Alternative to Fishmeal

Supplementing a scarce resource

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Fishmeal continues to be the gold standard protein ingredient in aquaculture diets[1]. As a proxy for the diet of fish in the wild, it has been extraordinarily successful. However, fishmeal supply is finite and dependent upon wild fish populations[2]. To date, the aquaculture industry has done an excellent job of growing despite this constraint. The market has effectively allocated this scarce resource, and financial pressures have driven significant reductions in marine ingredient inclusions across many applications[3].

Despite past success, the rapid continuing growth of the aquaculture industry is outpacing technical capabilities for fishmeal reduction[4]. The highest growth subsectors within aquaculture are carnivorous species requiring higher inclusion levels of fishmeal in order to achieve optimal growth[5, 6]. Rising standards of living in Asia will continue to drive a shift from extensive to intensive aquaculture, and from low to high trophic level species[7]. Both of these shifts are correlated with an increased fishmeal content in the aquaculture feeds employed[8].

As an example, under a business-as-usual projection, Indonesia will require over 7.8 million metric tons of marine fish as feed ingredients annually by 2030. If Indonesia pursues an export-oriented strategy with a focus on fishmeal-intensive shrimp and grouper, Indonesia will more than double its marine fish ingredient consumption, requiring up to 16.4 million metric tonnes of marine fish in the same time period[9]. Given the finite supply of fishmeal, growth in aquaculture cannot continue on this trajectory without the development of new alternatives to fishmeal.

One such alternative to fishmeal is FeedKind protein, which can provide a potential solution to the increased demand for high-quality feed ingredients. FeedKind protein is comprised of single cell protein produced by fermentation of methane[10]. FeedKind protein has a proximal composition similar to fishmeal (Table 1) and has been shown to be well tolerated in a number of livestock species[11]. Calysta and Cargill have partnered to produce FeedKind protein in North America, with the first plant under construction in Memphis, TN planned to produce up to 200,000 metric tons per year[12]. In May 2017, Calysta announced the successful operation of a market introduction facility in Teesside, England[13]. As of the announcement, the facility had produced over four metric tonnes of material. This material is destined for use in customer trials in feed formulations, regulatory review in new countries, and R&D trials across a wide variety of species including the trial reported here.

The trial

Using material from initial production of its UK facility, Calysta completed a trial in rainbow trout (Oncorhynchus mykiss) performed with Pontus Research, Ltd. in the UK. The trial included a reference diet with 45 percent super prime fishmeal, and three treatments with 10 percent, 20 percent, and 35 percent FeedKind protein with corresponding reductions in fishmeal

Figure 1

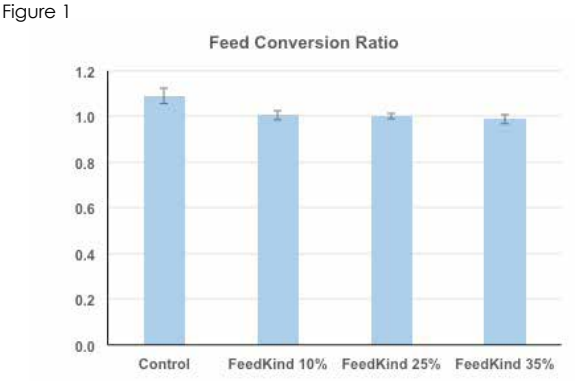
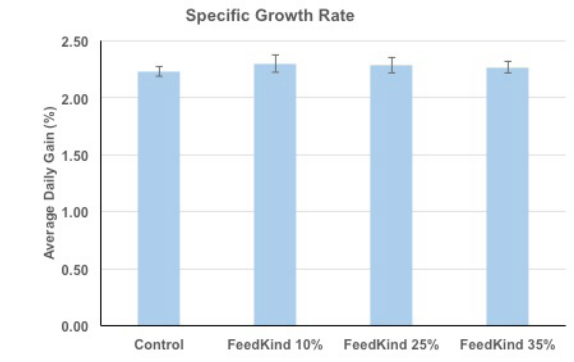


Figure 2



(Table 2). All feeds were formulated by Pontus and manufactured by Sparos as extruded floating 2.5mm pellets. All diets had variations in proximate analysis and minerals that were statistically insignificant with the exception of a gradual increase in calcium associated with increasing levels of FeedKind protein.

Table 1: FeedKind proximate analysis (dry weight basis)

Crude Protein	71%
Crude Fat	9%
Ash	7%
Crude Fibre	1%
Nitrogen free extract	12%

Juvenile fish with an average weight of 62 grams +/- 4.0 grams were randomly assigned to groups of 30 individuals each in 200-liter indoor tanks maintained at 14 degrees Celsius. All treatments were performed in triplicate for a total of 12 groups. Each group was acclimatized for one week on the control diet and then grown to a final weight of 187 grams on the control or test diet, tripling the starting weight in 49 days. Fish were fed to satiation five times daily and feed intake was monitored.

Table 2:

Ingredient (g/kg)	Control	10% FeedKind	20% FeedKind	35% FeedKind
Super prime fishmeal	450	350	250	100
FeedKind protein	0	100	200	350
Wheat gluten	134	138	142	149
Wheat meal	218	205	192	172
Fish oil	173	169	165	159
Premix	10	10	10	10
Methionine	5	5	5	5
Vitamin C	0.1	0.1	0.1	0.1
TiO2	10	10	10	10
CaCO3	0	8	17	29
Monocalcium Phosphate	0	5	10	17
	1,000	1,000	1,000	1,000

Results

All groups had comparable specific growth rates ranging from 2.2 to 2.3 percent of body weight per day. No statistically significant difference was found between treatments. Additionally, the distribution of individual growth rates was relatively narrow across all treatments and the margin of error ranged from 0.05 to 0.08 percent across all four treatments.

The control diet yielded a feed conversion ratio (FCR) of 1.09, which fell to 1.01, 1.00, and 0.99 in the 10 percent, 20 percent, and 35 percent treatments, respectively. All treatment groups were statistically significant from the control and improved FCR by eight to nine percent.

The steady improvements in FCR are remarkable given the fact that growth rate is unchanged among the groups. The results may indicate that FeedKind protein has significantly improved digestibility relative to the fishmeal being replaced in the diet. While apparent digestibility coefficients for single cell protein were previously shown to be reduced relative to fishmeal in Atlantic salmon, apparent nitrogen retention in fish fed diets containing single cell protein was improved compared to fish fed a control diet. This may point to a reallocation of nitrogen excretion from the gills and urine in the control diet to relatively higher nitrogen excretion in the faeces of fish fed a single cell protein diet[14].

However, single cell protein has also been shown to prevent

enteritis in Atlantic salmon fed a diet containing defatted soymeal[15, 16]. The results here, as well as the previously observed improvements in nitrogen retention, are consistent with an improvement in gut health of the fish, potentially improving the function of an otherwise healthy digestive tract to increase overall nutrient retention and uptake. Additional data collection measuring digestibility and gut histology are underway to further elucidate the mechanisms supporting the observed improvement in FCR.

Regardless of the mechanism, the observed improvements to FCR are highly significant to commercial diets. Feed is the largest driver of cost in intensive aquaculture, representing almost 50 percent of total production costs. A reduction of eight to nine percent in feed requirements could deliver significant cost savings to the farmer and improve the profitability of farming operations by up to 20 percent[17].

Next steps

These results confirm that FeedKind protein can be a valuable alternative to fishmeal in aquaculture diets and drive savings on feed through improved feed conversion ratios. In addition to its strong validation in salmonid species, FeedKind protein is currently being tested in shrimp, yellowtail, and other carnivorous finfish species. These studies will provide the basis to expand the use of FeedKind protein globally.

References

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[10]*http://calysta.com/wp-content/uploads/CalystaProteinManufacturingProcess.pdf*

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