

## OPTIMISING SALMON (*Salmo Salar*) NUTRITION: THE EFFICACY OF EGG POWDER AS A FUNCTIONAL AND SUSTAINABLE INGREDIENT

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The rapid expansion of global aquaculture, particularly salmon farming, faces significant sustainability challenges due to its heavy reliance on traditional marine ingredients like fishmeal, fish oil, and vegetable ingredients like soy protein concentrate and soy oil. This dependency contributes substantially to greenhouse gas emissions (over 70% of a farm's total GHG emissions are related to feed), exacerbates the decline of wild fishery resources, and leads to volatile, increasing feed costs. There is a critical need for sustainable, cost-effective, and nutritionally viable alternative ingredients. Egg powder emerges as a promising solution. It is a highly digestible, natural, and concentrated source of protein (approx. 49g/100g) and fat (approx. 40g/100g). Recognised for its exceptional and balanced amino acid profile, including all ten essential amino acids, egg protein boasts a high digestibility of above 95%. While rich in essential omega-3 and omega-6 fatty acids, it contains relatively low levels of long-chain EPA and DHA, suggesting a need for complementary marine or algal oil sources for salmon. Beyond macronutrients, egg powder provides essential micronutrients, including vitamins A, D, E, and various B vitamins, as well as minerals such as potassium, calcium, iron, and selenium. Crucially, egg powder contains bioactive compounds like antioxidants (lutein, zeaxanthin) and antimicrobial proteins (lysozyme, ovotransferrin, immunoglobulins). These compounds are known to enhance disease resistance and overall immunity in aquatic animals. Studies on related species, such as rainbow trout, indicate that egg powder can effectively substitute fishmeal at inclusion levels up to 25% without negatively impacting growth performance. The processing of egg powder, involving pasteurisation and spray drying, effectively inactivates anti-nutritional factors present in raw eggs, ensuring high nutrient bioavailability. From an environmental standpoint, egg powder is a sustainable alternative derived from by-products of the existing egg and poultry industries, promoting a circular economy. Its use directly reduces reliance on marine and vegetable ingredients, thereby lowering the aquaculture industry's carbon footprint. The carbon footprint of whole egg powder is approximately 1.2 kg CO<sub>2</sub>e/kg. Economically, egg powder offers a stable and cost-effective alternative to increasingly expensive and volatile traditional ingredients. Given that feed costs account for over 70% of aquaculture production expenses, incorporating egg powder can significantly enhance economic viability and profitability. In conclusion, egg powder is a highly promising, multi-functional ingredient that can sustainably complement marine ingredients in salmon aquaculture feeds. Its superior nutritional profile, health-promoting bioactive compounds, and favourable environmental and economic attributes position it as a key component for a more resilient and responsible salmon farming industry. Further targeted research on Atlantic salmon is ongoing to determine optimal inclusion levels and fully realise its potential.

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