PROJECT REPORT
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Rannsóknastofnun fiskiðnaðarins

JANUARY 2000

MULTISENSOR FOR FISH

- QUESTIONNAIRE ON QUALITY ATTRIBUTES AND CONTROL METHODS
- TEXTURE AND ELECTRONIC NOSE TO EVALUATE FISH FRESHNESS

FAIR CT - 98 - 4076

INDIVIDUAL PROGRESS REPORT FOR THE PERIOD FROM 01-12-98 TO 30-11-99

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Skýrsluágrip Rannsóknastofnunar fiskiðnaðarins

Icelandic Fisheries Laboratories Report Summary

Titill / Title	Multisensor for Fish Questionnaire on Quality Attributes and Control Methods Texture and Electronic Nose to Evaluate Fish Freshness		
Höfundar / Authors	*Soffía Vala Tryggvadóttir and Guðrún Ólafsdóttir*		
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Ágrip á íslensku:	Þessi skýrsla er fyrsta framvinduskýrsla Rf í Evrópuverkefninu ***Þróun á margþátta skynjaratækni til að meta gæði fisks***. Markmið verkefnisins er að prófa og bera saman ýmsa tækni, sem getur nýst í fjölskynjara til að mæla ferskleika fisks. Sex Evrópulönd taka þátt í verkefninu en allir þátttakendurnir vinna að þróun nýrrar tækni til ferskleikamælinga. Gerð var könnun í fiskiðnaðinum til að komast að því hvaða þættir eru taldir mikilvægir til að meta gæði fisks, einnig hvaða aðferðir eru helst notaðar og hvort þörf væri á nýrri tækni. Í ljós kom að skynmat var talin mikilvægasta aðferðin til að meta gæði fisks. Flestir voru sammála um að eiginleikar eins og útlit, lykt og litur væru mjög mikilvægir þættir í gæðaeftirliti. Þættir eins og tími frá veiðum, hitastig og hlutfall íss og fisks voru almennt taldir mjög mikilvægir. Einnig var talin mikil þörf á fljótvirkum mæliaðferðum til að meta ferskleika og gæði fisks. Könnunin sýndi að flestir voru jákvæðir gagnvart gæðamerkingum á öllum stigum í keðjunni frá veiðum til neytenda Tvær geymsluþolstilraunir á ýsu voru framkvæmdar á mismunandi árstíðum til að kanna möguleika þess að nota áferðarmælingar og mælingar með rafnefi til að meta ferskleika og skemmd í fiski. Niðurstöðurnar voru bornar saman við skynmat þar sem notuð var gæðastuðulsaðferð (QIM) og Torry ferskleikamat fyrir soðinn fisk. Niðurstöður áferðamælinga sérstaklega stífnimælingar sýna ákveðnar breytingar í stífni við geymslu í ís, sem eru sambærilegar milli árstíða. Það bendir til þess að áferðamælingar geta gefið vísbendingu um gæðabreytingar við geymslu. Rafnef getur greint breytingar sem gerast samfara geymslu í ís og fjölbreytugreining (PCA) á gögnunum sýna að hægt er að greina á milli fisksýna frá mismunandi geymslutíma. Niðurstöður geymsluþolstilraunanna sýna að bæði áferðarmælingar og mælingar með rafnefi gætu hugsanlega nýst sem fljótvirkar aðferðir sem hægt væri að nota í fjölskynjara til að greina ferskleika og skemmd í fiski.		

Lykilorð á íslensku:	*ferskleikamælingar á fiski, áferð, rafnef, skynmat, könnun*
Summary in English:	This report is an annual progress report of IFL for the EU project ***Multisensor for fish*** (CT98-4076). The aim of the project is to test and compare various techniques that can be combined in a multisensor to measure fish freshness. Six European countries are participating in the project and all the participants are working on the development of new techniques to measure fish freshness. A questionnaire was sent to the fish sector in Iceland to obtain information about important quality attributes and current methods used for fish freshness evaluation and the industrial needs for multisensor instruments to monitor the quality of fish. The respondents strongly agree that sensory evaluation is the most important method to evaluate freshness of fish. The various sensory characteristics such as outer appearance, odour and colour are very important in quality control. The need for monitoring quality and processing parameters such as time, temperature and ice/fish ratio are in general considered very important. Moreover the respondents strongly agree on the importance of measuring freshness in a rapid and objective way and similarily they strongly agree that a rapid instrument to determine the quality of fish is needed. The respondents agree that quality labels are needed at each link in the chain from catch to consumer. Two storage experiments on haddock were done at different seasons. The aim was to investigate the possibility to use texture analysis and electronic nose measurements to detect changes during storage in ice. The result were compared to sensory analysis using the Quality Index Method (QIM) and Torry scheme. The results of the texture measurements show that changes in hardness and firmness during storage are very similar for the two seasons. This suggests that texture measurements may be indicative of quality changes during storage. The electronic nose technique can be used to detect the onset of spoilage. Multivariate analysis (PCA) of the electronic nose data shows that samples can be discriminated based on different storage times or spoilage level. The results of the texture measurements and the electronic nose show that these techniques may be applied as non destructive measurements which can implemented in a multisensor to detect the freshness or onset of spoilage of fish.
English keywords:	*freshness evaluation of fish, texture, electronic nose, sensory analysis, survey*

FAIR- CT98-4076

Development of Multi-Sensor Techniques for Monitoring the Quality of Fish

Specific RTD and D Programme on Agricultural and Fisheries - FAIR (1994-1998)

Initial progress report - Dec.98 to Nov. 99

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1. Objectives

To ascertain the requirements of the fish processing industry
To integrate electronic nose and texture methods into the multi-sensor frame
To contribute to the formulation of the multi-sensor device
To disseminate and commercialise the results of the project

2. Actions in the project

Actions by tasks:

1.1 Identify points in the fish processing chain where measurements of fish quality are critical for the overall operation.
1.2 Find out the requirements of the fish industry for objective rapid measurement of the quality of fish and improved instrumentation.
2.1 Prepare volatiles (electronic nose) and texture meters for simultaneous measurements.
2.2 Conduct simultaneous measurements.
3.1 Take part in formulating of a practical multi-sensor instrument.
3.2 Take part in the dialogue with the fish industry and instrument makers.
4.1 Take part in disseminating the results and preparing the ground for commercialisation of the results.

Timetable of tasks for Partner 2 (Icelandic Fisheries Laboratory)

Sub-task	*1st year*	*2nd year*	*3rd year*
1.1	Identify critical points for quality measurements.		
	Determine requirements of the industry for quality measurements		Determine scenarios for use of multi-sensor device
2.1	Prepare sensors		
2.2		Simultaneous measurements	Simultaneous measurements
2.3		Data analysis and fusion	Data analysis and fusion
3.1		Recommend exploitation route	Recommend exploitation route
3.2		Formulate industrial device	Formulate industrial device
4.1	Dissemination.		Dialogue with manufacturers.

3. Planned Research Activities

Task 1. Consultation with the fish industry and the regulatory authorities on the type of device needed

During the first part of the project the main emphasis was on a questionnaire to obtain information about the industrial needs for multi-sensor instruments to monitor the quality of fish (Tasks 1.1 and 1.2). The work included formulating a questionnaire for the fish sector in all the participating countries. The questionnaire focused on finding out which quality attributes and control methods are most important for the fish sector. It also included some questions about quality defects, other quality factors, overall quality control and labelling.

Task 2 Simultaneous evaluation of physical methods for monitoring the quality of fish

Sub-task 2.1 Preparing for simultaneous evaluation of physical methods

- Develop and test a non-destructive texture method using the TA-X2i Stable Micro Systems instrument.

- Development and preliminary testing of methods to measure volatiles in fish with the FreshSense electronic nose instrument (Element Sensor System, Saudárkrókur, Iceland).

Two experiments were done at IFL to test the performance of the measurement techniques to detect freshness and onset of spoilage of fish during storage in ice. The fish used in the experiment was haddock (*Melanogrammus aeglefinus*) caught in Faxaflói south-west of Iceland.
The first experiment was done in May 99 and the second one in October 99. In May the haddock was just about to spawn and was therefore in a bad nutritional condition. In October the fish was on the other hand in good nutritional condition. The fish was kept on ice in both experiments at 0°C for 15 days in May and for 18 days in October. Samples were analysed every two or three days with texture measurements and measurements of volatile compounds using the electronic nose FreshSense. The results were compared to sensory evaluation using both the Torry scheme and the Quality Index Method (QIM).

4. Research activities during the first reporting period carried out by partner 2

4.1. Questionnaire on Quality attributes of fish and control methods (Task 1)

The aim of the questionnaire was to obtain information about the view of the various parts of the fish sector regarding which attributes are important to evaluate the quality of fish. The aim was also to investigate which control methods are currently used to evaluate quality and the need for quality monitoring instruments. The initial formulation of the questionnaire was done at the first project meeting in Hamburg Dec 1998. Further development, design and harmonisation of the questionnaire was the responsibility of partner 2 with input and advice from all partners. Furthermore, three selected persons from the fish industry in Iceland tried out the questionnaire to catch misinterpretations of questions.

An example of the questionnaire is in Appendix 1, including the raw data from the Icelandic fish sector. The number of respondents giving each score for all the questions is given. The survey was done in 12 countries in Europe and was a collaboration of two EU projects MUSTEC (Multisensor for Fish; CT98-4076) and FQLM (Fish Quality Labelling and Monitoring; CT98-4174).

385 questionnaires were sent to the various parts of the fish sector in Iceland in April 1999, see Table 1. A reminder was sent out two weeks later and in the end 24% responded. The target groups included all companies in the fish sector in Iceland from fishermen, fish auctions, fish processing industry, wholesale, retail and fish inspection authorities. The questionnaire was sent to quality managers in each company. The high number of fish processing industry (64) reflects the importance of this sector in Iceland. Statistical analysis using two sample t-test comparing responses from the processing industry and the combined answers from the other sectors, showed that there was no differences in the answers except for questions no.19, 26 and 28. It can nevertheless be concluded that the average responses are representative for the fish sector sampled in this questionnaire for the most important questions concerning quality attributes and control methods.

Table 1 Number of questionnaires sent to various parts of the fish sector and the number of responses

Fish sector	No. sent out	No. responses	Response rate %
Fishermen/vessels	32	5	16
Fish auctions	23	9	39
Processing industry	238	64	27
Wholesale	52	6	12
Retail	44	9	20
Fish inspection	3	1	33
Total	385	94	24

4.1.1. Quality attributes of fish and current control methods

Figure 1 shows the importance of information about monitoring time, temperature, microbes, chemical spoilage indicators and fishing techniques. It is obvious that information about time and temperature is considered very important, but information about microbial counts and chemical spoilage indicators is not considered as important. Also, the different fishing methods are in general considered very important factors influencing quality.

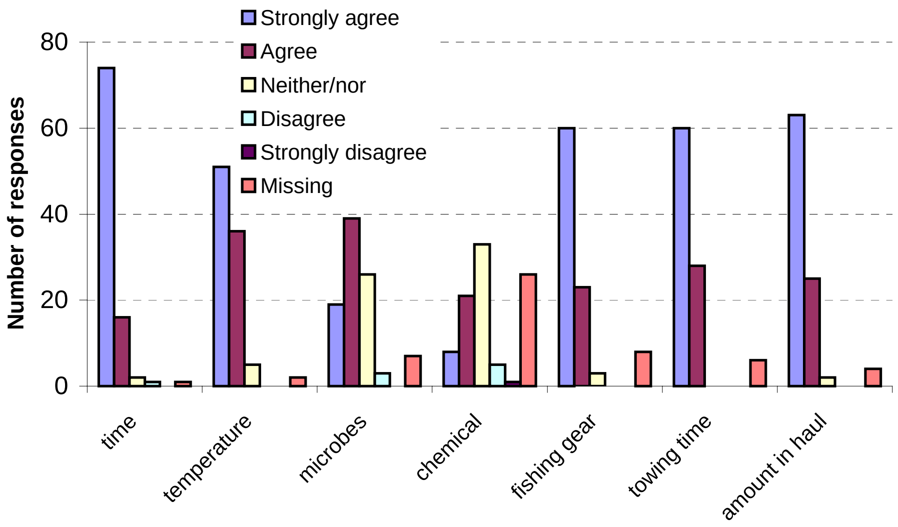


Figure 1 **Answers to questions on the importance of information about time, temperature, microbes, chemical spoilage indicators and fishing techniques (Questions 1-4 and 16 Appendix 1).**

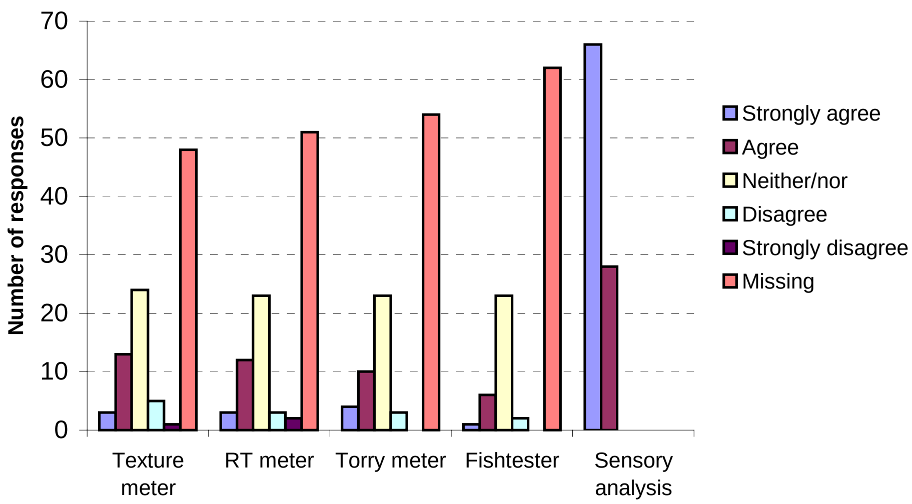


Figure 2. **Questions on the importance of existing instrumental techniques and sensory analysis (Questions 5 - 6 Appendix 1)**

In Figure 2 many missing values regarding questions on the importance of physical measurements may be explained by the fact that these techniques are not known in the industry. On the other hand the responses indicate that sensory analysis is the most recognised method to evaluate quality and considered very important.

Regarding methods used for sensory evaluation (Question 7, Appendix 1) quality grading of raw fish was most often used (57 occasions). Quality grading of cooked fish and Torry scheme for cooked fish were used on 39 occasions, and EU scheme for whole fish was used on 30 occasions. The Quality Index Method for whole fish was used on 16 occasions and other methods were used on 15 occasions.

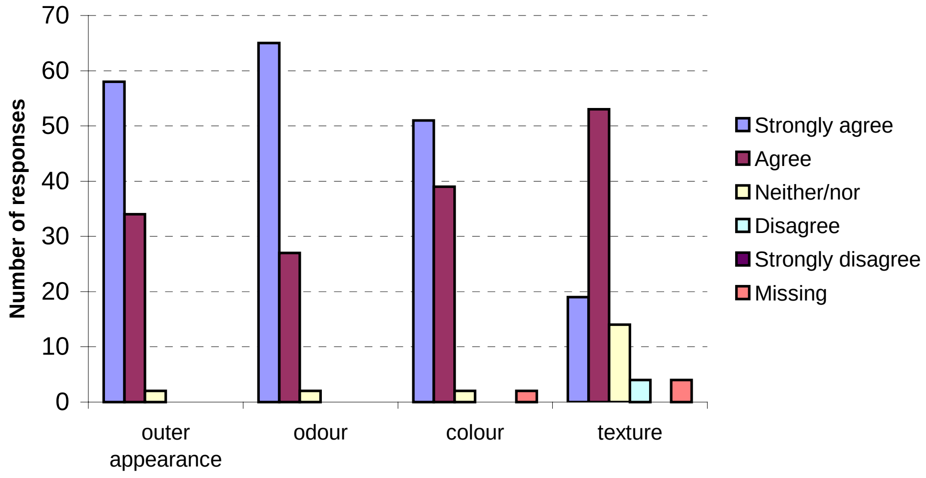


Figure 3. **Answers to questions on important sensory attributes (Questions 6a, b, c, d Appendix 1)**

Figure 3 shows that the sensory attributes outer appearance, odour and colour are considered very important quality indicators. The majority of respondents agree that texture is important as well.

4.1.2. Need for instrumental measurements

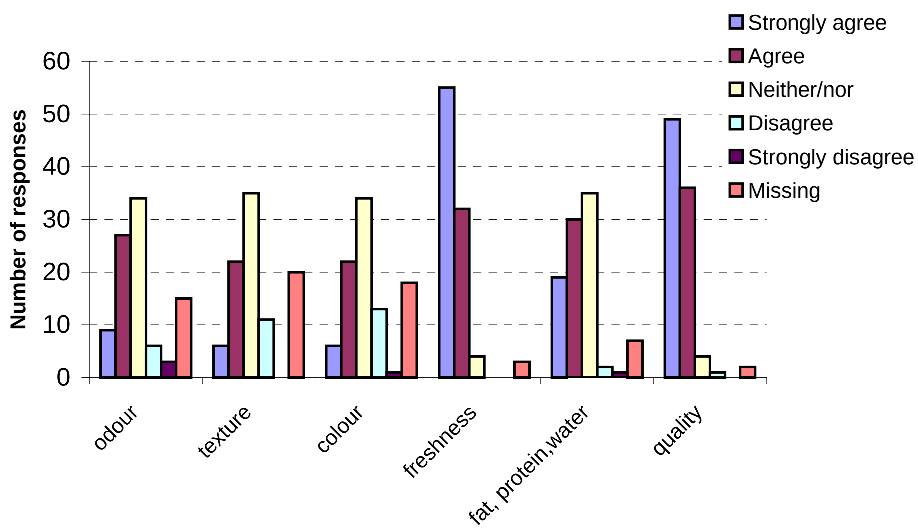


Figure 4. **Answers to the questions on the need for instrumental techniques to evaluate different quality attributes (Questions 8, 9, 10, 11, 12, 15 in Appendix 1)**

The responses about the need for rapid instrumental techniques to measure odour, texture or colour indicated that most respondents were neutral concerning the importance of such techniques or didn't know. It might be that the respondents are not familiar with the individual instruments in question and do not relate them directly to freshness or quality. Contradictory, the averages of the respondents strongly agree that it is important to measure freshness in a rapid and objective way and similarly they strongly agree that a rapid instrument to determine the quality of fish is needed. These results are encouraging for further research and development of new techniques to provide the industry with rapid instruments to detect fish freshness and quality.

4.1.3. Quality defects and other quality factors

Figure 5 shows that the evaluation of ice/fish ratio is considered a very important factor and other quality factors such as size, gaping, blood stains, parasites and bones are also important.

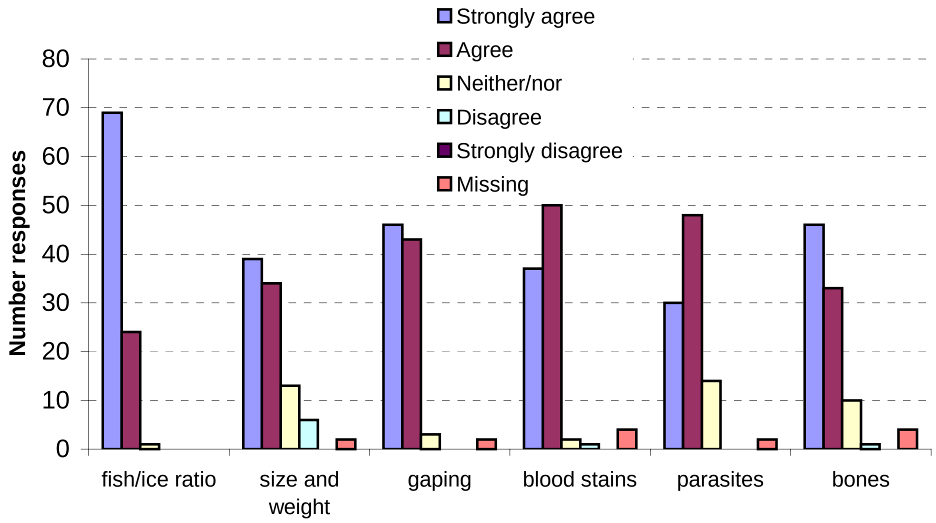


Figure 5. **Answers to questions on important quality defects (Questions 17 - 22 in Appendix 1)**

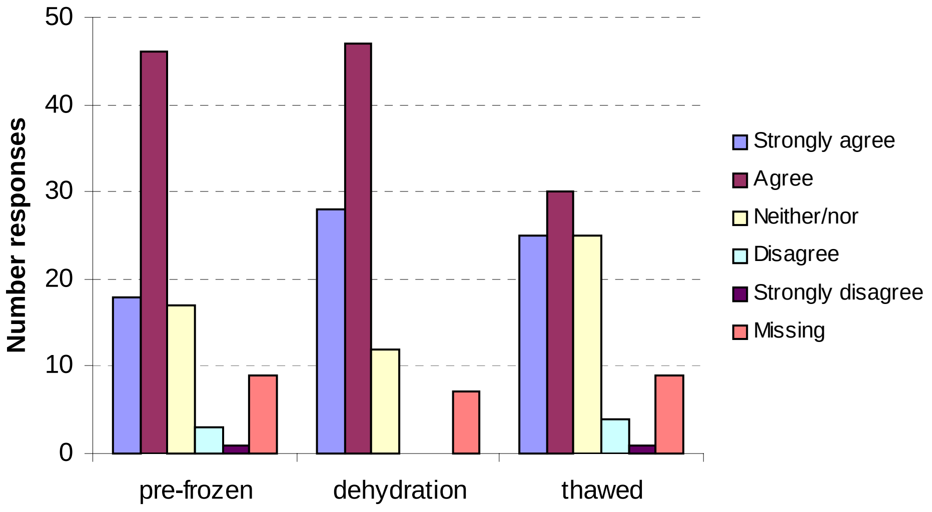


Figure 6. **Answers to questions on the need for control methods for frozen fish and importance of quality defects (Questions 14 and 23-24 in Appendix 1)**

Methods to evaluate the quality of pre-frozen fish and methods to detect quality defects after frozen storage such as dehydration are somewhat important. Also, methods to detect whether the fish has been pre-frozen and sold as fresh are considered somewhat important. In this case it would have been more advantageous to collect information about what type of raw material the respondents are working with. The questionnaire focused on fresh fish in general. The questions about frozen fish were added to get some additional information for further research on the development of techniques to evaluate the quality of frozen fish.

4.1.4. Overall quality control and labeling

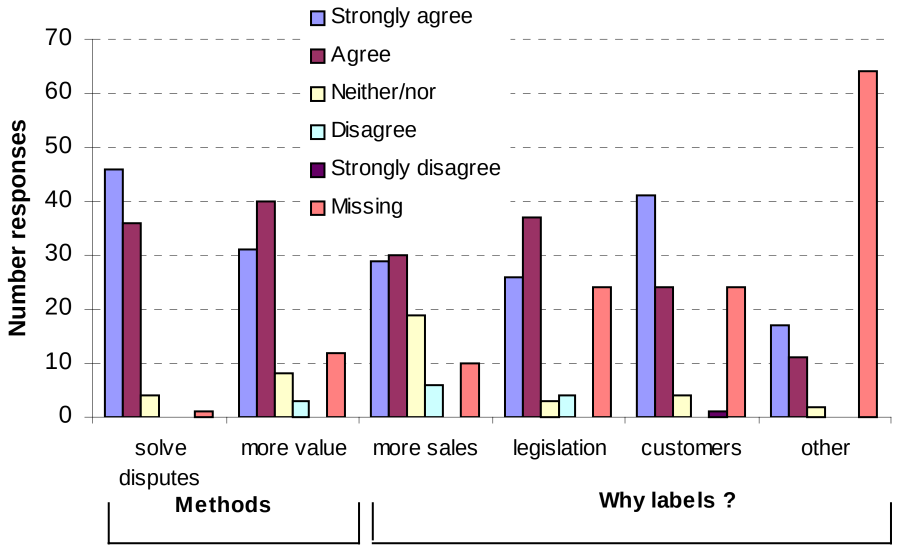


Figure 7. **Answers to questions on the need for methods to evaluate quality and the reasons for labelling (Questions 26-28 in Appendix 1)**

Figure 7 shows that most respondents strongly agree or agree that a method to evaluate quality would be important to solve disputes and would increase the value of the products. Most respondents agree that quality labels would increase sales of the products. The reasons for establishing quality labels are because of legal requirements or demand from customers. Others indicated that quality labels would facilitate inner control and quality management. Quality labels could possibly stimulate better processing quality and provide information to verify the quality of the products.

The respondents are in favour that quality labels are needed at each link in the chain from catch to the consumer. These responses may indicate the awareness of the fish sector regarding the importance of traceability throughout the supply chain. The need for monitoring quality and processing parameters such as time, temperature and ice/fish ratio are in general considered very important. The documentation of these parameters ensures traceablity, but effective quality labels are possibly only needed at the end of the supply chain for the consumers.

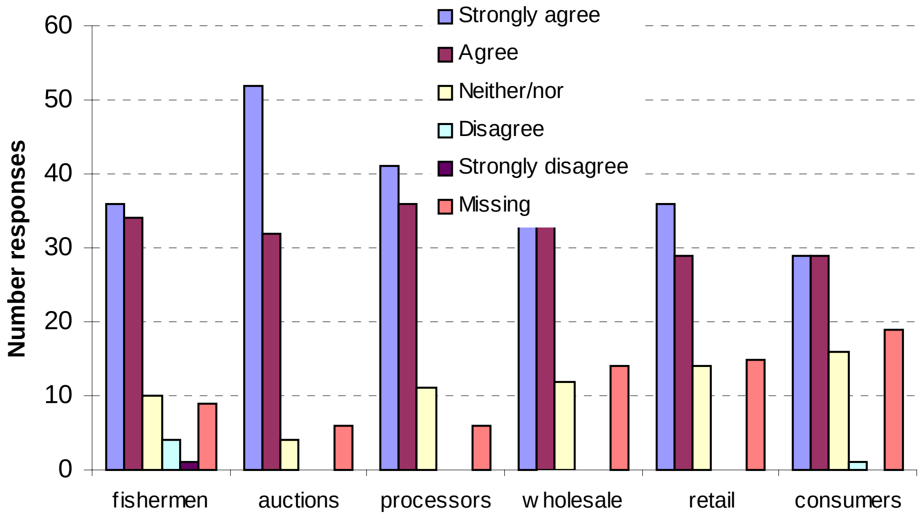


Figure 8. **Answers to questions on the need for quality labels at various stages in the supply chain (Questions 29 in Appendix 1)**

4.1.5. Conclusions of the questionnaire

The main results of the questionnaire regarding quality attributes and defects show that the average of the respondents agree or strongly agree that all the quality attributes and defects listed in the questionnaire are considered important. Moreover, on the average the respondents strongly agree that evaluation of the various sensory characteristics such as outer appearance, odour and colour using sensory analysis is very important in quality control.
The averages of the respondents strongly agree that it is important to measure freshness in a rapid and objective way and similarly they strongly agree that a rapid instrument to determine the quality of fish is needed.

Partner 7 will do further analysis of the data and comparison between countries and the plan is to write a paper together with the FQLM project. The paper will include the combined data from 12 countries.

4.2 Preliminary testing of texture measurements and electronic nose measurement (Sub-task 2.1)

Two storage studies were done on haddock in May and October 1999 to prepare for simultaneous evaluation of physical methods. The aim of the storage studies was to test the performance of texture measurement and the electronic nose FreshSense to detect changes of haddock stored in ice. The measurements were compared to sensory analysis.

Storage study on haddock (Melanogrammus aeglefinus) in May 1999
Haddock which was just about to spawn was caught by Danish seine on May 6th in Faxaflói southwest of Iceland. The fish was gutted and stored in ice in fish tubs and

was transported by truck the following day to the laboratory. The fish was stored whole in fishboxes (fish:ice ratio = 2:1) and stored at 0-2°C until analysed. Measurements were done on days 1, 4, 6, 8,11,13 and 15

Storage study of haddock (Melanogrammus aegle) in October 1999
Haddock was caught by longline on September 23rd southwest of Iceland. The fish was iced in boxes and was gutted the following day and sent to the laboratory at IFL by truck. The temperature of the fish was 0-4°C and was still in rigor when it reached the laboratory. The fish was stored in boxes at 0-2°C until analysed on days 1, 4, 6, 8, 11, 13 and 15.

4.2.1 Texture measurements

The texture analyser used was the Stable Micro Systems (TA.XT2i). The tests done were the TPA (Texture Profile Analysis) and firmness test (puncture test, breaking strength). The firmness test is non-destructive but the TPA analysis is a destructive test with the diameter of the compression plate much larger than the diameter of the sample.

4.2.1.1 Probes and calibrations
Firmness test (Puncture test)

- Ebonite cylinder probe, 10 mm in diameter (P/10)
- Pre test speed 2,0 mm/s; speed in sample 0,8 mm/s
- Strain (distance) 55%

TPA (Texture Profile Analysis)

- Aluminium Compression plate, 100 diameter (P/100)
- Pre test speed 2,0 mm/s; speed in sample 0,8 mm/s
- Strain (distance) 80%

4.2.1.2 Sample preparation for the texture analysis
For the firmness test (puncture test) the deskinned right fillets were used and used for the test the probe was penetrated into each fillet four times and the result is the average of the four measurements. The first penetration was done about 3 cm from the top (head part) of the fillet and again about 6 cm from the top, parallel penetrations were done in each location about 2-3 cm apart.
Sample preparation for the TPA analysis was that 3-4 cm of the top (head part) of the deskinned fillet was removed. Three to four 2.5-cm slices were cut across the fillet. Each slice was then cut into 2.5-cm cubes (sample size 2.5 x 2.5 cm). All samples were stored on plastic film on ice until analysed.

4.2.2 pH measurements

pH was measured at room temperature, with an Orion Ag/AgCl combination electrode (TRIODE TM pH electrode) connected to an Orion model 290A pH meter. The pH of fish mince was determined at 20-22°C by mixing 20 g sample with 80 ml of distilled water on a magnetic stirrer and measuring the pH in the slurry after 5-10 min equilibration.

4.2.3 Electronic nose measurements

Electronic nose measurements were performed using a gas sensor instrument called "FreshSense", developed by the Icelandic Fisheries Laboratories and Element Sensor Systems (Artorg 1, 550 Saudarkrokur, Iceland). The instrument consists of a glass container (5,2L) closed with a lid with a sensor box and a PC running a measurement and data analysis program. The sensor box contains five different electrochemical gas sensors (Dräger, Germany: CO, H_2S, NO and SO_2; City Technology, Britain: NH_3A7AM) and a temperature sensor. A fan is positioned in the glass container to ensure gas circulation. The measurement technique for the analysis of volatile compounds with the electronic nose instrument is based on a static headspace sampling, analysing directly the headspace of fish stored in the closed glass container during sampling at room temperature. The fish was filleted and skin removed and both fillets and heads were measured. The fillet samples comprised of 2-3 fillets (approximately 800-1000g) and 2-3 heads were used (approximately 600 –1000g). The samples were placed in the glass container and temperature was measured before the container was closed. Measurements were taken every 10 seconds for 10 minutes. The reported value (current) is the average of last three measurements of the 10 minutes measurement cycle The reported value (current) is the average of last three measurements of the 10 minutes measurement cycle minus the average of 18 signals before measurement begins.

4.2.4 Sensory analysis

Sensory analysis was performed by 10 - 12 trained members of the IFL sensory panel. The Torry scheme was used for cooked fish (Shewan, 1953) and the Quality Index Method (QIM) for whole raw fish (Bremner, 1985).

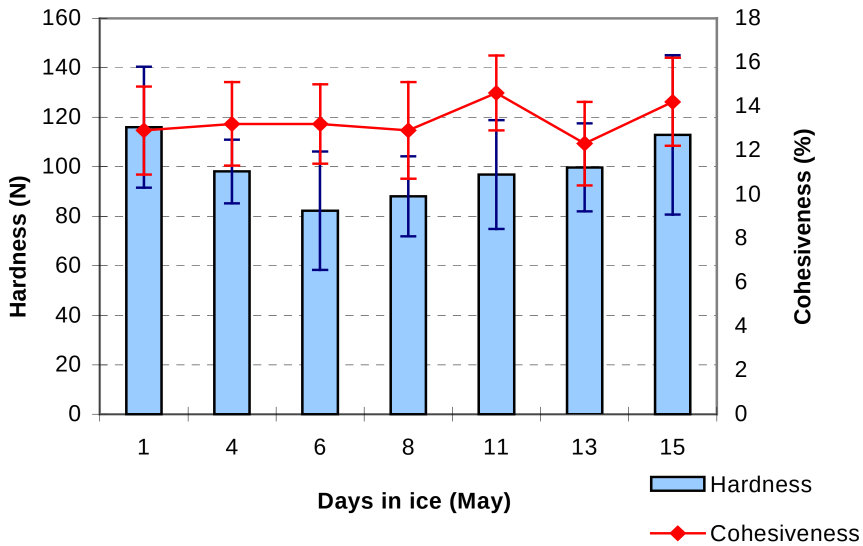
4.2.5 Results of texture measurements

4.2.5.1 Storage studies of haddock in May and October

The aim of the texture measurement in the storage study was to develop a non-destructive method to measure quality of fish. The method has to be reliable enough to detect quality of fish after different storage time whether kept on ice or in a freezer. Individual differences of fish are considerable and can be expected because within a haul of fish caught in one area at a certain time fish are of different sizes from different year classes and in different overall condition.

4.2.5.2 Texture Profile Analysis test

Figure 9 **Destructive texture profile analysis (TPA) of hardness and cohesieveness on haddock**



fillets in an experiment in May 1999. The texture value for each storage day is an average of five measured fishes.

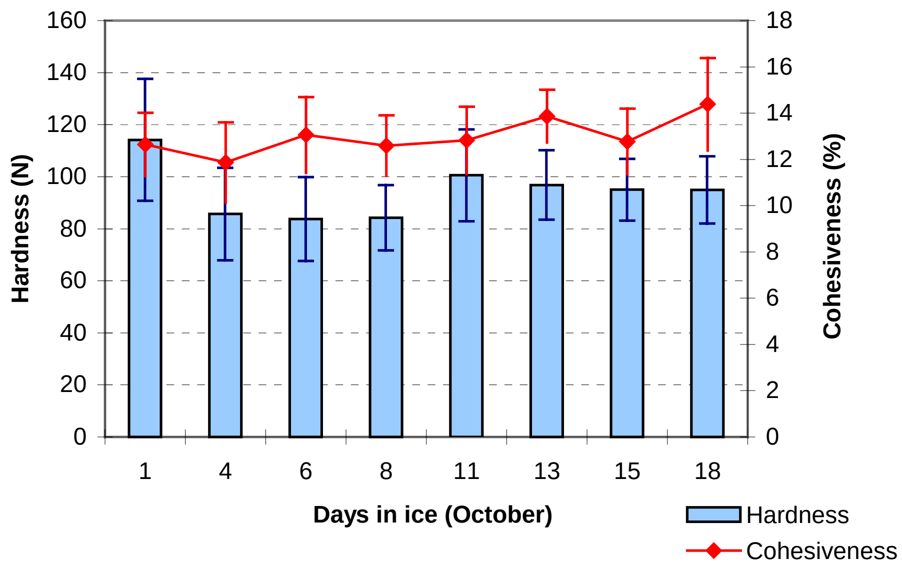


Figure 10 **Destructive texture profile analysis (TPA) of hardness and cohesiveness on haddock caught in October. The texture value for each storage day is an average of five measured fishes.**

Figures 9 and 10 show the TPA hardness and cohesiveness measurements of haddock during 15 days storage in ice from two seasons. The pattern seems to be very similar. No obvious difference can be seen between the measurement values for the two seasons except that the values from the May experiment are in general higher than in the October experiment. The cohesiveness in the May experiment shows about 1%

higher overall value than in the October experiment. The cohesiveness values are similar throughout the experiment and therefore do not give any indication of changes in fish freshness. The hardness for both seasons has the highest value on day one, the values decrease for the next two or three sampling days and increase again later on during the storage. The increase is on day 8 in the May experiment and on day 11 in the October experiment. It is possible that increased hardness at later stages of storage indicates spoilage.

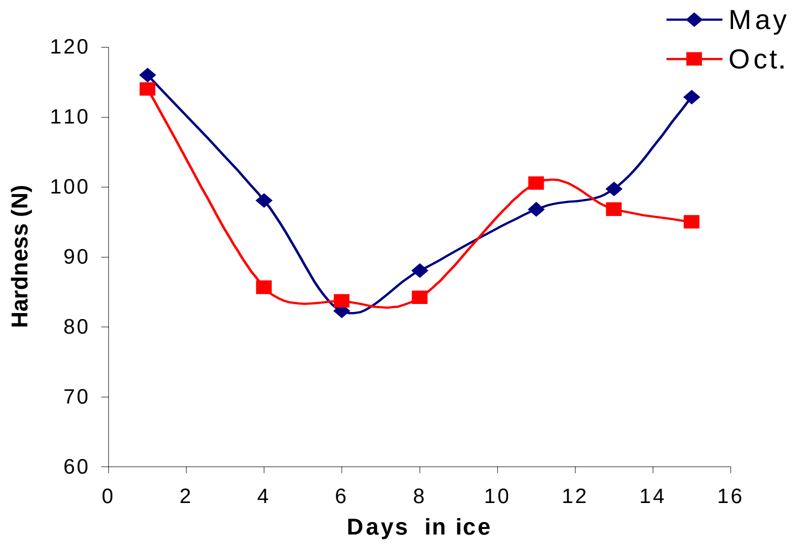


Figure 11 **Comparing hardness (TPA) measurements during storage experiments on haddock from two seasons.**

The TPA hardness values can be studied further in Figure 11. It can be seen that the values from the two seasons have a very similar pattern which illustrate that the hardness measurement give some indication, but whether it can be correlated directly into Torry sensory scores or another sensory scheme has to be studied further.

4.2.5.3 Firmness test (puncture test)

The non-destructive firmness test / puncture test shows a sharp decrease in force value between day one and four (Figure 12 and 13) for both seasons. After day four and throughout the experiment the firmness values changes very little. When comparing the firmness test to the hardness (TPA) it can be seen that the hardness shows also an obvious decrease in force between day one and four especially in the October experiment.

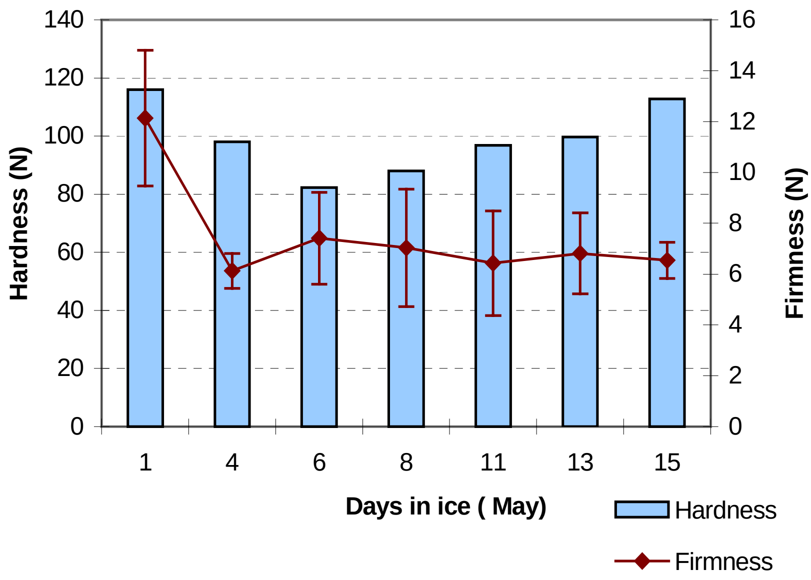


Figure 12 **Comparison of a destructive (TPA) hardness measurement and a non-destructive firmness (puncture) test of haddock caught in May. The texture value for each storage day is an average of five measured fishes.**

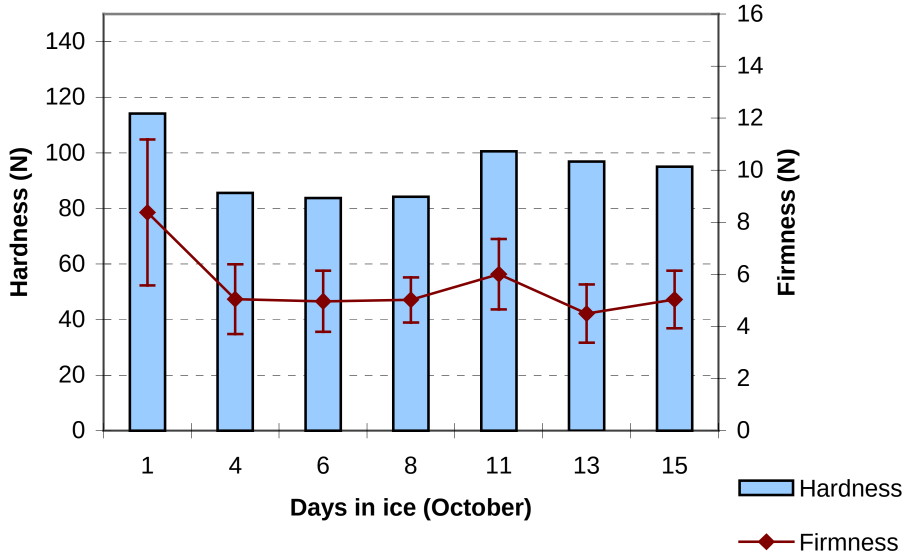


Figure 13 **Comparison of a destructive (TPA) hardness measurement and a non-destructive firmness (puncture) test of haddock caught in October 1999. The texture values for each storage day an average of five measured fishes.**

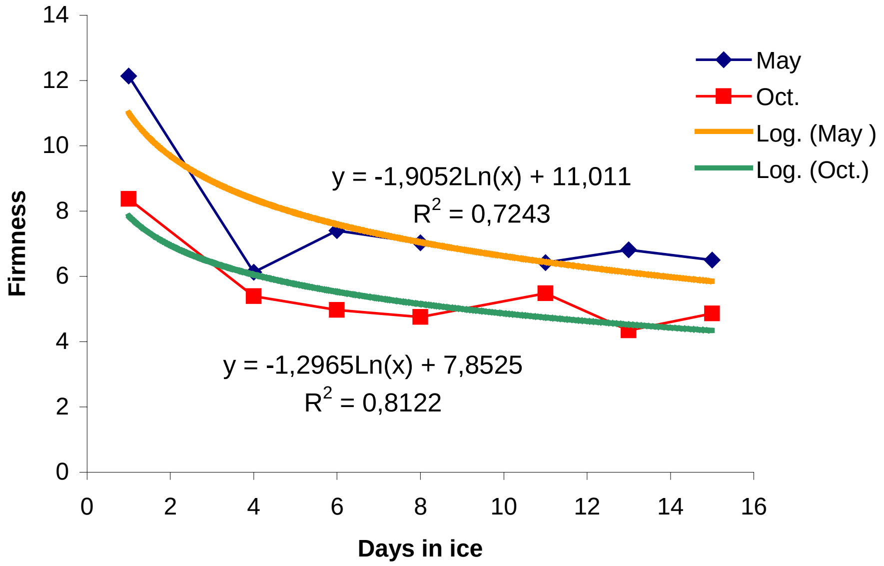


Figure 14 **Non-destructive firmness test (puncture test) measured on haddock caught in May 1999 and in October 1999. A logarithmic trendlines with its equation and R^2 factor are shown for both time periods.**

Figure 14 shows the values from the non-destructive firmness test. The pattern is very similar for the two seasons. The slope between day one and day four is considerably steeper for the May experiment. Firmness values for day two and three are needed to be able to evaluate whether the decrease in values between day one and four would follow the logarithmic trendline and be a possible indication of quality changes or only due to rigor changes.

4.2.5.3 Hardness (TPA) vs. pH

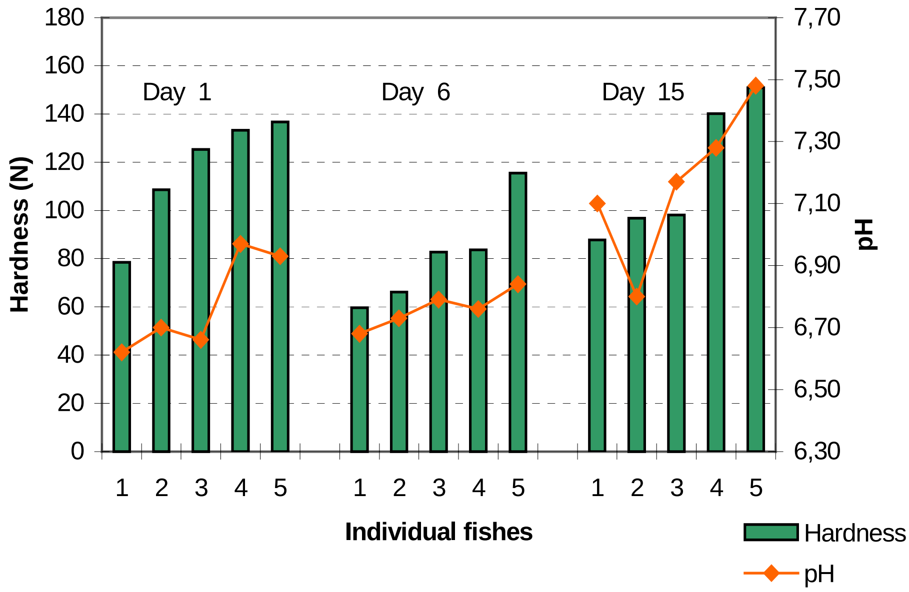


Figure 15 **Measured values of hardness (TPA) and pH of five individual haddocks caught in May 1999 and stored for 1, 6 and 15 days in ice.**

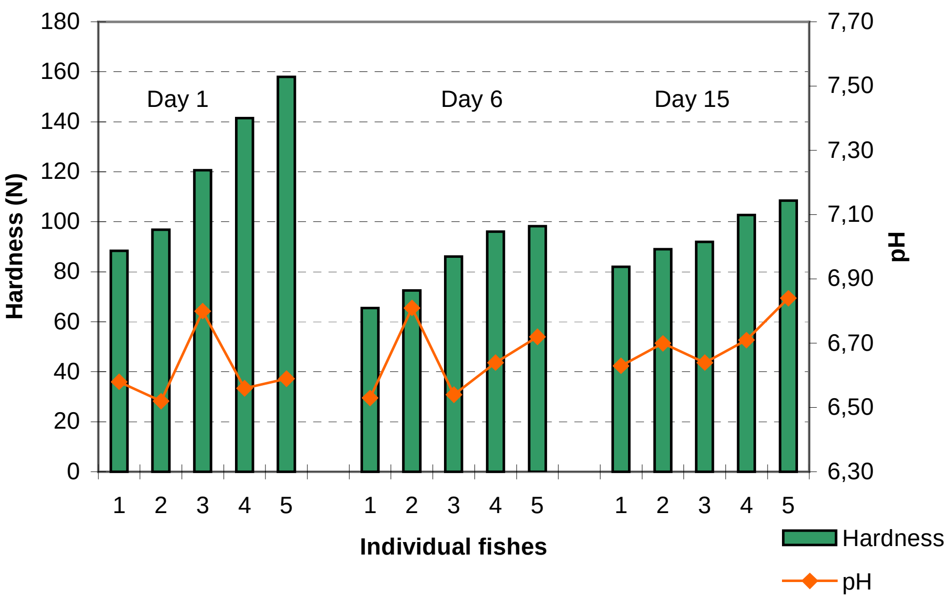


Figure 16 **Measured values of hardness (TPA) and pH of five individual haddocks caught in October 1999 and stored for 1, 6 and 15 days in ice.**

The nutritional differences of the haddock in the May and October experiments (Figures 15 and 16) can be seen by the generally higher pH values of the haddock from the May experiment. No obvious trend seems to be between hardness and pH. Figures 15 and 16 show measurements on individual basis, which demonstrate the great individual variation in both measurements.

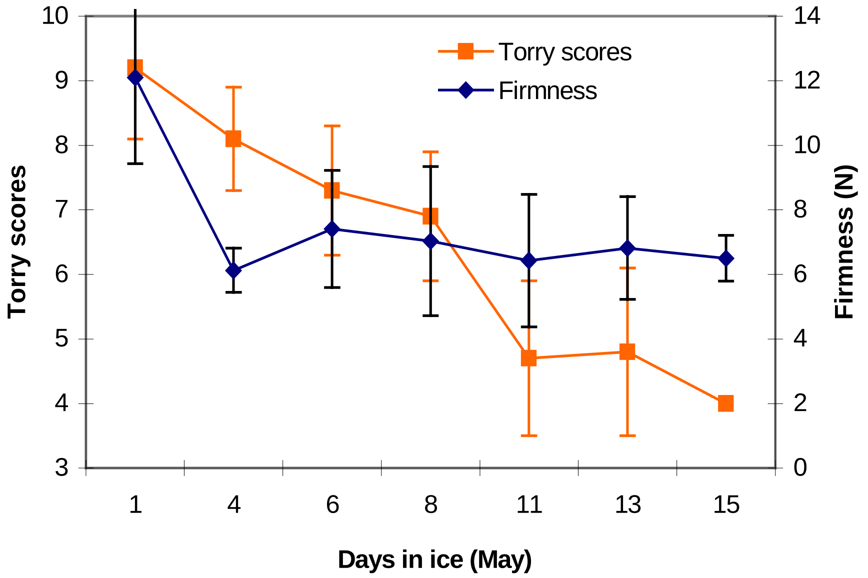


Figure 17 **Torry sensory scores and values from a non-destructive firmness (puncture) test are shown for haddock caught in May 1999**

4.2.5.2 Comparison of Torry sensory scores and firmness measurements

Figures 17 and 18 show the comparison of Torry sensory scores and the texture measurement of firmness. Continuous decrease can be seen in the Torry values but for the firmness values there is an initial decrease that levels off. As mentioned before the firmness values between day one and four have to be investigated to be able to detect whether the values can possibly be correlated into the Torry sensory values e.g. for the first week of storage. The Torry sensory scores showed that the end of shelf life was 9 -10 days for the May experiment and 14-15 days for the October experiment which demonstrates the initial quality difference of the haddock for the two seasons.

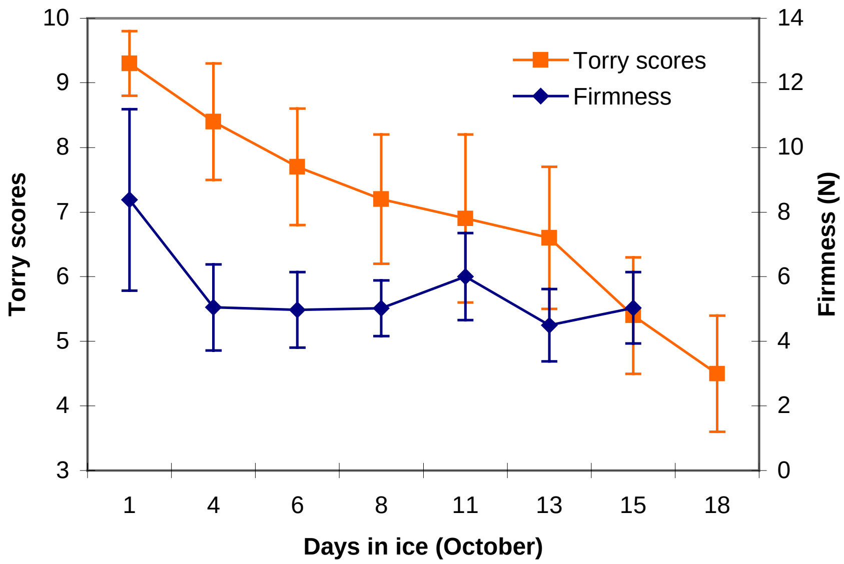


Figure 18 **Torry sensory scores and values from a non-destructive firmness (puncture) test are shown for haddock caught in October 1999.**

4.2.5.2 Conclusion of texture measurements

The texture measurements on haddock from the two seasons show the same overall trend but the May measurements show generally higher values than the measurements from the October experiment. The texture analysis might give more information about the nutritional condition of the fish rather than freshness. The finding for the May experiment, especially the Torry sensory scores and pH, reflect that the quality of the haddock was bad at that time. The shelf life is much shorter for the fish caught in May than in October. The shelf life difference between seasons is five days. In May the haddock in Iceland is just about to spawn and is therefore quite thin and in bad nutritional state. In October, the haddock is on the other hand in good growth. The cohesiveness values from the Texture Profile Analysis do not seem to indicate spoilage. The hardness (TPA) measurements during the storage show a particular pattern, which are similar for both seasons. The non-destructive firmness test (puncture test) shows a great decline in texture value between storage day 1 and 4 and after that there is hardly any change. It is possible that the firmness test can be used for quality grading the first few days of storage but before that is known storage values of day 2 and 3 have to be known.

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4.2.6 Results of electronic nose measurements

4.2.6.1 Storage studies of haddock May and October.

The aim of the storage studies was to investigate the possibility to use the electronic nose measurements to detect freshness and onset of spoilage of haddock. Figure 19 shows the results from the experiment in May for both heads and fillets. Three of the most important sensors (CO, NH_3 and SO_2) in the electronic nose are selected to illustrate the results. Electronic nose values are single measurements of each sample and the temperature was 8-10°C. Data is missing for the first two sampling days for the heads. The responses of all the sensors to the headspace of both fillets and heads increase with storage time

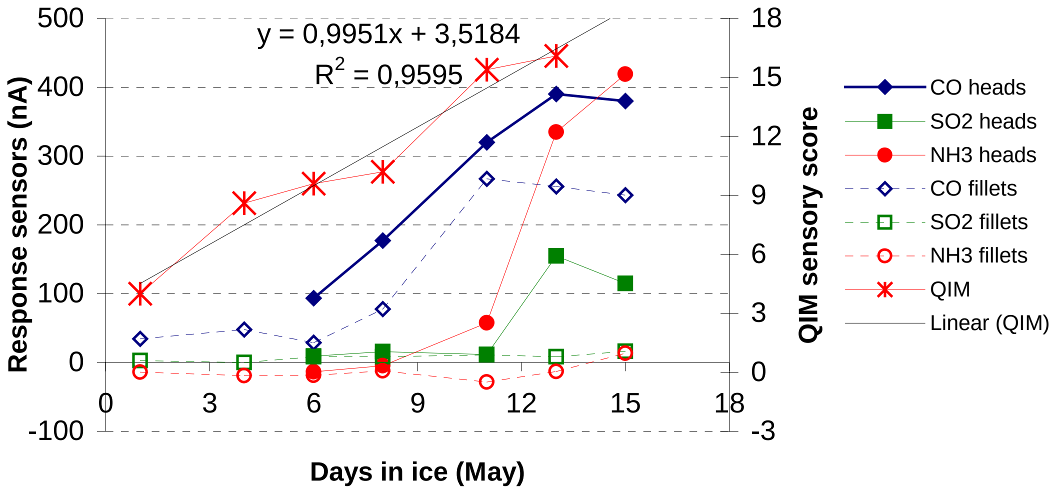

Figure 19 **QIM scores and electronic nose (FreshSense) measurement of haddock fillets and heads in May 1999. Temperature of samples was 8-10°C.**

In general the responses are slightly higher for the heads than the fillets. This is expected since the microbial spoilage activity is known to be higher in gills and on the skin. The CO sensor has the highest response and starts to increase after 6 days of storage but appears to level off after 13 days of storage. The responses of the NH_3 and

SO_2 sensors start to increase considerably after 13 days of storage for the heads but their response is very low towards the fillets.
The QIM scores show a linear increase throughout the storage time but the electronic nose has an initial lag phase. A comparison between the results of the QIM sensory score and the electronic nose data gives an idea how well the individual sensors can detect the freshness level of the fish. The CO sensor has the best linear correlation to storage time (R^2= 0,96 and 0,89 for heads and fillets, respectively) and to the QIM (R^2=0,97 and 0,90 for heads and fillets, respectively). The NH_3 sensor and the SO_2 sensors for the heads also show some linear correlation to storage time (R^2= 0,93 and 0,85 for NH_3 and SO_2, respectively) and to the QIM (R^2=0,78 and 0,64 for NH_3 and SO_2, respectively).

Similar overall trend is observed in October but the initial lag phase of the CO sensor appears to be longer (8 days) (Figure 20). Electronic nose values are averages of three repetitions of different samples from the same batch and temperature of samples was 8-10°C. The responses of the SO_2 and NH_3 sensors start to increase slightly on day 15 for the heads, but no significant increase is seen for the fillets at that time. The CO sensor has the best linear correlation to storage time (R^2= 0.80 and 0,89 for heads and fillets, respectively) and to the QIM (R^2=0,76 and 0,85 for heads and fillets, respectively).
When comparing the results from May and October it is obvious that the spoilage rate is faster in May as can be seen by the higher value for the slope of the QIM-line in May (0,99) compared to October (0,93). Moreover, the intercept of the line in May is higher and shows that the raw material had initially higher QIM score. This was expected since the haddock was just about to spawn in May and was therefore in a bad nutritional condition. In October the fish was on the other hand, in good condition and was thus more stable during storage and longer shelf life was observed. The shelf life as determined by the QIM method was
10-12 days in May, but 14-15 days in October. The responses of the NH_3 and SO_2 sensors start to increase at similar time as end of shelf life is reached in both experiments.

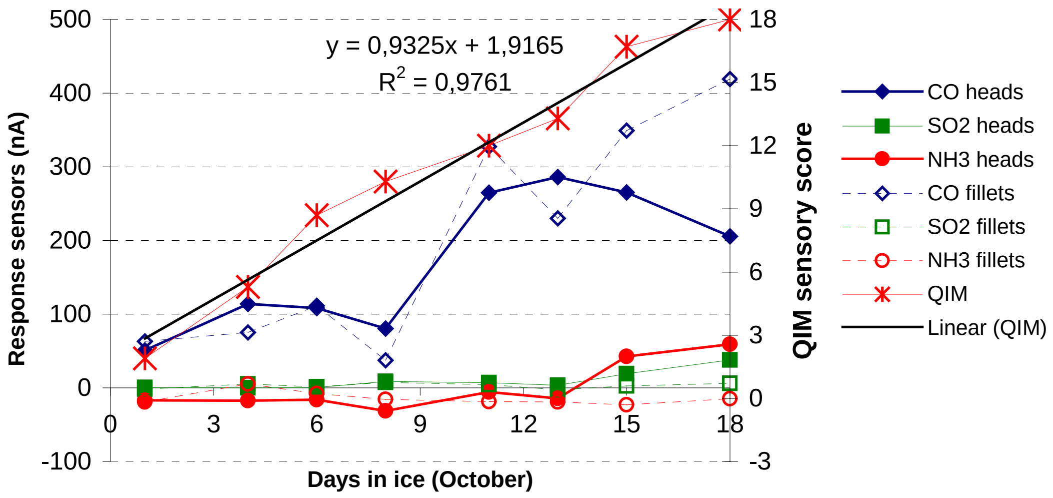

Figure 20 **QIM and electronic nose (FreshSense) measurement of haddock fillets and heads in October 1999.**

4.2.6.2. The effect of sample temperature on sensor responses

The storage study in May included preliminary experiments to see the effect of temperatures of samples when measuring, on the response of electronic nose. Each time the same sample was measured three times and the temperature was recorded when the measurement started. The measurements were done at ambient and the temperature of the samples increased during the measurements. The temperature of the samples was 8-10°C before the first measurement, it increased to 10-12°C before the second measurement started and had reached 14-15°C before the third measurement started.

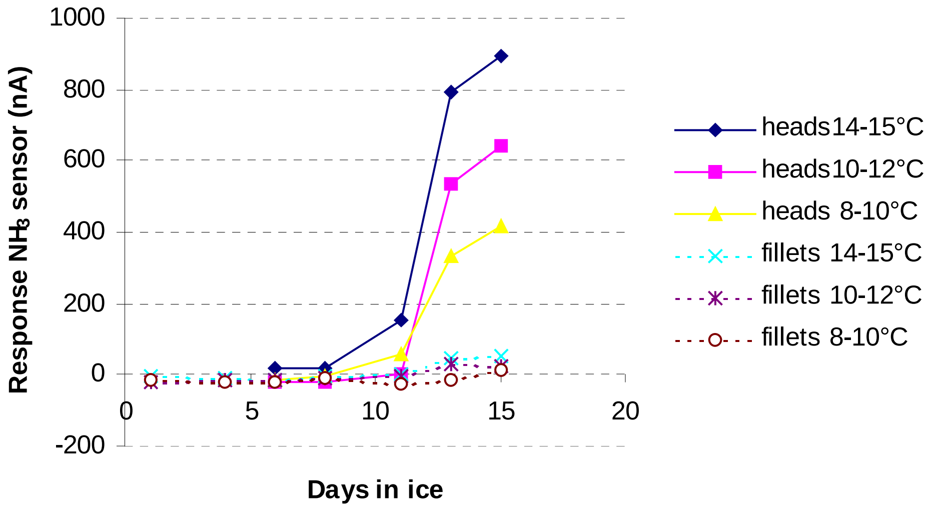

Figure 21 **Response of the NH_3 sensor to haddock fillets and heads during repeated measurements of the same sample at different temperatures each day of sampling.**

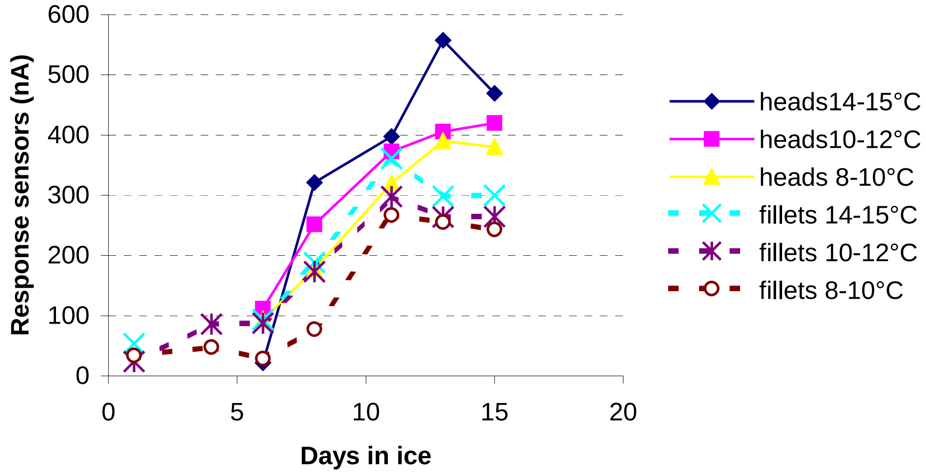

Figure 22 **Response of the CO sensor to haddock fillets and heads during repeated measurements of the same sample at different temperatures each day of sampling**

Increasing responses are seen for all sensors when temperature of the samples increases. In Figures 21 and 22 the NH_3 and CO sensors, respectively, were selected to show that the responses of the sensors appear to increase with increasing sample temperature. This is expected since the volatility of compounds increases with higher temperatures and therefore the concentration of volatiles increases in the headspace above the sample. These results show that it is necessary to study how much variation in sample temperature can be allowed so that samples can be discriminated based on storage time or spoilage level. Principal component analysis (PCA) is useful to study the main trend in the electronic nose data taking into account the responses of all the sensors.

4.2.6.3 PCA analysis of data from storage study in May

Principal component analysis (PCA) was performed using Unscrambler 6.1 (CAMO A/S) on all data from the May experiment to study the main variance in the data set. The main purpose was to study the effect of different temperature of samples (i.e. 8-10°C, 10-12°C; 14-15°C; +16°C) on the trend in the data set. Also, to see if samples could be discriminated based on spoilage level expressed as days of storage. In all PCA runs two principal components and full cross validation were used.

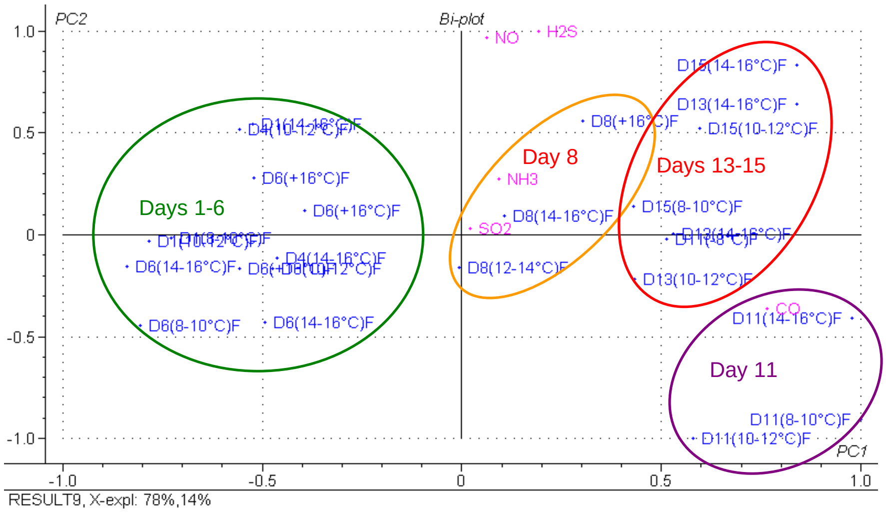

Figure 23 **PCA biplot of FreshSense measurements of haddock fillets after storage in ice. Sample scores are shown in blue and labeled with storage day and temperature range during measurement. The variable loadings are shown in pink (CO, H_2S, NO, SO_2 and NH_3 sensors).**

A PCA biplot of the electronic nose data for fillets is shown in Figure 23. Samples are grouped together according to days of storage. The first two PCs describe 78% and 14% respectively, of the variation of the samples. The samples from days 1, 4 and 6 are grouped together on the left side of the plot and the spoilage level or days of storage increases from left to right. The CO sensor is mainly influencing the first PC and the grouping of samples according to storage time is evident. The samples from day 11 had the highest response for the CO sensor and are therefore located furthest to the right on the plot. The samples from day 13 and 15 had lower CO responses, but slight increase in responses for the other sensors and are therefore grouped together.

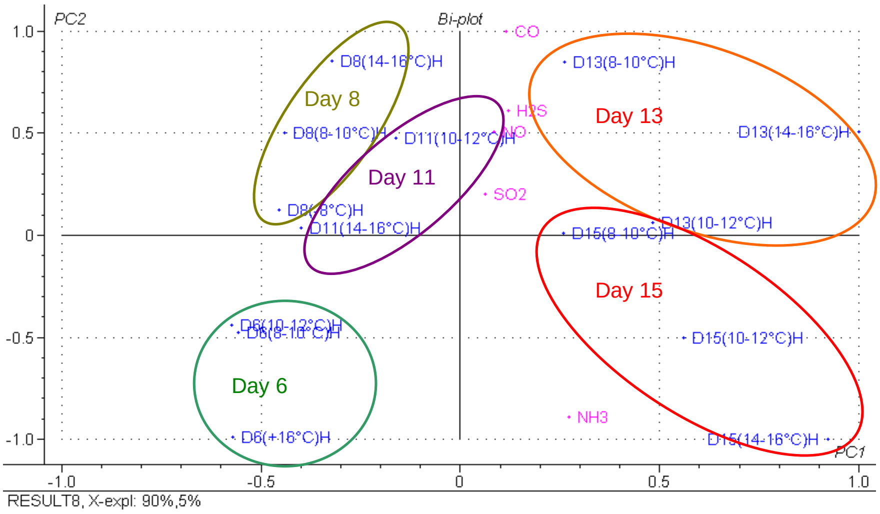

Figure 24 **PCA of FreshSense measurements of haddock heads during storage in ice. Samples scores are shown in blue and labeled with storage day and temperature range during measurement. The variable loadings are shown in pink (CO, H_2S, NO, SO_2 and NH_3 sensors).**

Similar grouping of samples according to storage days can be seen for the heads on the PCA biplot in Figure 24. The first two PCs describe 90% and 5% respectively, of the variation of the samples. Data from days 1 and 4 is missing. The samples from day 6 are well distinguished from the other samples on the left side of the plot. The discrimination between days is not as clear for the other samples, however there is an overall trend and the days of storage increase in a curve like pattern from left to right. The NH_3 sensor appears to contribute most to the grouping of samples from day 15. The discrimination of the samples according to days is not always clear and samples from different days are close to each other on the plot. The effect of temperature of samples is evident and better discrimination between days would be achieved if the same temperature were always used during measurements.

4.2.6.4. Conclusions of electronic nose measurements

The results of the electronic nose measurements of haddock from different seasons show the same overall trend. The responses of all the sensors increase during storage. The CO sensor appears to increase earlier than the other sensors and is most likely responding to short chain alcohols (i.e. ethanol) and aldehydes that form during storage. The response of the CO sensor levels off at advanced stages of storage. The responses of the NH_3 and SO_2 sensors increase at later stages of storage. These sensors are sensitive to amines and sulphur compounds respectively, that typically form in high concentrations at the end of the storage life. The slower spoilage rate observed in the October experiment compared to the May experiment is in agreement with the results of sensory analysis. The rapid spoilage rate in May is explained by the poor condition of the fish at that time.

The electronic nose measurements can discriminate between samples of haddock heads from different storage time (6, 8, 11, 13 and 15 days). The electronic nose data for fillets can not be used to discriminate between the first days of storage (1-6 days). However the measurements can be used to detect the onset of spoilage and can discriminate between days when fish has spoilage signs (8,11 and 13-15 days) similar to the results of the haddock heads. All the sensors appear to have an initial lag phase. This initial lag phase is in agreement with traditional microbial analysis of total viable counts (TVC) and chemical analysis of trimethylamine (TMA) and total volatile bases (TVB) (data not shown here). On the other hand sensory analysis can discriminate between days of storage and the QIM scores show a linear increase during the whole storage time.

The results of measurements of samples of different temperatures show that careful monitoring of temperature is needed during measurements. For meaningful comparison of samples the same temperature has to be used. More sensitive measurements are needed to detect differences between the first days of storage. Sensitivity of the electronic nose measurements can be increased by adjusting or modifying the sampling conditions for example by using a smaller sampling container to increase the sample/headspace ratio and thus increase the concentration of volatiles in the headspace.

The results of the electronic nose measurements of haddock during storage indicate that this technique has a potential to be used as a non-destructive measurement, which can be implemented in a multi-sensor to detect the freshness or onset of spoilage of fish.

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5. Other activities during the reporting time

The first project meeting was in Hamburg on December 18th -19th, 1999 and was attended by Soffia Vala Tryggvadottir and Gudrun Olafsdóttir.

The second project meeting was in Rome 24th - 25th of June 1999 and was also attended by Soffia Vala Tryggvadottir and Gudrun Olafsdóttir.
The results from the May 99 haddock experiment were presented at the second project meeting.

The third project meeting was a work-in in Reykjavík, Iceland (Task 2.2.) on November 12th-20th, 1999. During the work-in simultaneous measurements were carried out on cod at different storage time. The data analysis is not complete and the results of the experiment will be included in the next annual report.

6. Significant difficulties or delays experienced during the reporting period

The progress of the project has been according to the timetable of the project and no difficulties or delays have been during the first year.

7. Dissemination of results

Data on electronic nose measurements from the storage study on haddock in May were presented at a NOSE meeting in Ispra, Italy on June 18th and at a Nordic Sensory Workshop in Reykjavik, Iceland in September, 1999.

Gudrun Ólafsdóttir, 1999. Electronic Nose Instead of Sensory Analysis? Sensory Evaluation and Quality - Nordic Workshop VIII, September 9-11 Reykjavik, Iceland

Gudrun Ólafsdóttir, 1999. Electronic nose to characterize freshness and spoilage of fish. "Electronic NOSE User Forum", Network of Excellence on Artificial Olfactory Sensing, Ispra, Italy, June 17-18.

During the work-in in Iceland an article about the MUSTEC project appeared in one of the major newspapers in Iceland (see Appendix 2). Also, an article appeared in the IFL newsletter describing the project and giving a summary of the work-in. (Appendix 2). Pictures from the meeting are on the homepage of IFL: http://www.rfisk.is/NoseSense-adalsida.htm.

Appendix 1

Questionnaire

Quality attributes of fish and current control methods
Need for instrumental measurements
Quality defects and other quality factors
Overall quality control and labelling

Results of the questionnaire showing the raw data: number of respondents giving the scores: strongly agree, agree, neither agree nor disagree, disagree and strongly disagree, for each questions are shown. The number of missing values are added and shown as underlined.

Quality attributes of fish and control methods

= average score

Please check only one box for each statement

Quality attributes and current control methods		Strongly agree = 1	Agree =2	Neither agree nor disagree =3	Disagree = 4	Strongly disagree = 5	I don´t know
1. Information on catching time/day is important	1	74	16	2	1	0	0
2. It is important to record the temperature regularly during the whole chain	1	51	36	5	0	0	1
3. Bacterial count is important in quality grading	3	19	39	26	3	0	4
4. Chemical measurements (i.e. total volatile nitrogen (TVN) and trimethylamine (TMA)) are important	5	8	21	33	5	1	21
5. Following physical measurement devices are important:							
a) Texture meter,	17	3	13	24	5	1	31
b) RT meter	14	3	12	23	3	2	37
c) Torry meter	18	4	10	23	3	0	36
d) Fishtester	20	1	6	23	2	0	42
6. Sensory analysis is important in quality control	0	66	28	0	0	0	0
a. Outer appearance of fish is important (i.e. eyes, skin, gills etc.)	0	58	34	2	0	0	0
b. Odour is an important freshness/ quality indicator	0	65	27	2	0	0	0
c. Colour of fish and gills give good indication of quality.	0	51	39	2	0	0	2
d. Texture (finger test) is important as a quality indicator	0	19	53	14	4	0	4
e. Texture (mouthfeel) is important as a quality indicator	0	10	45	21	1	2	15
f. Flavour is important to detect quality	0	37	42	10	1	0	4

7. Which schemes do you use for your sensory analysis? **You may check more than one box and please rate according to usage;** 1= primarily, 2= occasionally, 3= rarely

64 EU scheme whole fish 1 **15** 2 **4** 3 **11**

77 QIM whole fish 1 **7** 2 **3** 3 **6**

76 Torry scale (for cooked fish) 1 **10** 2 **2** 3 **6**

37 Quality grading raw fish 1 **49** 2 **4** 3 **4**

72 Quaity grading cooked fish 1 **10** 2 **4** 3 **7**

78 Other ..... 1 **15** 2 **0** 3 **0** what please, explain..

☺ = average score

Please check only one box for each statement

Need for instrumental measurements	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	I don´t know
8. It would be important to detect odour changes with an instrument such as an electronic nose **3**	9	27	34 ☺	6	3	12
9. Texture measurement with texture analyser would be important in quality grading **2**	6	22	35 ☺	11	0	18
10. Detection of colour change with an instrument would be important **5**	6	22	34 ☺	13	1	13
11. It would be important to determine freshness (storage time) in a rapid and objective way. **2**	55 ☺	32	4	0	0	1
12. It is of interest to determine quality parameters such as chemical composition (fat, water, protein, etc.) in a rapid and objective way. **2**	19	30 ☺	35	2	1	5
13. Methods to detect whether the fish was pre-frozen are needed. **2**	13	36 ☺	29	7	1	6
14. Methods to evaluate the quality or freshness of prefrozen fish are needed **2**	18	46 ☺	17	3	1	7
15. A small hand-held instrument, that could rapidly determine the quality of fish would be useful for me. **2**	49 ☺	36	4	1	0	2

= average score

Please check only one box for each statement

Quality defects and other quality factors		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	I don´t know
16. Following factors influence quality:							
Fishing gear	6	60	23	3	0	0	2
Towing time	5	60	28	0	0	0	1
Amount of catch in haul	4	63	25	2	0	0	0
17. Evaluation of icing (fish/ice ratio) is important	0	69	24	1	0	0	0
18. Size and weight of fish is important for quality grading	1	39	34	13	6	0	1
19. It is important to detect defects such as gaping	0	46	43	3	0	0	2
20. Detection of blood stains in fillets is important	1	37	50	2	1	0	3
21. It is important to be able to detect parasites	0	30	48	14	0	0	2
22. Detection of bones in fillets is important	1	46	33	10	1	0	3
23. Detection of frozen storage defects such as dehydration is important	0	28	47	12	0	0	7
24. Methods to detect whether the fish has been pre-frozen are needed. (i.e. chilled pre-frozen fish sold as fresh)	0	25	30	25	4	1	9
25. Detection of other defects is important, please specify..................	54	10	12	8	0	0	10

☺ = average score

Overall quality control and labelling	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	I don´t know
	Please check only one box for each statement					
26. A standardised method to evaluate quality would be useful: a) in cases of disputes **7**	46	36 ☺	4	0	0	1
b) to increase the value of the product **10**	31	40 ☺	8	3	0	2
27. Quality labelling of fish would contribute to increased sales of fish **5**	29	30 ☺	19	6	0	5
28. What is your reason for documenting quality of your product : a) Legislation **23**	26	37 ☺	3	4	0	1
b) Customer requirements **23**	41	24 ☺	4	0	1	1
c) Other, what please, explain...................................... **62**	17	11	2	0	0	2
29. Quality labels are needed at the following stages of the supply chain ? a) Fishermen - quality labelling of catch **7**	**36**	**34** ☺	**10**	**4**	**1**	**2**
b) Auctions - quality labelling of raw material **6**	**52** ☺	**32**	**4**	**0**	**0**	**0**
c) Processors - quality labelling of raw material and products **5**	**41**	**36** ☺	**11**	**0**	**0**	**1**
d) Wholesalers - quality labelling of products **11**	**34**	**34** ☺	**12**	**0**	**0**	**3**
e) Retail - quality labelling of products **12**	**36**	**29** ☺	**14**	**0**	**0**	**3**
f) Consumers - quality labelling of products **14**	**29**	**29** ☺	**16**	**1**	**0**	**5**

Demographics	Fishermen	Fish auction	Processing industry	Wholesale dealers / exporters	Retail / Supermarket / ish merchants	Fish inspection	Other
30. In which part of the fishery chain do	18	9	62 ☺	12	11	2	0

31. What is the size of your company

36 1-10 employees | 22 10- 50 employees | 34 More than 50 employees

Appendix 2

Dissemination of results

1. Ferskleiki í fiski mældur: Article from the Reykjavik work-in, Morgunbladid, December 1, 1999
2. Sandgerðisþorskur í alþjóðlegri ferskleikamælingu: Article in Rf Newsletter:

FRÉTTIR

Ferskleiki í fiski mældur

Sameiginlegt Evrópuverkefni sjö þjóða

VÍSINDAMENN frá sjö þjóðum komu saman í húsakynnum Rannsóknastofnunar fiskiðnaðarins dagana 11. til 21. nóvember sl. þar sem ferskleiki fisks var mældur með ýmsum aðferðum. Fundurinn var liður í sameiginlegu Evrópuverkefni um fjölþáttaskynjaratækni til að mæla ferskleika í fiski en stefnt er að því að birta niðurstöður vinnufundarins í byrjun næsta árs.

SÉRFRÆÐINGAR hjá Rf og frá Bretlandi, Noregi, Danmörku, Spáni, Þýskalandi og Ítalíu vinna að umræddu verkefni, en þetta er í fyrsta sinn sem svona vinnufundur er haldinn hjá hópnum þar sem fólkið kemur saman með tækin sín og mælir sama fiskinn, að sögn Guðrúnar Ólafsdóttur, en hún og Soffía Tryggvadóttir eru fulltrúar Rf í verkefninu. „Venjulega er það þannig að fólk mælir fisk í sínu heimalandi með sínum tækjum og því er erfitt að bera saman niðurstöður þar sem aðstæður eru ekki þær sömu," segir Guðrún. „Því er það svolítið sérstakt að allir geri mælingar á sömu fiskunum en fyrirtækið Tros í Sandgerði aðstoðaði okkur við að safna fiski fyrir tilraunirnar. Mikilvægt var að hafa gott, ferskt hráefni í upphafi sem síðan var geymt í mislangan tíma og þannig fékkst hráefni af mismunandi ferskleika til mælinga."

Samanburður á tækjum

Markmið verkefnisins er að prófa og bera saman þau tæki sem eru notuð á markaðnum til að mæla ferskleika fisks en hvert land, sem að rannsókninni stendur, er að þróa ákveðna tækni í ferskleikamælingum. „Við erum með skynmat og notum svokallaða gæðastuðulsaðferð sem er mun nákvæmari og betri aðferð en gæðaflokkun sú sem gjarnan er notuð í fiskiðnaðinum. Jafnframt erum við að þróa nýjar hraðvirkar aðferðir eins og áferðarmælingar og rafnef sem getur greint efni sem myndast við skemmd á fiski. Í rannsókninni voru einnig notuð tæki sem þróuð voru fyrir þó nokkuð löngu. Um er að ræða RT-ferskleikamælinn, sem þróaður var hérlendis, ásamt Torry-mæli, sem er frá Skotlandi, og einnig þýskur mælir, „Fishtester". Þessi tæki byggjast á því að mæla mismunandi raffræðilega eiginleika í fiskroði. Mælingar með þessum tækjum hafa gefið góða fylgni við skynmat á fiski, en notkun þeirra í iðnaði hefur samt ekki náð mikilli útbreiðslu."

Guðrún segir að aukin þörf sé fyrir ferskleikamælingar því það fari vaxandi að fiskur sé seldur óséður með rafrænum viðskiptum og þá sé meiri þörf fyrir mæliaðferðir til að sannprófa ferskleika fisks. Ferskleikamælingar auðveldi mjög framleiðslustýringu og gæðaeftirlit í fyrirtækjum og mikil þörf sé á að fá þessar mælingar á sem fljótlegastan og öruggastan hátt til að tefja ekki framleiðsluna of mikið. „Á vinnufundinum báru vísindamennirnir saman ýmsar mæliaðferðir og má þar telja auk þeirra aðferða sem áður voru nefndar, myndgreiningu með ljósmyndatækni og ljósgleypniaðferðir með innrauðum og sýnilegum geislum. Öllum gögnum verður safnað saman og skoðað hvaða tækni hefur bestu fylgni við skynmatið auk þess sem rannsóknin nýtist til að betrumbæta þær aðferðir sem eru í þróun," segir Guðrún.

Niðurstöður verkefnisins um aðferðir til að meta ferskleika fisks munu koma til góða öllum þeim sem vinna að dreifingu, sölu, kaupum og vinnslu á fiski, að sögn Guðrúnar. Stefnt er að því að niðurstöður vinnufundarins verði birtar í byrjun næsta árs en verkefninu í heild lýkur eftir tvö ár.

Morgunblaðið/Árni Sæberg

Vísindamennirnir að störfum í húsakynnum Rannsóknastofnunar fiskiðnaðarins.

Sandgerðisþorskur í alþjóðlegri ferskleikamælingu

Sumir þukluðu þorskana með tilþrifum og voru síðan góða stund með nefið niðri í fiskinum - í bókstaflegum skilningi. Aðrir potuðu léttilega í þorskana sína, lyktuðu rétt sem snöggvast af þeim og voru ekki yfir sig hrifnir af ilmi sjávarfangsins ef marka mátti svipbrigði. Þetta voru vísindamenn frá Bretlandi, Noregi, Danmörku, Þýskalandi, Spáni og Ítalíu í tilraunaeldhúsi Rf í nóvember sl., önnum kafnir við að skynmeta fisk eftir kúnstarinnar reglum.

Gestirnir komu hingað til lands á vinnufund vegna Evrópuverkefnis sem hefur að markmiði að bera saman mismunandi aðferðir til að mæla og meta ferskleika fisks. Guðrún Ólafsdóttir og Soffía Vala Tryggvadóttir eru fulltrúar Rf í verkefninu en verkefnisstjórinn heitir Paul Nesvadba, Tékki búsettur í Skotlandi. Sumir í hópnum voru alvanir að skynmeta fisk, aðrir höfðu ekki komið nálægt slíku fyrr en komust furðu fljótt upp á lag með það. En það sem fyrst og fremst gerði vinnufundinn á Rf sérstakan var að útlendu þátttakendurnir komu með tæki og tól með sér að heiman og þau voru prófuð hér á sama fiskinum við sömu aðstæðurnar, til að hægt væri að bera saman niðurstöður ferskleikamælinga. Fyrirtækið Tros í Sandgerði útvegaði fisk fyrir verkefnið og hann var geymdur mislengi til að hægt væri að meta mismunandi ferskleika.

Hópurinn sem tók þátt í ferskleikamælingunum. Þetta var fólk sem kom víða að: frá Bretlandi, Noregi, Danmörku, Þýskalandi, Spáni og Ítalíu auk Íslendinga.

Rf lagði til rafnefið

Tækin sem komu við sögu í verkefninu voru mörg og ólík, sum gamalreynd en önnur nýleg. Af eldri tækjum má nefna RT-ferskleikamæli, sem er íslensk smíð, skoska Torry-mælinn og þýska mælinn Fishtester. Með þeim öllum eru mældir raffræðilegir eiginleikar í fiskroði og þessir mælar skiluðu góðum árangri í verkefninu, þ.e. niðurstaðan úr mælingum var í góðu samræmi við skynmat á sama fiski.

Notuð var svokölluð gæðastuðulsaðferð (QIM) sem nú er að ryðja sér til rúms í skynmati og er mun nákvæmari og betri aðferð en sú gæðaflokkun sem gjarnan er notuð í fiskiðnaðinum. Rf lagði til verkefnisins „rafnef", nýtt og hraðvirkt tæki sem þróað var í samvinnu Rf við fyrirtækið Element á Sauðárkróki. Einnig er verið að þróa aðferðir á Rf vegna áferðarmælinga til að meta þéttleika fiskholds.

Önnur tæki í verkefninu voru meira framandi, t.d tæki sem byggja á myndgreiningu með ljósmyndatækni, ljósgleypnimælingar með innrauðum og sýnilegum geislum. Dr. Jörg Oehlenschläger frá Þýskalandi nefndi sérstaklega í samtali við Rf-tíðindi handhægan litamæli sem notaður er í bíla- og plastframleiðslu til að meta liti (lakk). Þetta tæki hefur ekki verið notað á fisk fyrr en nú á Rf. Hann benti líka á ítalskt rafnef sem notað hefur verið í rannsóknum til greiningar á ýmsum sjúkdómum með því að mæla loft sem sjúklingar anda frá sér. Nú var tækið notað við að mæla ferskleika fisks.

Skjót og örugg ferskleikamæling auðveldar gæðaeftirlit í fiskvinnslu

Markmiðið með Evrópuverkefninu um ferskleikamælingar er að kanna hvers konar tækni og mæliaðferðir skila mestri fylgni við skynmat og bæta enn frekar þær aðferðir sem þykja gefa góða raun. Unnið er að því að fara yfir allar mælingarnar á Rf og stefnt að því að niðurstöður liggi fyrir snemma árs 2000. Sjálft verkefnið hófst fyrir einu ári og því lýkur að tveimur árum liðnum. Guðrún Ólafsdóttir og Soffía Vala Tryggvadóttir segja að víða megi merkja áhuga fyrir því að finna leiðir til að meta ferskleika fisks skjótt og örugglega. Hugsanlegt sé að Evrópuverkefnið umrædda skili þeim árangri að hægt verði að búa til handhægt tæki sem mæli ferskleika á augabragði en samt með hliðstæðri nákvæmi og gerist í skynmati. Slíkt gagnist víða í viðskiptum með fisk og í fiskvinnslu, til dæmis gangi fiskur kaupum og sölum á fjarskiptamörkuðum og þá skorti tækni til að mæla ferskleika vörunnar í snarheitum svo kaupandinn viti nákvæmlega ástand vörunnar þegar viðskipti eiga sér stað. Ferskleikamæling styrki auk heldur gæðaeftirlit og auðveldi framleiðslustýringu í fiskvinnslunni.