INTENSIVE RECIRCULATING PRODUCTION SYSTEM IN SEABASS, *DICENTRARCHUS LABRAX L.*

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Introduction

Development of marine finfish aquaculture is now restrained in most european countries because of available sites. Conflicts of interest between tourism, urbanization, industry, harbour activities and fisheries are particularly acute along the cost line. Attempts for fish offshore production has been limited by technical constraints, high investisments and difficulties to be correctly insured. Furthermore, around Mediterranean sea, reared marine fish selling price all the more fell because of the recent (1990-95) production increase. At last the environment preservation regulations lead all the farmers to decrease waste, pathogen and chemical discharge.
Faced with that critical situation, land based fish farming in closed system, as a technical alternative, has got strong arguments. In fact the drastic reduction of water needs gives to this rearing system its main advantages. Investors will have possibility to settle their farm in relation to profitable factors instead of water availability and climatic conditions. In the looking for competitiveness closed system offers possibilities by adapting environmental rearing conditions to rid itself of seasonal constraints, to extend species diversification or to fit market demand with required fish quality.
After 10 years of research to define and promote recycling in hatcheries, our laboratory has been dealing with the ongrowing phase since 1992. Today we can propose results from 6 last months operation in closed system in Seabass (150-345g). The aim of this study is to evaluate with high stocking densities (30-140kg/m3) the present status of the recycling technology and rearing tanks we have selected by determining (1) Seabass biological performances relative to environmental parameters proper to recirculated water; (2) Biofilter nitrifying activity; (3) Global efficiency of our recycling device; (4) Parasitism and sexual maturation status compared to a flow-through system.

Materials and methods

Experiment was conducted in a middle scale (2 tons carrying capacity, 25m3) semiclosed system (10-50h water residence time). The 2 rearing tanks were 10m3 each. Water was recycled through a mechanical filter, U.V. lamps, nitrifying biofilter, CO2 degazing column while pH was controlled by caustic soda (NaOH) supply. Oxygen fish demand was satisfied on a continuous basis by a computerized O2 supply system linked to each tank O2 level recording and integrated with a failure management system.
2 000 and 4 300 150g prereared fish in recirculated water were respectively stocked in tank A and B. They were fed commercial extruded pellets (45% crude proteins and 20% crude lipids) by self-feeder (24h/24h) coupled with a feeding activity recorder. Temperature (22°C) and photoperiod (16-hL/8-hD) were maintained stable whilst TA-N, NO2-N, NO3-N, total inorganic carbon levels and pH resulted from fish influence and recycling efficiency.
Biological performances were estimated by specific growth rate (SGR), feed conversion ratio (FCR), total ammonia nitrogen excretion (TAN-E). Parasitism and sexual maturation status were compared to those recorded on fish issued from the same hatchery reared population in a flow-through private farm.
The biofilter was described by the bacterial support specificities, the water residence time and flow velocity while the nitrifying activity was characterized by (1) ammonia nitrogen removal per m3 of bacterial support and (2) O2 consumption per ammonia nitrogen removal. Biofiltration results have been recorded during 2 periods of 29 and 37 days for fish weight ranges of 150 to 190g and 290 to 350g respectively.
The whole rearing facility performances were estimated by the water, O2 and NaOH needs by kg of fish production during the 180 days the experiment lasted.

Main results

During the whole rearing period the environmental parameters have been maintained at satisfactory levels with TAN-N, UIA-N, NO2-N, NO3-N respective (A-B) average concentrations of 1.52-1.87, 0.017-0.015, 0.80-0.75, 17.9-17.5mg/l. Total inorganic carbon level ranged between 80 and 150mg/l while pH mean was 7.3. Stocking densities raised from 30 to 70 and from 65 to 140 kg/m3 in tank A and B for a global FCR of 1.8. No peculiar mortality occured. The recirculated water yields were respectively 120 and 80m3/kg of produced fish biomass.
In our recycling setup 4.5kg NaOH and 5.2m^3 seawater per kg of fish were required to produce a total biomass of 1160 kg of 345g (mean) fish. In the private farm fish weight reached only 230g during the same period mainly due to temperature (17°C).
During the 2 investigated periods (P1 and P2) TAN-E ranged between 0.30 and 0.50g/day/kg of fish and between 30 and 40g/day/kg of ingested feed. Biofilter activity allowed an average ammonia nitrogen removal of 204 (P1) and 226 (P2)g per day per cubic meter of bacterial support for a nominal residence time of 7mn (P1) and 5mn (P2) and a flow velocity of 29 (P1) and 38 (P2)m/h.
More, we can assume a closed system protected by sand filtration (10-15 µm) against parasites (Diplectanum aequens) was effective since we never found contaminated individuals when we did in case of unprotected flow-through rearings.
At last stable high temperature combined with long lighting time seemed to affect sexual maturation with only 13% of males fluent against 40% in the other case.

Conclusion

Considering the results recorded during this study are basic data allowing us to point out critical aspects at a middle scale production setup, solutions will be discussed in order to improve the efficiency of such intensive closed system to make it fully operationnal concerning biological, technical and economical aspects.