NUTRIENT BALANCES IN A CULTURE OF *"Ulva ohnoi"* ASSOCIATED TO A *"Solea senegalensis"* RECIRCULATING AQUACULTURE SYSTEM

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Integrated multi-trophic aquaculture (IMTA) use multiple species from different trophic levels for reducing wastes, contributing to increase the sustainability of aquaculture. One of the most common IMTA systems consist of the integration of seaweed cultures in land-based fish farms. It allows to counterbalance nutrient inputs and other metabolic aspects, such as dissolved oxygen, acidity, and CO_2 levels.

When the seaweed production is associated to a recirculating fish production system, it should be noted that the environmental conditions are significantly different than in a flow-throw system. In Recirculating Aquaculture Systems (RAS) only a small percentage of the circulating water (usually from 1 to 10% of the system volume) is discharged daily. Recirculated water is passed through a biofilter for biological conversion of ammonia-nitrogen to nitrate-nitrogen, less damaging for fish. This allows concentrating wastes into smaller flows and raising fish in a controlled environment.

The major differences which can be perceived in RAS include much higher concentrations of carbon dioxide, nitrates and phosphates than those observed in flow-throw systems, and a decrease in the oxygen content, alkalinity and pH values. These differences must be taken into account in the design and management of IMTA facilities associated to a recirculating aquaculture system (IMTA-RAS).

The objective of this work is to analyse the balance of nutrients and metabolites achieved in an *Ulva ohnoi* culture system integrated with a *Solea senegalensis* RAS, in order to give some guidelines for the design and management of this kind of facilities.

Experiments were conducted in a laboratory scale model which integrates: a fish tank with *Solea seneganensis* feeded at a ratio of 300g per week, mechanical and biological filters and algae tanks with a total area 2,2 m^2 and total capacity 630L.

No marine water replacement was done along 24 days. Only a small flow rate of fresh water was added to compensate the water evaporation produced mainly in the algae tanks. The weekly amount of fed provided to fish was around 300g. Protein content of feed was 57% and the molar ratio N/P was 12.25. Peristaltic pumps allowed controlling the water flow rate from the fish tank to the respective algae tanks, the fresh water flow rate and the addition of hydrochloride acid to avoid pH values above 8.5. Sodium carbonate was weekly provided to maintain alkalinity over 100 mg/L CO_3Ca. No external oxygen was added to the fish tank, being the DO enrichment provided only by the algae.

Concentrations of DO in the water of fish tank were maintained, along the 24 days, at 6.5±0.5 mg/L, pH was 7.6±0.2, salinity 34.1±1.05 g/L and CO_2 around 4 mg/L.

The daily biomass productivity of algae was quantified and the tissue content of N and P was determined to estimate the daily uptake of these elements. A balance of nutrients, DO and CO_2 was done for the fish tanks, seaweed tanks and biofilter, and some guidelines for the integration of *Ulva ohnoi* production in a *Solea senegalensis* RAS are given.

Fresh Water + HCl 0,117M

3,84 L/d

7,92 L/d

Algae tanks R (ATR)
vol.   270 L

Mixing tank to S (MR)

134 L/d

Mixing tank to S (MS)

Algae tanks S (ATS)
vol.   360 L
672 prod gdw/d

133,60 L/d

672 L/d

481,121818 L/h

Fish tank (FT)

BioF. + mix. (BF)

500 L/h