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MOBILE IMMERSION FILTER:

DECREASING AMMONIUM CONCENTRATION IN LONG-TERM SHIPPING TANKS TO REDUCE AQUATIC STRESS AND NEW TECHNOLOGICAL IMPROVEMENTS ON PRODOCT QUALITY

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INTRODUCTION

One of the most frequently transported live fish species in Europe is the rainbow trout *(Oncorhynchus mykiss)*. The conditions prior to and during transport have a significant impact on the fish's health, stress response, and final product quality. Despite the implementation of starvation periods and water changes before shipment, water quality deterioration during transport is unavoidable. During transport, the water's hazardous concentrations of ammonium and carbon dioxide increase. To counteract this, additional filtering technology can be utilized. The Alfred Wegener Institute (AWI) has developed mobile immersion filters that have been tested and proven to effectively control ammonia and carbon dioxide concentrations during fish transport. The related scientific research on the use of the **Mobile Immersion Filter (Patent DE102019122146B3)** has shown notable results, as summarized below..(Fig. 1).

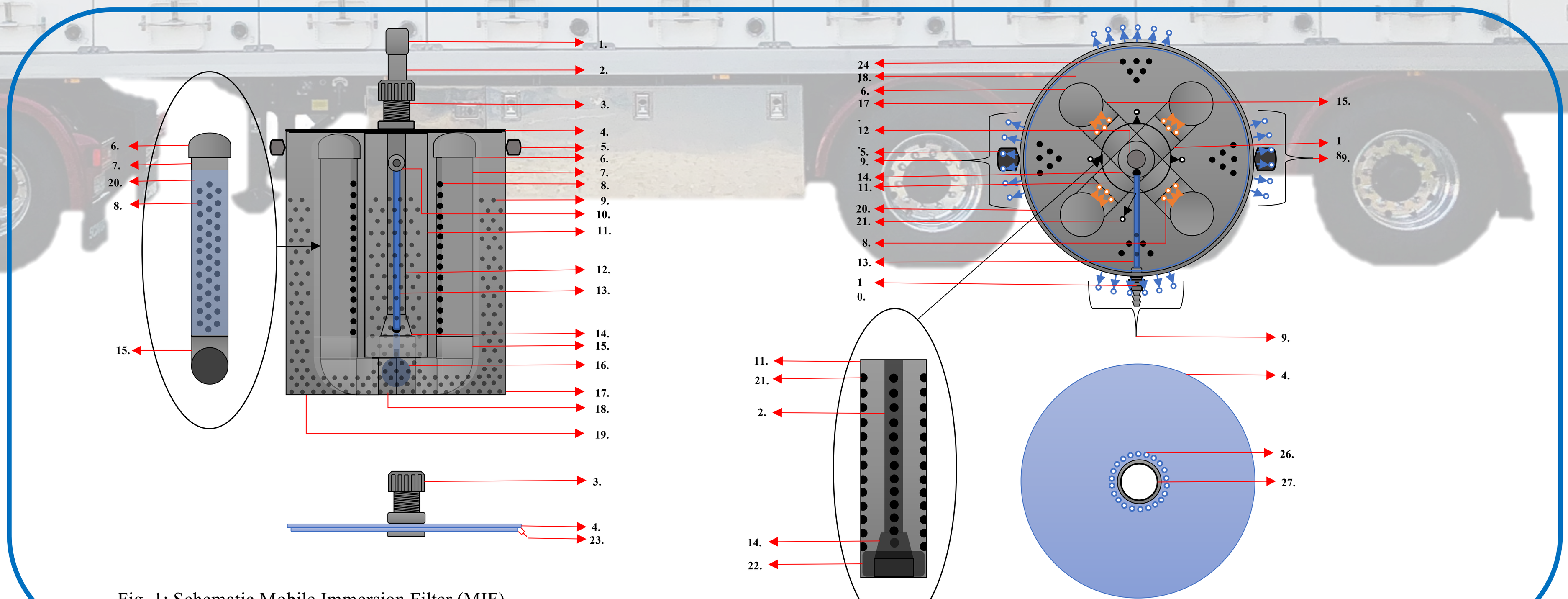

Fig. 1: Schematic Mobile Immersion Filter (MIF)

MATERIALS AND METHODS

Initially, three different design concepts for immersion filters were evaluated for their ability to reduce ammonia and carbon dioxide in the transport water of fish. The results focused on the reduction of ammonia, with a reduction compared to the control being evaluated as a technical proof of concept. Fish transport boxes were used and prepared by adding ammonium chloride as a solution of 12 ± 0.1 mg/L to the water. After 9 hours, a substantial difference was detected between tanks with a Mobile Immersion Filter (MIF) and the control tanks, with the dissolved ammonium level in the water of the transport tanks decreasing to 3 ± 0.5 mg/liter with the use of a MIF.(Fig. 2).

Although all models performed well, Model A2 (one of the patented version) with 10 kg of zeolite and 2 kg of activated carbon was selected for controlled trials with fish transport tanks containing 50 kg of live rainbow trout *(Oncorhynchus mykiss)* and 500 liters of water in each tank. The transport tanks for this experiment were directly filled with water from a Recirculating Aquaculture System (RAS). A transport simulation was carried out for four hours, with water samples taken from the tanks every hour. At the end of four hours, three fish were randomly selected from each tank for blood sampling.

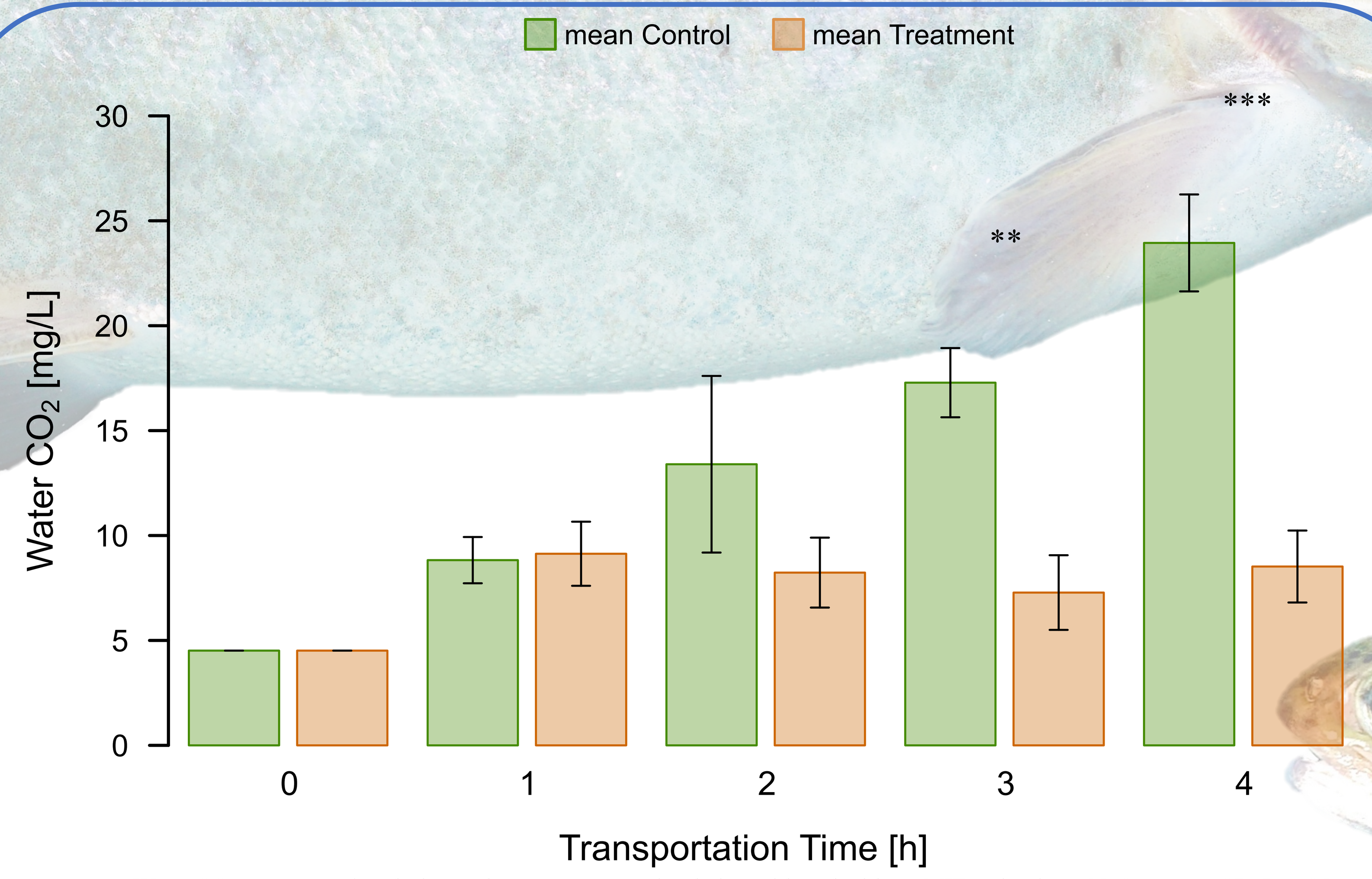

Fig. 6: Water CO_2- concentration during a 4h trout transport simulation with and without MIF technology. N=3, mean ± SD. P>0.05 .

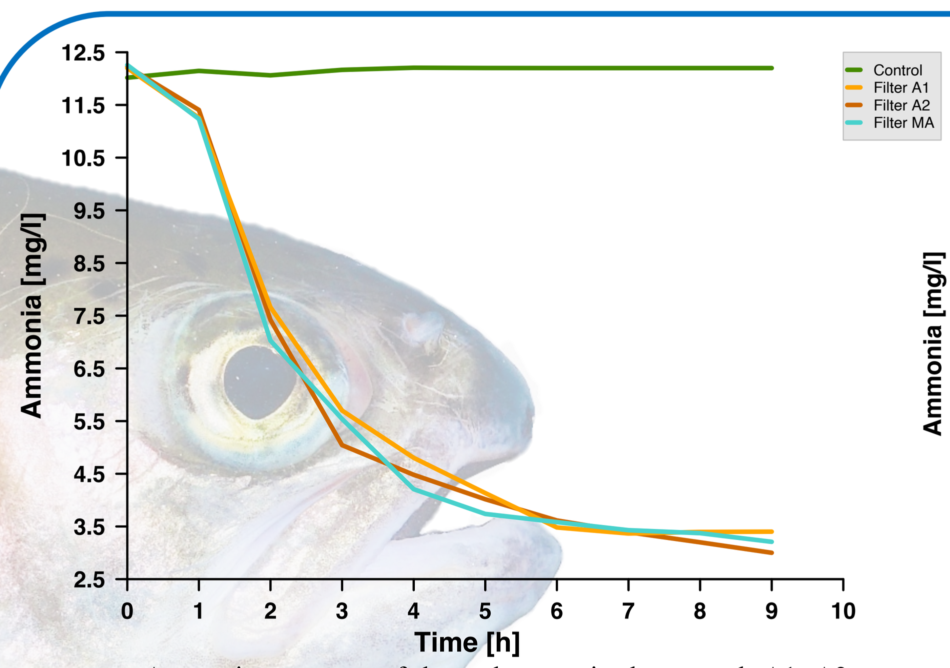

Fig. 2: Ammonium content of the tank water in the control, A1, A2, MA Filters (MIF) during a 9h transport simulation without using fish and prepared by adding ammonium chloride as a solution of 12 mg/L to the water. N=3, mean ± SD. P>0.05

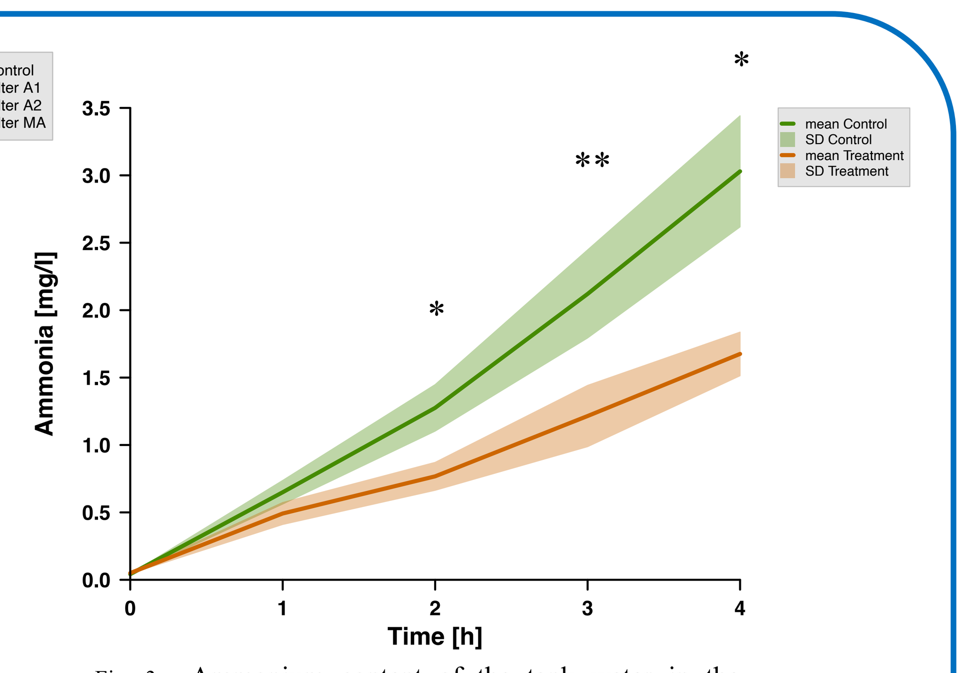

Fig. 3: Ammonium content of the tank water in the control and the MIF A2 treatments during a 4h transport simulation of trout. N=3, mean ± SD. P>0.05

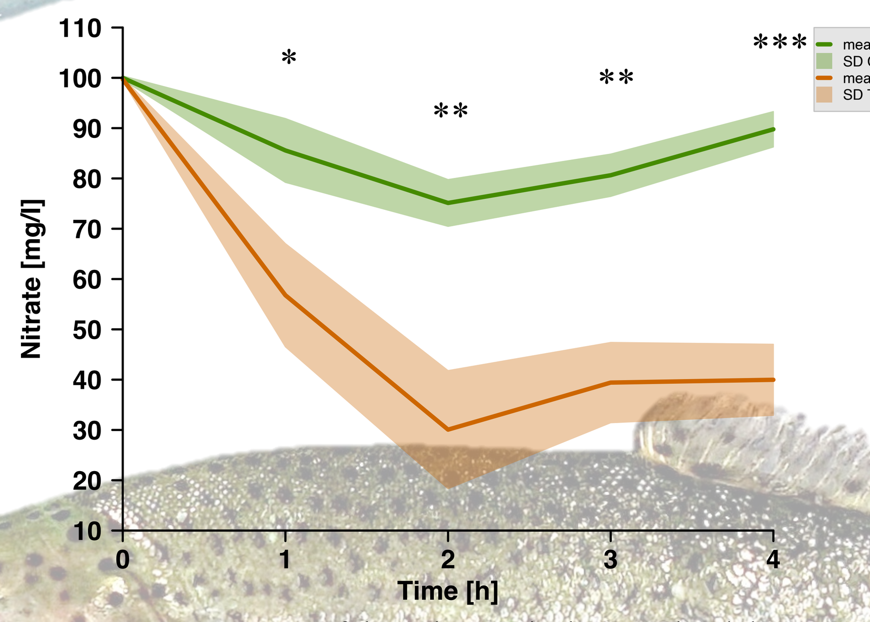

Fig. 4: Nitrate content of the tank water in the control and the MIF A2 treatments during a 4h transport simulation of trout. N=3, mean ± SD. P>0.05

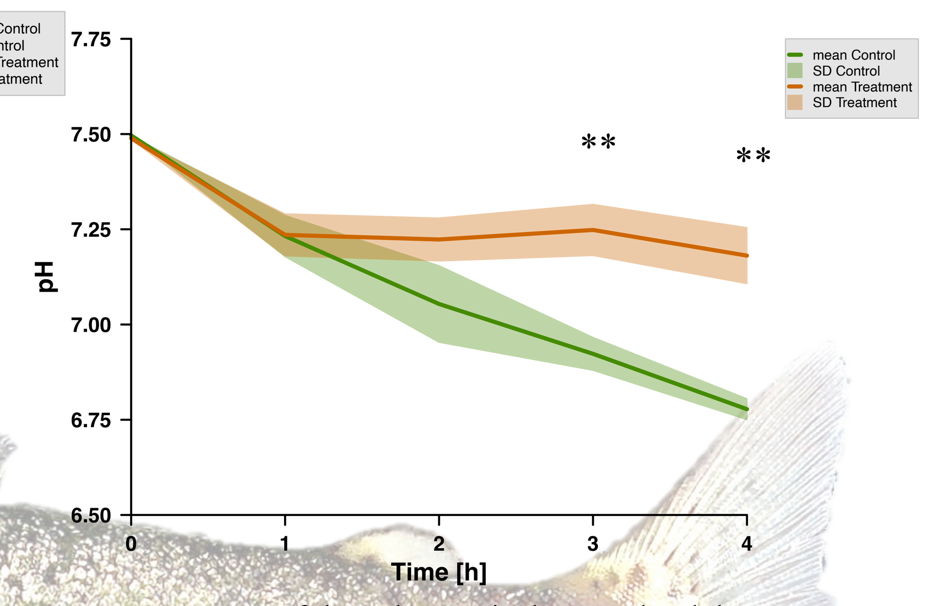

Fig. 5: pH content of the tank water in the control and the MIF A2 Filter treatments during a 4h transport simulation of trout. N=3, mean ± SD. P>0.05

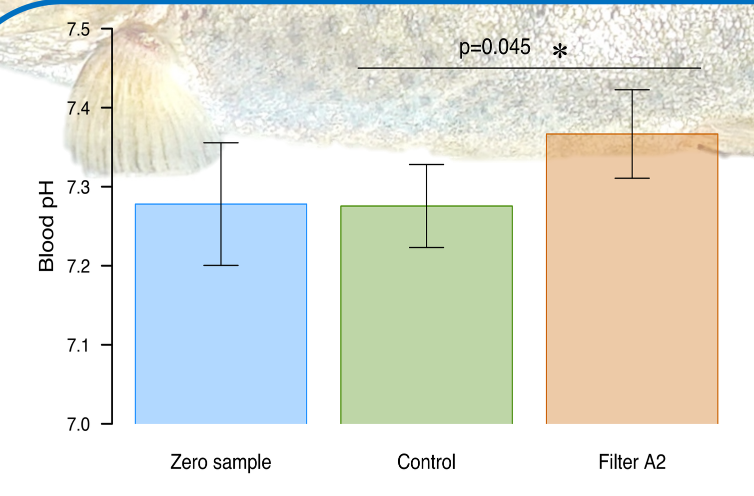

Fig.7: Blood pH of trout before and after a 4h transport simulation reared in tanks with MIF A2 and control. N=9, mean ± SD. Superscript letters indicate significance. P>0.05

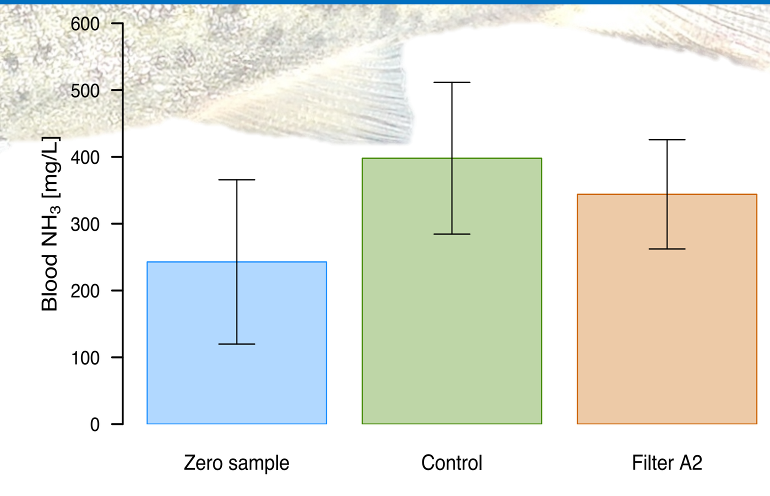

Fig. 8: Blood NH_3 (Ammonia) of trout before and after a 4h transport simulation reared in tanks with MIF A2 and control. N=9, mean ± SD.. P<0.05

RESULTS

Degassing with Mobile Immersion Filter (MIF): The average CO2 levels in the control tanks increased to 24 ± 1.9 mg/L after only 4 hours of transport simulation, but remained significantly lower, at 8.5 ± 1.6 mg/L, in the MIF (A2) treatment (Fig. 6). The pH decreased from 7.5 ± 0.1 to 6.7 ± 0.1 in the control tanks, while it increased from 7.5 ± 0.1 to 7.1 ± 0.1 in the MIF treatment (Fig. 5).

Blood Parameters: The blood pH of the rainbow trout *(Oncorhynchus mykiss)* showed a significant increase in the fish from the MIF (A2) treatment after 4 hours of transport simulation, which could be due to a decrease in carbon dioxide levels in the fish's blood (Fig. 7). The blood ammonia concentration of the trout was somewhat lower in the fish from the MIF treatment, but not significantly so. This difference will probably show a significant difference between the control and treatment in longer transportation periods (Fig. 8). Other blood parameters were not measured.

Ammonium and Nitrate Exchanger in MIF: The transport tanks for this experiment were directly filled with RAS system water that contained 98 ± 2 mg/L nitrate and 0.04 ± 0.01 mg/L ammonium. The ammonium concentrations in the water in the control tanks increased steadily over the simulated transport period, but remained at significantly lower levels in the MIF treatments (Fig. 3). The nitrate concentrations in the control tank water remained constant during the simulated transport period, but the MIF treatments had significantly lower levels (Fig. 4), and the nitrite level did not change.

DISCUSSION AND CONCLUSION

According to the findings of the present study, Mobile Immersion Filter (MIF) technology is an effective method for improving water quality during the transport of rainbow trout *Oncorhynchus mykiss*. The quality of the transport water has a direct impact on physiological markers, resulting in improved animal welfare, stress reduction, safety, and final product quality. In cases where water change is not feasible, MIF technology can also be utilized as an efficient emergency measure to enhance the water quality of small-scale aquaculture systems.

References

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