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NOTA CIENTÍFICA

State of the art in the cultivation of octopod cephalopods in offshore and recirculating systems

Estado del arte en el cultivo de cefalópodos octópodos en sistemas emplazados en el mar y en recirculación

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ABSTRACT

Cephalopods such as *Octopus mimus* and *Octopus vulgaris* represent promising candidates for aquaculture due to their high nutritional value and commercial demand. This study investigates their culture potential, focusing on behavior in recirculating systems and open sea cages. The results indicate the high adaptability of O. vulgaris to captivity and remarkable reproductive rates, thriving on a diet of low-value fish. On the other hand, O. mimus demonstrates camouflage abilities and potential for captive breeding, although with less documented experience. These findings highlight the viability of commercial culture for both species in diverse marine environments, with significant implications for the aquaculture industry.

Keywords: *Octopus mimus*, aquaculture, *Octopus vulgaris*, octopus.

RESUMEN

Los cefalópodos como *Octopus mimus* y *Octopus vulgaris*, representan candidatos prometedores para la acuicultura debido a su alto valor nutricional y demanda comercial. Este estudio investiga su potencial de cultivo, centrándose en el comportamiento en sistemas de recirculación y jaulas en mar abierto. Los resultados indican la alta adaptabilidad de *O. vulgaris* a la cautividad y tasas reproductivas notables, prosperando con una dieta de peces de bajo valor. Por otro lado, *O. mimus* demuestra habilidades de camuflaje y potencial para la cría en cautiverio, aunque con menos experiencia documentada. Estos hallazgos subrayan la viabilidad del cultivo comercial para ambas especies en diversos entornos marinos, con implicaciones significativas para la industria acuícola.

Palabras claves: *Octopus mimus*, acuicultura, *Octopus vulgaris*, pulpo.

INTRODUCTION

The cephalopods belong to a class of strictly marine invertebrates, belonging to the Phylum Mollusca, encompassing about 700 species, including squids, cuttlefish, octopuses, nautiluses, and squids. They are carnivorous (Okutani, 1990; Boucher-Rodoni y col., 1987; Lee, 1994) and active predators in oceanic food chains (Boletzky y Hanlon, 1983). Currently, there is great interest in their capture in commerce due to their high protein content when dried (Lee, 1994). Therefore, attempts have been made to farm some species of octopuses in captivity (Dominguez y col., 2004), of which *Octopus mimus* Gould, 1852 and *Octopus vulgaris* Cuvier, 1797 represent the most successful ones (Dominguez y col., 2004; Socorro y col., 2005; Zúñiga y col., 2011; Baltazar y col., 2000; Oltra y col., 2005).

O. mimus

Corresponds to a cephalopod with a bulging head serving for visceral protection. It has simple eyes similar to those of vertebrates. The skin is soft with a high capacity for camouflage in natural environments. Associated with the head are 8 flexible tentacles provided with suckers. Typically, the coloration is brown and purple. They possess a strong beak in the oral cavity used to crush the exoskeletons of crabs and lobsters (Méndez-Abarca, 2015; Méndez-Abarca y Pepe-Victoriano, 2020). There are few studies on the cultivation of *O. mimus*, although this does not mean it lacks potential as a species for consumption cultivation (Zuñiga, 1995; Olivares, 1996; Cortez y col., 1999) and even as a species for ornamental purposes (Méndez-Abarca, 2015; Méndez-Abarca y Pepe-Victoriano, 2020). Experimental work for this species has been carried out in two geographical locations precisely associated with the natural distribution of the species. Baltazar y col. (2000) associate the species with long-line cultures in open sea, in Casma, Peru, as well as successful cultures in recirculation systems.

On the other hand, Zúñiga y col. (2011) conduct feeding versus growth analysis in recirculation culture, in Antofagasta, Chile. According to Méndez-Abarca (2015), the maintenance in captivity for *O. mimus* in recirculation systems is based on physicochemical parameters of seawater with a pH of 8.1-8.4, temperature of 15-22°C, and ideally zero ammonia nitrogen. Méndez-Abarca (2015) does not have data on reproduction in captivity; however, Baltazar y col. (2000) achieved reproduction under recirculation systems with a temperature of 21 to 22°C and obtained paralarvae with a maximum survival of 17 days, which were fed with Artemia nauplii (brine shrimp).

Méndez-Abarca (2015) indefinitely maintained *O. mimus* specimens in captivity by supplying live crustaceans. On the other hand, Zúñiga y col. (2011) successfully maintained O. mimus juveniles in captivity for 57 days and compared growth and survival with three different diets: two wet diets bound with gelatin solution stuffed in lamb tripe and a natural control diet (C). Diet (A) was based on a mixture of minced fillet of *Cheilodactylus variegatus* fish with salmon pellet flour, diet (B) with *Protothaca thaca* clam paste mixed with *C. variegatus* fillet, and the control diet consisted of the supply of frozen fresh clams (C). Diet B obtained excellent results with 0% mortality, well above the 16.7% of the natural diet (C) and the 33.3% of diet A. All breeding and reproduction records of *O. mimus* have been

conducted in recirculation systems (Méndez-Abarca, 2015; Zúñiga y col., 2011), except for Baltazar y col. (2000) who conducted fattening in cultivation lines, which consisted of placing them in 10 hanging systems with 10 PVC shelters (30 cm long and 25 cm in diameter), open at one end and with a hinged lid to observe and feed the animals. This system generated optimal results and surpassed breeding in recirculation systems, with a growth rate from 117.5 g to 721.2 g in 5 months of cultivation.

O. vulgaris

It corresponds to a species native to the Mediterranean Sea, which has ideal characteristics for commercial cultivation, as it adapts well to captivity, in addition to high rates of reproduction and growth (Mangold, 1983). Unlike *O. mimus*, which has limited experience in relation to rearing and fattening in open sea (Baltazar y col., 2000), *O. vulgaris* has been the subject of several experiments in cages in open sea, even surpassing those conducted in recirculation systems (Socorro y col., 2005). Oltra y col. (2005), based on experiences of captive breeding by Rama-Villar y col. (1997); Luaces-Canosa y Rey-Méndez (2001); Rodríguez, Carrasco, and Rodríguez (2005), successfully fattened juvenile *O. vulgaris* in open sea cages through natural feeding mainly based on crustaceans, resulting in higher survival in females (52.2%) than in males (30.3%), with no significant difference in final mean weight and an average weight gain of 652 g/month. On the other hand, Socorro y col. modified the crustacean-based diet to one of low commercial value fish, such as bogue (*Boops boops*), obtaining individuals weighing 2.64 kg and 3.81 kg, respectively, with survival rates of 91% and 82% respectively. Both experiments were conducted in the Mediterranean Sea, where *O. vulgaris* is native. Currently, this species presents great interest for rearing and fattening in floating cages, mainly along the coasts of Galicia (where industrial-scale initiatives have also been carried out) and Asturias (Rama-Villar y col., 1997; Luaces-Canosa y Rey-Méndez, 2001).

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