Catch Index: Development of a tool for measurement the quality of the catch handling at sea

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Abstract

Correct fish handling on board of vessels is essential for the quality of the fish throughout the complete fishery chain. Developments in the fishery sector with respect to quality control, traceability and remote trade demand a tool to assess the performance of fish handling by fishermen. Therefore an assessment tool for expected quality of fish before landing, a so-called "Catch Index", is under development.
In the first stage of the development of the Catch Index interviews were held with fishermen about possible traceable factors that may influence the quality of the fish during catching and handling. In combination with some pilot experiments the effects of a few handling procedures on the quality of landed plaice were established. The quality of plaice after landing and during storage was determined by Quality Index Method (QIM) as reference method. The outcome of this study forms the basis for a comprehensive experimental design for further development of the Catch Index.

Keywords: Quality, Catch-Index, catch handling, plaice, QIM

Introduction

The development of a Catch Index is an initiative within the context of the development of electronic communication between fishing vessels at sea and the fish auctions. This communication between sea and land has been developed to make it possible for the auctions to have information about the expected time of landing and amount of fish to be landed. This information is useful for the trade. With this development of electronic communication (in special codes to keep the costs low) it also became possible to have information about the quality of the fish to be landed. This catch quality needs to be effectively predefined and measured on board. As it is not possible and useful to have an inspector on every fishing vessel, assessing the quality of the catch the concept of a quality index system was launched. The Catch Index will be easy to operate by fishermen and meet a level of objectivity in assessing the quality of the catch. It will benefit:

- the speed of handling at the auction
- better prediction of quality development (deterioration) in the chain
- better price for the fishermen

The Catch Index should be based on a model, predicting the quality of the fish after catching and handling on board. The model has to be based on those factors during catching and handling being of major influence on the quality of the fish. This approach

would make it possible to grade landed fish in quality classes, without the need of inspecting every batch at the auction or point of landing. In respect with the development of e-commerce and traceability this quality information should be available through the whole chain.
The aim of this preliminary study was to investigate which factors during catching and handling have the most important effect on the quality of the fish and the development of a Catch Index model taking into account these factors. The Quality Index Method (QIM), used as the reference method for the measurement of freshness of fish in this study, made it possible to determine the effect of catching and handling procedures onboard. This study was performed with plaice, one of the most important fish species in The Netherlands.

Materials and methods

Interviewing nine individual Dutch fishermen with beam-trawl fishing vessels identified possible factors influencing the quality/freshness of fish during catching and handling onboard. Also five researchers at RIVO, experienced in fishing, fish technology and quality, gave input on this subjects.

Pilot study

The Catch Index needs to become a practical tool, therefore the experiments are to be performed on commercial fishing vessels. The collaboration between scientists and fishermen is rather unique and therefore a pilot study was used to answer the following questions:

- Taking into account a normal fishing scheme and workload of the crew, how many experiments are possible to perform during one fishing trip?
- Is it possible to perform experiments exactly according to the experimental design?
- Is it possible to record information about all relevant factors influencing the quality?
- Is it possible to measure differences in quality when a few factors, likely to influence the quality, are changed?

For the pilot experiments the quality of gutting (good and poor) and the duration of the haul (short and long) were selected as important controllable factors that can influence the quality of fish. Good gutting is according to Good Manufacturing Practice (GMP): a clear cut near the gills and removal of all intestines. In case of poor gutting some or all intestines are still inside the fish. Poor gutting will lead to faster spoilage of the fish. For the duration of the haul two limits were set by the fishermen, according to their experience and practical use: 120 minutes as upper limit and 45 minutes as lower limit. A short duration of the haul is expected to have a positive influence on the quality.
During the fishing trip of the vessel "Oudorp 1" three experiments were applied twice: once at the beginning of the fishing trip and repeated at the last day of the fishing trip (day 4). The design of these experiments is shown in Table 1. During the experiments the following information was recorded: date, duration of the haul, duration of sorting, duration of gutting, duration of washing, total processing time, amount of fish (kg) in the 60 lt. boxes, amount of ice (scoops) in the boxes, temperature of the storage room, catching area, description of the fishing ground (stones, sand etc.) wind force, temperature

Table 1. The experimental design for the pilot study.

	Gutting quality	Duration of the haul (min)		
		45	90	120
Fishing day 1	Good	1		2
	Poor		3	
Fishing day 4	Good	4		5
	Poor		6	

of sea water, wave height, weather condition, amount of total catch, amount of by-catch, type of by-catch and remarks on the content of the nets.

Quality Index Method

As response variable quality is recorded by the QIM-score (Martinsdóttir and others 2001) directly after landing and during further controlled storage in ice. Per batch, 5 fishes were assessed every 2-3 days by 5-7 trained QIM inspectors from RIVO. QIM scores normally have a linear relation with the controlled storage time in ice. This makes it possible to analyze the effect of catching and handling onboard at different storage periods.

Statistical analyses

SPSS, version 10.1 software was used. The results were calculated by using General Linear Models (GLM), based on the least-squares method. Univariate analysis of variance was used to evaluate any effect of the gutting and duration of the haul on the QIM regression line. Significance level (P) of 95% was used.

Results and discussion

All information collected during the experiments is presented in Table 2. Without giving hard evidence it was clear that carrying out these experiments have an impact on the daily practice onboard (Coomans 2001). The routine of 45 minutes working, 75 minutes rest for the crew was interrupted. It was not difficult to set another duration of the haul, but it has to be regularly, announced in advance and not incidentally. A controlled performance of the gutting was more difficult to organize. Within the experiments one member of the crew was selected to take care of this. The onboard researcher performed the registration and control of all information. For the experiments a lot of the information was collected/registered manually. The catching method (beam-trawling) and storage method (icing in boxes) did not vary during the fishing trip. Some information is not recorded but registered, like temperature in the storage room and temperature of the seawater. The following information is normally registered on paper: catching day, duration of each haul,

Table 2. The registered values of different factors expecting to affect the quality of the fish during the catching and handling of the catch in the pilot experiments.

	Exp. 1	Exp. 2	Exp. 3	Exp. 4	Exp. 5	Exp. 6
Design variables						
Duration of the haul (min)	45	129	98	53	128	97
Performance of gutting	good	good	poor	good	Good	Poor
Non design variable						
Performance of washing: time (min)	1	1	1	5	1	1
Processing time before gutting (min)	21	20	20	10	15	15
Processing time between gutting and storage (min)	5	4	14	4	13	12
Weight of fish in 60 Lt. Boxes (kg)	20	20	20	20	20	20
Weight of ice in the boxes (scoops)	3	3	3	3	3	3
Storage temperature (°C)	-1	-1	-1	-1.5	0	1.5
Seawater temp (°C)	11	11	11	11	11	11
Fishing ground	Stone and sand	Stone and sand	Stone,sand and shells	Hard sand	Hard sand	Hard sand
By catch: kind	Turbot,brill, whiting, dab	Dab, red gournard	Red gournard	Cod	Red gournard	Brill, whiting
By catch: weight (kg)	370	1270	420	240	230	220
Catch: total weight (kg)	500	1500	600	300	450	400
Catching area (geographical code)	32F2	32F2	32F2	34F3	34F3	34F3
Wind force	1	1	2	4	4	4

sorts of by-catch, amount of by-catch. For the information concerning fishing ground, amount of fish in the net, weather condition, wind-force, wave height, gutting performance, washing performance, processing times, amount of fish per box and amount of ice per box, more or less registration effort had to be made.

QIM results

The results of the QIM evaluation are shown in Table 3. The QIM scores are the average values per batch during the storage period. Experiments 1, 2 and 3 were performed at the first day of the fishing trip, and therefore it was not possible to assess the quality of the fish during the first 4 days of storage. The results of the calculated regression lines are shown in Figure 1. For experiment 4, 5 and 6 the calculated regression lines are shown in Figure 2. The design of the experiments makes it possible to combine results of the experiments performed at the first day of the fishing trip with the last day of the fishing trip. These results are shown in Figure 3. The results show the difference in the deterioration of the freshness of plaice. As expected the results show that a longer duration of the haul has a permanent negative effect on the freshness, resulting in significant higher QIM scores during the storage in ice from day 1 to day 11. The poor gutting

Table 3. Results of the sensory evaluation of the freshness (QIM score) with the Quality Index Method.

Response variables	Exp. 1	Exp. 2	Exp. 3	Exp. 4	Exp. 5	Exp. 6
QIM storage day 1				1,3	3,6	1,0
QIM storage day 4	3,2	5,1	5,6	5,8	6,0	6,5
QIM storage day 6				5,9	6,7	8,7
QIM storage day 7	6,1	8,2	11,4			
QIM storage day 8				9,8	11,6	14,0
QIM storage day 9	8,0	9,4	10,7			
QIM storage day 11	13,7	14,5	16,6			

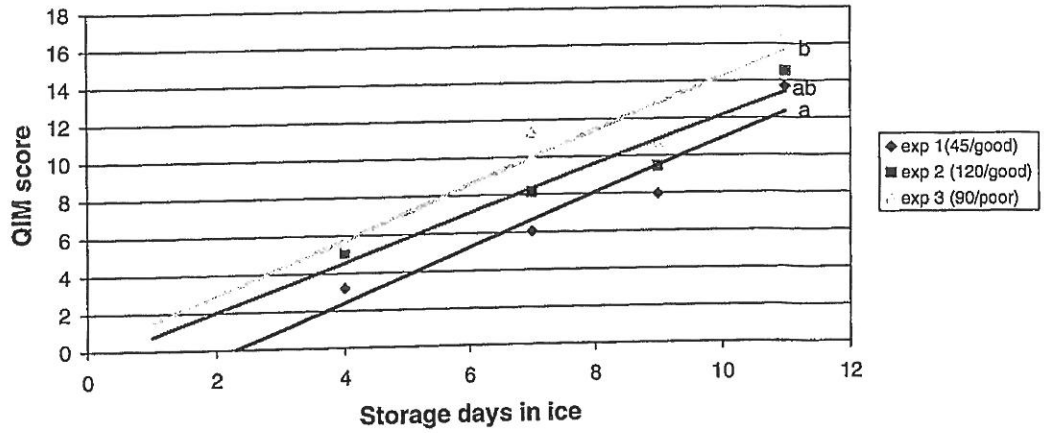

Figure 1. Average results and calculated linear regression of three experiments performed at the first fishing day of the pilot experiment. Different letters in the graph represent significant differences (P<0,05).

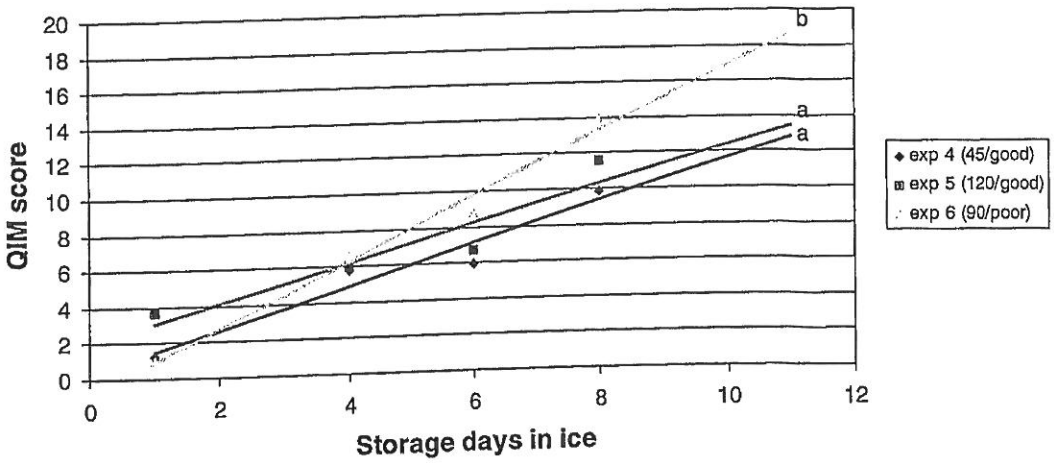

Figure 2. Average results and calculated linear regression of three experiments performed at the last fishing day of the pilot experiment. Different letters in the graph represent significant differences (P<0,05).

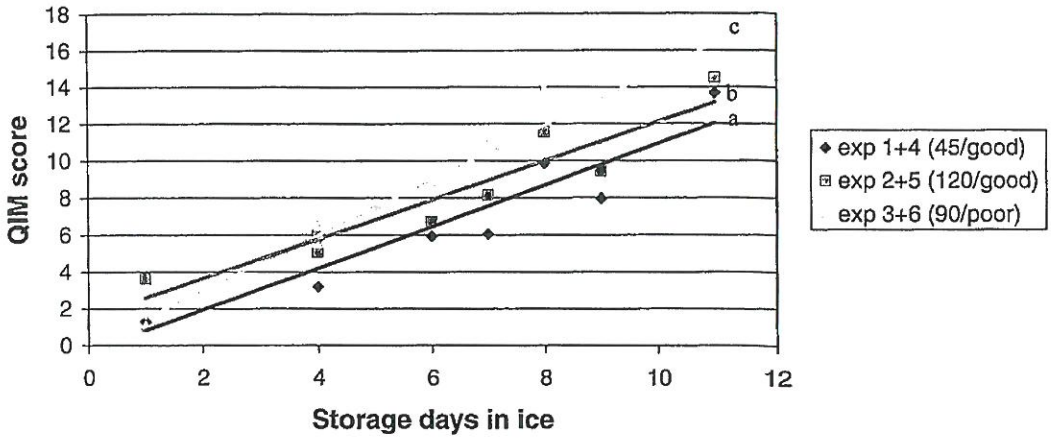

Figure 3. Combined results and calculated linear regression of the experiments performed during the pilot experiment. Different letters in the graph represent significant differences (P<0,05).

performance has a negative effect on the freshness during the storage in ice. The increase in the QIM scores of plaice is significantly larger at the same storage time for poor gutted plaice in comparison with good gutted plaice. The minor differences between the results of experiment 1, 2 and 3 and experiments 4, 5 and 6 may be due to other factors which varied during fishing and processing e.g. washing time, processing time, fishing ground and amount of catch.

Conclusion and further activities

Although experimental work onboard commercial fishing vessels has an impact on the routine of the crew it is possible to carry out experiments needed for the development of the Catch Index. Experiments should be performed preferably at the last day of fishing in order to assess freshness of the fish at the first day after catching. However, for the development of the Catch Index for the registration of the various parameters further automation is necessary. Minor differences in the controllable factors from the experimental design are likely to occur.
As expected a longer duration of the haul and a poor gutting practice of plaice has a significant effect on the freshness determined by QIM. It is possible to measure differences in quality when duration of the haul and gutting performance varies. Future research on the Catch Index must focus on the selection of the factors influencing the quality and building a model for the Catch-Index, It is likely that gutting and duration of the haul will be important factors.

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