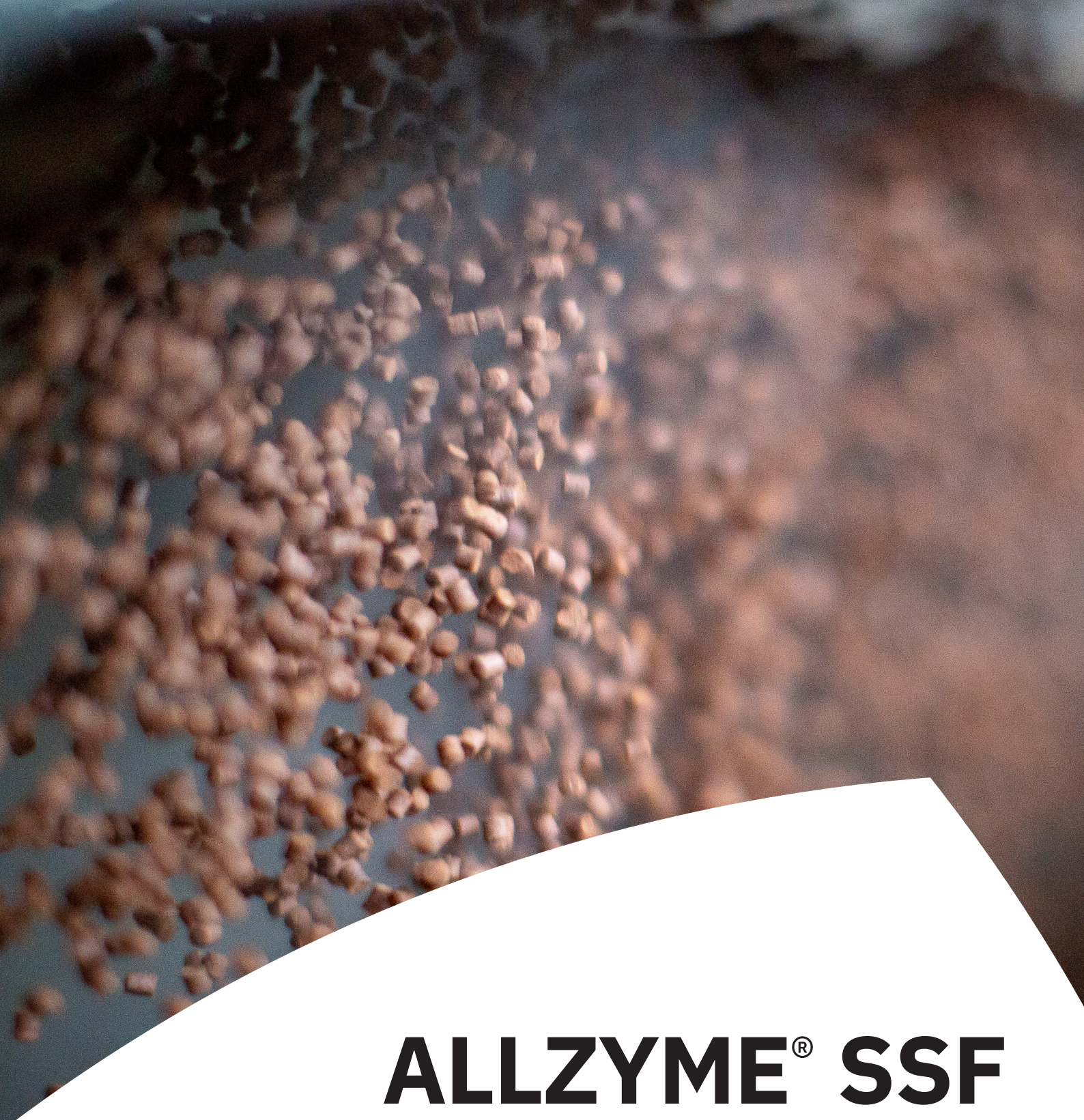


ALLZYME® SSF

Maximizing feed efficiency

in aquafeeds with multi-enzyme technologies

Alltech®

ALLZYME® SSF

Introduction: The rise of plant-based ingredients in aquafeed

In modern aquafeed formulations, a high inclusion of plant-based ingredients has become a common standard rather than a trend. However, plant ingredients often contain anti-nutritional factors, such as phytate (i.e., phytic acid). Fish cannot easily digest this substrate due to the lack of phytase, which can result in higher phosphorus excretion and pose a risk for pollution of the aquatic environment.

Nutritional challenges associated with plant-based diets

Along with their other challenges, substrates like phytate can form complexes with minerals, proteins and other nutrients, decreasing their availability and leading to potential deficiencies and suboptimal growth performance. As such, feeding diets that include high levels of plant materials can pose a nutritional challenge to aquatic farmed animals.

Feed substrates and enzymes

INGREDIENTS	SUBSTRATES	ENZYMES
Almost all plants	Phytic acid	Phytase
Wheat	Arabinoxylans (NSP)	Xylanase
Almost all plants	Cellulose, hemicellulose (NSP)	Cellulase
Soya, sunflower, lupins	Pectins	Pectinase
Soya, sunflower, rapeseed	Oligo-saccharides	α-galactosidases
Soya, sunflower, rapeseed	β-galactomannans	β-mannanase
Barley	β-glucans	β-glucanase
All	protein	Protease
Corn, rice, wheat, etc.	Starch	Amylase

Enzyme supplementation: A key strategy

The strategic use of enzymes in diets for farmed fish can transform complex feed components into absorbable nutrients by enhancing nutrient digestibility and improving overall feed efficiency.

Alltech is committed to utilizing scientific insights to improve enzyme technologies. An analysis of both our historical research and our more recent studies on the applications of enzymes demonstrates the potential of enzymes to improve the nutritional quality of diets high in plant-based proteins for warm-water species reared in both marine and freshwater environments.

Advanced enzyme technologies

Allzyme® SSF is a multi-enzyme complex that maximizes nutrient utilization by breaking down many substrates typically included in commercial aquafeed formulations, leading to improved efficiency and more sustainable fish farming while maximizing your returns.

Recommended application and inclusion rates, based on scientific evidence

Supplementing Allzyme technology within a range of between 0.04% to up to 0.20% is recommended based on our research findings across different aquatic species. This broad range is due to the dose dependency based on several factors, including species-specific digestive physiology, diet composition, water temperature and other environmental conditions. These variables can significantly affect the optimal enzyme dosage and, as a result, must be taken into consideration. Post-extrusion application through coating is also recommended to ensure maximum enzyme activity and potential efficiency.

Alltech®

Sustainably

optimizing

how nutrients are used to reduce feed costs

Alltech's commitment to enzyme research in multiple fish species

Nile tilapia trial:

An evaluation of the supplementation of different levels of Allzyme SSF (0%, 0.04%, 0.06%, 0.08% and 0.1%) in extruded diets for Nile tilapia juveniles during a 56-day study. Allzyme SSF was incorporated in the feed via gelatin topcoat.

Moura *et al.*, Brazil (2014)

Growth and feed utilization

The supplementation of Allzyme SSF at 0.04% improved weight gain by 29.58% and lowered the feed conversion ratio (FCR) by 22.62% compared to the negative control.

	Negative control	SSF 0.04%	SSF 0.06%	SSF 0.08%	SSF 0.1%
Weight gain (g)	55.75^{a}	72.24^{b}	72.35^{b}	72.73^{b}	72.75^{b}
FCR	1.68^{b}	1.30^{a}	1.30^{a}	1.29^{a}	1.29^{a}

Nile tilapia trial:

Applying Allzyme SSF pre-extrusion was associated with improved feed digestibility for pre-grow-out Nile tilapia in a 21-day trial.

Furuya *et al.,* Brazil (2023)

Protein and phosphorus digestibility (%)

The supplementation of Allzyme SSF at 0.0450% in plant-rich diets for Nile tilapia improved the digestibility of protein and phosphorus. Improved digestibility led to an increase in the nutritional value of feeds, as confirmed by increased body weight gains and an improved FCR in Nile tilapia fed a diet supplemented with Alltech SSF at 0.0450%.

	Negative control	SSF 0.0225%	SSF 0.0450%
Crude protein	85.83^{b}	87.01^{ab}	88.99^{a}
Phosphorus	61.84^{b}	64.95^{b}	70.10^{a}

Essential and non-essential amino acid digestibility (%)

Nile tilapia fed a diet supplemented with Allzyme SSF at 0.0450% displayed significantly higher digestibility in most essential amino acids (including histidine, isoleucine, leucine, lysine, phenylalanine, threonine and tryptophan) and non-essential amino acids (e.g., alanine, cysteine and serine) compared to the Nile tilapia fed the negative control.

	Negative control	SSF 0.0225%	SSF 0.0450%
Essential amino acids			
Histidine	89.00[b]	89.46[b]	91.31[a]
Isoleucine	89.57[b]	90.24[ab]	91.68[a]
Leucine	88.03[b]	89.67[ab]	90.86[a]
Lysine	91.01[b]	91.15[b]	92.50[a]
Phenylalanine	90.04[b]	90.93[ab]	91.74[a]
Threonine	83.96[b]	87.04[a]	88.29[a]
Tryptophan	88.27[b]	89.77[a]	90.66[a]
Non-essential amino acids			
Alanine	84.98[b]	84.82[b]	87.71[a]
Cysteine	85.51[b]	87.74[ab]	89.72[a]
Serine	90.00[b]	90.52[ab]	91.64[a]

Digestible energy (kcal/kg) and protein (g/kg)

Nile tilapia fed the diets supplemented with Allzyme SSF at 0.0225% and 0.0450% exhibited a markedly higher dietary digestible energy content than the Nile tilapia fed the negative control, with increases of 108.81 kcal/kg and 221.25 kcal/kg, respectively. In the diet supplemented with Allzyme SSF 0.0450%, the digestible protein content also increased by 10.54 g/kg compared to the negative control.

	Negative control	SSF 0.0225%	SSF 0.0450%
Digestible energy	3,271.89[c]	3,380.70[b]	3,493.14[a]
Digestible protein	285.81[b]	289.75[ab]	296.35[a]

Nitrogen (N) and phosphorus (P) excretion (g/kg BWG)

The supplementation of Allzyme SSF at 0.0450% improved the efficiency of nitrogen (N) and phosphorus (P) utilization by reducing their excretion by Nile tilapia.

	Negative control	SSF 0.0225%	SSF 0.0450%
N-excretion	53.14[a]	47.97[a]	40.48[b]
P-excretion	13.38[a]	12.81[a]	10.91[b]

Overall, supplementation with Allzyme SSF appears to have significant implications for producers and nutritionists formulating cost-effective and environmentally sustainable diets for tilapia farming operations.

Seabass trial:

This 112-day study illustrated the ability to maximize the nutritional value of plant ingredients in seabass diets by supplementing Allzyme SSF at 0.05%, which was incorporated as a plant ingredient pre-treatment or pre-extrusion or as a liquid post-extrusion.

HCMR, Greece (2023)

Growth and feed utilization

Growth performance and feed utilization both improved when seabass were fed the plant mix supplemented with Allzyme SSF, irrespective of its application method.

	Positive control	Negative control	Pre-treated	Pre-extrusion	Post-extrusion
Weight gain (g)	46.45^{ab}	40.47^{a}	44.15^{ab}	47.88^{b}	46.33^{ab}
FCR	1.18^{a}	1.31^{b}	1.24^{ab}	1.20^{ab}	1.21^{ab}

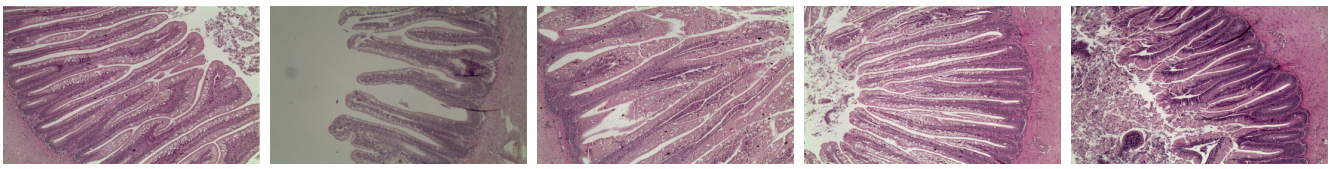
Protein and phosphorus digestibility (%)

Irrespective of its application method, seabass fed a plant mix supplemented with Allzyme SSF displayed higher protein and phosphorus digestibility.

	Positive control	Negative control	Pre-treated	Pre-extrusion	Post-extrusion
Protein	93.69^{a}	90.30^{b}	92.35^{a}	92.96^{a}	93.23^{a}
Phosphorus	47.90	37.60	45.50	46.30	44.90

Gut histology

Supplementation with Allzyme SSF was associated with a restored intestinal structure in the seabass fed the plant-mix diets.



Positive control | Negative control | Pre-treated | Pre-extrusion | Post-extrusion

Red seabream trial:

This 112-day study considered the effects of post-extrusion supplementation with Allzyme SSF at 0.13% in a non-fishmeal (FM0) diet for adult red seabream. A 50% fishmeal-based diet (FM50) was used as a positive control.

Matsukura et al., Japan (2017)

Growth and feed utilization

Adult red seabream fed the FM0 diet supplemented with Allzyme SSF at 0.13% exhibited the highest growth rate, with their final weight 5.9% higher than the weight of seabream fed the negative control (FM0). The depressed daily feed intake observed in the fish fed the FM0 diet improved after supplementation with Allzyme SSF at similar level as the positive control (FM50).

	FM50	FM0	FM0 + SSF 0.13
Weight gain (g)	324.20[a]	322.00[a]	361.40[b]
Daily feed intake (%/day)	1.11[b]	1.00[a]	1.12[b]

African catfish trial:

African catfish fed highly plant-based diets experienced improved phosphorus digestibility when Allzyme SSF was applied after extrusion (top-coated) at a rate of 0.2% in this 42-day study.

Alltech Coppens Aqua Centre, the Netherlands (2017)

Phosphorus digestibility (%)

Higher phosphorus digestibility is associated with improved growth rates, reduced water pollution and a general increase in economic viability for farming operations.

	Negative control	SSF post-extrusion	SSF pre-extrusion
Phosphorus digestibility (%)	64.59[b]	71.53[a]	67.85[b]
Reduction in faecal phosphorous level compared to negative control		13.9%	5.7%

Pangasius catfish trial:

Applying Allzyme SSF post-pelleting at rates of 0%, 0.02% or 0.05% in the diets of pangasius farmed in Vietnam (Tra catfish) with reduced fishmeal utilization (between 5–15%) in this 56-day study.

University of Agriculture and Forestry, Ho Chi Minh City, Vietnam (2010)

Growth, feed utilization and survival (%)

The inclusion of Allzyme SSF at rates between 0.02–0.05% was shown to help improve fish growth and feed utilization. Supplementation with Allzyme SSF had a bigger impact on the fish fed the low-fishmeal diet, and it also generally increased the survival rate. These results indicate that supplementing the diet with Allzyme SSF can contribute to more sustainable feed formulations by further reducing the inclusion of fishmeal.

	Low-fishmeal (LFM)			**High-fishmeal (HFM)**		
	SSF 0%	SSF 0.02%	SSF 0.05%	SSF 0%	SSF 0.02%	SSF 0.05%
Weight gain (g)	21.9[a]	35.9[b]	56.17[c]	31.47[b]	53.27[c]	59.13[c]
FCR	2.29[c]	1.58b[c]	1.44[a]	1.73[b]	1.51[a]	1.41[a]
Survival (%)	85.83[a]	96.60[b]	100.0[b]	96.60[b]	96.60[b]	96.60[b]

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For more information on our nutritional solutions for aquaculture please contact

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Alltech Aquaculture