Quality Index Method Developed for Raw Gilthead Seabream (Sparus aurata)

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ABSTRACT: Sensory assessment is one of the principal methods of measuring fish quality. One of the most interesting sensory methods at the moment is the quality index method (QIM). The QIM provides weighted evaluation of the key parameters in deterioration of individual species, assigning demerit points according to the importance of the parameter. This paper describes the development of a QIM for gilthead seabream (Sparus aurata). As result of this study, a QIM is proposed for this species. The appearance of skin and slime, flesh elasticity, odor of the fish, clarity and shape of the eyes, and color and odor of the gills are the parameters included which gave a total of 15 demerit points. The index scored lower when the fish was washed.

Key words: QIM, gilthead seabream, sensory analysis, chilled

Introduction

Consumer acceptance of food products is determined by sensory quality. It is therefore extremely useful to have methods for describing the sensory properties of foods as a means of ascertaining their initial sensory characteristics and any changes undergone by the product in the course of storage. For decades now, sensory analysis has been one of the key criteria in defining the quality of most fishery products.

Loss of freshness of seafood is the consequence of postmortem biochemical, physicochemical and microbiological processes characteristic of each species, of handling on board and on land, and of technological processing. These changes are appreciable in sensory terms and can be evaluated by sight, touch, smell and taste. Researchers from the Tasmanian Food Research Unit (Bremner 1985; Branch and Vail 1985; Bremner and others 1987) proposed a descriptive, fast and simple method to determine freshness quality, known as the quality index method (QIM). The quality index method is useful essentially because it evaluates those sensory parameters and attributes that change most significantly in each species during degradation processes. The set of characteristic attributes of each parameter is assigned a range of demerit points (≤ 3) that is in direct proportion to their importance in the deterioration pattern of the species. All attributes score 0 when the fish is very fresh. The sum of the points awarded to each parameter gives a total score, which is the quality index at the time of assessment. As various different parameters are considered, the contribution of each one to the total is a relative value, and changes in attributes do not markedly unbalance the final assessment. In this way a linear relationship can be established between the freshness quality expressed by the index and the storage time in ice. The maximum QIM score is forced to be reached at the point in storage when the sensory panel rejects the cooked product. When QIM is applied to raw fish it can be used to predict the remaining iced storage time. This provide a new alternative to the methods based on structured scales which had hitherto been used for raw fish (Shewan and others 1953; Wittfogel 1958; Connell and Shewan,1980; Howgate and others 1992; Botta 1995).

In recent years, QIM has been developed for a number of different species, taking into account the intactness of the fish (whole, gutted, fillets) and the technological treatment used (chilling, freezing, freeze-thawing or cooking). The quality index method has been developed for round fish (Branch and Vail 1985), saithe (Nielsen and others 1992), raw intact plaice (Nielsen and others 1992), herring (Jonsdöttir 1992), red fish (Martinsdottir and Arnason 1992), anchovy (Nielsen and others 1992), gutted raw Atlantic cod (Larsen and others 1992), whole thawed cod and fillets from thawed cod (Nielsen and others 1994; Warm and others 1997), sardine (Nielsen and others 1992; Andrade and others 1997), iced horse mackerel and Atlantic mackerel (Andrade and others 1997) and whole shrimp (Martinsdottir and others 1998).

In 1998 roughly 23% of total Spanish fish output for human consumption was produced by fish farming. In recent years the sector has been industrialized and new species have been farmed notably gilthead seabream (Sparus aurata). Farming of gilthead seabream in Spain grew from 127 tons in 1985 to 6330 tons in 1998, accounting approximately 56% of all marine-farmed fish production. The same trend is apparent in most south European countries that produce gilthead seabream (Ministry of Agriculture, Fisheries and Food 1997; Basurco and Larrazabal 1999). The species is mainly commercialized in chilled form. The industry has now become aware of the need to use indexes with uniform criteria for physicochemical, biochemical and sensory assessment of the freshness of gilthead seabream at the production, commercialization and sale stages. The evolution of some indexes has been studied for this species (Huidobro and others 1999).

The aim of this study was to develop a quality index specific to gilthead seabream.

Materials and Methods

Fish source

Different batches of immature gilthead seabream (Sparus aurata), fasted for 48h, were obtained from a Spanish fish farm (CUPIMAR, San Fernando, Cádiz, Spain) and killed by immersion in ice-water slurry. After death the fish were packed in expanded polystyrene boxes with perforated bottoms, covered by a perforated plastic film with ice flakes on top, sealed and freighted to the laboratory in refrigerated trucks. At the laboratory the fish were kept in boxes with ice in cold stores at 2 ± 1°C, and ice was added to the boxes as required. A total of 200 Kg (700 fish) of gilthead seabream were used for selection and training of
QIM for Raw Gilthead Seabream... inspectors and for the design of the quality index method.

Analyses performed

Proximate analyses: moisture, crude protein and ash (AOAC 1995) and crude fat (Knudsen and others 1985) were measured.

Development of QIM

To develop the quality index for chilled gilthead seabream, assessors were selected from among the staff of the Instituto del Frío (CSIC) on the basis of ability to identify odors and flavors as demonstrated in prior training sessions, and familiarity with the fundamentals and principles of sensory analysis. The fish used in training the assessors came from several batches, which were chilled and stored for up to three weeks. In each session a minimum of 10 fish were used to study and achieve a common perception of the sensory characteristics of raw fish on the basis of structured scales. Sensory assessments of cooked fillets were carried out in parallel. The following parameters were assessed in the batches used for selection and training of assessors in sensory evaluation of raw gilthead seabream: appearance of skin, odor and color of gills, eye shape (convex, flat or concave), eye clarity and flesh (recovery at pressure). It was decided to include some parameters relating to open surfaces for the color and odor of the flesh and the peritoneum (difficult–easy to tear). Structured scales (0 to 10; 0 minimum – 10 maximum) were used in all cases; the rejection threshold was set at < 4. Eight candidates were selected to study the sensory assessment of raw and cooked gilthead seabream. The selected assessors evaluated several batches of raw gilthead seabream to design an initial quality index (QIMI) with a view to evaluating the evolution of each parameter during chilled storage. The parameters selected in this initial QIMI were appearance of skin and slime, rigor condition, elasticity of flesh, consistency of belly, odor of the fish, clarity and shape of eyes, color and odor of gills, color of flesh and condition of the peritoneum. In this initial QIMI demerit points were assigned to each parameter, according to the expected importance of the parameter in the loss of freshness of this species. This initial QIMI was sent to Spanish and Portuguese gilthead seabream farmers (131), wholesalers and veterinary inspectors (30) and retailers (21) given that the personnel involved in production, distribution and sale of this species could attach different values to each of the parameters. The aim was to know their opinion on the selected parameters and attributes and even if some parameters or attributes important for assessment of the freshness or deterioration of this species had not been considered. The percent return was 40.4% (25% of fish farmers, 73% of wholesalers and inspectors and 100% of retailers; in the latter case the comments were obtained directly at points of sale). Their opinions helped us to prioritize the parameters used in QIMI and to assess the scale allocated to each parameter. In light of the panel’s scores and the answers obtained it was decided to modify QIMI. The end result was a final QIM (QIMf) which was the one used for the final study.

A quality test was carried out in parallel to establish the reject point of the cooked fillets. To prepare the cooked fillets, the fish were filleted and skinned by hand and then packed in heat-resistant bags (WIPAK/GRYSEPERT model PÆ 110 K FP; permeability to oxygen 30 cc/m²/24h measured at 23 °C/75% RH, distributed by ILPRA Systems España, S.L., Mataró, Spain). The fillets were cooked for 10 min at 100 °C using a saturated steam oven (Rational Combi-Master CM6, Gro küchentechnik GmbH, Landsberg a. Lech, Germany). The panel was asked to evaluate juiciness, toughness, adhesiveness, flavor, odor and color. Structured scales (0 to 10; 0 minimum – 10 maximum) were used in all cases, and the reject threshold was set at < 4.

A time-dependent linear regression analysis was performed for the results (Statgraphics Program: Graphic Software System Inc., Rockville, Md., U.S.A.).

Results and Discussion

The mean weight and length of the fish studied in the course of the experiment were 278.81 g (± 59.12) and 21.76 cm (± 1.29) respectively. The means in proximate composition were: crude protein 21.39 ± 0.54%, crude fat 6.10 ± 0.66%, moisture 72.70 ± 1.39% and ash 1.55 ± 0.15%.

Sensory assessment of raw gilthead seabream (Table 1) showed that all the parameters decreased during chilled storage, reaching the reject threshold (score < 4) at 15 d of storage. The earliest and most pronounced changes were found in gills color (< 4 at 5 d of storage), eye shape (< 4 at 11 d of storage) and odor of gills. The quality score of cooked gilthead seabream fillets (Table 2) showed that at 15 d the panel detected unpleasant flavors and odors, which brought the quality score below the established sensory limit while juiciness, toughness, adhesiveness and color remained above the rejection threshold up to 15 d of storage. According to the results, flavor was selected to determine the reject point of the cooked samples.

The results of the assessment of sensory attributes for raw gilthead seabream (Table 1) were used to design the initial 22 demerit point index (QIMI) (Table 3). This initial QIMI was applied to evaluate a batch of gilthead seabream chilled stored for 23 d (Table 4). At day 14 of storage, the point at which the cooked fillets were judged unacceptable, the parameters eye clarity, gill odor and fish odor all reached the maximum demerit point assigned (2, 3 and 2 demerit points respectively). However for fish odor the scale was expanded as the panel considered that an intermediate attribute between neutral and off odor was needed. Eyes shape and gills color scored at day 14 very close to maximum. Nevertheless in gill color it was decided to unify the attributes brownish red and discolored, as the results indicated that the evolution of gill color was irregular as discolored or brownish red gills could be observed in gilthead seabream of the same quality, and even in the same fish. The attributes assigned to skin, slime and elasticity of flesh were considered to be too detailed; the skin and flesh elasticity parameters failed to reach the
maximum even after 23 d of storage. Rigor condition had reached maximum by the 2nd d of storage, but it was considered this was not an important parameter to evaluate quality in gilthead seabream. Evaluation of belly, flesh color and peritoneum failed to reach the assigned maximum of 1 demerit point during the time that the cooked fillets remained above the rejection threshold. According to the comments of all the groups of the sector asked to weight up the parameters and ranges selected in this initial QIMI, the priority parameters for gilthead seabream were those related to odor of fish and gills, and to the eyes (clarity and shape). The evolution of gill color was also considered irregular.

In light of the results obtained by the panel and the comments made by the sector it was decided to modify the parameters and attributes from the initial QIM design. The quality index that emerged from these assessments included 8 parameters having attributes representing a total of 15 demerit points (QIMF; Table 5).

Figure 1 shows the quality index when applying QIMF to a batch of gilthead seabream iced stored for 18 d. The rejection point for the cooked fillets was established when the quality score for flavor was < 4. Index evolution was linear during ice storage, reaching maximum around day 15. The quality score of the cooked fillets passed the set limit around day 14. Quality index values evolved linearly over storage \((y = 0.962x - 0.051, R^2 = 0.9920)\) and fitted significantly with the theoretical quality index \((P \leq 0.01)\). It was therefore considered that an index of a maximum of 15 demerit points would be suitable for gilthead seabream. The number of parameters included in the QIM developed for gilthead seabream is similar to the ones considered for saithe (Nielsen and others 1992), raw intact plaice (Nielsen and others 1992), herring (Jonsdottir 1992) and fillets from thawed cod (Nielsen and others 1994; Warm and others 1997), although the total number of demerit points differs according to
the species. More parameters than for gilthead seabream are considered in QIM developed for round fish (Branch and Vail, 1985), red fish (Martinsdottir and Arnason 1992), anchovy (Nielsen and others 1992), gutted raw Atlantic cod (Larsen and others 1992), sardine (Nielsen and others 1992; Andrade and others 1997), iced horse mackerel and Atlantic mackerel (Andrade and others 1997). Less parameters are considered for thawed cod (Nielsen and others 1994; Warm and others 1997) and whole shrimp (Martinsdottir and others 1998).

The effect produced on evolution of the quality index developed for gilthead seabream by simulation of fish washing practice using tap water was studied (Fig. 2). At the outset no differences were found in the quality indexes of either batch; however the index for the washed batch scored lower as storage progressed. This was due to the lower demerit points assigned to the parameters related to skin, appearance of slime and odor of fish and gills. On the other hand, elasticity of flesh reached maximum earlier than in the control. On prolonging of chilled storage, it was found that the 15-point maximum was not reached even at 25 d of storage.

Conclusions

The quality index developed for gilthead seabream consisted of 8 parameters covering attributes, which gave a total of 15 demerit points. This index scored significantly lower when fish washing was simulated using tap water.

References


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