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Aquafeeds

Innovative feed additives improve feed utilization in Nile tilapia

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Improving FCR, fillet yield important from an economical and ecological point of view

Significant price increases have occurred during the past years for major aquafeed ingredients, including fishmeal, fish oil, vegetable proteins and fats. In the livestock industry, the combined efforts of industry and academic institutes resulted in the development of a wide range of additives to improve nutrient utilization and reduce feed formulation costs.

Various types of feed additives enhance the digestibility and/or utilization efficiency of nutrients, including exogenous enzymes; stimulators of enzyme secretion; compounds that aid in the digestive process by improving absorption, mobilization and transport of nutrients; feeding stimulants that reduce feed/nutrient waste; prebiotics and probiotics; and botanical extracts that modulate gut microflora.

Some of these innovative additives show great potential for use in aquaculture, but as warm-blooded land animals have different feeding biology, digestive physiology and nutrient requirements than aquaculture species, the additives' applications in aquaculture feed remain unclear.

Nile tilapia that received diets supplemented with a mixture of digestive herbal extracts, natural emulsifying agents and co-factors of digestion had better feed conversion and protein efficiency than fish whose diets did not contain the mixture.

Digestive phytobiotics

Recent screening work under controlled lab conditions at Caditec Testing in Spain revealed the potential of several synergistic blends of digestive phytobiotics, natural emulsifying agents and co-factors of digestion. Phytobiotics is a term used to describe plant-derived natural bioactive compounds that affect animal growth and health due to their antimicrobial, digestive metabolic-stimulating properties.

Spices, for example, are widely used to flavor human food but also exert stimulant actions on the digestive system.

Herbal digestive properties include appetite enhancement, stimulation of gastric and bile secretions, and hepato-protective properties. Emulsifying agents are a diverse class of molecules that aid in the dispersion of fat into water by forming micelles. Adding emulsifiers to diets complements lipid digestion by improving the emulsification and absorption of the dietary fats in the gut.

Laboratory trials

Through two lab trials, the authors examined the potential of such feed additives to increase growth and feed utilization in Nile tilapia. In trial 1, a practical control diet was formulated with 33 percent protein and 7.6 percent fat (Table 1). The extruded treatment diet was created by replacing 0.3 percent filler with Aquagest OMF, a mixture of digestive herbal extracts and natural emulsifying agents. For a second lab trial, three extruded diets were formulated to contain 31 percent protein and 7.5 percent fat: a practical control diet (Table 1) and two treatment diets created by replacing 0.15 and 0.3 percent filler with the digestive aid blend.

Ceulemans, Formulation of the control diets, Table 1

Trial 1 (33% Protein/7.6% Fat)	Trial 1 (33% Protein/7.6% Fat)	Trial 2 (31% Protein/7.5% Fat)	Trial 2 (31% Protein/7.5% Fat)
Defatted soybean meal	30%	Defatted soybean meal	37.51%
Full fat soya	10%	Wheat bran	24.08%
Whole wheat	31.49%	Wheat flour	8%
Wheat flour	10%	Whole corn	9%
Wheat gluten	2.01%	Rapeseed	8%
Corn gluten	6%	Fishmeal	4%
Fishmeal	5%	Corn gluten	3%
Fish oil	2%	Fish oil	2.31%
Dicalcium phosphate	2%	Dicalcium phosphate	1.86%
Filler	1%	Soybean oil	1.47%
Vitamine mineral mix	0.5%	Vitamine mineral mix	0.5%
		Lysine (78%)	0.12%
		Methionine (99%)	0.15%

Table 1. Formulation of the control diets.

Both trials were executed in a recirculating system. For trial 1, 25 *Oreochromis niloticus* tilapia with initial weight of 38.8 ± 0.2 grams were stocked in each of three cylindrical fiberglass tanks with 100 L active volume. For trial 2, 35 tilapia weighing 9.1 ± 0.2 grams were stocked in three similar tanks.

Freshwater at 26 degrees-C was recirculated over a biofiltration unit, sand filter and protein skimmer. Water renewal was 10-15 percent/day depending on water quality. Photoperiod was set to provide 12 hours of light daily.

After a one-week acclimatization in which the control diet was fed to all tanks, feeds were fed to triplicate groups of animals for 10 weeks in trial 1 and eight weeks in trial 2. Feed rations were calculated on a percentage of body weight for both trials. Feeding was done by automatic belt feeders placed on top of the tanks. Uneaten pellets were recovered, and the feed intake was adjusted accordingly.

Ceulemans, Performance of Nile tilapia fed test diets, Table 2

	Control Diet	Test Diet With 0.15% Digestive Aid Blend	Test Diet With 0.3% Digestive Aid Blend
Survival (%)	100 ± 0	100 ± 0	100 ± 0
Initial weight (g)	9.17 ± 0.04	9.15 ± 0.13	8.93 ± 0.21
Final weight (g)	41.84 ± 0.83	44.32 ± 1.25	44.3 ± 1.99
Specific growth rate (%/day)	2.71 ± 0.03^{a}	2.82 ± 0.03^{ab}	2.86 ± 0.08^{b}
Feed intake (g/fish)	37.86 ± 0.65	38.83 ± 1.18	38.3 ± 1.15
Feed-conversion ratio	1.16 ± 0.01^{a}	1.1 ± 0.01^{b}	1.08 ± 0.03^{b}
Protein-efficiency ratio	2.75 ± 0.03^{a}	2.86 ± 0.02^{ab}	2.92 ± 0.1^{b}
Hepatosomatic index (%)	1.6 ± 0.15	1.48 ± 0.11	1.43 ± 0.01
Viscerasomatic index (%)	8.45 ± 0.09^{a}	7.79 ± 0.11^{b}	8.41 ± 0.13^{a}

Table 2. Performance of Nile tilapia fed test diets for eight weeks. Values marked with superscripts are significantly different (P > 0.05).

Results

In trial 1, survival was over 95 percent. The addition of the mix of digestibility enhancers to a practical control diet resulted in improved growth, feed utilization and protein efficiency (Figure 1). Also, the weight of the fish livers and viscera was reduced compared to the control diet.

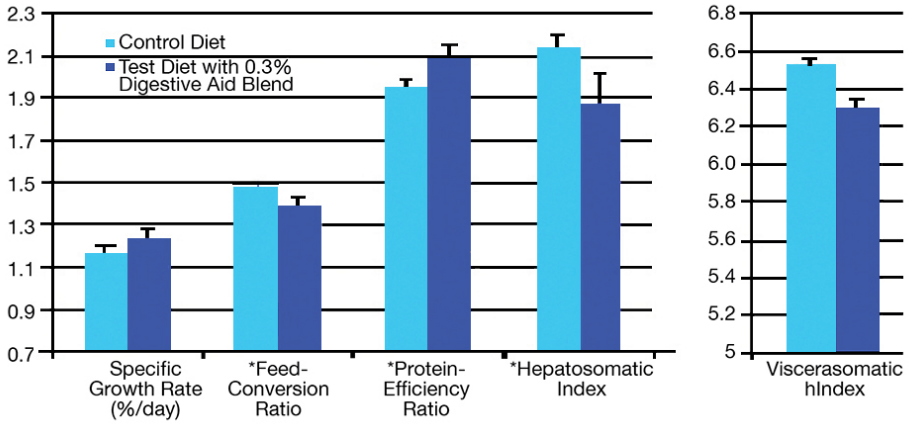

Fig. 1: Performance of Nile tilapia fed test diets for 10 weeks. Columns marked * are significantly different (P < 0.05).

Both farmers and the environment can benefit from the application of innovative additives in aquaculture feed.

In trial 2, supplementation of the feed with 0.15 percent digestive aid blend yielded 5 percent better feed conversion, 4 percent higher growth and 4 percent higher protein utilization. When increasing the supplementation from 0.15 to 0.3 percent, these factors were further improved. The hepatosomatic index was reduced by increasing levels of digest aid blend, amounting to a reduction of 11 percent for the 0.3 percent extract diet. The viscerasomatic index was reduced by 8 percent in the 0.15 percent-supplemented diet, but this effect disappeared in the 0.3 percent-supplemented diet. Overall, little visceral fat was found in these young animals.

The decreased hepatosomatic index indicated that more dietary energy was made available for the fish's metabolism, resulting in more protein available for fillet growth as illustrated by the improved protein-efficiency ratio. Improving feed conversion and fillet yield while reducing visceral wastes is not only important from an economical but also from an ecological point of view.

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