Quality Index Method– An Objective Tool for Determination of Sensory Quality

Grethe Hyldig
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ABSTRACT. Sensory evaluation is one of the most important methods for assessing freshness and quality in the fish sector and in fish-inspection services. Sensory methods performed in a proper way are a rapid and accurate tool providing unique information about food. Traditionally, sensory methods have been seen as a subjective assessment of quality. However, sensory methods can be turned into an objective tool. European fisheries research institutes have developed such a tool, by which sensory assessment is performed in a systematic way with an objective quality assessment method called the Quality Index Method (QIM). It is foreseen that the QIM will be useful to give feedback to fishermen concerning the quality of their catch, which may in turn influence better handling on board. The QIM is a promising method for quick and reliable assessment of the freshness of fish. It is expected to become the leading reference method for the assessment of fresh fish within the European community. It could also become a part of labelling and identification of the catch, particularly in electronic auctioning of catch. *[Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH. E-mail address: <docdelivery@haworthpress.com> Website: <http://www.HaworthPress.com>*

KEYWORDS. Quality Index Method, fish, sensory quality, objective sensory, quality

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BACKGROUND AND INTRODUCTION TO QIM

It is well known that food quality by no means is clearly defined, and great confusion can be created when research and development experts try to communicate with marketing experts (Bremner, 2000). The quality concept itself is a difficult one and Botta (1995) cites 15 different definitions of quality. These range from general statements to consumer definitions. Each definition can be used in a specific situation, but none of them are comprehensive. Quality cannot be defined simply as the definition changes with the particular context where it is applied, and is dependent on the multitude of fish species, the influence of biological parameters (such as season and spawning period) and technological parameters (such as handling, temperature and time). Quality must be defined in each stage of the production chain from catch to consumer, and it is necessary to develop quantitative test methods suitable for all stages.

The quality concept is frequently described by using terms related to nutritional, microbiological and physiochemical characteristics alone, but none of these terms serve as fully comprehensive indices of quality. Sensory perception and consumer acceptability must be included (Nielsen et al., 2002). The sensory method offers immediate measurement of perceived attributes and provides information that may be of help in better understanding consumer responses. Sensory testing can be both objective and subjective. The objective tests include discriminative (triangle test and forced choice) and descriptive (profiling and structured scaling) tests. Both groups of tests are analytical measurements of the intrinsic (such as species, fat content, smell, taste and appearance) quality of the product, whereas affective (subjective test) methods are used for consumer testing to measure the attitude and emotional response of the consumer towards the product including both intrinsic and extrinsic (such as price, convenience, origin and handling) quality of the product (Ophuis and Van Trijp, 1995). Sensory assessment of fish and fish products has for years been the method of choice to evaluate quality throughout the fishery chain. There is, however, a need for new methods of sensory analysis that can be used as integrated objective markers and systems that can build a bridge between research, product development, industry, fishermen, fishmongers, marketing personnel and consumer (Hyldig and Larsen, 2003). A structured scaling method, the QIM, is suggested as a practical and objective tool for evaluating fresh fish in production management, in official seafood inspection as well as other parts of the chain.

Since the late 1980s fishery technologists in seafood laboratories in Nordic and European countries have developed the QIM (Hyldig and Nielsen, 1997; Luten and Martinsdóttir, 1997) based on a method suggested by Bremner et al. (1986). This work has been undertaken in close cooperation between the seafood industry and research institutes. QIM takes the inherent differences between fish species into account; therefore, it is necessary to developed QIM schemes for each fish species. To illustrate this, Table 1 shows the part with the eyes from the QIM schemes for cod (*Gadus morhua*) and salmon (*Salmo salar*). As it can be seen there are three quality parameters concerning the eyes in the scheme for cod (corona, form of the eyes and the pupil) and only two in the scheme for salmon (pupil and form of the eyes).

To date, QIM schemes have been developed for: cod (*Gadus morhua)*, saithe (*Pollachius virens*), red fish (*Sebastes marinus*), sardines (*Sardina pilcharolus*), haddock (*Melanogrammus aeglefinus*), pollock (*Pollachius virens*), plaice (*Pleuronectes platessa*), dab (*Limanda limanda*), sole (*Solea vulgaris*), brill (*Rhombus laevis*), turbot (*Scophtalmus maximus*), herring (*Clupea harengus*), salmon (*Salmo salar*), hybrid striped bass

TABLE 1. The part of the QIM schemes with the quality parameter for the eyes for cod (*Gadus morhua*) and salmon (*Salmo salar*).

Quality parameter		**Description**	**Score**
Eyes From the QIM scheme for **Cod**	Corona	Clear	0
		Opalescent	1
		Milky	2
	Form	Convex	0
		Flat, slightly sunken	1
		Sunken, concave	2
	Pupil	Black	0
		Opaque	1
		Grey	2
			QI from 0 to max. 6
Eyes From the QIM scheme for **Salmon**	Pupils	Clear and black, metal shiny	0
		Dark grey	1
		Matt, grey	2
	Form	Convex	0
		Flat	1
		Sunken	2
			QI from 0 to max. 4

(*Morone chrysops* and *Morone saxatalis*), gilthead sea bream (*Sparus aurata*) and trout (*Oncorhynchus mykiss*) (Martinsdóttír et al., 2001; Nielsen et al., 2003; Huidobro et al., 2000; Sveinsdóttír et al., 2002, 2003). The QIM has been tailored to the seafood industry needs to fit the production of a variety of products (Larsen et al., 1992; Jonsdottir et al., 1999). There are developed QIM schemes for frozen thawed whole cod and cod fillet (Hyldig and Nielsen, 1997) and by Herrero et al. (2003) for frozen hake (*M. capensis* and *M. paradoxus*). At the Danish Institute for Fisheries Research there are developed QIM schemes for cod fillet and plaice fillet (unpublished). Warm et al. (2000) developed a simple scheme for the consumer, called C-QIM. This work is now continued in a national project with less known fish species on the Danish market.

Ongoing research on QIM is through two European projects: one is a strategic alliance called QIM Eurofish and the other is QIMCHAIN (supported by the European Commission, 5th Framework programme for research, technological development and demonstration activities). The mission for QIM Eurofish is to promote and implement the use of QIM as a versatile quality tool within fisheries distribution and production chains in Europe. In the QIMCHAIN project the objectives are (1) to introduce QIM and stimulate the implementation of QIM in the relevant parts of the European fishery chain, thereby facilitating fish trade and ensuring traceability of the information on quality of fish and fish products for European consumers; (2) to enhance the European dimension of the exploitation of research results on QIM in the European fish sector; (3) to raise the awareness of the benefits of using standardized methods for evaluating fish freshness in Europe; and (4) to identify the need for further research in this area.

QIM Eurofish core institutes, The Danish Institute for Fisheries Research, The Icelandic Fisheries Laboratories, and The Netherlands Institute for Fisheries Research, are partners in the QIMCHAIN project together with the following research institutes: The Federal Research Centre for Fisheries (Germany), The Norwegian Institute of Fisheries and Aquaculture, The Portuguese Institute of Marine Research, The Fisheries and Food Technological Institute (Spain) and the software company Maritech ehf. (Iceland). More information about the projects can be found on the website *www.qim-eurofish.com*.

The Quality Index Method

QIM is a scaling method that establishes robust data reflecting the different quality levels of fish in a simple and well-documented way.

QIM is based on significant sensory quality parameters for whole fish using many weighted quality parameters and a score system from 0 to 3 demerit points. In the QIM scheme for farmed salmon the quality parameters are skin, eyes, gills and abdomen. Each quality parameter is divided with a description of each. The QIM scheme for farmed salmon is shown in Table 2. The scores for all the characteristics are added to give an overall sensory score, the so-called quality index (QI). A QI of zero is given for very fresh fish and QI score increases as the fish deteriorates. With QIM it is possible to predict the remaining shelf life when the fish is stored in ice.

During the development of QIM, one of the objectives is to develop a linear correlation between the sensory quality (expressed as the QI) and the storage time in ice, which makes it possible to predict remaining shelf life in ice (Larsen et al., 1992; Hyldig and Nielsen, 1997; Luten and Martinsdóttír, 1997; Sveinsdóttír et al., 2003). The maximum storage time in ice is defined as the day when the fish is unfit for human consumption. This can be measured by descriptive sensory analysis (e.g., profiling (Sveinsdóttír et al., 2003)). Therefore, the remaining shelf life (in days in ice) can be calculated on the basis of the correlation between the QI and storage time in ice and information about the quality index corresponding to the time of rejection.

The selection of parameters for QIM is determined as a combination of the best descriptors for the spoiling fish, which also fulfil the aim that it is possible to predict the remaining shelf life. Figure 1 shows a batch of fish reaching a QI of 10 points–corresponding to 12 days in ice–and having a remaining shelf life of 8 days in ice.

The results from the sensory profiling of cooked samples, with a trained panel, showed that salmon with a QI between [0-7] have a cucumber odor, sea odor, mushroom flavor, sweet flavor and fresh fish oil flavor. With a QI between [8-15] the salmon is neutral in odor and flavor, when QI is between [16-20] it is getting sour and rancid, and when the QI is above 20 it is no longer fit for human consumption (Sveinsdóttír et al., 2002, 2003).

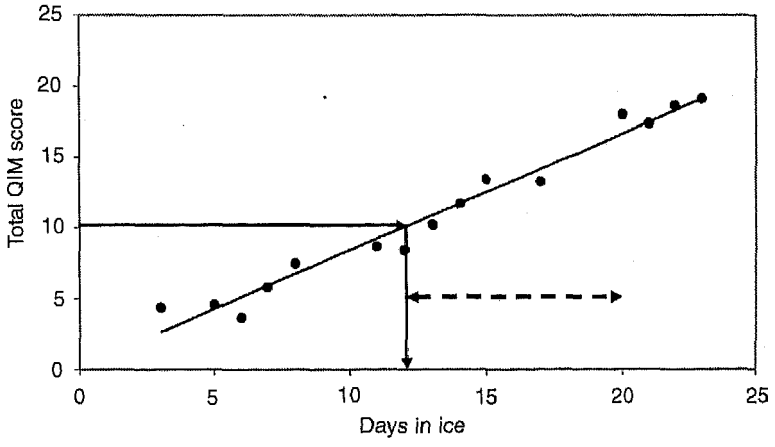
Application of QIM

Sensory evaluation of whole fish is generally carried out by trained assessors at fish factories, in the reception or processing halls, or at auction sites. The sampling is very important, but not different from that generally practiced for quality management. The sampling must be randomized and the number depends on the lot. The testing area must be as

TABLE 2. QIM scheme for whole farmed salmon (*Salmo salar)* containing description for each parameter and the given scores in succession from 0 to 3.

Quality parameters		Description	Score
Skin:	**Color/ appearance**	Pearl-shiny all over the skin	0
		The skin is less pearl-shiny	1
		The fish is yellowish, mainly near the abdomen	2
	Mucus	Clear, not clotted	0
		Milky, clotted	1
		Yellow and clotted	2
	Odor	Fresh seaweedy, neutral	0
		Cucumber, metal, hey	1
		Sour, dish cloth	2
		Rotten	3
	Texture	In Rigor	0
		Finger mark disappears rapidly	1
		Finger leaves mark over 3 seconds	2
Eyes:	**Pupils**	Clear and black, metal shiny	0
		Dark grey	1
		Mat, grey	2
	Form	Convex	0
		Flat	1
		Sunken	2
Gills:	**Color/ appearance**	Red/dark brown	0
		Light red, pink/hazel	1
		Grey-brown, brown, grey, green	2
	Mucus	Transparent	0
		Milky, clotted	1
		Brown, clotted	2
	Odor	Fresh, seaweed	0
		Metal, cucumber	1
		Sour, moldy	2
		Rotten	3
Abdomen:	**Blood in abdomen**	Blood red/not present	0
		Blood more brown, yellowish	1
	Odor	Neutral	0
		Cucumber, melon	1
		Sour, reminds of fermentation	2
		Rotten/rotten kale	3
Quality Index (0-24)			

FIGURE 1. QIM–linear calibration curve (quality index versus days in ice) for salmon (Y = 0.692x + 1.57; R^2 = 0.953). When a batch of fish reaches a QI of 10 points it corresponds to 12 days in ice and the remaining shelf life is 8 days in ice.



neutral as possible concerning noise and smell. The lighting is also important and should not be colored and be of artificial daylight or color-matching quality, which is with a color temperature in the region of 5500-6500 °K and an intensity of 600-1500 LUX/m^2. Trained assessors can evaluate as much as 40 fish using QIM in 20 minutes, and the method is non-destructive.

Today QIM is implemented at research institutes in Denmark, Iceland, Germany, Netherlands, Norway, and Spain, but also at some fish auctions such as United Fish Auction in the Netherlands. The United Fish Auction has used QIM for several years now both for training and for labelling (Martínsdóttír et al., 2003; Vader et al., 2003).

Recently, in the QIMCHAIN project, the QIM manual (Martinsdóttír et al., 2001) has been translated and published in English, Danish, Icelandic, Dutch, German, Spanish, France, Portuguese, Italian, and Greek. The manual supports QIM in an excellent way in quality assurance and production. The manual contains the total plan for evaluation, explanation of the evaluation terms, and color photos illustrating fish at different levels of sensory quality. Sensory evaluation of cooked fillets is introduced as well. Part of the manual addresses sensory evaluation facilities and the selection and training of assessors.

CONCLUSION

Today the EU scheme (Council Regulation (EC) No 2406/96 of November 26, 1996 (Anon, 1996)) for quality assessment is used in the inspection service and in the fishing industry. There are three quality grades given in the EU-scheme: E (Extra), A, and B. E represents the highest quality and quality below B is the level where fish is rejected for human consumption. The primary producers need a finer quality grading than is represented by these three grades. It is foreseen that the QIM will be useful to give feedback to fishermen concerning the quality of their catch, which may stimulate better handling on board. Fish processing plants would have a better tool than the traditional overall grading to measure freshness and, thereby, the possibility to better influence the freshness of their raw material. The sensory quality of the fish/fish product the consumer buys depends on the quality of the raw material used for the final product sold at retail level. QIM will be very useful for the retailer: they can set up a limit QI value for the fish the are buying, for example, only buy cod with a QI below 5. With the QIM it is possible to give more detailed information of the sensory quality and thereby fulfil the primary producer's demand. The QIM can also measure the influences of transport/storage on the sensory quality and the remaining shelf life when the fish/fish product is stored in ice. QIM is suggested as a reference tool for verifying quality labelling of fish and will be useful as a part of the traceability data of the fish. Given the usefulness of this method it is expected that QIM will become the leading reference method for the assessment of fresh fish in Europe in the future.

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