SHELLFISH FARMING AND PREPARATION FOR THE MARKET

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UZGOJ I PRIPREMA ŠKOLJKAŠA ZA TRŽIŠTE

Abstrakt
Ovaj rad predstavlja kratki prikaz proizvodnje školjkašana istočnoj obali Jadrana. Na ovom se prostoru komercijalno uzgajaju dvije vrste školjkaša, kamenica *Ostrea edulis* i dagnja *Mytilus galloprovincialis*, dok se ostale vrste izlovljavaju iz prirodnih populacija. Pored tehnologije uzgoja, opisani su i zakonski uvjeti potrebni za plasman školjkaša na tržište. To su u prvom redu monitoring uzgojnih područja, potrebna infrastruktura (otpremni i centri za prečišćavanje) i te pravilan postupak sa školjkašima nakon izlova.

Ključne reči*: uzgoj školjki, ostriga, dagnja, centri za prečišćavanje*

INTRODUCTION

The increasing demand for protein rich food sources have led to a significant increase in aquaculture production, including shellfish culture. Higher demand for healthy food sources have also increased the consumption of fish and shellfish. In comparison to intensive shrimp and fish culture, shellfish cultivation is simpler and less demanding.

Commercial production of the european flat oyster *Ostrea edulis* and the black mussel *Mytilus galloprovincialis* is carried out on the East Adriatic Coast. Several other shellfish species (*Venus verrucosa*, *Tapes decussatus, Chamelea gallina, Arca noae* and *Pecten jacobeus*) are available to the local market, but they are derived from the wild catch.

Shellfish are filter feeders, feeding on phytoplankton and zooplankton, dissolved mineral salts, and organic detritus, so no additional artificial feeding is required (Gosling, 2003; Gavrilović, 2011). However, different harmful microorganisms (bacteria, viruses, parasites, aquatic biotoxins, etc.) and chemical pollutants can be present in the sea water

surrounding the cultured shellfish populations. These contaminants can accumulate in the shellfish soft tissue during the cultivation process and cause food borne diseases (Huss et al., 2004). The most common pollutant and the cause of most foodborne diseases is fecal contamination of the sea water (Jackson i Ogburn, 1999). The most effective protection of consumer health is with the control of seawater quality through the regulation of the shellfish farming/collecting areas, as well as during the handling of shellfish after harvest (on-shore infrastructure, such dispatch and depuration centers).

FARMING TECHNOLOGY AND WATER QUALITY

Shellfish farming on the eastern adriatic coast is still based on the collection of larvae from their natural habitat. Collectors with an attached spat of oysters and black mussels remain in the water for an average of six months. They are then placed on growout installations until the shellfish reach market size. The growout phase in the eastern adriatic region is carried out between the sea bottom and surface (considered the mediterranian method), on fixed or floating installations. Lately, floating long lines are the most commonly used installations (Marguš i Teskerdžić, 1993; Gavrilović and Petrinec, 2003).

In this region, shellfish farms are usually situated within in-shore locales: shallow productive coastal areas, protected coves, lagoons, and river estuaries. Besides having suitable geomorphological and ecological characteristics (optimal temperature, oxygen saturation, salinity, pH, suitable concentration of nutrients and plankton, etc.) (Hrs-Brenko, 1973), the shellfish farming aquatoria must be of satisfactory sanitary quality. This is especially important for the shellfish that are consumed raw, such as oysters. This is also a priority for the other species as well, since they are usually consumed after minimal termical processing.

With reference to the microbiological water quality, the farming areas in the EU and most other european countries are divided into three categories:

- Category A : less than 230 *Escherichia coli* per 100g of shellfish meat and intervalval fluid
- Category B: 230-4600 *E. coli* per 100g of shellfish meat and intervalval fluid
- Category C (> 4600 *E. coli* per 100g of shellfish meat and intervalval fluid).

The specific procedures followed with the shellfish after harvesting depends on the microbiological quality of the cultured sea water. By regulation, following harvest and before distribution to the market, all shellfish must pass through a dispatch center, where they are cleaned, sorted, packed and labeled. Shellfish from Zone B, have to undergo a depuration process. The depuration unit can be located within a separate facility, or within the dispatch center. Only after depuration can shellfish from Zone B pass through the prescribed procedures within the dispatch center, and be placed on the market. Direct harvesting of the shellfish from zone C is not permited. In order to be harvested, the shellfish would be required to relay for a longer period within an approved area of proper water quality, and then sent to the depuration/dispatch center (Regulation EC 854/2004).

The legal requirements for the construction and operation of dispatch and depuration centers, for storage and transport of shellfish to the market, and the obligatory application of good hygienic practices, HACCP and traceability in all facilities that deal with food, are clearly defined. According to the legislation, the responsibility for food safety assurance rests with the commercial food handler, who must satisfy prescribed requirements (Regulation EC 852/2004; Regulation EC 853/2004; Regulation EC 854/2004; Regulation EC 882/2004).

In addition to the selection of an optimal culture location with frequent monitoring of the farmed area, and using adequate farming techniques, procedures for the handling of the shellfish after harvest are also of great impotance.

SHELLFISH HANDLING AFTER HARVESTING

According to the legislation, those involved in the shellfish business, and with harvesting or handling of live shellfish after harvest, are required to fullfill all prescribed legal requisites. All harvesting methods and techniques, and handling following harvest, must be carried out carefully to prevent physical damage (braking, scraching, vibration etc.), or contamination. Once harvested, live shellfish cannot be returned to the culture water. Transport vehicles must be equipped with proper drainage outlets for the waste water, provide optimal conditions for shellfish survival (maintaining an optimal temperature regime), and assure effective protection from contamination (Regulation EC 852/2004; Regulation EC 853/2004; Regulation EC 854/2004; Regulation EC 882/2004).

Improper handling during harvest, or during delivery to the dispach center, can lead to damage of the shell, stress, or a multiplication of the bacterial populations (exposure to high temperatures, repeated placement within the culture area after harvest, or contact of the shellfish with infected or ill workers), resulting in the product being unfit for human consumption, and negating the depuration process (Jackson i Ogburn, 1999; Huss at al., 2004).

LEGAL REQUIREMENTS FOR DEPURATION AND DISPATCH CENTERS

Design and construction of dispatch and depuration centers is regulated by law. Shellfish producers are responsible for the appropriate design, and the maintenance and operation of these centers, as well as the proper education of their employees. Only correctly labeled shellfish, with a proper declaration, can be distributed from the dispatch center to the market. Transport vehicles also must satisfy the hygienic regulations, with the proper documentation accompanying the transport of all shellfish.

According to the prescribed requirements for the dispatch centers and depuration facilities are:

1. They must be located on sites that are not endangered by possible flooding due to tidal changes or water runoff.
2. Water tanks and reservoires must meet the following requiremants:

a) Inner surfaces has to be smooth, rigid and water proof, and must be easy to clean
b) They must be designed to allows for easy water drainage
c) Water inlets must be positioned in such a way as to avoid water contamination.

3. In the depuration centers, reservoirs for depuration must be sized to accomodate the requirements and quantities of the treated species.

Basic hygienic requirements and procedures (good hygiene practices, HACCP, traceability) for the dispatch/depuration centers are also defined and regulated by law (Regulation EC 852/2004; Regulation EC 853/2004; Regulation EC 854/2004; Regulation EC 882/2004). These are basic requrements described for the design, construction and organization of activities within the dispatch/depuration center .

SHELLFISH DEPURATION

Depuration (purification) is a process by which live shellfish harvested for market are placed within a facility where the contents of their digestive tract are purified using clean sea water under controlled conditions (Jackson i Ogburn, 1999). In this manner, bacteria are eliminated from the gut, and a significant reduction in the presense of viruses is also achived. By the application of this process, which is prescribed by law for shellfish from Zone B, the most common human pathogens are eliminated.

The depuration process is carried out untill the microbiologically correct product is achieved, usually within 48 hours. CEFAS recommends a minimal period for purification of 42 hours, whereas the Canadian regulatory body recommends 44 hours (Jackson i Ogburn, 1999.

Theoretically, the depuration process seems simple, but several factors influence its efficiency: the handling of shellfish after harvest, the design and efficiency of the depuration system components, water quality, sliminess of the shell, the initial number and species of the microorganisms present within the shellfish, and their physical condition. For this reason, a knowledge of the local farming conditions is necessary in order to achieve maximal efficiency of the depuration process (Jackson i Ogburn, 1999; Jug-Dujaković i sur., 2010).

Basic components of the depuration system include those that achieve: mechanical filtration, biological filtration, temperature control, salinity control, oxygenation, and chemical purification. Factors that have to be taken into account in the process of designing the depuration system are: efficiency, legal requirements, characteristics of the aquatoria, profitability, cost, and the ease of construction and maintenance. As an example, the depuration system designed in the Technology and Business Innovation Center for Mariculture (MARIBIC) is presented. For reasons of efficiency, a vertical depuration design is used. From the live shellfish holding tanks, sea water flows to a reservoir, and is then pumped through a sand filter which removes particles larger than 2-5μm. After the sand filter, the water passes through a diatomaceous earth (DE) filter which separates particles as small as 1μm. The mechanically treated water then flows through a UV reactor for sterilization. A side-stream chiller is also included in the system to maintain coolwater conditions during summer. A biofilter within the main reservoir removes ammonia, a product of shellfish metabolism, and a protein skimmer, also included in the system, removes very fine and dissolved organic solids. The entire process, and the proper functioning of the system components, is monitored or controlled by computer. The computer also records all important water quality parameters of the depuration process (Jug-Dujaković i sur., 2010).

CONCLUSION

Shellfish are mostly consumed raw or after minimal thermal processing. For this reason, they can easily cause food borne diseases. In order to protect consumers health, the legal requirements for the construction and operation of dispatch and depuration centers, for storage and transport of shellfish to the market, and the obligatory application of good hygienic practices, HACCP and traceability in all facilities that deal with food, should be followed carefully.

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