Popular science summary of the PhD thesis

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Title of the PhD thesis	Microbiology of hydrogen sulfide production in recirculating aquaculture systems
PhD school/Department	DTU AQUA / Aquaculture section

Science summary

* Please give a short popular summary in English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology.

Microbiology of hydrogen sulfide production in recirculating aquaculture systems:

Over the last decades, aquaculture has become the world's fastest growing food sector due to the continuously increasing demand for aquatic products e.g. fish, shellfish, and aquatic plants. One of the most promising and environmentally friendly aquaculture production methods is the recirculating aquaculture systems (RAS), where fish and other aquatic products are grown in tanks on land under controlled conditions and high water re-use rate. This allows RAS to have higher potential to mitigate environmental impacts, better control over growing conditions and higher production densities as compared to more traditional methods. However, RAS also face critical challenges, one of the most critical ones being the unexpected production of hydrogen sulfide (H_2S), a highly toxic gas that can cause the deaths of fish within hours and pose serious risk to the farm worker's health. H_2S is usually produced by sulfate reducing bacteria, which use sulfate present in aquaculture water for their respiration and produce H_2S as a byproduct.

However, in this Ph.D. project, I revealed that other bacteria may be responsible for the H_2S production in RAS. This alternative, previously neglected H_2S production pathway is based on the degradation of sulfur-containing amino acid cysteine. The lack of fundamental knowledge on this process in engineered systems like RAS may hinder the development of effective strategies to monitor, prevent, and manage hydrogen sulfide outbreaks.

By using a combination of advanced molecular biology techniques and high-resolution microprofiling, I obtained broader knowledge on both sulfate and cysteine-driven H_2S production in aquaculture environment. I identified bacterial groups, genes, and enzymes involved in cysteine degradation. Moreover, I showed that sulfate reduction can produce H_2S also in freshwater, which has previously been ignored due to low sulfate concentrations present. I also showed that the H_2S can be generated in just a few hours when fish waste accumulated at the bottom of the tank in both freshwater and marine water

By obtaining more knowledge and a better understanding of how and where H_2S can be produced, fish farmers and engineers may develop safer and more efficient systems to prevent accidents and therefore protecting the fish's health and human safety. Overall, this Ph.D project highlights the significant role of cysteine as a potential H_2S source and the importance of a good tank design and effective waste management to reduce the risk of toxic gas production and accumulation possibly at the bottom of the tanks.

Please submit the summary to the department PhD coordinator together with your thesis