

# Nutritional evaluation of barley protein concentrate in aquafeeds: Performance in rainbow trout, gilthead seabream and European seabass

**About Diallo, ClonBio Group**



As aquaculture production expands, the need for sustainable protein alternatives in aquafeeds has become urgent. Barley protein concentrate (BPC) is emerging as a plant-based ingredient with the potential to partially replace conventional proteins like fishmeal, soy protein concentrate (SPC), and corn gluten meal (CGM). This review synthesizes recent growth trials and digestibility trials in rainbow trout, gilthead seabream, and European seabass, focusing exclusively on BPC's nutritional efficacy.

Barley protein concentrate (BPC) is produced via an integrated upcycling process within Europe's largest circular biorefinery, achieving full valorization of input streams and eliminating waste. This sustainable origin underpins the environmental advantages of BPC, supporting the transition of aquaculture towards more resource-efficient, lower-footprint feed solutions.

### **Nutritional composition of BPC**

Barley protein concentrate, as used in these studies, offers a concentrated source of plant protein with a

Table 1. Apparent digestibility coefficients for selected fish species (ADC, %)

Species	Protein (%)	Fat (%)	Phosphorus (%)	Energy (%)
Rainbow trout	90.0	97.0	50.1	86.2
Gilthead seabream	87.7	93.3	33.7	86.5
European seabass	92.2	94.1	32.1	87.7

well-balanced amino acid profile, suitable for partial or substantial replacement of conventional protein sources in aquafeeds. Barley protein concentrate contains approximately 63% crude protein on a dry matter basis, making it a high-quality protein ingredient for aquafeed formulations. Its nutritional quality makes it a promising candidate for modern, sustainable formulations targeting major aquaculture species.

## Digestibility results

Apparent digestibility coefficients were assessed for rainbow trout, gilthead seabream and European seabass (Table 1).

- Protein digestibility of BPC is consistently high across all tested species, demonstrating reliable performance as a protein source when compared with other conventional and novel plant concentrates.
- Fat digestibility is excellent (>93%), supporting BPC's energy value.
- Phosphorus digestibility is substantial; the value in rainbow trout (50.1%) is notably higher than other plant proteins, likely due to barley's endogenous phytase activity. This is advantageous for both fish nutrition and reducing environmental phosphorus discharge.
- Amino acid digestibility is consistently high, with BPC generally supporting adequate lysine and methionine absorption for practical formulation.

## Growth performance results

### Rainbow trout

Two diets, BPC50 and BPC100, corresponding to diets where 50% or 100% of the digestible protein contribution from soy protein concentrate (SPC) and corn gluten meal (CGM) in the control diet was replaced

by BPC, were tested in a 14-week growth trial in rainbow trout.

No reductions in feed intake or palatability were observed at these inclusion levels, as indicated by maintained growth and feed conversion ratios across all treatments (Table 2).

These results highlight the flexibility of BPC as a nutritious ingredient in aquafeed formulation. At moderate inclusion levels (such as 50% replacement), BPC can enhance feed utilization metrics without compromising growth. Its consistent performance across replacement levels demonstrates its potential for tailored formulation strategies in both cost-driven and sustainability-focused diets.

Both protein and lipid retention were high in the BPC50 group, while phosphorus excretion was reduced – an ecological advantage.

### Gilthead seabream

As with trout, two diets were tested against a control in gilthead seabream: BPC50 and BPC100 indicating replacement of 50% or 100% of SPC+CGM digestible protein in the control diet with BPC.

Feed intake and palatability remained unaffected by BPC inclusion, supporting the practicality of BPC in high-performance commercial diets (Table 3).

Growth performance parameters were maintained with BPC inclusion, FCR, or PER, confirming that BPC can successfully substitute significant proportions of conventional plant protein sources without loss of productivity.

Fish on BPC diets demonstrated improved phosphorus digestibility compared to some other protein sources, aiding in nutrient utilization and potentially minimizing effluent phosphorus.

Table 2. Growth and feed utilization results of rainbow trout

Diet	Final body weight (g)	SGR (%/d)	FCR	PER
Control	123.1 ± 2.2	1.44	1.07	2.28
BPC50	123.0 ± 2.7	1.43	0.96	2.56
BPC100	122.8 ± 1.9	1.43	1.05	2.32

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Table 3. Growth and feed utilization results of gilthead seabream

Diet	Final body weight (g)	SGR (%/d)	FCR	PER
Control	166.1 ± 2.2	1.32	1.28	1.85
BPC50	170.2 ± 2.3	1.35	1.27	1.86
BPC100	169.2 ± 3.2	1.34	1.30	1.81

Table 4. Summary of performance parameters for all species

Species	Protein ADC (%)	Phosphorous ADC (%)	SGR (%/d)	FCR	Key benefit
Rainbow trout	90.0	50.1	1.43-1.51	0.94-1.07	Reduced P loss, high retention
Gilthead seabream	87.7	33.7	1.32-1.38	1.25-1.30	Stable growth & FCR
European seabass	92.2	32.1	NA	NA	High protein digestibility

## Application in European seabass

Although the focus here is on trout and seabream, European seabass trials confirm BPC's digestibility profile. BPC showed a protein ADC of 92.2%, a fat ADC of 94.1% and an energy ADC of 87.7%.

Moreover, feed intake changes were observed at up to 30% dietary inclusion.

## Conclusions

Barley protein concentrate demonstrates consistent, high digestibility and supports robust growth performance in major aquaculture species.

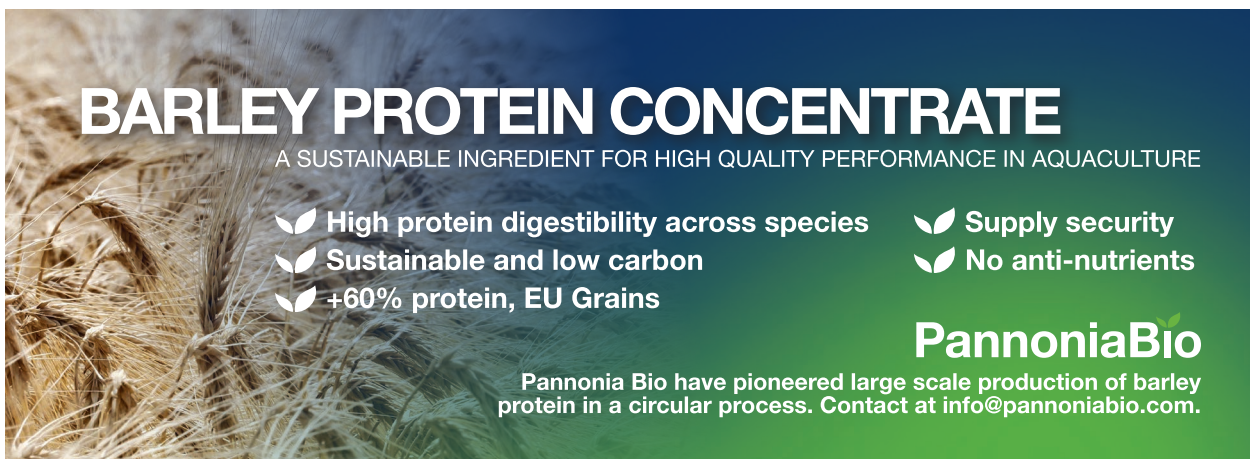
At up to 50% replacement of conventional plant protein concentrates, BPC maintains or improves feed conversion efficiency and protein utilization in rainbow trout and gilthead seabream; offers superior phosphorus digestibility (especially in trout), which can reduce environmental nutrient loading; and provides a balanced amino acid profile, supporting the formulation of nutritionally complete diets at a wide range of inclusion levels.

Collectively, these results position barley protein concentrate as a highly adaptable and scientifically validated ingredient with significant promise for the next generation of sustainable aquafeed formulations. Its demonstrated nutritional efficacy, compatibility with existing feed technologies and contribution to environmental stewardship make BPC a compelling option for feed manufacturers aiming to balance production efficiency with responsible resource management.

### More information:

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## BARLEY PROTEIN CONCENTRATE

A SUSTAINABLE INGREDIENT FOR HIGH QUALITY PERFORMANCE IN AQUACULTURE

- High protein digestibility across species
- Sustainable and low carbon
- +60% protein, EU Grains

- Supply security
- No anti-nutrients

### PannoniaBio

Pannonia Bio have pioneered large scale production of barley protein in a circular process. Contact at [info@pannoniabio.com](mailto:info@pannoniabio.com).