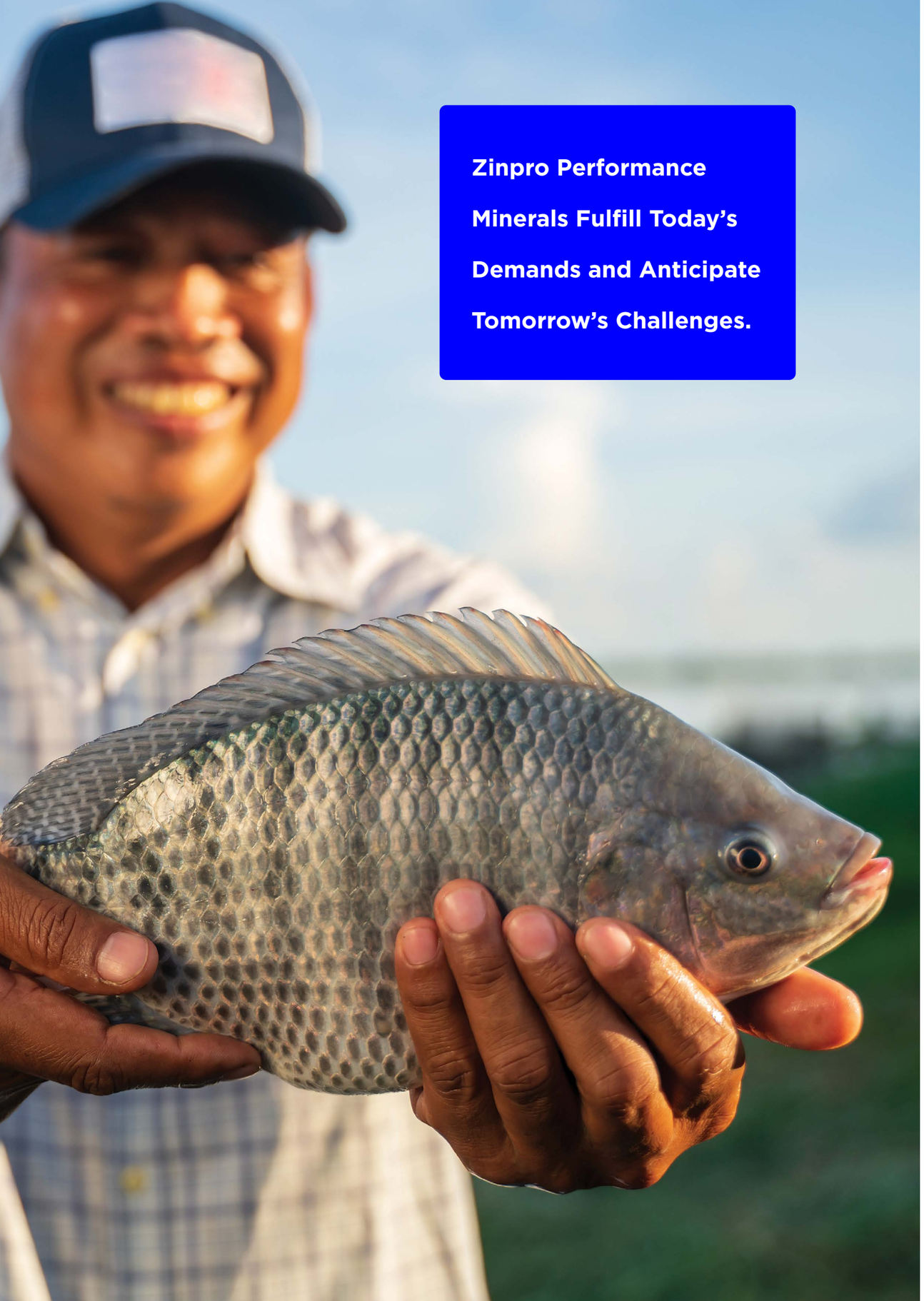

ZINPRO®
ADVANCING
PERFORMANCE
TOGETHER
Improve
Tilapia Health and
Productivity with
Zinpro® Performance
Minerals®

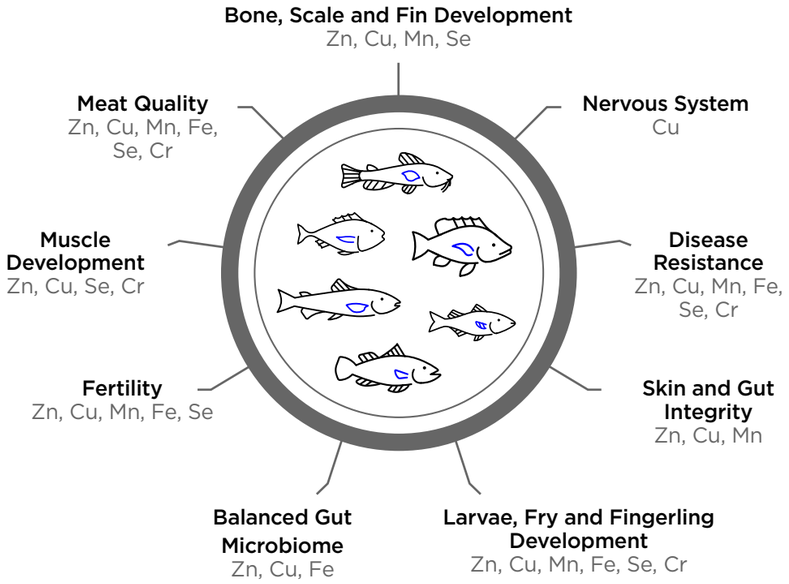


Modernizing Tilapia Nutrition: Advanced Trace Mineral Strategies to Help Boost Yields and Fish Health

As profit margins tighten, raw feed materials change and sustainability pressures mount in modern tilapia operations, Zinpro Performance Minerals are an advanced nutrition solution to optimize productivity from broodstock performance through harvest. Unlike conventional inorganic and organic trace minerals, the advanced molecular design and mode of action of our performance minerals maximizes efficacy of zinc, manganese, copper, iron, selenium and chromium to support exceptional growth, strong immune responses and superior product quality.

Trace minerals support hundreds of biological processes from DNA synthesis to disease resistance. Performance minerals elevate the efficacy of each trace mineral, enabling them to reach their full health and productivity potential.

Trace Mineral Benefits in Finfish



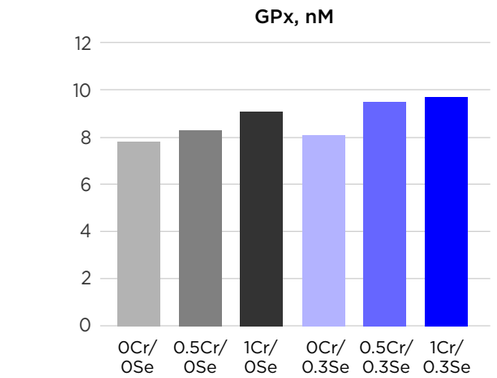
Study 1

Effects of Zinpro® Availa® Se and Zinpro® Chromium Methionine Complex* on Nile Tilapia Growth Performance and Health-related Parameters

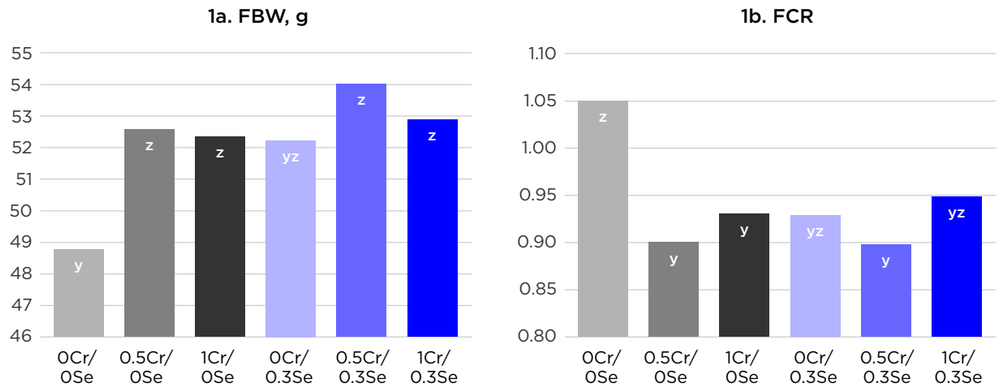
Key Findings

- Supplementation of Nile tilapia diets with 0.5 ppm Cr as Zinpro Chromium Methionine Complex significantly improved final body weight (FBW, Fig. 1a) and feed conversion ratio (FCR, Fig. 1b) by 8 and 14%, respectively. Supplementation with 1 ppm vs 0.5 ppm Cr did not result in any additional benefit.
- Supplementation with 0.3 ppm Se as Zinpro Availa Se improved final body weight and FCR by 7 and 11.4%, respectively, although not statistically significant.
- Highest final body weight and lowest FCR were found with the combination of 0.5 ppm Cr and 0.3 ppm Se.
- Anti-oxidant and anti-bacterial defense evaluated by glutathione peroxidase (GPx, Fig. 2) and lysozyme activity (Fig. 3), respectively, were not significantly affected by supplementation with Cr (0.5 or 1 ppm) or Se (0.3 ppm).
- Limited number of fish per tank (1 fish per tank) together with short study duration may have limited detection of an anti-oxidant and anti-bacterial response to Cr and Se supplementation, requiring further investigation.

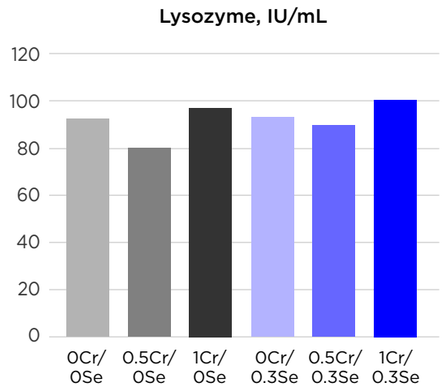
Health Fig. 2



Growth Performance Fig. 1



Health Fig. 3



*Zinpro Chromium Methionine Complex is also known as Zinpro® Availa® Cr or Zinpro® MICROPLEX® in some markets.

Study Criteria

This study was designed to assess the effect of chromium and selenium on growth performance and health-related parameters of Nile tilapia.

Treatment	Cr, ppm as Zinpro Chromium Methionine Complex	Se, ppm as Zinpro Availa Se
0Cr/0Se	0.0	0.0
0.5Cr/0Se	0.5	0.0
1Cr/0Se	1.0	0.0
0Cr/0.3Se	0.0	0.3
0.5Cr/0.3Se	0.5	0.3
1Cr/0.3Se	1.0	0.3

Initial body weight: 25 to 30 g
Density: 1 fish/tank/replicate, 100 L tanks
Replications: 20
Duration: 4 weeks

36% CP/6% fat
Feeding: 2 times/day, 3-4% BW

Location:
Kasetsart University,
Bangkok, Thailand

Source: Auepaiboon, S., Jintasataporn, O., & Chumkam, S. 2020. Effect of zinc-L-selenomethionine and chromium-L-methionine on growth performance, blood glucose and digestive tract pH of Nile tilapia (*Oreochromis niloticus*). 11th International Academic Conference. Global Goals, Local Actions: Looking Back and Moving Forward 2020, March 2020, Bangkok, Thailand.

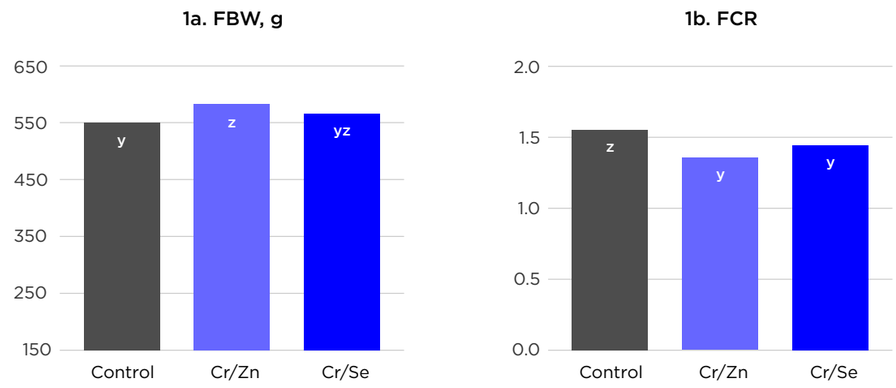
Study 2

Zinpro® Chromium Methionine Complex* Combined with Zinpro® Availa® Zn or Zinpro® Availa® Se Promotes Red Tilapia Performance and Anti-oxidant Defense During Growth Phase

Key Findings

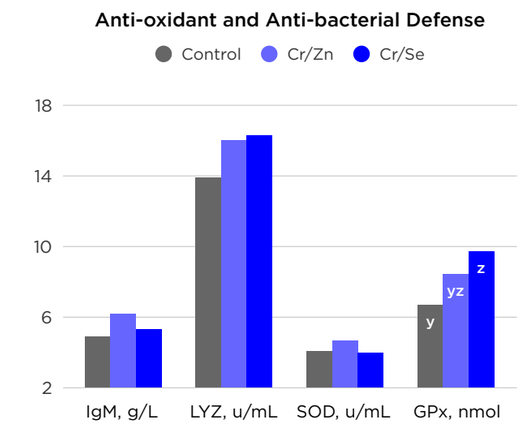
- Results indicate that supplementation with 0.5 ppm Cr as Zinpro Chromium Methionine Complex in combination with 60 ppm Zn as Zinpro Availa Zn or 0.3 ppm Se as Zinpro Availa Se can improve growth and health of red tilapia during the grow-out phase.
- Compared to Control, supplemental 0.5 ppm Cr as Zinpro Chromium Methionine Complex + 60 ppm Zn as Zinpro Availa Zn:
  - Increased final body weight (FBW) by 7% (Fig. 1a),
  - Reduced feed conversion ratio (FCR) by 12% (Fig. 1b),
  - Numerically increased anti-bacterial defense through lysozyme (LYZ) activity by 15% (Fig. 2),
  - Increased anti-oxidant capacity through glutathione peroxidase (GPx) activity by 25% (Fig. 2),
  - Resulted in an economic advantage over Control (ROI) of 58%.
- Compared to Control, supplemental 0.5 ppm Cr as Zinpro Chromium Methionine Complex + 0.3 ppm Se as Zinpro Availa Se:
  - Reduced FCR by 7% (Fig. 1b) and increased anti-oxidant activity of GPx by 44% (Fig. 2),
  - Numerically increased final body weight, weight gain (not shown) and anti-bacterial defense by 4, 6 and 17%, respectively,
  - Resulted in an economic advantage over Control (ROI) of 29%.

Growth Performance Fig. 1



*Zinpro Chromium Methionine Complex is also known as Zinpro® Availa® Cr or Zinpro® MICROPLEX® in some markets.

Health Fig. 2



Study Criteria

Determine effect of supplemental Cr, in combination with Zn or Se, on performance and health-related parameters of red tilapia during the grow-out phase.

Treatment	Cr, ppm as Zinpro Chromium Methionine Complex	Zn, ppm as Zinpro Availa Zn	Se, ppm as Zinpro Availa Se
Control*	0	0	0
Cr/Zn	0.5	60	0
Cr/Se	0.5	0	0.3

* 0 Cr/40 Zn/0.25 Se from inorganic sources

Initial body weight: 190 g
Density: 34 fish/cage
Replications: 4
Duration: 8 weeks

30% CP/4% fat
Feeding: 2 times/day

Location:
Kasetsart University,
Bangkok, Thailand

Source: Limwachirakhorn, R., Triwutanon, S., Chumkam, S., & Jintasataporn, O. 2022. Effects of Chromium-L-Methionine in Combination with a Zinc Amino Acid Complex or Selenomethionine on Growth Performance, Intestinal Morphology, and Antioxidative Enzymes in Red Tilapia *Oreochromis spp.* Animals 12: 2182. https://doi.org/10.3390/ani12172182

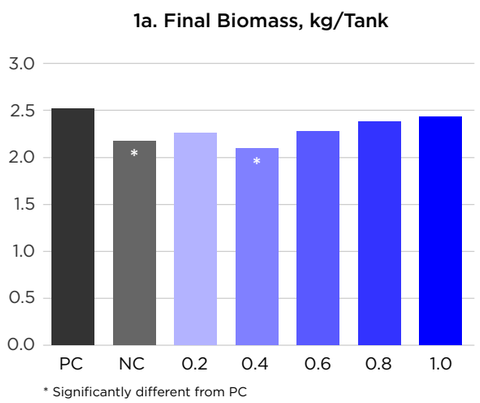
Study 3

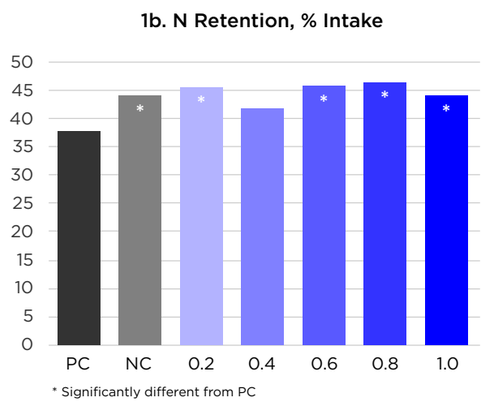
Zinpro® Chromium Methionine Complex* Can Cost-effectively Reduce Protein Content in Nile Tilapia Diets

Key Findings

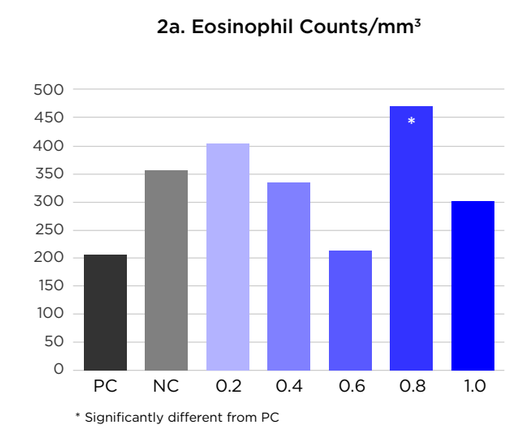
- Supplementation of the low protein diet (21%DP) with 0.8 or 1 ppm Zinpro Chromium Methionine Complex translated into an economic advantage over positive Control (26%DP) of 0.11 and 2.88%, respectively.
- Similar profitability was found through regression analysis between the positive control and the negative control supplemented with 0.91 ppm Zinpro Chromium Methionine Complex.
- Similar growth performance was found between groups of fish fed the positive control (26%DP) and the negative control (21%DP) when supplemented with 0.8 or 1 ppm Zinpro Chromium Methionine Complex. Final biomass per tank (Fig. 1a) did not differ between positive control and negative control supplemented with Zinpro Chromium Methionine Complex above 0.4 ppm (0.6, 0.8 and 1 ppm).
- Reduction of the dietary protein content has increased overall nitrogen retention (Fig. 1b).
- Supplementation of the low protein diets with Zinpro Chromium Methionine Complex from 0.4 to 1 ppm increased muscle glycogen content, indicating enhanced glucose uptake and utilization by the cell (not shown).
- Reduction of dietary protein level has increased overall leukocyte content in blood. Content of eosinophils (Fig. 2a) and lymphocytes (Fig. 2b) was highest in fish fed the low protein diet supplemented with 0.8 ppm Zinpro Chromium Methionine Complex.

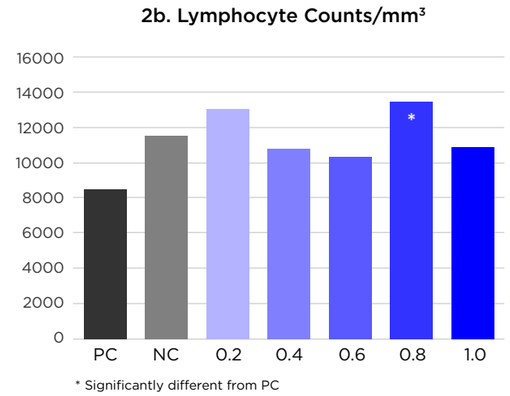
Growth Performance Fig. 1





Health Fig. 2





*Zinpro Chromium Methionine Complex is also known as Zinpro® Availa® Cr or Zinpro® MICROPLEX® in some markets.

Study Criteria

Evaluate the effects of supplementation of Zinpro Chromium Methionine Complex in diets containing reduced protein content on growth performance, carcass composition, nutrient retention and hematobiochemical responses in juvenile Nile tilapia.

Treatment	CP% (DP%)	Cr, ppm as Zinpro Chromium Methionine Complex
PC, Positive Control	31(26)	0.0
NC, Negative Control	26(21)	0.0
0.2	26(21)	0.2
0.4	26(21)	0.4
0.6	26(21)	0.6
0.8	26(21)	0.8
1.0	26(21)	1.0

Initial body weight: 34 g
Density: 2.3 kg/m³
Replications: 3
Duration: 9 weeks

Positive control 31% CP (26% DP),
Negative control 26% (21% DP), 4% Fat
Feeding: 3 times/day

Location:
Escola de Medicina Veterinária e Zootecnia Universidade Federal da Bahia Bahia, Brazil

Source: De Oliveira, C. P. B., Copatti, C. E., da Paixão Lemos, C. H., Couto, R. D., Figueiredo-Silva, C., Silva, J. F., & Vidal, L. V. O. 2024. Chromium-methionine chelate can reduce protein content in Nile tilapia diets: An analysis of growth, carcass biochemical and hematological parameters, and economic return. Aquaculture International. https://doi.org/10.1007/s10499-024-01636-8

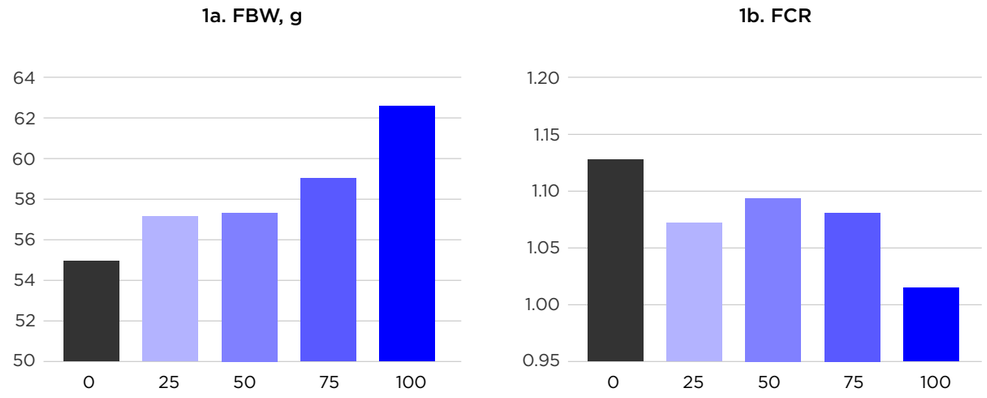
Study 4

Supplementation with Zinpro® Availa® Zn Improves Performance and Health-related Parameters in Nile Tilapia

Key Findings

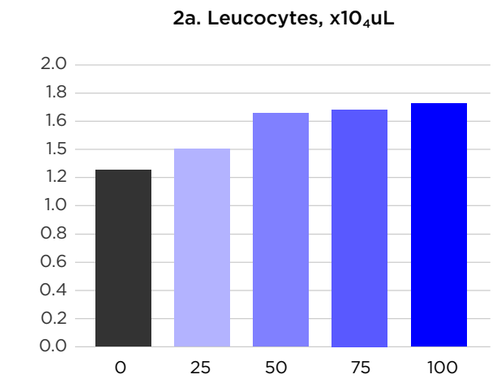
- Supplementation with 100 ppm Zn as Zinpro Availa Zn was found to optimize Nile tilapia growth performance and health-related parameters, with an economic advantage over Control of 27%.
- Highest final body weight (FBW, Fig. 1a) and lowest FCR (Fig. 1b) were found in fish fed with 100 ppm Zn as Availa Zn.
- After a transportation-induced stress challenge, plasma hemoglobin (not shown) and leukocyte (Fig. 2a) levels were found to increase and aspartate aminotransferase (AST, Fig. 2b) to decrease with the supplementation of Zn as Zinpro Availa Zn. Results indicate that fish supplemented with Zinpro Availa Zn could mobilize more white blood cells while minimizing any possible liver damage in response to stress.

Growth Performance Fig. 1

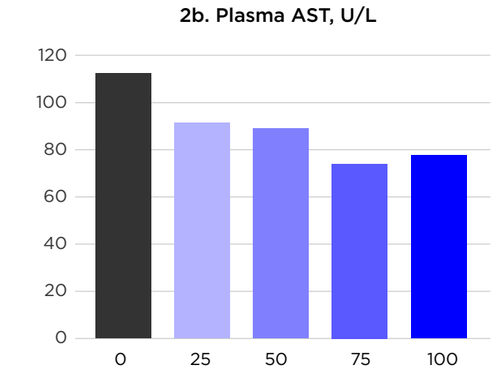


One-Way ANOVA, $P > 0.05$
Linear effect of FBW, $P < 0.05$

Health Fig. 2



One-Way ANOVA, $P > 0.05$
Linear effect of Leucocyte activity, $P < 0.05$



One-Way ANOVA, $P > 0.05$
Linear effect of AST activity, $P < 0.05$

Study Criteria

Evaluate the effects on growth and health in Nile tilapia supplemented with graded levels of Zn as Zinpro Availa Zn and subjected to transport stress.

Treatment	Zn, ppm as Zinpro Availa Zn
0	0
25	25
50	50
75	75
100	100

Initial body weight: 21.8 g
Density: 1.0 kg/m³
Replications: 4
Duration: 8.5 weeks, followed by 3-hr transportation challenge

29%CP/6% Fat
Feeding: 3 times/day

Location:
Pisciculture Laboratory
Lauro de Freitas, Bahia, Brazil

Source: Lemos, C. H. P., De Oliveira, C. P. B., De Oliveira, I. C., Lima, A. O., Couto, R. D., Vidal, L. V. O., & Copatti, C. E. 2024. Responses to graded levels of zinc amino acid complex in Nile tilapia (Oreochromis niloticus). Veterinary Research Communications, 48, 1025–1036. https://doi.org/10.1007/s11259-023-10278-9

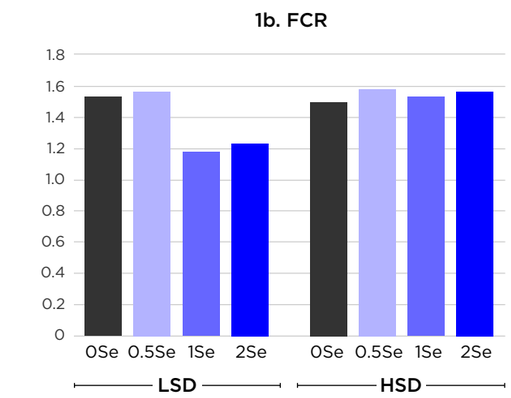
Study 5

Zinpro® Availa® Se Improves Growth and Health-related Parameters in Nile Tilapia

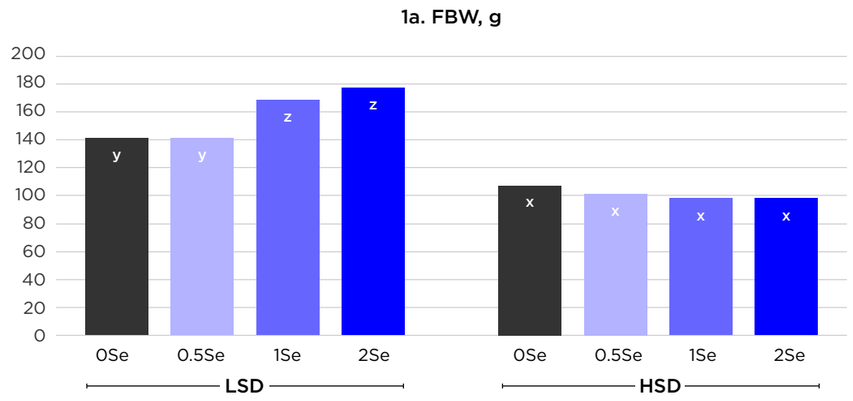
Key Findings

- Supplementation with 1 to 2 ppm Se as Zinpro Availa Se resulted in positive growth improvements (Fig. 1a) and an economic advantage over Control above 50%.
- Although not statistically significant, supplementation with 1 to 2 ppm Se as Zinpro Availa Se reduced feed conversion ratio (FCR; Fig. 1b).
- Reduced plasma aspartate aminotransferase (AST) activity in fish supplemented with 1 ppm Se at the low stocking density (LSD) or 2 ppm Se at the high stocking density (HSD) vs other treatments (Fig. 2), indicate that fish fed with Zinpro Availa Se are more protected against liver–related disease and thus, in a better health condition.
- The HSD negatively affected performance and plasma biochemical parameters compared to the LSD which may have limited the response to Zinpro Availa Se supplementation. At HSD, the Se requirement may be greater than the levels tested.

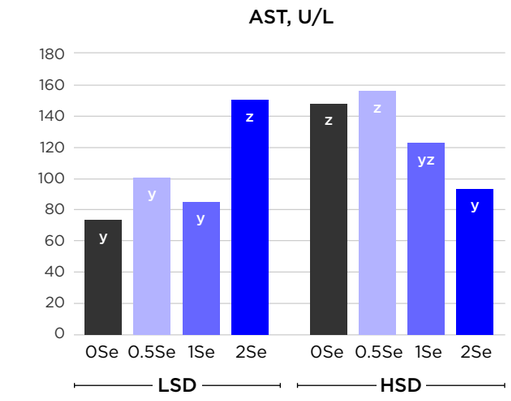
Growth Performance Fig. 1



Growth Performance Fig. 1



Health Fig. 2



Study Criteria

Evaluate the interaction between diets supplemented with zinc-L-selenomethionine (Zinpro Availa Se) and two stocking densities on Nile tilapia.

Treatment	Se, ppm as Zinpro Availa Se			
LSD 4.35 kg/m³	0Se	0.5Se	1Se	2Se
HSD 13.05 kg/m³	0Se	0.5Se	1Se	2Se

Initial body weight: 58 g
Density: 2 stocking densities
4.4 kg/m³ (LSD) and 13.1 kg/m3 (HSD)
Replications: 3
Duration: 8 weeks

29.4% CP (28% DP)/6% Fat
Feeding: 3 times/day

Location:
Aquaculture Laboratory
Universidade Federal da Bahia
Bahia, Brazil

Source: Lemos, C. H. P., Santos, A. A., De Oliveira, C. P. B., Silva, I. S., Couto, R. D., Braga, L. G. T., Vidal, L. V. O., & Copatti, C. E. 2025. Zinc-L-selenomethionine improves growth and hemato-biochemical parameters at low but not at high stocking density for Nile tilapia males. Biological Trace Element Research. https://doi.org/10.1007/s12011-025-04516-1

Study 6

Iron Source and Level Affects Nile Tilapia Growth, Innate Immunity and Anti-oxidant Defense

Key Findings

Supplementation with Zinpro® Fe vs inorganic Fe has significantly:

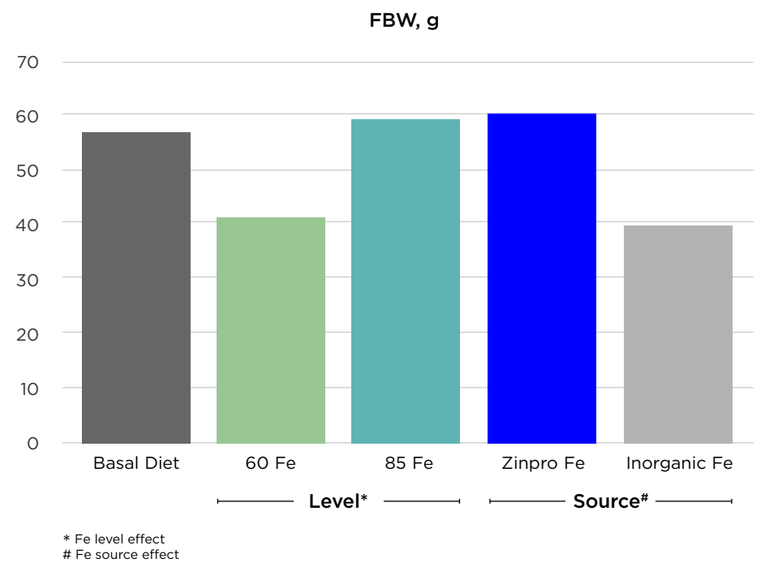
- Improved final body weight (FBW, Fig. 1) and hemoglobin levels (Fig. 2a),
- Reduced TBARS in liver (Fig. 2b).

Supplementation with 85 ppm vs 60 ppm Fe has significantly:

- Improved FBW with no effect on hemoglobin levels (Fig. 2a),
- Reduced TBARS in liver (Fig. 2b).

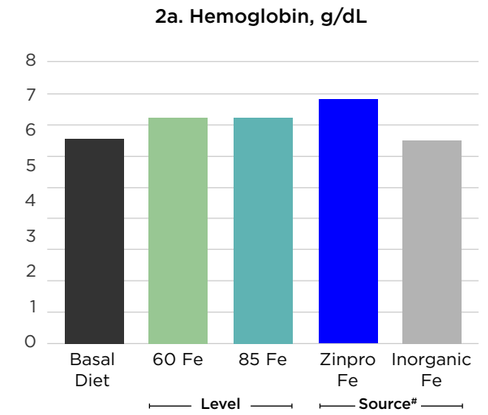
Based on these results, supplementation with 85 ppm Fe as Zinpro Fe is recommended to improve tilapia growth performance, reduce tissue fat oxidation and possible associated negative impacts on product quality. Moreover, supplementation with Zinpro Fe should be considered as a strategy to prevent and minimize anemia in farmed tilapia.

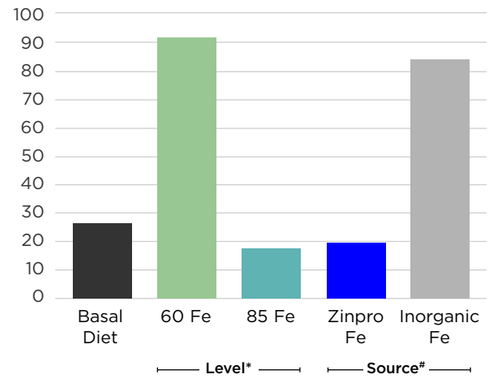
Growth Performance Fig. 1



* Fe level effect
\# Fe source effect

Health Fig. 2





* Fe level effect
\# Fe source effect

Study Criteria

Evaluate the effect of iron source and level on the performance, innate immune response and anti-oxidant defense of Nile tilapia through a 2x2 factorial arrangement of treatments.

	Fe, ppm as Fe Sulfate		Fe, ppm as Zinpro Fe	
Treatment	60	85	60	85
Basal diet	-	-	-	-
60 Fe Inorganic	X			
60 Fe Organic			X	
85 Fe Inorganic		X		
85 Fe Organic				X

Initial body weight: 16.6 g
Density: 20 fish/tank, 240 L tanks
Replications: 4
Duration: 7 weeks

35% CP/7% Fat
Feeding: 3 times/day

Location:
Fish Farming Laboratory, Departamento de Zootecnia e Ciências Biológicas of the UFSM, Campus Palmeira das Missões, Brazil

Source: Hermes, L. B., Peixoto, N. C., Battisti, E. K., Schneider, T. L. S., & Lazzari, R. 2023. Dietary iron affects innate immunity, hematological and oxidative responses in Nile tilapia (Oreochromis niloticus). Aquaculture Nutrition. https://doi.org/10.1007/s10499-023-01361-8

Study 7

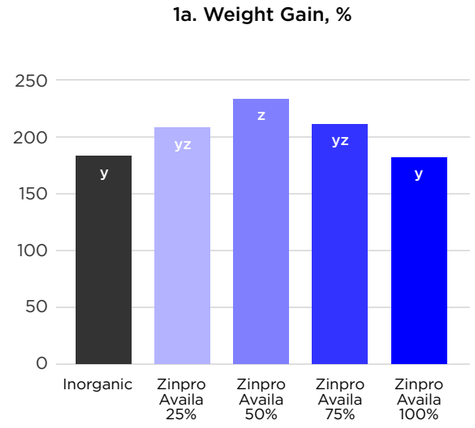
Replacement of Inorganic Trace Minerals with Zinpro® Performance Minerals® Can Cost-effectively Improve Nile Tilapia Performance, Immunity, Anti-oxidant Defense and Modulate Intestinal Microbiome

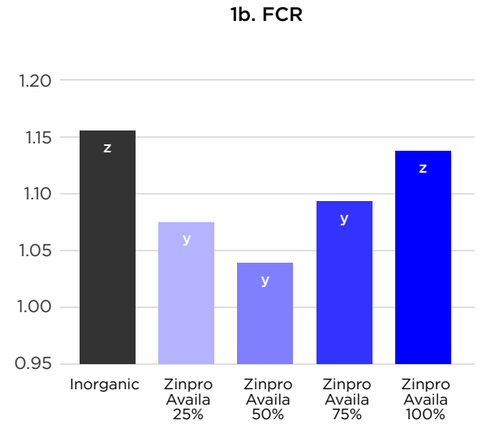
Key Findings

Replacement of inorganic minerals with Zinpro Performance Minerals:

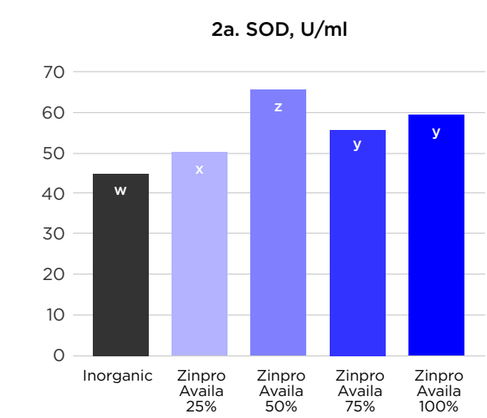
- Translated into a positive economic advantage, being highest (21%) at 50%,
- Increased weight gain (Fig. 1a) by 26% and reduced feed conversion ratio FCR by 12.4% (Fig. 1b) at 50%,
- Showed greatest bone Zn and Se content at 50% and 100%, respectively (not shown),
- Showed greatest fillet Se content at 75% and 100% (not shown),
- Increased activity of key anti-oxidant enzymes such as superoxide dismutase (SOD, Fig. 2a) and glutathione peroxidase (not shown),
- Increased activity of anti-bacterial enzymes such as lysozyme (not shown) at 50%,
- Maximized expression of immune cytokines at about 60% (not shown),
- Positively modulated intestinal microbiome by increasing beneficial bacteria, such as *Bacillus* (Fig. 2c) and lactic acid bacteria (not shown), and reducing harmful bacteria such as *Streptococcus* (Fig. 2b) and *Staphylococcus* (not shown) at 50 to 100%.

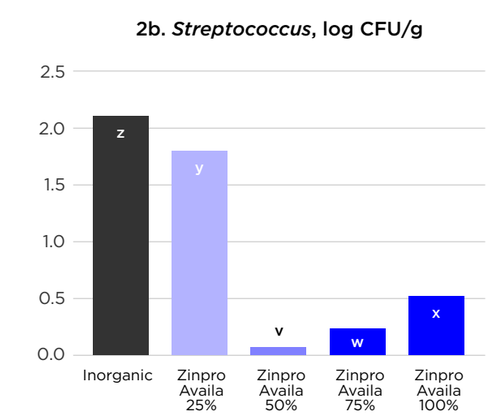
Growth Performance Fig. 1

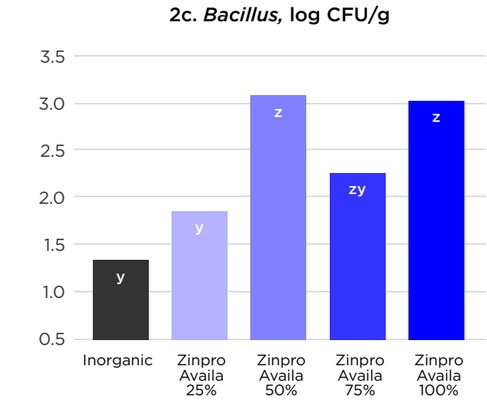




Health Fig. 2







Study Criteria

Evaluate the effects of gradually replacing inorganic trace materials with Zinpro Performance Minerals on growth performance, immune response, anti-oxidant capacity and modulation of intestinal microbiome.

Treatment	Inorganic, ppm	Zinpro Availa, ppm
Inorganic	60Zn, 0.2Se, 10Cu, 30Mn, 100Fe	-
Zinpro Availa 25%	45Zn, 0.15Se, 7.5Cu, 22.5Mn, 75Fe	15Zn, 0.05Se, 2.5Cu, 7.5Mn, 25Fe
Zinpro Availa 50%	30Zn, 0.1Se, 5Cu, 15Mn, 50Fe	30Zn, 0.1Se, 5Cu, 15Mn, 50Fe
Zinpro Availa 75%	15Zn, 0.05Se, 2.5Cu, 7.5Mn, 25Fe	45Zn, 0.15Se, 7.5Cu, 22.5Mn, 75Fe
Zinpro Availa 100%	-	60Zn, 0.2Se, 10Cu, 30Mn, 100Fe

Initial body weight: 91 g
Density: 60 fish/hapa
Replications: 4
Duration: 8 weeks

30% CP/7% Fat
Feeding: 3 times/day

Location:
Alexandria University,
Alexandria, Egypt
Farm location: Edku, Beheira
Governate, Egypt

Sources:
El-Sayed, M. A.-F., Figueiredo-Silva, C., Zeid, S. M. S., & Makled, S. O. 2023b. Metal–amino acid complexes (Zn, Se, Cu, Fe, and Mn) enhance immune response, anti-oxidant capacity, liver function enzymes, and expression of cytokine genes in Nile tilapia reared under field conditions. Journal of Aquatic Animal Health, 00, 1–15.

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Essential Trace Minerals for Tilapia and Freshwater Fish

BENEFIT	TRACE MINERALS	HOW IT WORKS
Disease Resistance	Zinc, Copper, Manganese, Iron, Selenium, Chromium	• Humoral immunity • Cell-mediated immunity • Non-specific immunity • Anti-oxidant activity to remove free radicals and protect cell membranes • Reduced mortality, prevent and treat anemia
Bone, Scale and Fin Development	Zinc, Copper, Manganese, Selenium	• Bone matrix development and maintenance • Cell division and protein synthesis for normal tissue mineralization
Skin and Gut Integrity	Zinc, Copper, Manganese	• Improves wound healing • Skin and gut integrity • Optimize goblet cells, villus height and intestinal barrier
Fertility	Zinc, Copper, Manganese, Iron, 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	• Insulin signaling pathway activation • Energy and protein metabolism • Cell membrane protection from peroxides • Influences glucose, lipid and protein metabolism
Larvae, Fry and Fingerling Development	Zinc, Copper, Manganese, Iron, Selenium, Chromium	• Energy and protein metabolism • Cell proliferation • Normal tissue mineralization • Cell membrane protection • Hemoglobin synthesis and tissue oxygenation
Meat Quality	Zinc, Copper, Manganese, Iron, Selenium, Chromium	• Influences lipid and protein content • Enhanced meat color • Reduced drip loss • Improved product shelf-life
Balanced Gut Microbiome	Zinc, Copper, Iron	• Reduction of pathogenic bacteria • Shift the balance of intestinal bacteria in favor of beneficial species

Feeding Recommendations

Mineral	Zinpro® Performance Minerals® Products	Zinpro Performance Minerals Minimum Requirements, mg/kg diet: Tilapia	Tilapia Broodstock	Tilapia Early Stages
Zn	Zinpro® Availa® Zn Zinpro® ProPath® Zn	60	100	80-120*
Cu	Zinpro® Availa® Cu Zinpro® ProPath® Cu	10	10	10
Mn	Zinpro® Availa® Mn Zinpro® ProPath® Mn	30	30	30
Fe	Zinpro® ProPath® Fe	100	100	100
I[a]		1	1	1
Se[b]	Zinpro® Availa® Se	0.3	0.4	0.4
Cr[c]	Zinpro® MICROPLEX® Zinpro® Availa® Cr	0.4	0.4	0.4

* Sanitary challenging conditions
[a] Not a current Zinpro Performance Mineral source
[b] Note upper limit allowed in EU is of 0.2 ppm, provided as organic source
[c] Use where commercially available

Two advanced lines of performance minerals available to help you achieve your performance and sustainability goals.

Zinpro Performance Minerals Fulfill Today's Demands and Anticipate Tomorrow's Challenges.

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INT-SP-8075 | 072025