Food Research International 100 (2017) 396–406

Contents lists available at ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

Sensory characterization, physico-chemical properties and somatic yields of five emerging fish species

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ARTICLE INFO

Keywords:
New aquaculture fish species
Somatic
Physicochemical
Instrumental texture
Sensory characterization
Sensory references

ABSTRACT

Aquaculture plays an important role in supplying the fresh fish. However its production is dominated by only few long-established species that in turn limit the variety of available products in the market. Therefore, new fish species need to be properly introduced to create a diversification in the current market. In order to achieve this goal, it is important to know, understand and characterize their quality features so they can be addressed to local and global markets. Sensory, compositional, instrumental texture parameters and somatic properties of five emerging fish species, namely wreckfish, greater amberjack, grey mullet, meagre, and pikeperch, were examined for characterization purposes. Sensory references were specifically developed for the training of the assessors, both from a qualitative and quantitative perspective. Twenty two sensory descriptors were used for describing the samples. Several differences were observed among the measured parameters. Somatic measures revealed the filleting yield to be the most important of them. Regarding the compositional parameters, fat content was among the most relevant discriminating aspect between species, while hardness was among the most differentiating ones when dealing with texture. Greater amberjack was described with sour flavor, pikeperch was associated to an earthy flavor and grey mullet was characterized by bitter flavor. Sensory firmness was clearly distinctive for wreckfish, while meagre related to juicy texture. The analysis of the relationship between all parameters provided important correlations, especially those related to texture parameters, fat content, laminar structure and teeth adherence. The species in this study exhibited a wide range of physicochemical and sensory characteristics that show their potential for being further exploited when designing new products.

1. Introduction

Aquaculture plays an important role in the fish supply of the European market. Europe is the fifth largest producer worldwide, providing about 3.2% of global fish production. However, aquaculture is still far from reaching its full potential development, since only 20% of the total fish production is of aquaculture origin (Europa, 2013). This fact can be attributed to the production costs, the competition for space (inland and coastal) with other activities, as well as to the less positive image of farmed fish when compared with wild-caught counterparts among consumers (Claret, Guerrero, Gartzia, Garcia-Quiroga, & Ginés, 2016; Claret et al., 2014). The relative low market share of aquaculture can also be a direct consequence of the poor variety of aquaculture products in the market, and in particular because of the lack of processed aquaculture foodstuffs (Failler, 2007; FAO, 2012). It is important to remark that product variety has been identified as a relevant factor in order to stimulate consumers' purchase (Lähteenmäki & Arvola, 2001), thus avoiding boredom and satisfying individual curiosity. European aquaculture production is dominated by only few long-established species such as Atlantic salmon (*Salmo salar*), rainbow trout (*Oncorhynchus mykiss*) common carp (*Cyprinus carpio*), European sea bass (*Dicentrarchus labrax*) and gilthead sea bream (*Sparus aurata*) (EATIP, 2012), that in turn limits the number of aquaculture products available in the market. Increasing global consumption of aquaculture fish constitutes a great challenge and opportunity for the EU aquaculture industry. Therefore, the demand for European aquaculture products

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http://dx.doi.org/10.1016/j.foodres.2017.07.023
Received 25 April 2017; Received in revised form 5 July 2017; Accepted 12 July 2017
Available online 15 July 2017

Table 1
Origin, season, sample (N), feed and size information of the selected fish species.

Species	Season	N	Origin – farming conditions	Feed	Fish size
Greater amberjack (*Seriola dumerili*)	Winter	8	Farm (Argosaronikos S.A.) – Attiki, C. Greece - floating sea cages	Frozen fish	15–20 kg
Pikeperch (*Sander lucioperca*)	Summer	10	Farm France –sweet water intensive farming	Commercial extruded feed	1–2 kg
Grey mullet (*Mugil cephalus*)	Winter	10	Wild fish. Bay of Cadiz – earthen ponds with sea water	Natural feeding	500 g–1 kg
Meagre (*Argyrosomus regius*)	Winter	10	Farm (Andromeda Group), Burriana, Spain – floating sea cages	Commercial extruded feed	1.5–2 kg
Wreckfish (*Polyprion americanus*)	Winter	5	Wild specimens: 2 caught in FAO 34.1.2 ATLANTIC N by the Canary Islands fishermen and 3 caught in Azores by Galicia's fisheries	Natural feeding	Two specimens of 25–30 kg[a] Three specimens of 2–3 kg

[a] These high weight value specimens were kept to include the range of commercial sizes available in the market.

needs to be further developed. A possible way to satisfy this request could be rearing new emerging species that would provide a higher variety within the EU market.

In order to successfully introduce new species, it is important to characterize their quality features so they can be properly addressed to local and global markets. This characterization often includes somatometric and edible parts' compositional parameters, which could be advantageous tools for product design. Sensory characteristics are also important determinants of food quality and drivers for consumer acceptance and food choice (Siret & Issanchou, 2000); they can also provide valuable information in order to select the most appropriate market for each species and their respective products. Defining and measuring the sensory attributes that characterize fish, seems to be necessary for product development in order to satisfy consumer expectations. The better the knowledge about accurate descriptors that best define fish, the less time needed for its product development (Carpenter, Lyon, & Hasdell, 2000). Moreover, in the case of fish, taste has proven to be the strongest motive of consumption intention (Verbeke & Vackier, 2005).

In order to cover the entire European fish culture domain and to stimulate different aquaculture categories, five species were selected in the present study based on both their biological and economical potential: meagre (*Argyrosomus regius*) and greater amberjack (*Seriola dumerili*) for marine warm-water cage culture, wreckfish (*Polyprion americanus*) for warm- and cool-water marine cage culture, grey mullet (*Mugil cephalus*) for warm-water pond, extensive and integrated culture, and pikeperch (*Sanders lucioperca*) for freshwater intensive culture using Recirculation Aquaculture Systems (RAS). These species, when farmed with sustainable methods, could help the development of high added-value products and represent an important driver for the growth of the of EU aquaculture market.

Several preliminary studies have been already performed over these selected species. Regarding greater amberjack, proximate and fatty acid composition of wild and reared fish (O'Neill, Le Roux, & Hoffman, 2015; Rodríguez-Barreto et al., 2012; Shioya, Takemura, Ishizuka, & Yamaguchi, 2012; Zupa et al., 2017) and some somatometric evaluations and lipid analysis (Rodríguez-Barreto et al., 2012) have been carried out. Respective data on pikeperch are scarce. Pikeperch quality has been assessed focusing on the freshness of wild fish (Özyurt et al., 2007). Some information is also available regarding the quality of farmed fish (Zakęś, Szczepkowski, Jankowska, Kowalska, & Demska-Zakęś, 2012), while Jankowska, Zakes, Zmijewski, and Szczepkowski (2003) compared wild and cultivated pikeperch by analyzing, color, compositional parameters and fatty acid profiles. Meagre has received much more attention in aspects of composition and sensory quality and relevant studies have been recently published (Grigorakis, Alexi, Vasilaki, Giogios, & Fountoulaki, 2016). Giogios, Grigorakis, and Kalogeropoulos (2013) measured somatometric parameters, volatile compounds and fatty acids between two groups of meagre of different size. Overall acceptability was also assessed in order to validate the existence of organoleptic differences as well. In addition, Hernández et al. (2009), estimated the shelf-life of commercial-sized meagre fillets held in ice storage. Sporadic data exist on fat composition (reviewed by Grigorakis et al., 2016) and post-mortem quality changes (Bahmani et al., 2011; Cayhan & Selli, 2011; El-Sabaiy, Metwalli, & Khalil, 1987) of grey mullet. Very few studies have been published regarding wreckfish characteristics. Roncarati, Cappuccinelli, Stocchi, and Melotti (2014) analyzed the proximate composition and fatty acid profile of meat in a wreckfish population from the Mediterranean Sea.

In any case, it is important to highlight that none of the studies found in the scientific literature about these five species focused in their complete sensory quality description, nor the relationship between their different characteristics. Therefore, the aim of this study is to characterize these five fish species based on their somatometric features, compositional, instrumental texture and sensory properties as well as to outline the existing relationship between these quality parameters.

2. Materials and methods

2.1. Experimental fish

Specimens of meagre, greater amberjack, and pikeperch used in the present study were of aquaculture origin whereas wreckfish and grey mullet were caught from the wild (unavailability of reared specimens because of the existence of important bottlenecks for its incorporation into the aquaculture industry) by commercial fishing vessels using long line or fishing nets, respectively (Table 1).

The greater amberjack was slaughtered by bleeding after cutting gill arches, while the meagre and pikeperch were ice-slaughtered according to custom commercial EFSA-approved method (European Food Safety Authority, 2009). Fish were subsequently packed with flaked ice into polystyrene boxes until the somatometric analysis was performed within the first 24 h.

2.2. Somatometric measurements

After reception, total weight and body length were measured in all sampled individuals. Fish from each species were gutted and body weight, visceral, gonad and liver weights were measured as well. Samples were subsequently filleted and fillets were also weighed. The following somatometric indexes were calculated individually:

Condition index (CI) = [100 × (body weight/body length)]

Dressing yield (DY) = [100 × (gutted body weight/body weight)]

Filleting yield (FY) = [100 × (fillet weight/body weight)],

Hepatosomatic index (HSI) = [100 × (liver weight/body weight)],