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Seasonal variations in chemical, physical, textural, and microstructural properties of adductor muscles of Pacific lions-paw scallop (*Nodipecten subnodosus*)

Ana I. Beltrán-Lugo [a,1], Alfonso N. Maeda-Martínez [a,*], Ramón Pacheco-Aguilar [b], Héctor G. Nolasco-Soria [a]

[a] *Centro de Investigaciones Biológicas del Noroeste (CIBNOR). Mar Bermejo No.195, Col. Playa Palo de Santa Rita, La Paz, B.C.S. 23090, Mexico*

[b] *Centro de Investigación en Alimentación y Desarrollo (CIAD). Carretera a la Victoria Km. 0.6 Hermosillo, Sonora 83000, México*

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Abstract

This study analyzes the relationship between the physiological state of the Pacific lions-paw scallop *Nodipecten subnodosus* and the quality of the meat, in relation to two environmental variables (temperature and chlorophyll *a* concentration). Muscle and gonadosomatic indices, gonadal stage, and glycogen were determined in scallops of similar size (66.3±6.9 mm) as indicators of their physiological state. The scallops were harvested once every season from a shellfish farm located at Laguna Manuela, Mexico. Quality of adductor muscles was determined by means of pH, water-holding capacity, color parameters, proximate composition, free amino acid content, texture, collagen, and microstructure. As a reference, temperature was recorded every half hour and chlorophyll *a* every fifteen days from January to November 2003. Results indicate that temperature and chlorophyll *a* concentrations peaked in September (summer), matching the highest muscle and gonadosomatic indices and glycogen content. In summer, carbohydrate concentration and weight of muscles were highest and color was whiter and brighter. However pH was significantly lower making water-holding capacity drop to the lowest level recorded, increasing the probability of water loss during handling, processing, and storage. Amino acid content was also affected by season. Concentration of several amino acids that give sweet flavor to meat (glycine, arginine, taurine, and alanine) dropped. Humidity, protein, and lipid concentrations also decreased, making the muscles tenderer, as confirmed by texture parameters of cut, hardness, elasticity, chewiness, gumminess, and adhesiveness. Changes in texture were explained by a decrease in collagen, which is an important component of connective tissue, and a lower density of muscle fibers per surface area. With these results, the definition of the optimum harvest season is controversial. Despite a higher weight per muscle in summer, muscles show the lowest quality, considering most of the parameters studied.

Keywords: Pacific lions-paw scallop; Texture; Muscle quality; Seasonal variations; Color

1. Introduction

The Pacific lions-paw scallop *Nodipecten subnodosus* is one of the most economically important

* Corresponding author. Tel.: +52 612 123 8461; fax: +54 612 125 3625.
E-mail address: amaeda04@cibnor.mx (A.N. Maeda-Martínez).
[1] Present address: Universidad Autónoma de Baja California Sur (UABCS). Carretera al Sur Km. 5.5, La Paz, B.C.S. 23080, Mexico.

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bivalves in Mexico. In 1990, a new fishery developed at Laguna Ojo de Liebre and Laguna Guerrero Negro, located on the west coast of the Baja California Peninsula (Fig. 1). It reached an average annual production of 100 ton of muscles in the last six years (Massó-Rojas et al., 2000). Open (April 15–August 15) and closed (September 15–December 15) seasons have been defined for protection, based only on the reproductive cycle of the species (Massó-Rojas et al., 2000). Five years ago, this species started to be cultured in Laguna Guerrero Negro and Laguna Manuela (Fig. 1), using spat produced in two hatcheries. Suspended Nestier trays are used for nursery and the initial grow-out phase, although one company is using oyster bags fixed to steel frames on the bottom for the latter phase. Once the scallops reached 4–5 cm shell height, the specimens are released directly to the bottom without any protective gear, where they remain until they reach the desired size. Harvest occurs throughout the year to meet the demand of the market. In both activities (fishery and aquaculture) the quality of the muscles as an edible product has been neglected, despite several authors having demonstrated important variations in the properties of this organism throughout the year. The quality of a scallop muscle depends on its taste, color, and texture. Texture is influenced by several factors such as chemical composition (Dunajski, 1979; Crapo et al., 1999; Thakur et al., 2003) and structure (Taylor et al., 2002; Bjornevik et al., 2004). These show large fluctuations, depending on temperature and food, which also regulate reproductive activity. Transfer of energy reserves (glycogen) from the muscle (reservoir organ) to the gonad during gametogenesis in several scallops (Mathieu and Lubet, 1993; Reinecke-Reyes, 1996; Román et al., 2001; Racotta et al., 2003; Arellano-Martínez, 2005) has been described. Seasonal variations in chemical composition in several scallop species are well documented (Ansell, 1974; Pollero et al., 1979; Robinson et al., 1981; Epp et al., 1988; Thompson and MacDonald, 1990; Acosta and Roman, 1991; Martínez, 1991; Pazos et al., 1996; Hayashi et al., 1981; Arellano-Martínez et al., 2003, 2004). Information on the effect of these variations on meat quality is still lacking. In this work, we assessed the relationship between the physiological state of the Pacific lions-paw scallop with the quality of the meats, in relation to two environmental variables (temperature and chlorophyll *a* concentrations).

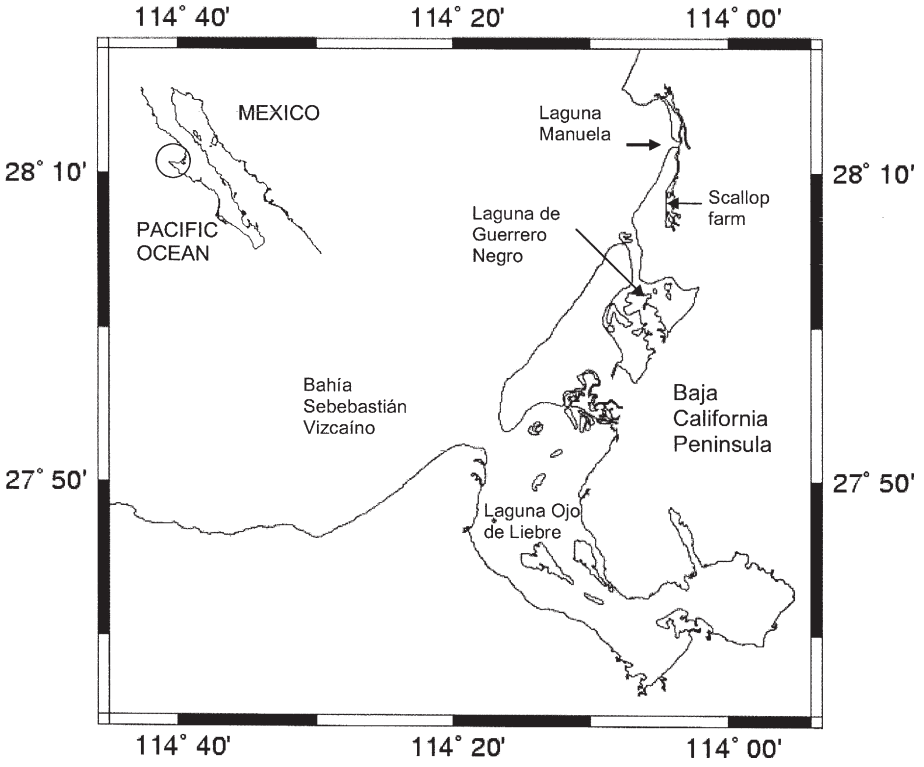

Fig. 1. Study area. Laguna Manuela, Baja California, Mexico. The arrow shows the location of the scallop farm that provided the specimens.