

SHORT COMMUNICATION

Automation of live food in industrial hatcheries: zootechnics and economics

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The intensive larval rearing of marine fish is completely dependent on live food (mainly rotifers and *Artemia*) during the first feeding period. Live food production is a very intensive and costly matter (Olsen *et al.*, 1992; Gatland, 1995). Production outputs are not always satisfactory and are a function of many variables. Production techniques can be simplified and kept more constant by the installation of automated systems and standard operation procedures, thus guaranteeing more predictable outputs.

The goal of this short communication is to compare, in a commercial operation traditional live food production techniques with an automated production system, especially in terms of labour intensity, output efficacy and production costs. Thalassa Foods SA, a relatively big sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*) hatchery in Greece, was chosen for the case study. Their daily rotifer and *Artemia* consumption during peak production is 3 billions and 20–30 kg cysts day⁻¹, respectively. Their live food production was adapted as follows.

***Artemia* production: decapsulation, hatching and enrichment**

Artemia nauplii are produced following the standard decapsulation, hatching and enrichment techniques described in Lavens and Sorgeloos (1995). The system is designed to produce batches of 20 kg decapsulated cysts. Therefore, in the manual method the decapsulation procedure has to be repeated several times to end up with 20 kg at the end. In the automated procedure (schematically presented in Fig. 1) all steps, including automatic rinsing, take place in one recipient (the concentrator/rinser = C/R, mesh size $\pm 110\mu\text{m}$), which results in approximately four times less manpower needed, compared to the manual method. Also, in the manual method two harvests need to be done in filter devices which require the continuous presence of one person.

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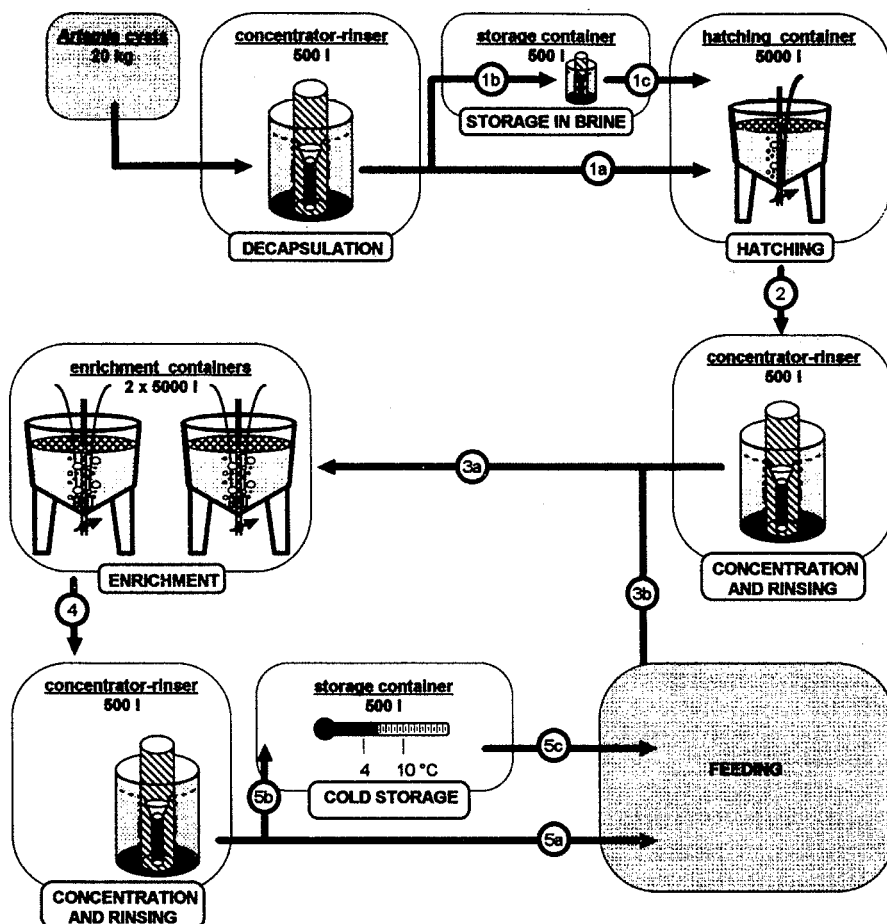


FIG. 1. Schematic overview of automation during decapsulation, hatching, harvest, enrichment and cold storage of *Artemia* nauplii: (a) Transfer of decapsulated cysts into the hatching container; (b) dehydration of decapsulated cysts by storage in brine (for future hatching); (c) transfer of dehydrated, decapsulated cysts into the hatching container. (2) Harvest of *Artemia* nauplii and transfer to the concentrator/rinser (C/R). (3a) Transfer of rinsed *Artemia* nauplii to the enrichment tanks; (3b) Direct feeding of rinsed *Artemia* nauplii. (4) Harvest of enriched *Artemia* nauplii and transfer to the concentrator/rinser. (5) Transfer of rinsed, enriched *Artemia* nauplii to the larval rearing tanks (a) or to the cold storage container (b) for future feeding (c).

In Table 1 the two methods are compared in terms of devices, presence of personnel and manpower needed. The data used assume the daily decapsulation of 20 kg cysts for the production of 4000 million *Artemia* nauplii day⁻¹.

Directly from the C/R the required quantities are pumped into the hatching tanks, the rest to a dehydration tank with brine where the cysts can be stored for several

TABLE 1. Comparison between manual and automated decapsulation for a total quantity of 20 kg *Artemia* cysts

Step in production	Manual decapsulation ¹			Automated decapsulation ²		
	device	man ³	labour	device	man ³	labour
1. Hydratation and washing	Tank 1 and harvest	+	++++	C/R-no harvest	-	-
2. Decapsulation	Tank 2	+	++++	C/R	+	+
3. Washing	Harvest in filter device	+	++++	C/R	-	-
4. Neutralization	Filter device	+	+	C/R	+	-
5. Hatching incubation	Manual	+	++++	pump out	+	-
6. Storage	None	-	-	C/R	-	+

¹Maximum quantity = 5 kg; ²maximum quantity = 20 kg; ³presence of personnel required.

days. In the automated system, it is no problem to harvest 5 m³ at once, which means that 10 kg *Artemia* cysts can be incubated per tank. Also, the use of a standpipe facilitates the separation of the non-hatched cysts. From the concentrator/rinser, the rinsed nauplii can be pumped directly to the enrichment tanks. When harvesting is done manually, the maximum capacity of the filter devices is 1 m³ and 2 kg of cysts. This means that for the harvest of 2 billion *Artemia* nauplii five times more manpower is needed in the traditional system. In the automated system no personnel had to be present during rinsing.

Approximately the same figures account for the enrichment. In the case of *Thalassa*, during peak periods, three tanks of 5 m³ are harvested daily. As two C/Rs are available, two tanks are harvested at the same time and, moreover, during this period hatching tanks are prepared. During the harvest of the third enrichment tank, three new enrichment tanks are prepared as well as the tank for decapsulation and the preparation of the enrichment emulsions. All this work that can be done during the automatic harvest and rinsing of the enrichment tanks accounts for 140 min which in the manual system needs to be counted in addition.

Rotifer production

In rotifer production systems, the most labour-intensive step is the harvesting of the culture tanks before feeding or enrichment. If the harvest is done manually, only 800 l can be harvested at one time, and one person is needed continuously to avoid clogging of the filter. Since in *Thalassa* rotifers are cultured in 2.5 m³ tanks the harvest of one tank of 2.5 m³ requires three times (i.e. 3 × 20 min) this action. After the complete harvest, the concentrated rotifers are transferred to a 20 l bucket to settle for 20 min as to remove debris that will concentrate at the surface. The whole procedure takes 90 min for one tank. The automated procedure applies a reversed filter system, in which the rotifers first pass through a bigger filter (±300 µm) and are then concentrated outside the central cylindrical filter (±60 µm). This system does not need extra manual labour because the aeration collar at the bottom of the filter avoids clogging of the filter screen. After harvest, the settling of the rotifers occurs

in the same device. This procedure takes 40 min for one tank. If one considers that during peak periods, at least three tanks need to be harvested per day, the total gain in time is 2 h 30 min and one person. In practice this means that the same production of rotifers could be done by one instead of two persons and that the final rotifer quality is constant being independent of manual handlings. From these data the advantages for the automated system over the manual can be summarized as follows:

1. Production techniques are simplified.
2. More intensification is made possible which means less tanks are needed and required space/infrastructure is reduced.
3. Less labour is required, can alternatively be called in for installation of quality control and assurance.
4. Less need of highly-skilled personnel.
5. Manipulations are reduced and higher outputs/unit of volume are reached.
6. The extra costs to install automated procedures are minimal (C/R; pumps) and are easily compensated by reduction in tanks and labour.

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