Microbial dynamics in RAS water: Effects of adding acetate as a biodegradable carbon-source - DTU Orbit (31/10/2019)

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This study evaluated the effect of an abrupt increase in easily biodegradable carbon (acetate) on bacterial activity and abundance in the water of recirculating aquaculture systems (RAS). The study included a batch experiment with RAS water only, and an experiment at system level where twelve pilot scale RAS were used. The batch experiment was made to test how acetate concentration would influence the microbial state in RAS water. Further, we wanted to observe if the selected microbial analysis tools would be able to detect these changes. The second experiment was carried out in twelve identical and independent RAS that had been operated under constant loading conditions (1.6 kg/m3 make-up water) for five months prior to the trial. The twelve RAS were divided into four treatment groups in triplicates: i) control with submerged biofilter (Ctrl+bf); ii) control without submerged biofilter (Ctrl-bf); iii) acetate addition in RAS with submerged biofilter (Ac+bf); and iv) acetate addition in RAS without submerged biofilter (Ac-bf). The biofilter media from the groups without submerged biofilter (Ac-bf and Ctrl-bf) was removed just 5h prior to the start of the trial. The two acetate treatment groups (Ac+bf and Ac-bf) were spiked with 40 mg/L of acetate three consecutive times (0, 24 and 48h). Consumption of acetate, bacterial abundance and bacterial activity were followed for 72h after the first acetate spike for both experiments. Bacterial activity was quantified by BactiQuant® and hydrogen peroxide (HP) degradation assay. Bacterial abundance was assessed by quantifying micro-particles and free-living bacteria. In the batch experiment we observed a significant increase in bacterial activity proportional to the amount of acetate added, and a corresponding significant increase in microparticles (1–3 μm). In the pilot scale RAS experiment, the acetate addition in RAS with submerged biofilter did not cause an increase in bacterial activity, or in the number of microparticles in the water phase but a significant increase in bacterial activity and number of microparticles were observed in the RAS without submerged biofilter (Ac-bf). These changes were particularly pronounced shortly after each acetate spike.

In RAS with submerged biofilters, the acetate was presumably consumed primarily by the bacterial community within the biofilm, and consequently, only minor changes were observed in densities of free-living bacteria in the water phase. The results of the study suggest that heterotrophic bacteria in the submerged biofilter have a high capacity to handle fluctuation of organic matter loading in RAS, thereby stabilizing the abundance and activity of bacteria in the water column.

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