

NEW ACADEMIC ARTICLE

Optimization of precision nutrition for aquaculture feed application

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Precision nutrition is an advanced feeding strategy that aims to provide the right nutrients, in the right amounts, at the right time



Considers a range of variables such as **species, genetics, size, health status, and environmental conditions.**



Ensures that **animals receive optimal nutrition** throughout their production cycle, while reducing waste.



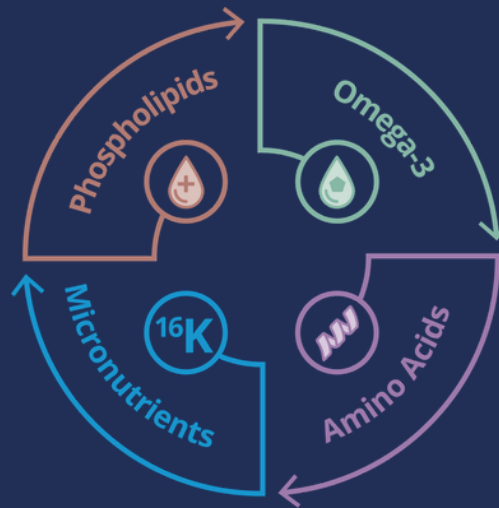
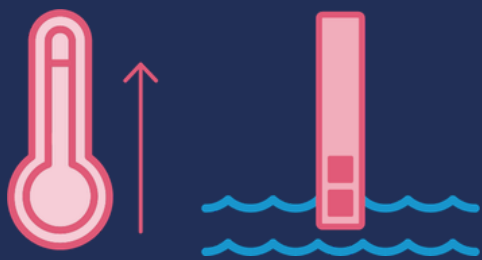
Traditional feeds often include excess nutrients to cover variability within populations, which can lead to inefficiencies and increased waste.

Environments

Hundreds of species




40+ nutrients that matter

Energy specifications



Energy is the cornerstone of any diet, as it drives feed intake and influences the utilisation of other nutrients

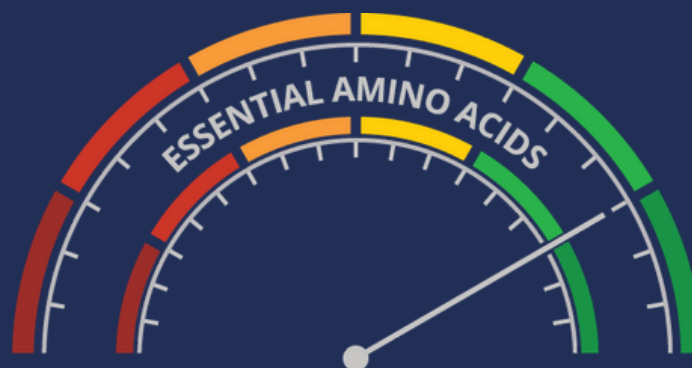


-  Traditional aquaculture feeds formulations **did not account for losses during digestion and metabolism.**
-  Precision nutrition introduces more **refined metrics such as digestible energy and net energy**, providing clarity on the energy available for maintenance and growth.
-  Digestible energy considers losses in faeces, while **net energy goes further** by accounting for urinary and metabolic losses, as well as the heat increment of feeding.

Changing protein and energy balance



Optimising essential amino acid levels



Designing diets based on absorbable supplies



Precision nutrition emphasises the accurate supply of essential nutrients while reducing waste



Traditional feeds relied on crude protein and fat levels, masking imbalances in individual nutrient profiles.



Modern strategies focus on digestible nutrient specifications so that diets are formulated to **match the amino acid profile of the animal** rather than relying on total protein content.



Long-chain omega-3 fatty acids are vital for fish health and product quality. Feeds now adjust to the vary demands of species, life stage, and even market demands for flesh composition.

Suggested optimum omega-3 inclusion for **Atlantic salmon**

% of omega-3
Included in the
diet, out of total
fatty acids

20%	14%	12%	10%	8%	7%	6%
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Fish
size
range

1g	5g	50g	100g	500g	1000g	5000g
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eggs	alevin	fry	parr	pre-smolt	smolt	adult
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Precision nutrition takes into account feed intake and palatability as the first hurdle to a successful feed

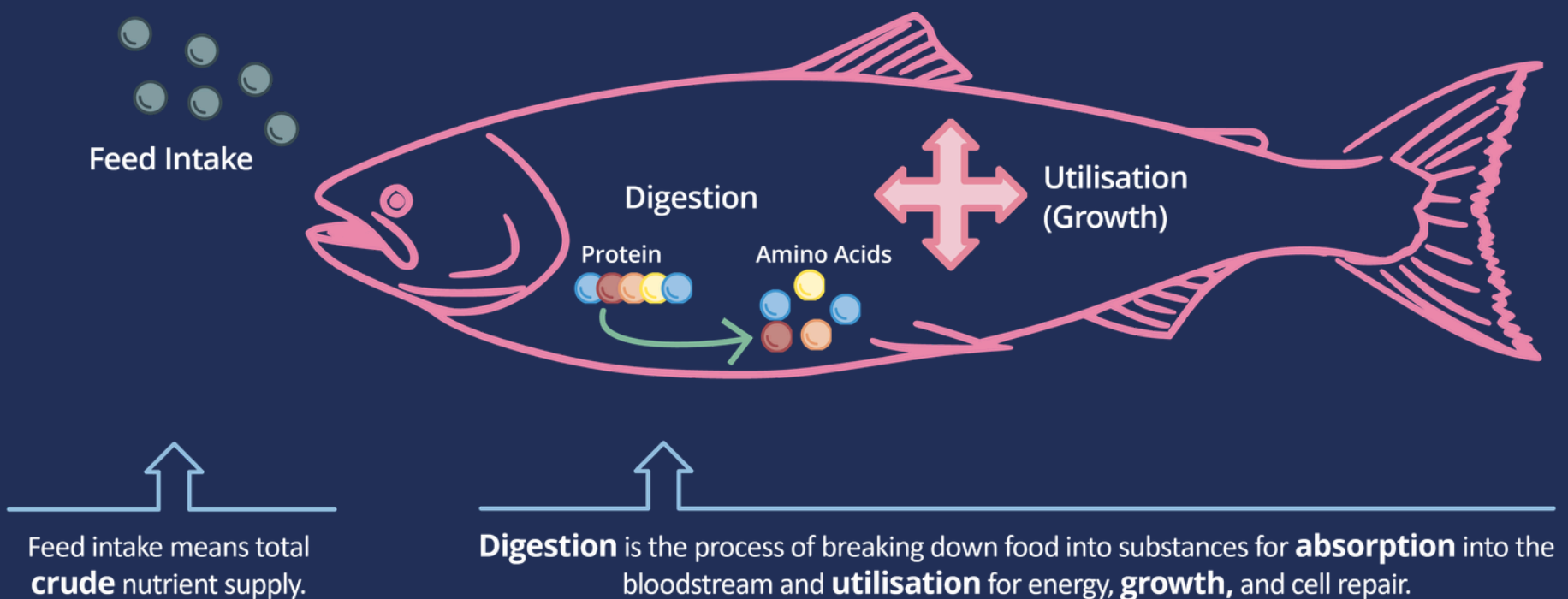
Precision nutrition helps understand the drivers of feed intake. In a precision nutrition approach, diet formulation needs to address both hedonic and homeostatic feed intake regulation.

Hedonic factors relate to sensory cues such as taste, smell, and texture.

and

Homeostatic factors are linked to energy balance and physiological needs.

Ingredients such as fishmeal are naturally rich in compounds that stimulate feeding, but as formulations shift towards plant-based proteins and alternative sources, maintaining palatability becomes more challenging.



Ingredient selection is a critical aspect of precision nutrition, taking into consideration cost, availability, consistency, and sustainability

While diets are formulated based on nutrients, it is the ingredients that deliver them and ideally, ingredients should not compete with human food supply and should be sourced responsibly to minimise environmental impact.



Digital tools, including formulation software and nutrient modelling systems, allow nutritionists to **design diets with unprecedented accuracy, and develop highly customised feeding programmes.**



Sustainability is key to formulations, by improving nutrient utilisation and reducing waste, precision nutrition contributes to lower environmental impact. It also supports economic resilience by optimising feed costs and mitigating risks associated with ingredient volatility.



Consumer demand for transparency and ethical sourcing is growing, making these practices become increasingly important for maintaining market competitiveness.

A precision nutrition and data-driven approach offer significant benefits in terms of productivity, sustainability and animal welfare



The integration of advanced technologies, from modelling software to artificial intelligence, is accelerating this transition, enabling **more accurate and responsive feeding strategies**.



A **renewed focus on ingredient evaluation and palatability** ensures that these innovations translate into practical, effective solutions.



Precision nutrition represents a paradigm shift in aquaculture feed formulation and will play a central role towards a more responsible aquaculture.



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