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Aquafeeds

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# What aquafeed ingredients can substitute for krill meal? Research team develops a method to find out

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By Darryl Jory, Ph.D.

**Lead author Dr. Rick Barrows says plant-based feed ingredients can also increase feed intake and growth, while krill meal is a good palatant**



A recent study highlighted the lack of effect of krill meal when used as a supplement at 2.5–5.0 percent in alternative animal-based aquafeeds for Atlantic salmon. However, when used in plant-based aquafeeds, krill meal appears to act as a palatant, increasing salmon feed intake and growth. Photo by Uwe Kils, via Wikimedia Commons.

A recent **study** (<https://doi.org/10.3390/fishes8120590>), published in *Fishes* – conducted by scientists from several U.S. companies in Florida, California, Montana and South Carolina; the U.S. Fish and Wildlife Service Fish Technology center in Bozeman, Montana; and the Centro Experimental Acuícola of Vitapro Chile, in Puerto Montt, Chile – details the influence of krill meal inclusion at various levels in both plant-based feeds and poultry byproduct feeds without fishmeal and fish oil on Atlantic salmon growth.

“This study was designed to determine if adding krill to either a poultry meal-based series of diets or a plant-based series of diets had a beneficial effect on either feed intake or growth. We now have the methodology to determine if an ingredient can replace krill meal in a plant-based diet,” Dr. Rick Barrows, leading author of the study, told the *Advocate*.

The research was carried out in tanks at the Centro Experimental Acuícola, Vitapro Chile, in Puerto Montt, Chile. The purpose was to determine the influence of krill meal inclusion at various levels (0, 2.5, and 5 percent) in plant-based and animal-based feeds – that were all fishmeal and fish oil free – on Atlantic salmon growth.

The team found that there were no differences in weight, length or condition factor (K) between treatment groups at the start of the trial, and that test diets had no negative impact on the survival of experimental fish over the length of the study. Replacement of fish oil with vegetable and algal oils, while altering dietary profiles of individual fatty acids, did not affect total dietary saturated, monounsaturated, or polyunsaturated fatty acids.



(<https://globalseafood.typeform.com/podcastq124>).

In contrast to the animal protein-based feeds, benefits were observed for **krill meal** (<https://doi.org/10.1111/are.13792>), supplementation in the diets containing plant proteins. Increasing the **inclusion rate** (<https://doi.org/10.1111/j.1749-7345.2005.tb00338.x>) of krill meal resulted in improved weight gain, with fish achieving growth parity to animals fed the fishmeal and fish oil-based feed. Other researchers have reported **similar results** (<https://doi.org/10.1111/are.14573>), with various fish species presented with substantially reduced dietary fishmeal, or its complete substitution with **plant proteins** (<https://doi.org/10.47853/FAS.2021.e11>).

Results also showed that Atlantic salmon fed on a primarily plant-based diet grew ~220 percent throughout the current trial without mortality. Moreover, values for their specific feeding rate (SFR), protein productive value (PPV), protein efficiency ratio (PER), morphological characteristics, and composition did not vary compared to those of the control fish fed a **fishmeal and fish oil** (<https://doi.org/10.1016/j.aquaculture.2005.12.030>)-based diet. Fish growth rates, however, lagged behind all other treatment groups from day 45 onwards. These observations are thus generally in agreement with several other studies on Atlantic salmon where fishmeal has been replaced with **various plant proteins** (<https://doi.org/10.1016/j.aquaculture.2010.04.019>).



## Aquaculture Exchange: Rick Barrows

After 14 years with the USDA's Agricultural Research Service, Rick Barrows talks about the importance of finding 'complete' and commercially viable alternative sources of omega-3 fatty acids and continuing innovation in the aquafeed sector.



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No nutritional benefit was apparent for the plant-based krill meal test diets since they contained similar protein levels to the fishmeal and fish oil control feeds but differed in individual EAA content and lipid content. Since the plant-5 percent krill meal diet (P3) returned identical results in various parameters measured to those of the control, the benefits gained by the former group can be best explained by increased feed intake due to enhanced palatability.

However, because there were no differences in whole-body composition or visceral indices between the two groups, protein-sparing effects cannot be discounted. It is also possible that the krill meal itself contributed some **nutritional benefit** (<https://doi.org/10.1111/j.1365-2095.2007.00471.x>) by providing additional nutrients to the feed, including astaxanthin and nucleotides, both of which are known to **influence salmon health** (<https://doi.org/10.1021/jf051308i>) and growth.

It is inevitable that **new plant-based protein** (<https://doi.org/10.1111/j.1365-2109.2007.01704.x>) blends will be identified that more resemble the nutritional qualities of fishmeal while reducing the potential for nutrient deficiencies. As pressure increases for the inclusion of **alternative proteins** (<https://doi.org/10.1016/j.aquaculture.2020.735551>) to replace fishmeal, the incorporation of **rendered products** (<https://doi.org/10.1111/raq.12673>) too will inevitably expand.

Per the authors of the study “As in the case of [fishmeal/fish oil], it would be prudent for feed formulators to utilize several more reliable (consistent quality and cost-effective) products rather than limiting themselves to a single unpredictable wild-caught ingredient. Thus, the **F3 Future of Fish Feed** (<http://f3challenge.org/>), launched the F3 Krill Replacement Challenge, utilizing a close variation of the P3 feed formula and experimental protocols described herein to identify potential krill replacements for aquafeeds. The challenge will wrap up in 2024, and results of this trial will be made available at that time, with the hope that the industry may adopt some of the tested market-ready krill replacements.”

Some reports indicate that the benefits of krill meal on **feed intake** (<https://doi.org/10.1155/2022/3170854>) may only be transitory. Moreover, partially deshelled krill meal can significantly **decrease the stability** (<https://doi.org/10.1016/j.aquaculture.2011.02.038>) of feed pellets in the water column when compared to traditional pellets, which may be a function of the higher levels of soluble proteins in **krill meal** (<https://doi.org/10.1111/j.1365-2095.2006.00400.x>) compared to fishmeal.

Overall “this manuscript highlights the lack of effect of krill meal when used as a supplement at 2.5–5.0 percent in alternative animal-based aquafeeds for Atlantic salmon. However, when used in plant-based aquafeeds, krill meal appears to act as a palatant, increasing salmon feed intake and growth” concluded the study authors.

**Read the full study.** (<https://doi.org/10.3390/fishes8120590>).

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