

Grass Juice Protein

Supports Welfare and Fillet Quality in Atlantic Salmon

Background

Blue–green innovation that reduces soy import dependency and climate footprint, increases self-sufficiency, and strengthens a circular and competitive value chain for future fish feeds.

Grass and legumes are widely used in livestock feed and grow across Norway. In fact, two-thirds of Norwegian farmland is unsuitable for other crops. Norwegian forage protein could supply ~100,000 t (5%) of salmon feed by 2050 (SINTEF, 2020).

Alfalfa protein concentrate showed potential as a sustainable protein ingredient in freshwater salmon diets. Based on these findings, further testing was conducted in seawater.

Alfalfa Protein Concentrate

Alfalfa (lucerne) is a nitrogen-fixing legume that requires little or no nitrogen fertilisation. Protein-rich juice from the plant was dried into a meal and used as an ingredient in salmon feed, while the remaining dry material was used for ruminants.

The protein concentrate is a non-GMO source containing more than 50% protein, carotenoid pigments, chlorophylls, omega-3 fatty acids, and vitamins.

The term “*grass juice protein*” in this study refers to a meal produced from dried alfalfa juice.

Methodology

Atlantic salmon (*Salmo salar*) were fed either a standard commercial feed or the same feed in which soy protein (SPC) was substituted by grass juice protein (5% alfalfa). Each diet was fed to three cages (125 m³) from December 2024 to June 2025 at the seawater site Flotenaset in Vadheim, Norway.

Two different feeds

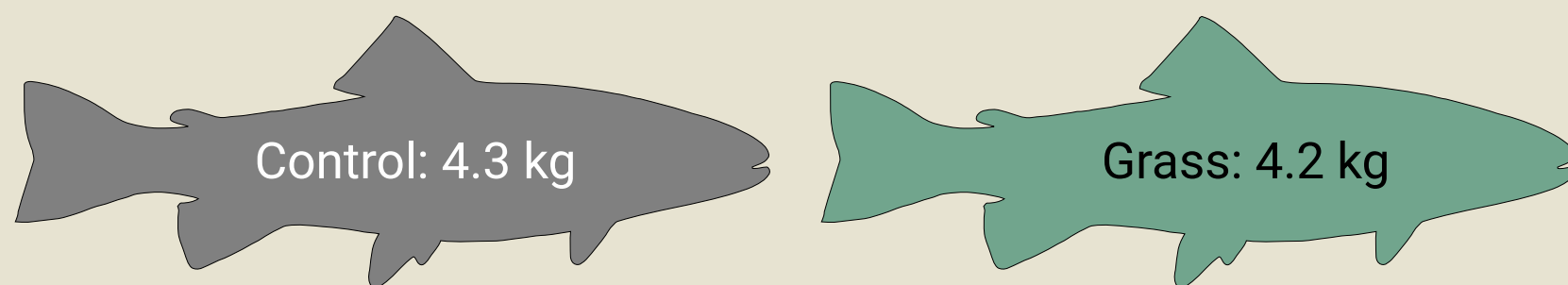
Control Diet

Grass juice protein (5% alfalfa)



Results

Body weight after a six-months feeding trial



Growth performance did not differ statistically between the fish groups, showing increased weight compared with the start weight of 1.6 kg and 1.4 kg for the commercial feed and the grass juice protein feed, respectively.

Good fish welfare and health

- **Fish health and welfare** assessments revealed no adverse effects on mortality, sea lice infestations, scale loss, wounds, eye health, gut health or health indicators of the liver and heart.
- **Faecal consistency** was slightly softer in salmon fed the grass juice protein feed; however, no fish fed grass juice protein had diarrhoea.

Good fillet quality

- **Yield** after gutting and filleting were similar between the groups, with an indication of increased fillet thickness in salmon fed grass juice protein.
- **Fillet quality parameters**, including omega-3 (EPA and DHA) and protein composition, flesh colour, melanin spots, firmness, and gaping, were similar between the feed groups, with results pointing towards firmer fillets of salmon fed grass juice protein.
- **Evaluation of fillets by a professional chef** showed high quality scores for both groups, with a numerically higher score for salmon fed grass juice protein.



Fillets of salmon fed grass juice protein during a period of six months

Summary

Alfalfa (lucerne) meal is an unrefined protein source compared with soy protein concentrate (SPC), the largest protein source in salmon diets.

Results from small-scale studies in both freshwater and seawater demonstrate a strong potential of locally produced grass juice protein as a future sustainable ingredient in salmon feed.

- Future studies should define the upper inclusion level of grass juice protein.
- Commercial-scale studies are required.



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