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Roe enhancement of *Paracentrotus lividus*: Nutritional effects of fresh and formulated diets

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Abstract

Sea urchin gonads are exploited both for gastronomic and scientific purposes; thus, the production of large and mature gonads is essential. Natural populations of the Mediterranean Sea urchin *Paracentrotus lividus* are subject to increasing fishing efforts, due to continuous intensification of consumptions. Aquaculture practices may represent an answer, but the availability of artificial feeds accelerating the production of high-quality gonads in terms of size, taste, colour, firmness, maturity and viability of gametes is critical to boost the productions. The accessibility of cheap and effective feeds promoting the fattening of gonads and the quality of gametes is still a bottleneck slowing down the expansion of echinoculture practices. This investigation is aimed at enabling the development of this strategic sector, by comparing the dietetic effects of fresh foods and a commercial feed for aquaculture, to four newly formulated feeds. The protein contents of diets were strongly related to the GSIs. The abundance of fatty acids appeared inversely related to the viability of embryos and abnormalities of larvae. The features of an ideal diet for this sea urchin were defined, based on the results of experimental trials, and the need for increasing levels of plant-derived proteins during the grow-out period was demonstrated.

KEYWORDS
artificial diets, fats, gametes, gonadic index, proteins, sea urchin

1 | INTRODUCTION

Most sea urchins are typical plant feeders. They are the major consumers of huge standing stocks produced by macroalgae and seagrasses in various coastal environments (Lawrence, 1975). Their natural populations are important to control and keep constant the crops of many seagrasses (Boudouresque & Verlaque, 2007; Zupo, 1994), and their trophic role is usually played as large and abundant macroherbivores (Zupo, Alexander, & Edgar, 2017). Their natural diets are quite complex and contain, in addition to the main plant tissues, several items (Zupo, 1993) including small animal prey and various epiphytes, indispensable to complete the assortment of feeding principles ingested (Mazzella et al., 1992). Therefore, they could be considered as opportunistic herbivores (Zupi & Fresi, 1984). In addition, each species of sea urchin is adapted to local ecological conditions and evolved specific dietetic patterns (Lawrence, 2007).

The sea urchin *Paracentrotus lividus* (Lamark, 1816) is quite common throughout the Mediterranean Sea (Boudouresque & Verlaque, 2007), from the North Atlantic coasts of Ireland to southern Morocco (Bayed, Quiniou, Benrha, & Guillou, 2005; Symonds, Kelly, Caris-Veyrat, & Young, 2007). It is an important resource since the last century (Koehler, 1883), both as a marketable good (Devin, 2002; Williams, 2002) and an animal model for research in the life sciences (Buitrago et al., 2005; Yamabe, 1962). Its importance for

