87-93109-84-1
Original language: English
Electronic versions:
Process_analysis_and_data_driven_optimization_in_the_salmon_industry.pdf