

# Scientists create healthy salmon feed from CO<sub>2</sub> emissions

Polluting CO<sub>2</sub> gas is turned into nutritious food for farmed salmon. All it takes is three innovative research facilities, a visionary leader, and a large amount of microalgae.

**Polluting CO<sub>2</sub> gas is turned into nutritious food for farmed salmon. Science fiction? Not at all. Just three innovative research environments, a visionary leader in the heavy metals industry, and a large amount of microalgae.**



Finnfjord AS, a ferrosilicon producer in northern Norway, emits 300,000 tonnes of CO<sub>2</sub> per year, which is captured by microalgae. Algae use carbon dioxide (CO<sub>2</sub>) as an energy source. Algae 'eat' CO<sub>2</sub>, so to speak – just like land plants.

Based on that principle, Nofima produces feed containing algae:

*' We incorporated the algae into the feed and conducted growth trials with salmon, from fry to market weight. This was technically challenging, but the results so far show that the salmon grow well on the algae-based feed and are in good health, '* said senior scientist Sten Siikavuopio, who leads the project at Nofima.

Finnfjord AS aims to be emissions-free – and to utilise all the CO<sub>2</sub> produced by the plant. The goal of converting CO<sub>2</sub> into food for diatoms – which in turn become a valuable ingredient in salmon feed – is being pursued by UiT – the Arctic University of Norway, SINTEF and Nofima in partnership with Finnfjord AS.

## Diatoms are rich in fatty acids.

One of the major challenges facing the global aquaculture industry is sourcing enough marine oils to feed salmon. At the bottom of the food chain, scientists are now exploring the most promising new ingredients for fish feed, including microalgae. Algae are rich in omega-3 fatty acids such as DHA and EPA, which salmon need in their diets.

*' Microalgae can grow rapidly and produce more healthy omega-3 fatty acids when grown in large reactors at Finnfjord AS. This makes them particularly interesting as a feed ingredient ,'* says Sten Siikavuopio.

He believes that algal oil has properties that allow it to replace fish oil in fish feed.

The AlgOpti research project at Finnfjord AS has received NOK 93.3 million in 2021 from the Green Platform, a funding programme for new sustainable technologies and green solutions, to develop salmon feed using CO<sub>2</sub>. The project will also establish methods for cultivating useful algae. This has given rise to the project Mikro-fôr – Microalgae as feed ingredient for farmed fish. The project is funded by the Norwegian Seafood Research Fund (FHF) and led by SINTEF Ocean.

*' Previous trials of adding diatoms to standard salmon feed have shown that salmon remain healthy throughout their life cycle on this feed. However, the maximum amount of algae added to the feed so far has been only 3%. We need to find out how much algae can be added to the feed, '* said Siikavuopio.

One reason for the low proportion of algae in feeds to date has been the problem of water in processed algal biomass, but advanced technology has now allowed for the addition of algae to feeds.

*' With the new feed we have tested, we have been able to add up to 15% algae to the feed. Trials so far have shown that the fish grow and develop very well with a high algae content in the feed ,'* says Sten Siikavuopio.



## Carefully developed formula

The search for a system to treat CO<sub>2</sub> and NO<sub>x</sub> emissions from the production of ferrosilicon for algae has been developed by Finnjord AS and UiT – The Arctic University of Norway. The collaboration between UiT and Finnjord involves growing algae in large tanks located at the smelter.

Algae are grown in large tanks. Carbon dioxide – a waste gas – from ferrosilicon production is piped into the tanks, and the algae produce protein, valuable marine oil.

The algae biomass was then sent to feed manufacturers at Nofima, Skretting and Cargill, who used a carefully developed formula – a detailed recipe – to develop feed containing the algae biomass.

This specially developed feed is currently being tested in salmon farming. In addition to growth and good health, scientists and fish farmers have noted another very positive side effect of algae feed:

*' Microalgae in feed also helps reduce salmon lice infestation. This has been documented ,'* reveals Sten Siikavuopio.

## Interdisciplinary at the highest level

It was colleagues at Nofima's feed technology center who developed the feed formula together with Sten Siikavuopio. Quality scientist Stein Harris Olsen and fish health scientist Elisabeth Ytteborg led the work documenting the quality and health of salmon fed the algae diet:



– **Is fish edible?** The answer is definitely yes.

– **Does the muscle of salmon fed on algae absorb CO<sub>2</sub> differently than other salmon?** The answer is no.

– **Is salmon healthy?** Again, the answer is yes.

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