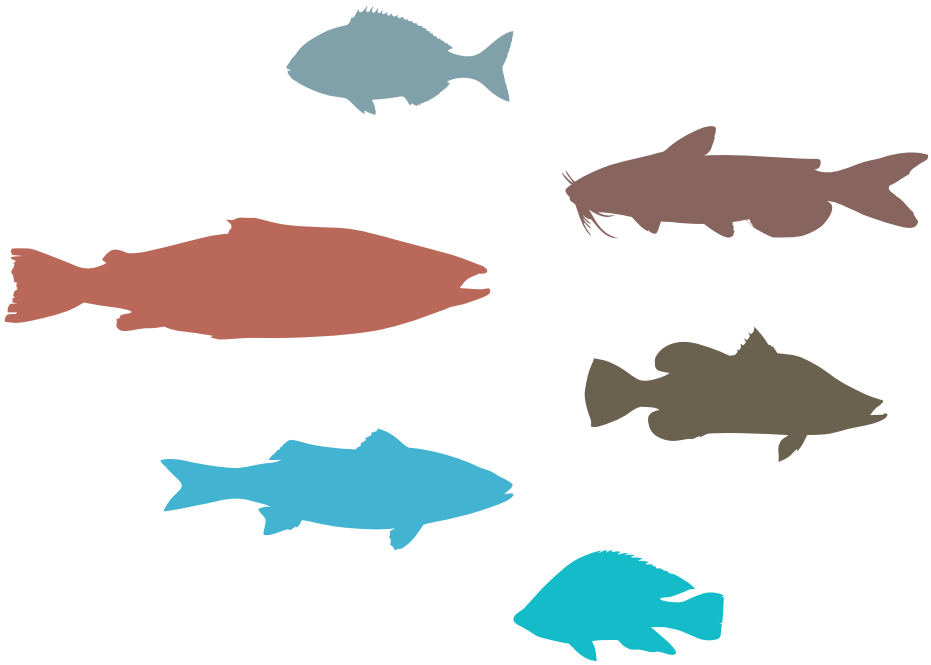
ZINPRO
PERFORMANCE MINERALS®

Essential Trace Minerals

for **Exceptional Performance**



Zinpro Performance Minerals® deliver proven benefits for

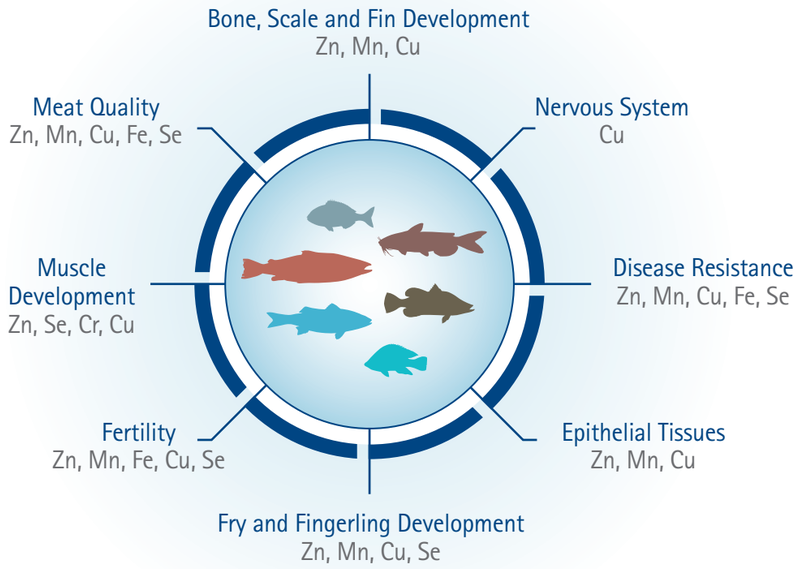
Finfish Performance, Health and Meat Quality

Trace minerals play numerous essential roles within cells and metabolic processes, which makes them vital for optimal nutrition and health of animals – including fish.

The molecular design of Zinpro Performance Minerals® guarantees essential trace minerals, such as Zinc, Manganese, Copper, Iron, Selenium and Chromium, are effectively delivered and best utilized by fish for modern aquaculture production. Research shows that supplementing fish diets with Zinpro Performance Minerals is essential for optimizing growth performance, boosting immune response and improving fillet quality.

The source and availability of trace minerals are key to satisfy the needs of finfish in an efficient and sustainable way through their life cycle.

Trace Mineral Benefits in Finfish



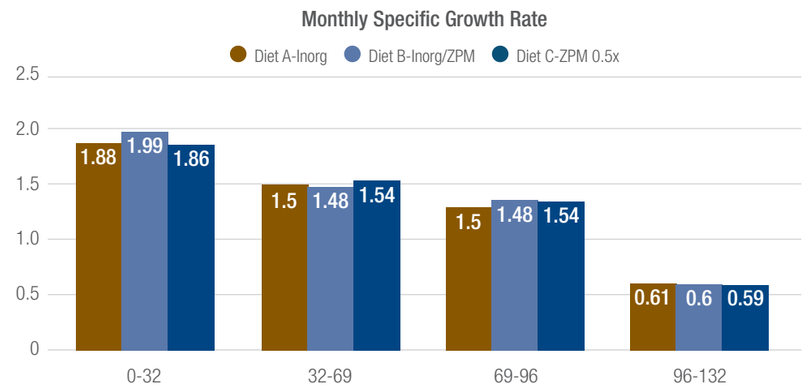
Study 1

Comparison of European Seabass Response to Inorganic Minerals and Zinpro Performance Minerals (0.5x)

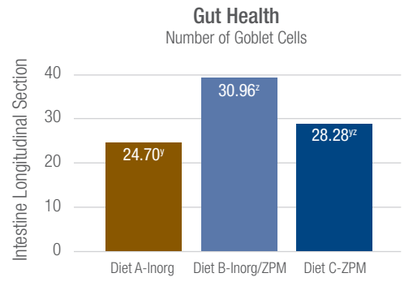
Key Findings

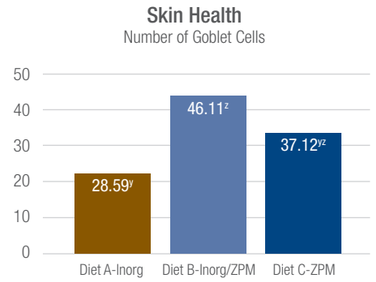
- Zinpro Performance Minerals (ZPM) supplemented at half the level of inorganic sources maintained growth performance of European seabass (Fig. 1), indicating ZPM is a more effective trace mineral source than inorganic forms.
- Partial or complete replacement of inorganic trace minerals with ZPM significantly ($P < 0.05$) increased the number of goblet cells in the intestine and skin of European seabass (Fig. 2), demonstrating enhanced barrier defense mechanisms against pathogens.
- Activity of glutathione peroxidase (GPx) significantly ($P < 0.05$) increased in fish supplemented with ZPM at half the level of inorganic trace minerals (Fig. 3), indicating ZPM (in particular Availa®Se vs. Selenite), is more effective in sustaining antioxidant capacity in European seabass.

Growth Performance *Fig. 1*

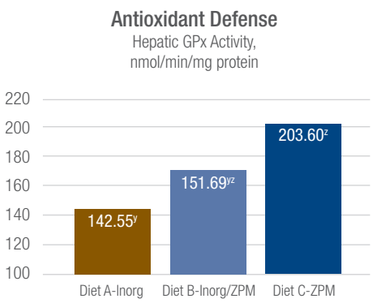


Health *Fig. 2*





Health *Fig. 3*



Study Criteria

This study compared the efficacy of Zinpro Performance Minerals (metal-amino acid complexes) with inorganic minerals (sulfates) in the diet of European seabass. Growth performance and health biomarkers were evaluated.

	Diet A-Inorg	Diet B-Inorg/ZPM		Diet C-ZPM 0.5x
Fe, ppm	80	40	40	40
Cu, ppm	6	3	3	3
Zn, ppm	100	50	50	50
Mn, ppm	24	12	12	12
Se, ppm	0.24	0.12	0.12	0.12

Initial body weight: 15 g
Stocking density: 1.24 kg/m³
Replications: 4
Duration: 120 days
Salinity: 34 ppt

46% CP/18% fat
19% fish meal,
8% fish oil

Feeding: 2 times/day, to satiation

Location:
Hellenic Centre for Marine Research (HMCR)
Crete, Greece

Source: A.C. Figueiredo-Silva, C. Boggino, M. Sun, Maria Mastoraki, I. Papadakis, A. Theodoridou, M. Pavlidis, S. Chatzifotis. Effects of Complexed Trace Minerals at Different Inclusion Rates in Commercial Seabass *(Dicentrarchus labrax)* Diets. Aquaculture Europe, 7-10 October, 2019, Berlin, Germany.

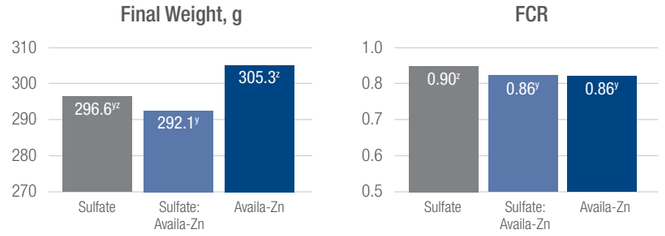
Study 2

Availa®Zn Improves Atlantic Salmon Growth and Resistance to Sea Lice

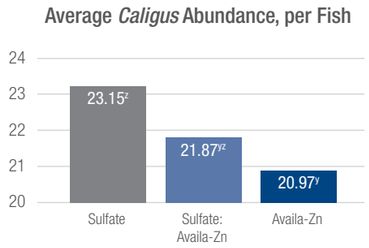
Key Findings

- Availa®Zn supplemented at half (60 ppm or mg/kg diet) the level of inorganic zinc (120 ppm or mg/kg) resulted in numerically higher body weight and significantly ($P < 0.05$) improved FCR of Atlantic salmon (Fig. 1).
- Furthermore, Availa-Zn supplemented at half the level of inorganic zinc was significantly ($P < 0.05$) more efficient in reducing *Caligus* abundance in salmon (Fig. 2).
- Skin score evaluation indicated fish fed zinc as Availa-Zn had a more desirable level of skin integrity than fish fed either diet containing inorganic zinc (Fig. 3). In this study, best performance and health results were found with a 20% fish meal diet supplemented with 60 ppm zinc as Availa-Zn. Yet, required supplementation level of zinc as of other essential trace minerals is expected to increase as their level and availability is becoming severely limited through progressive replacement of fish meal with plant proteins.

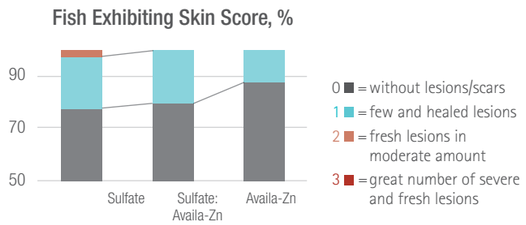
Growth Performance *Fig. 1*



Health *Fig. 2*



Health *Fig. 3*



Study Criteria

The objective of this study was to evaluate the impact of supplemental zinc sources and level on growth performance and resistance of Atlantic salmon (Salmo salar) against sea lice (Caligus rogercresseyi).

Zn Supplementation, ppm

	$ZnSO_4$	Availa®Zn
Sulfate	120	-
Sulfate:Availa-Zn	60	60
Availa-Zn	-	60

Initial body weight: 118 g
Stocking density:
45 fish/tank (600 L)
Replications: 4
Duration: 80 days
(60 d growth +
20 d Caligus challenge)
Salinity: 32 ppt

47% CP/20% fat
20% fish meal,
6% fish oil

Feeding:
2 times/day, to satiation

Location:
Fundación Chile;
Puerto Montt, Chile

Source: Mihai Sun, Alba K. Fireman, Terry L. Ward, Claudia V. Pavez, and Javier Alcaíno. Growth Performance, Skin Strength and Consequent Infestation of Sea Lice *Caligus rogercresseyi* on Atlantic Salmon (*Salmo salar*) Fed with Availa-Zn. 2017 World Aquaculture Society, Latin American & Caribbean Chapter, November 7-10, 2017, Mazatlán, Mexico.

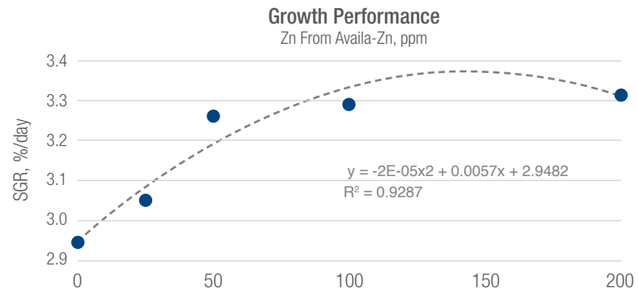
Study 3

Effects of Availa-Zn on Asian Seabass Growth Performance and Zinc Deposition

Key Findings

- Increasing zinc from Availa-Zn, from 0 to 50 ppm significantly ($P < 0.05$) improved specific growth rate (SGR) (Fig. 1).
- Availa-Zn supplementation increased whole body and bone zinc content (Fig. 2).
- Results suggest that 50 ppm zinc from Availa-Zn is the minimum supplemental level for Asian seabass under this study conditions to promote growth performance and deposition of zinc for body reserves.

Growth Performance *Fig. 1*



Growth Performance *Fig. 2*

Body and Tissues Zinc Deposition

	Treatment				
Zn, mg/kg	Control	Availa-Zn 25	Availa-Zn 50	Availa-Zn 100	Availa-Zn 200
Whole Body	12.64	13.87	12.38	12.23	11.74
Bone	47.03	47.97	51.85	53.45	52.68
Liver	12.20	16.55	19.27	18.62	18.22
Fillet	5.22	5.95	6.38	6.76	7.36

Study Criteria

This study was designed to assess the optimum level of supplemental Availa-Zn in the diet of Asian sea bass (Lates calcarifer). Availa-Zn was evaluated based on parameters measured for zinc deposition and growth performance.

Treatment	Zn, ppm Availa-Zn
Control	0
Availa-Zn 25	25
Availa-Zn 50	50
Availa-Zn 100	100
Availa-Zn 200	200

Initial body weight: 3.5 g
Density:
40 fish/tank (500 L)
Replications: 4
Duration: 8 weeks

47% CP/8% fat

Feeding:
3 times/day, 2-3.5% BW

Location:
Kasetsart University
Bangkok, Thailand

Source: Orapint Jintasataporn, Terry Ward, Srinoy Chumkam and Oratai Jintasataporn. The Optimum Dose and Relative Bioavailability of Zinc Amino Acid Complex in Diet for Asian Seabass (*Lates calcarifer*, Bloch 1790). International Symposium on the Feeding and Nutrition of Fish, June 5-10, 2016, Sun Valley, Idaho, USA.

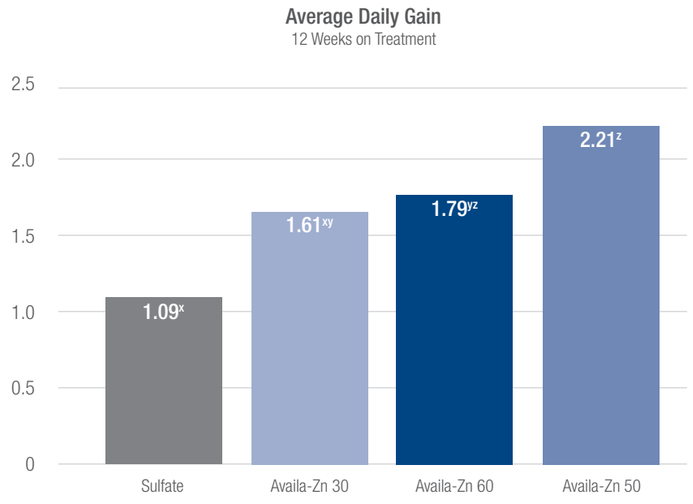
Study 4

Efficacy of Availa-Zn on Growth Performance and Immune Status of Pangasius Catfish

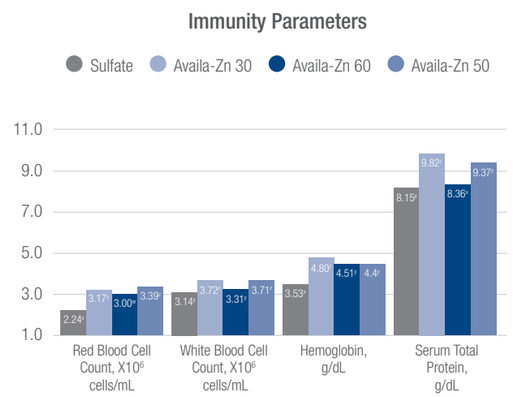
Key Findings

- Supplementing Availa-Zn in diets of Pangasius catfish significantly ($P < 0.05$) improved fish average daily gain. Adding 50 ppm zinc from Availa-Zn as the sole source showed the best growth performance (Fig. 1).
- Gradual replacement of inorganic zinc with Availa-Zn significantly ($P < 0.05$) improved fish immune parameters, such as red and white blood cell count, and serum protein (Fig. 2).
- Gradual replacement of inorganic zinc with Availa-Zn significantly ($P < 0.05$) decreased fillet drip loss on week 4 and 8 (Fig. 3).

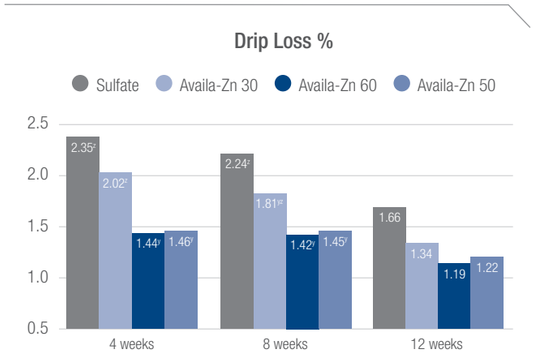
Growth Performance *Fig. 1*



Health *Fig. 2*



Meat Quality *Fig. 3*



Study Criteria

This study was designed to assess the effect of supplemental zinc in Pangasius catfish (Pangasianodon hypophthalmus). Zinc was supplied as sole source $ZnSO_4$ or Availa-Zn, or as a combination of the two sources.

	Zn Supplementation, ppm	
	$ZnSO_4$	Availa-Zn
Sulfate	100	-
Availa-Zn 30	70	30
Availa-Zn 60	40	60
Availa-Zn 50	-	50

Initial body weight: 210 g
Density: 15 fish/tank (1000 L)
Replications: 4
Duration: 12 weeks

30% CP/6% fat
5% fish meal, 32% soybean meal
Feeding: 3 times/day, 3-4% BW

Location:
Kasetsart University, Bangkok, Thailand

Source: Orapint Jintasataporn, Terry L. Ward, and Supalug Kattakdad. The Effect of Zinc Source and Level on Growth Performance and Immune Parameters of Pangasius Catfish *(Pangasianodon hypophthalmus).* International Symposium on the Feeding and Nutrition of Fish, June 5-10, 2016, Sun Valley, Idaho, USA.

Essential Trace Minerals for Finfish

BENEFIT	TRACE MINERALS	DESCRIPTION
Disease Resistance	Zinc, Manganese, Copper, Selenium, Iron	• Humoral immunity • Cell-mediated immunity • Non-specific immunity • Antioxidant activity to remove free radicals and protect cell membranes
Bone, Scale and Fin Development	Zinc, Manganese, Copper, Selenium, Iron	• Bone matrix development and maintenance • Cell division and protein synthesis for normal tissue mineralization
Skin and Gut Integrity	Zinc, Manganese, Copper	• Improves wound healing • Epithelial tissue integrity through maintenance of cell division, protein synthesis and antioxidant activity to remove superoxide radicals
Fertility	Zinc, Manganese, Iron, Copper, Selenium	• Reproductive hormone synthesis: steroidogenesis • Helps avoid or reduce nutritional anemia • Female maturity and fertility • Egg development • Egg viability • Hatching rate • Sperm maturation and quality • Key to normal ovarian function
Muscle Development	Zinc, Copper, Selenium, Chromium	• Enzyme systems required for growth • Energy and protein metabolism • Cell membrane protection from peroxides • Influences carbohydrate, lipid and protein metabolism
Early Stage Development	Zinc, Manganese, Copper, Selenium	• Energy and protein metabolism • Cell proliferation • Normal tissue mineralization • Cell membrane protection • Hemoglobin formation
Meat Quality	Zinc, Selenium, Chromium, Iron	• Cell membrane protection • Antioxidant activity • Influences carbohydrate, lipid and protein metabolism • Enhanced meat color • Reduced drip loss

Finfish Feeding Recommendations

Mineral	ZPM Products	Zinpro Recommendations Minimum Requirement ZPM, mg/kg diet	
		Coldwater Fish and Salmonids	Warmwater Fish
Zn	ZINPRO® zinc methionine Availa®Zn	80	60
Cu	CuPlex® Availa®Cu	10	10
Mn	MANPRO® Availa®Mn	30	30
Fe	Availa®Fe	100	100
I[a]		1	1
Se[b]	Availa®Se	0.3	0.3
Cr[c]	MiCroPlex® Availa®Cr	0.4	0.4

[a] Not a current ZPM source
[b] Note upper limit allowed in EU is of 0.2 ppm, provided as organic source
[c] Use where commercially available

Zinpro exists to improve the wellness and performance of animals and contribute to a healthier, more sustainable world.

Visit **zinpro.com/aquaculture** to learn more about the products available in your area.

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