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Intelligence

Critical decisions for shrimp harvesting and packing, Part 1

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Important steps to follow in order to maintain product quality

Significant resources and time to properly raise a quality crop of shrimp have already been invested at the time of harvest, and this quality must be preserved.

The harvest of a shrimp pond is the final step of a long production cycle (several months), and is a most important one despite its short duration of a few hours. The entire harvest team must perform optimally for the best results in terms of shrimp yield and product quality.

Both shrimp farmers and the packing plant have made significant investments to harvest products of the highest quality, but often the implementation of inadequate planning or practices can negate the effort of several months of hard work – and significant resources invested – in just a few minutes. The most important factors to consider during a harvest are time and temperature, but hygiene also has a very important role not only for food security reasons but also for the quality of the product itself.

Product quality can be interpreted in multiple ways depending on the markets and the different consumers and cultures. It is therefore very important to list and define with customers the various quality parameters in the most objective and comprehensive as possible. This list and the definitions of each parameter must be written and accepted by all parties to avoid misunderstandings that could have important commercial implications for all involved.

Even in countries where the local market does not seem overly concerned today with the quality of the products, be aware that consumer requirements in terms of quality are increasing rapidly in parallel with the rise of their living standards. This is a situation that can be observed in all developing countries for all the products of everyday life in general, and for shrimp in particular. Shrimp producers must be ready to adapt their standards to this increase in product quality expectations by the market, and must adapt their harvest procedures and personnel training accordingly.

Making the decision to harvest

Shrimp farmers decide the date of their harvests mostly based on the optimal average body weight of the shrimp in the particular pond, and considering the market demands and the best prices for given animal sizes. But considering that each market has its preferences and requirements, farmers should strongly guide their decisions not only in terms of unit prices offered to them but also significantly in terms of their potential net margin (Fig. 1), which will depend on the various markets available.

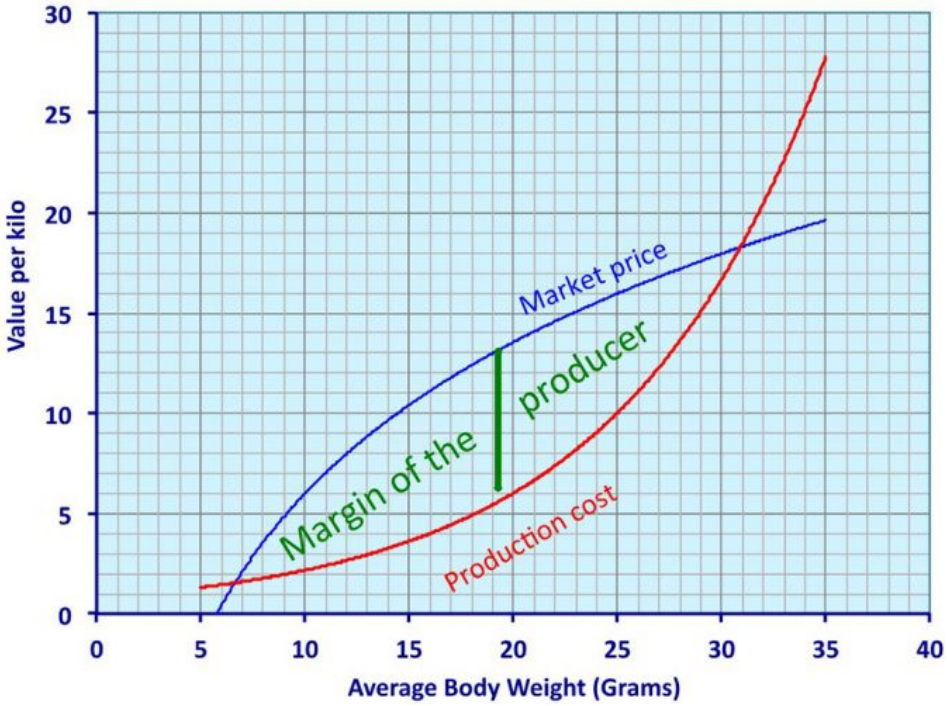

Fig. 1: Estimation of the net margin potential – with all factors involved – before deciding to proceed with a shrimp harvest.

When the farmer decides to harvest a pond, selecting the day must carefully consider the condition of the shrimp. Most farmers typically conduct a preliminary sampling of a small number of shrimp to check, to determine shell hardness and overall aspect of the animals, to check for animal color and flavor, deformities, stains, injuries and other aspects that affect product quality. In general, the decision to harvest proceeds if the following three criteria are met:

1 – Less than 5 percent of the shrimp are molting and less than 10 percent of the shrimp have soft shells;

2 – Less than 5 percent of the shrimp have any physical defects; and

3 – Shrimp have the correct odor and taste.

The hardness percentage by itself is not information adequate enough to make the decision to harvest. The main difficulty with this is the accurate determination of the stage of the intermolt cycle. The fact that the shrimp have hard shells when the preliminary sampling is conducted is not sufficient. It is necessary to determine the intermolt stage to make sure that harvesting stress will not induce massive molting during the harvest, which could force the suspension of the harvest or the consequence of reduced product quality and value. Even if the shrimp are not molting, their current stage could inadequate for a product with the desirable good texture, as a high water content in the animals can loosen their shells.

The determination of the intermolt stage is relatively easy and has been described by several authors The easiest way is to observe the endopodites of the shrimp uropods (the equal sides of the tail) using a binocular microscope at a 40× magnification (Fig. 2). The arrow in the top left shrimp picture points to the region of the endopodite of the uropod used for setogenesis (formation of new setae). From stages A to E:

- *Stage A (early postmolt)* – arrow points to the setal lumen filled with setal matrix;
- *Stage B (late postmolt)* – arrow shows retraction of the setal matrix and the beginning of internal cone formation;
- *Stage C (intermolt)* – arrow reveals empty setal lumen, note chromatophores expanded;
- *Stage D0 (onset of premolt)* – arrows show the onset of the separation of the cuticle and epidermis;
- *Stage D1 (early premolt)* – arrow points to the increasing space between the cuticle and epidermis;
- *Stage D2 (intermediate premolt)* – dark arrows reveal large space between cuticle and epidermis, white arrow shows details of the newly formed setae;
- *Stage D3 (late premolt)* – arrow features new setae completely formed and folded under the old carapace;
- *Stage E (molt)* – old carapace shedding revealing the new carapace and new setae.

The most suitable stage for harvest is D0-DI, when a very well defined separation is observed between the pigmented tissue zone and the cuticle. The decision to harvest could be made at stage C, but the product quality would not be optimal because there is still a slight space between the cuticle and the cell matrix, which will not result in shrimp with the best texture.

If harvest starts when the shrimp are at the D2-D3 stage, there is a very high probability that the shrimp will have a massive molting during the harvest – this is most undesirable and can lead to suspension of the harvest. Therefore, a highly recommended procedure is to sample about 100 shrimp from different areas of a prospective pond and check their telsons (part of the tail fan) with a binocular microscope (40x) to determine the intermolt stage of the population.

Fig. 2: Morphological changes in setogenesis during the intermolt cycle (from de Oliveira Cesar et al., 2006). All images are 40-X magnification, from 3-month-old animals.

Once the decision to harvest a pond is made, shrimp feeding must be suspended for 4-6 hours (no more) before starting the operation. It used to be that feeding was suspended for at least 48 hours or more before harvesting, but I believe this was a mistake. Shrimp will not stop eating if feed applications are suspended for several hours.

If no formulated feed is available because feeding was suspended, the shrimp will burrow into the pond bottom sediment in search of food and will incorporate large amount of blackish bottom particles, which will give them an unattractive appearance because their hepatopancreas will show as a big, black patch in their cephalothorax (the head of a shrimp).

It is clear that the best quality that can result is that quality the shrimp has when it exits from the pond. From that instant, its quality only decreases depending on several parameters, most of which can be controlled with good planning and execution. The selection of the best times to harvest a pond to obtain the highest quality possible is mostly the decision of the farmer. Unfortunately, in many instances farmers are paid for their shrimp at the harvesting gate of the pond, based on the average body weight and harvested quantity of shrimp.

In Ecuador, the system is different and it makes the farmers to be very concerned about the quality of their final product. The farmers select a packing plant to sell their harvest, based on ng a price list of commercial sizes for HOSO (head-on, shell-on) product grades A & B, and HLSO (headless, shell-on) products A&B. The packing plant provides the transportation, ice and all needed products for the harvest, including sodium metabisulfite (to prevent melanosis or black spots), and sends the harvested shrimp to the packing plant.

The Ecuadoran farmers send a representative to the packing plant to control the process, and they are paid according to the real, final packed shrimp by size and quality. This results in a higher remuneration to the farmer than if all the product is packed in a lower quality class. Therefore, farmers have a direct economic interest to harvest shrimp of the highest quality possible. This is a very good system that has made farmers more aware about quality and encourages them to harvest the best product possible.

Mechanized harvest during daytime in New Caledonia shrimp farm.

Preparation for the harvest

Once it has been decided to harvest a shrimp pond, the water level in the pond must be lowered enough to permit a quick and complete harvest. There is no rule establishing what is the best water column depth to start the harvest, because it can depend on many parameters including the estimated shrimp biomass in the pond, pond area, speed of water drainage, pond bottom slope and others. The personnel responsible must have a good knowledge of all ponds to properly determine the optimum water level to begin the harvest. Because many ponds within a farm can be different, the is no substitute for experience.

Ideally, a pond harvest must be concluded in a few hours (4 to 8, depending on the pond area) to maintain the shrimp in good conditions. When lowering the water level, it should be done carefully so as to not stress the shrimp, which generally induces a massive molt. Starting a harvest with water levels too high can also have unwanted consequences, because the harvest time could be too long and also induce stress and massive molting of the shrimp.

Shrimp ponds were routinely harvested manually for many years, but more farms are switching to mechanical harvesting using various types of harvesters, including impeller pumps, submersible or not, Archimedes' screws, elevator belts and others. Mechanical harvesters allow for faster removal of larger

amounts of shrimp from ponds, and require fewer people than manual harvesting. But all the post-harvest operations must be very well organized to avoid any delays and backlogs (which can affect product quality) of harvested shrimp during the process.

Manual harvest during daytime at shrimp farm in Madagascar.

Shrimp ponds are commonly harvested during the night, because temperatures are typically milder and more suitable. However, nocturnal harvests have the important disadvantage of less control relative to daytime harvests. Both manual and mechanized harvesting of shrimp, ponds can be easily accomplished with sufficient planning and precautions. The most important one is to shade the post-harvest area by installing a protective tent or cover to shield the harvested shrimp and workers from the direct impact of the sun. Another very important consideration is to avoid any preventable delays moving product between the harvest location (like in the example in the picture below) to where the chilled transport vehicle is. The main advantage of daytime harvesting is that it better allows for continuous control of the process and of the quality of the shrimp.

Before the harvesting begins, the harvesting facilities must be totally ready and organized, and follow the principle of “only forward movement” and avoiding crossing the paths of “clean” and “dirty” products and/or materials, in accordance with established HACCP norms. This is very important must be carefully considered, especially for manual harvests where numerous people are typically involved. It goes without saying that cleanliness and the sanitary condition of materials must be carefully checked before harvesting operations are started.

Draining harvested shrimp before weighing, a practice that wastes time and is not recommended.

Another key aspect for efficient harvests that maintain product quality is to make sure all personnel involved are understand the entire procedure, and their specific roles and positions. Harvest procedures should be clearly written and each person involved should have a copy of these SOPs, and read and understand them. Training sessions should be organized periodically and supervisors should verify that all employees are familiar with these procedures and understand them clearly.

References available from author.

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