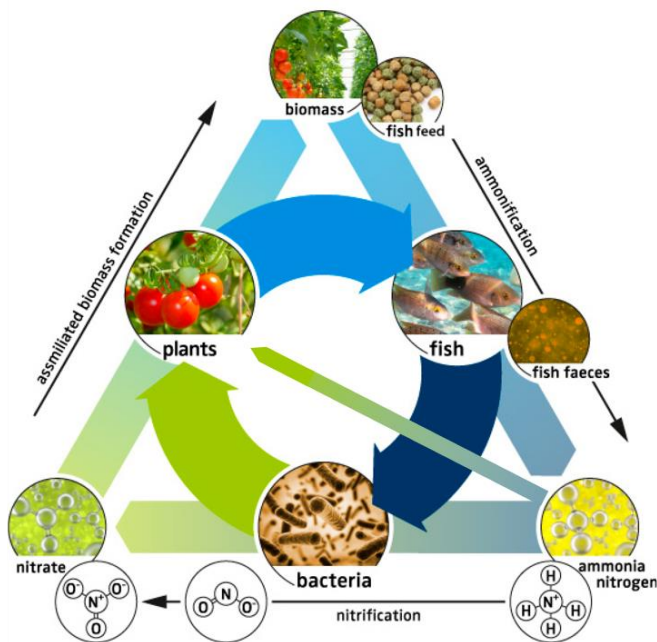


Nitrogen cycling in aquaponics

Nitrogen is an essential element for all living organisms. It occurs in amino acids (parts of proteins), nucleic acids (DNA and RNA) and in the energy transfer molecule adenosine triphosphate [1].

Nitrogen enters the aquaponic system in form of proteins via fish feed. Feed is eaten by fish and further on excreted as total ammonia nitrogen (TAN, ammonia - NH_3 and ammonium - NH_4^+) [2]. Mostly in biofilters, TAN is oxidized by ammonia oxidizing bacteria (AOB) to nitrite (NO_2^-), which is by nitrite oxidizing bacteria (NOB) later on oxidized to nitrate (NO_3^-). NO_3^- and part of NH_4^+ are taken up by plants [3]. With this, compounds that are toxic for the fish (NH_4^+ and NO_2^-) are removed from the system, and plants have nutrients available for their growth.



Adapted from [4]

References:

- [1] Pratt CW and Cornely K (2014). Essential Biochemistry, 3rd ed. John Wiley and Sons, Inc., MA
- [2] Timmons MB et al. (2002). Recirculating aquaculture systems, 2nd ed. Cayuga Aqua Ventures, Ithaca, NY.
- [3] Graber A and Junge R (2009). Aquaponic systems: Nutrient recycling from fish wastewater by vegetable production. *Distillation*, 246: 147-156.
- [4] Goddek S et al. (2015). Challenges of Sustainable and Commercial Aquaponics. *Sustainability*, 7(4): 4199-4224

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AOB (bacteria of the genus *Nitrosomonas*, *Nitrosospira*, *Nitrosovibrio* sp., etc.) and NOB (bacteria of the genus *Nitrobacter*, *Nitrospira*, *Nitrococcus*, etc.) have different growth rates, causing partial nitrification, especially during the start-up period, leading to NO_2^- accumulation until nitrifiers are fully established, which can take up to 4 weeks.

