

## Fillet proximate composition, lipid quality, yields, and organoleptic quality of Mediterranean-farmed marine fish: A review with emphasis on new species

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### ABSTRACT

Species diversification in Mediterranean mariculture involves various important fish that contribute to the diet of many human populations. These include meagres (*Sciaenidae*), flatfishes, mullets, and various sparids. Their quality aspects (yields, fillet proximate composition, and lipid quality) are discussed in this review. Their filleting yield is mostly 40–45%. The viscerosomatic index ranges from 1.5% to 14%, depending on species. Low muscle fat contents of flatfishes and meagres differentiate them from the rest of the farmed species. Farmed fish contain high n-3 polyunsaturates fatty acids (PUFA; 12.3–36.3% vs. 5.48–37.2% in the wild) and have higher muscle fat and n-6 PUFA contents (mainly 18:2 n-6) than their wild counterparts. The aquaculture management, diet, and season can affect fillet composition and fatty acids, while season (i.e. food availability and maturation) largely affects lipid quality in wild fish. Data on the sensory quality of Mediterranean-farmed species are mainly limited to whether specific management differentiates the sensory quality; thus, further development of tools for sensory analysis is required. Observations on the quality features in farmed Mediterranean fish indicate that species diversification can also provide product diversification based on different commercial weights and fillet quality specifications.

### KEYWORDS

Quality; fat; filleting yield; fatty acids; sensory quality

### Introduction

The farmed finfish production worldwide was 66.6 million metric tons in 2012 (Food and Agriculture Organization (FAO), 2014). The Mediterranean area is an important contributor to world aquaculture, with two countries Egypt and Spain being among the top 12 and 20 world aquaculture producers, respectively (FAO, 2013, 2014). The Mediterranean marine finfish production has been growing to reach a share of 36% of its total aquaculture output versus 48% of freshwater fish and 14% of molluscs. Specifically, marine finfish production in the Mediterranean area has grown from 61,024 tons in 1995 to 436,401 tons in 2007 (Barazi-Yeroulanos, 2010). The spark for the continuous growth of the contemporary Mediterranean mariculture was in the late 1970s or the early 1980s. The Mediterranean marine finfish farming all these years has been dominated by two species, the European sea bass (*Dicentrarchus labrax*) and the gilthead sea bream (*Sparus aurata*). These two species are produced industrially and account for approximately 52% of the total marine finfish production in the area (Table 1). The other dominating species, the flathead grey mullet (*Mugil cephalus*), is traditionally semi-intensively farmed in brackish water ponds, and its production is mainly based on wild fry collection (Saleh, 2008). However, there have been some serious fry overfishing issues and recent pressure toward banning of wild fry (McGrath, 2012).

In the 1990s, the ranching of Atlantic bluefin tuna, *Thunnus thynnus*, was introduced in the area, based on wild stocks capture, since no integrated production could be achieved. The latter has led to almost crashing of the species' stocks in the Mediterranean

(MacKenzie et al., 2009). Other sparid species (Table 1) have been farmed with variable success. The market saturation for gilthead sea bream and sea bass, and the crisis of this sector during the 1990s, has led to a persistent recession situation that was enhanced by a general economic crisis (Cardia and Lovatelli, 2007; Perdicaris and Paschos, 2011). Species diversification has been considered a possible way out from this situation (Cardia and Lovatelli, 2007). Among the candidates, various species, mainly from Sciaenidae and Caragidae families, have been proposed and produced nowadays, with meagre (*Argyrosomus regius*) being the most successful one (in terms of production and know-how) (Table 1). Among the flatfish, the most commercialized in Mediterranean countries is turbot (*Psetta maxima*), mainly produced in Spain since the 1990s. Its farming is integrated, and intensive rearing is mostly land-based (Rodríguez Villanueva and Fernández Souto, 2015).

Regarding their commercial characteristics, these fish species have various commercialization sizes and forms. The grey mullet, besides being sold as whole fish weighing about 300–800 g, is used for its role to produce a highly valued traditional product named bottarga (Barra et al., 2008). The Sciaenidae species, which include the meagre, the brown meagre (*Sciaena umbra*), and the shi drum (*Umbrina cirrosa*), are fast growers that are usually commercialized in sizes bigger than 1 kg. Although they are usually commercialized as a whole, for larger fish various forms, such as cuts and fillets, can be available (Monfort, 2010). In addition, small quantities of frozen fish, smoked fillets, and sushi sales have been reported for meagre (Monfort, 2010). Usual commercialization weights for the various sparid species are similar to those for gilthead sea bream, i.e.