Bacterial activity dynamics in the water phase during start-up of recirculating aquaculture systems

Microbial water quality in recirculating aquaculture systems (RAS) is important for successful RAS operation but difficult to assess and control. There is a need to identify factors affecting changes in the bacterial dynamics – in terms of abundance and activity – to get the information needed to manage microbial stability in RAS. This study aimed to quantify bacterial activity in the water phase in six identical, pilot scale freshwater RAS stocked with rainbow trout (Oncorhynchus mykiss) during a three months period from start-up. Bacterial activity and dynamics were investigated by the use of a patented method, BactiQuant®. The method relies on the hydrolysis of a fluorescent enzyme-substrate and is a rapid technique for quantifying bacterial enzyme activity in a water sample. The results showed a forty-fold increase in bacterial activity within the first 24 days from start-up. Average BactiQuant® values (BQV) were below 1000 at Day 0 and stabilized around 40,000 BQV after four weeks from start. The study revealed considerable variation in initial BQV levels between identically operated and designed RAS; over time these differences diminished. Total ammonia nitrogen, nitrite and nitrate levels were very similar in all six RAS and were neither related to nor affected by BQV. Chemical oxygen demand (COD) and biological oxygen demand (BOD5) were highly reproducible parameters between RAS with a stable equilibrium dynamic over time. This study showed that bacterial activity was not a straightforward predictable parameter in the water phase as e.g. nitrate-N would be in identical RAS, and showed unexpected sudden changes/fluctuations within specific RAS. However, a bacterial activity stabilization phase was observed as systems matured and reached equilibrium, suggesting a successive transition from fragile to robust microbial community compositions.