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Technical note

Long-term maintenance of the sea urchin *Paracentrotus lividus* in culture

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ABSTRACT

The common sea urchin *Paracentrotus lividus* (Lamarck, 1816) is an important commercial species in the Mediterranean Sea for the consumption of its gonads (roe). This species has also long been used as an animal model in developmental biology and as an indicator in the assessment of environmental quality. In recent decades, the exploitation of this marine resource has become increasingly intensive, causing the depletion of wild stocks. The ripple effect observed in the laboratory use of this species has been the growing difficulty in finding valiant mature animals in the wild. We focused on the long-term maintenance of wild *P. lividus* and on the essential question of diet to maintain the animals and improve gonad development. The use of practical ration blocks which are nutrient-rich and show stability, easy storage and handling, resulted reduction in labor requirement and time for feeding streamlining the feeding practice. A significantly higher gonad production and a prolonged period of reproduction were obtained compared to wild caught individuals over the same period of time.

1. Introduction

The common sea urchin *Paracentrotus lividus* (Lamarck, 1816) is a regular edible echinoid, which is very widespread throughout the Mediterranean coasts and in the north eastern Atlantic, from Scotland to southern Morocco (Tortonese, 1965; Boudouresque and Verlaque, 2013). Over the years, several laboratories have chosen this species as an animal model. Molecular biology and eco-toxicology studies, which require the use of gametes and embryos at various stages of development (Giudice, 1973; Pagano et al., 1986; Pagano et al., 1993; Privitera et al., 2012), have been added to the classic studies on fertilization and development (Monroy, 1986). One of the basic requirements demanded by an experimental model is its availability throughout the year.

P. lividus living along the Italian coasts has a single reproductive period, which generally lasts from October to June with a peak from December to March. Gonads vary in size and gametogenetic state according to this annual cycle. These seasonal fluctuations lead to a limited availability of gametes at certain times of the year, which is a major limitation to using this model system in biological experimentation.

Sea urchins are also a valuable resource for the high commercial value of gonads (roe), and there is an international demand for the production of marketable quality gonads. *P. lividus* gonads are esteemed as a luxury sea food by Mediterranean countries. Due to its importance in research as an animal model and in aquaculture as seafood, much research has been carried out on this species to determine all the phases of the reproductive cycle and relate them to environmental characteristics (Byrne, 1990; Lozano et al., 1995; Spirlet et al., 1998; Sanchez-Espana et al., 2004; Sellem and Guillou, 2007; Garmendia et al., 2010). Three factors are universally cited as important to the reproductive cycle: diet, photoperiod and temperature. Copious work has been produced on the modification of the gametogenic cycle through experimental manipulation while rearing the sea urchins in confinement, to obtain gonads with features that increase their commercial value (Lawrence et al., 1997; Walker and Lesser, 1998; Spirlet et al., 2000; Shpigel et al., 2004; Shpigel et al., 2005; Kirchhoff et al., 2010; McCarron et al., 2010; Marsh et al., 2013; Sartori et al., 2015). This field is still underdeveloped because of each species of sea urchin has its own environmental or chemical cue (Kirchhoff et al., 2010). Food appears to play a pivotal role in the regulation of the reproductive cycle and it has been attested that the gonadic growth is strongly correlated with the availability, quantity and quality of food (Fernandez et al., 1995; Boudouresque and Verlaque, 2013 and ref. therein). Several studies have shown that sea urchins fed with high rations of good quality food improve their reproductive capacity. Therefore, one of the critical aspects in maintaining productive individuals in the laboratory is the determination of an optimal or at least efficient feeding regime.

This study was at first addressed towards the enhancement of the research status of *P. lividus*, improving their use as laboratory animal. A coveted result in this latter direction is control the reproductive cycle, maintaining individuals in a “ready to spawn” condition. This allows us to quickly obtain gametes (on demand) for their application in different

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