



ADVANCING
PERFORMANCE
TOGETHER

**Essential
Trace Minerals**
for Exceptional
Performance



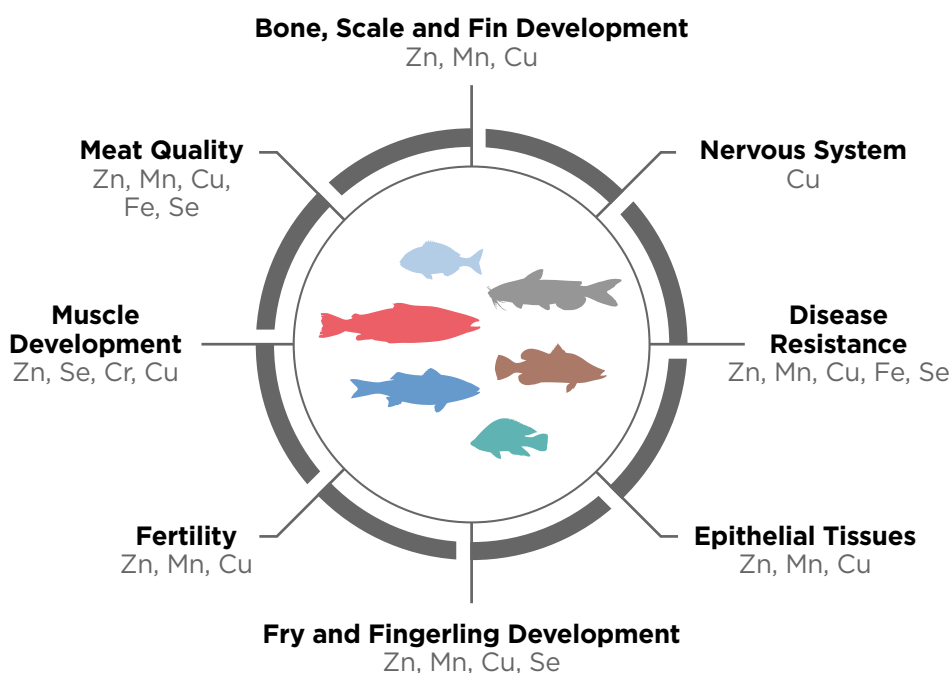
Zinpro Performance Minerals® Deliver Proven Benefits for Tilapia and Freshwater Fish Performance, Health and Meat Quality

Trace minerals play numerous essential roles within cells and metabolic processes, which makes them vital for the optimal nutrition and health of animals – including tilapia and freshwater 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, modulating immune system response and improving product quality.

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

Trace Mineral Benefits in Finfish



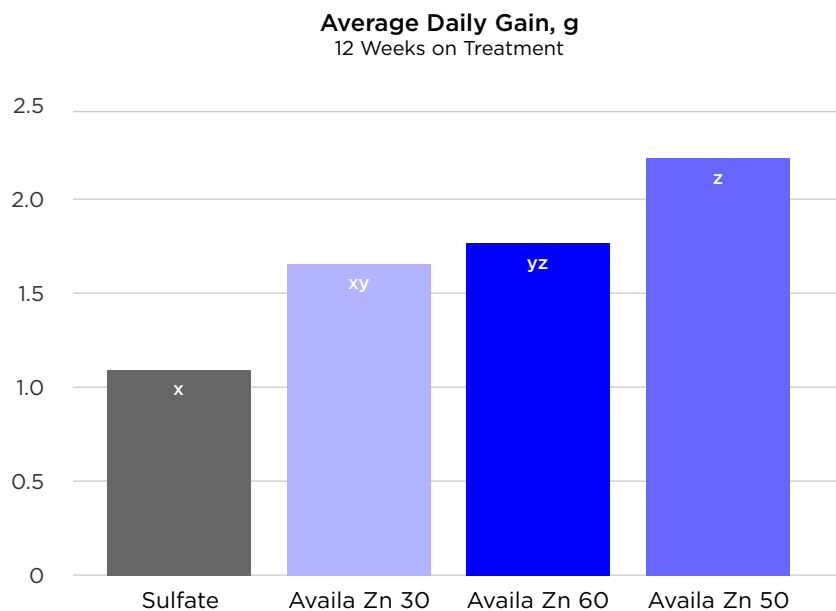
Study 1

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



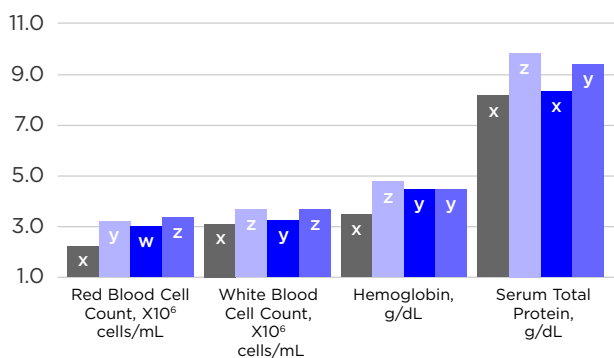
Source: Orapint Jintasataporn, Terry L. Ward, and Supalug Kattakdad. The Effect of Zinc Source and Level on Growth Performance and Immune Parameters of Pangasius Catfish (*Pangasianodon hypophthalmus*). International Symposium on the Feeding and Nutrition of Fish, June 5-10, 2016, Sun Valley, Idaho,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



Health Fig. 2

Immunity Parameters

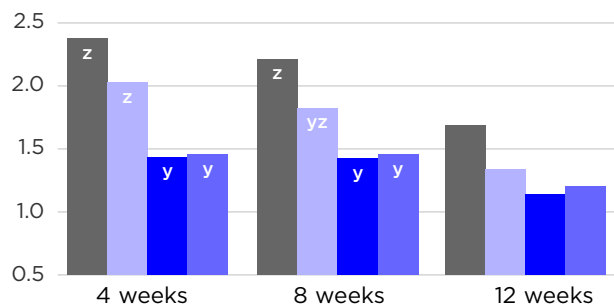
● Sulfate ● Availa Zn 30 ● Availa Zn 60 ● Availa Zn 50



Meat Quality Fig. 3

Drip Loss %

● Sulfate ● Availa Zn 30 ● Availa Zn 60 ● Availa Zn 50



Study Criteria



This study was designed to assess the effect of supplemental zinc in *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

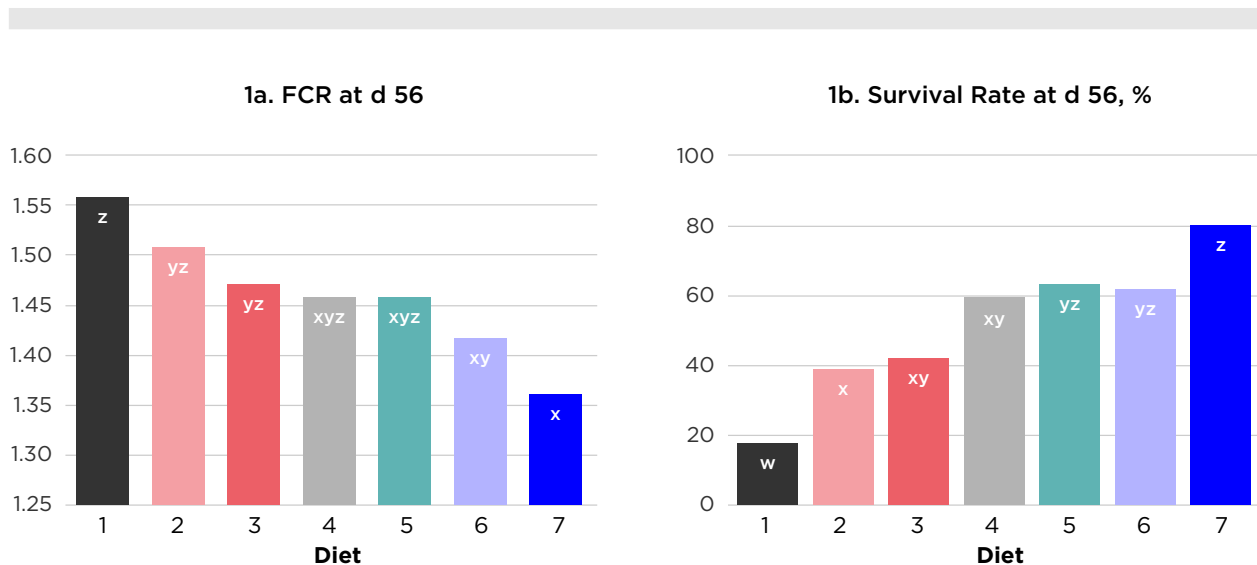
Study 2

ZPM Improves Pangasius Growth Performance and Survival to *Edwardsiella ictaluri* During Nursery Phase

Key Findings

- Total replacement of inorganic TM with ZPM during nursery phase improved SGR (not shown), FCR (Fig. 1a) and survival rates (Fig. 1b) of pangasius by 2%, 3% and 52%, respectively.
- Supplementation with 0.4 ppm Cr (Availa® Cr) on top of other ZPM, further improved FCR, survival rates of pangasius by 3%, 4% and 52%, 28% respectively.
- Supplementation with 0.4 ppm Cr (Availa Cr) on top of other ZPM significantly enhanced monocyte number before the challenge and enhanced both monocytes and neutrophils number after challenge (Fig. 3a).
- Increase of Se levels from 0.25 to 0.4 ppm (Availa® Se) and supplementation with Cr at 0.4 ppm (Availa Cr) significantly reduced mortality of fish challenged with *E. Ictaluri* (Fig. 3b).
- Supplementation with minimum 60ppm Zn from Availa® Zn, 0.4 ppm Se from Availa Se and 0.4 pm Cr from Availa Cr is recommended for improving pangasius survival, growth and FCR translating in an economic advantage over control (ROI) > 500%.

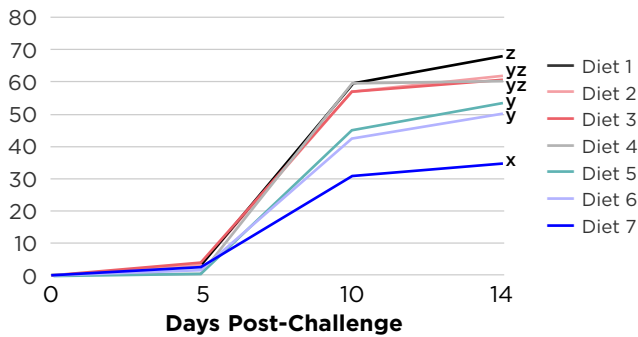
Growth Performance Fig. 1





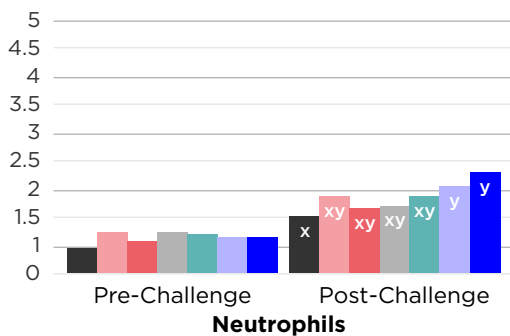
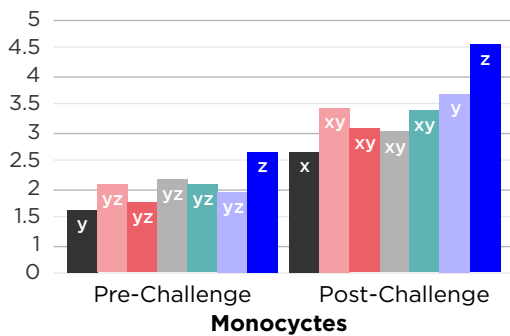
Health Fig. 2

2a. Mortality, %



2b. Leucocyte N
10⁴/mm³

● Diet 1 ● Diet 2 ● Diet 3 ● Diet 4 ● Diet 5 ● Diet 6 ● Diet 7



Study Criteria



This study evaluates the effect of replacing inorganic minerals with ZPM on growth performance and pangasius survival to *Edwardsiella ictaluri* during nursery phase.



Treatment	Inorganic Mineral (mg/kg feed)		ZPM (mg/kg feed)				
	D1	D2	D3	D4	D5	D6	D7
Zn	20	60	20	60	20	60	60
Se	0.25	0.25	0.25	0.25	0.40	0.40	0.40
Mn	2.40	2.40	2.40	2.40	2.40	2.40	2.40
Cu	5	5	5	5	5	5	5
Cr							0.40
Fe	30	30	30	30	30	30	30



Initial body weight: 0.13 g
Density: 500 fish/hapa (xL)
Replications: 4
Duration: 56 days + 14 days challenge



38% CP/6.5% fat
Feeding: ad libitum,
4x day in 1st nursery stage and
2 x daily in 2nd nursery stage



Location:
Nong Lam University, Vietnam

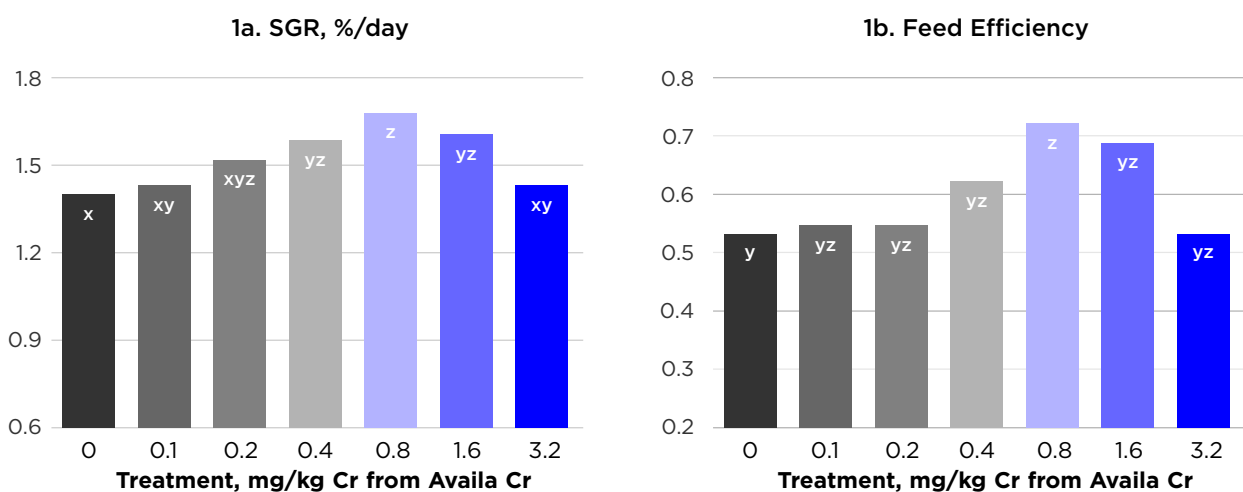
Study 3

Effects of Availa® Cr on Carp Growth Performance, Glucose Utilization and Cortisol Levels

Key Findings

- Supplementation of common carp diets with 0.4 to 0.8 ppm Cr as Availa Cr significantly improved specific growth rate (SGR, Fig. 1a) and feed efficiency (FE, Fig. 1b) from 18.5 to 37% and 13.8 to 21%, respectively.
- Supplementation up to 3.2 ppm Cr as Availa Cr proved safe and with no negative impact on SGR or FE when compared with control, not supplemented with Cr.
- Supplementation with 0.8 to 3.2 ppm Cr as Availa Cr significantly enhanced hepatic hexokinase activity (Fig. 2a), indicating Cr positive effect on glucose cellular uptake.
- Doubled glucose utilization measured as reduction of glucose levels (Fig. 2b), confirms the important effect of Cr on fish glucose utilization, as reported in several other animal species.
- Interestingly, supplementation with 0.4 to 0.8 ppm Cr reduced cortisol levels (Fig. 3) by half, indicating an important effect of Cr on stress levels.
- Supplementation of common carp diets with 0.4 to 0.8 ppm Cr as Availa Cr translated in an economic advantage over control (ROI) of 29% and 58%, respectively.

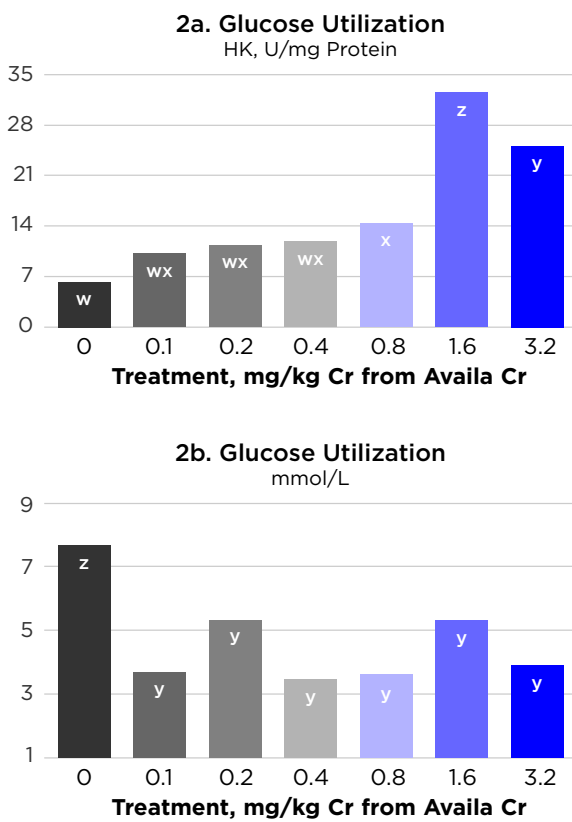
Growth Performance Fig. 1



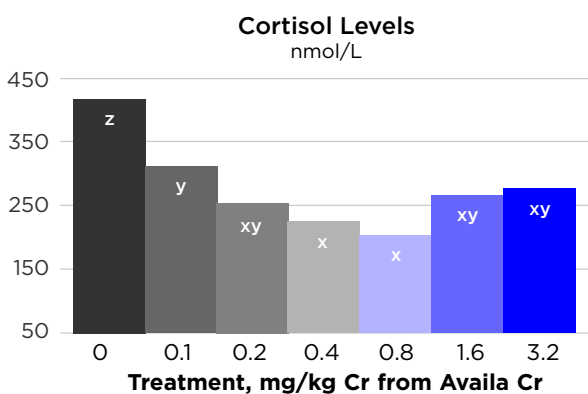
Source: Cui, P., Yin, S., Cheng, Z., Qiao, X., Zhou, Q., 2018. Effects of dietary chromium methionine on growth performance, hematological characteristics and carbohydrate metabolic enzyme activities of common carp (*Cyprinus carpio*). The Israeli Journal of Aquaculture - Bamidgah 69:1524



Health Fig. 2



Health Fig. 3



Study Criteria



This study was designed to assess the optimum level of supplemental Availa Cr in common carp growth performance, glucose utilization and resistance to stress.



Treatment	Cr, ppm Availa Cr
Control	0
Availa Cr 0.1	0.1
Availa Cr 0.2	0.2
Availa Cr 0.4	0.4
Availa Cr 0.8	0.8
Availa Cr 1.6	1.6
Availa Cr 3.2	3.2



Initial body weight: 40.95g
Density: 20 fish/tank (xL)
Replications: 3
Duration: 8 weeks



32% CP/5-6% fat
Feeding: 2 times/day, 4-6% BW



Location:
Tianjin Chenhui Feed Co., LTD, China

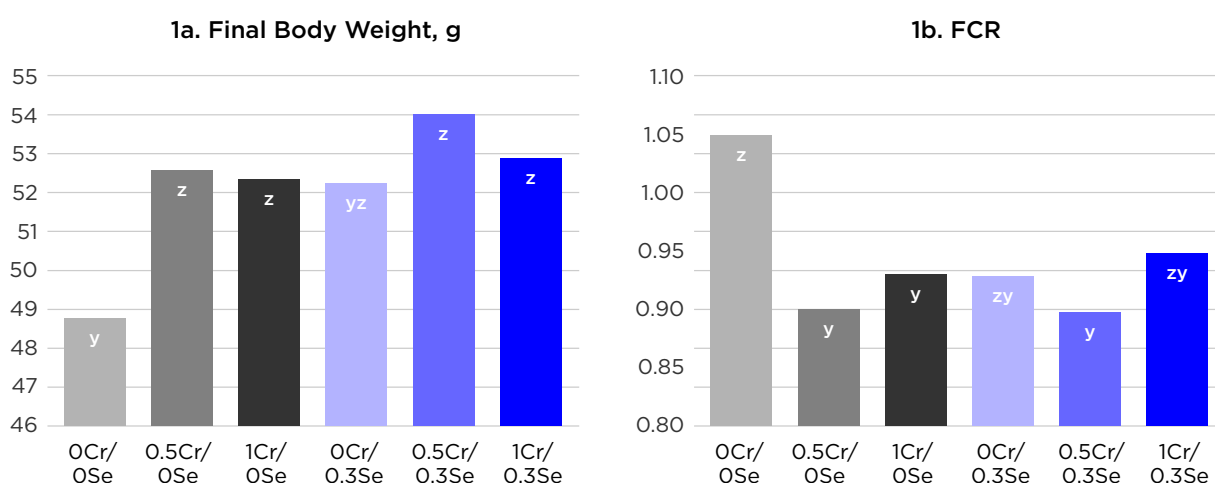
Study 4

Effects of Availa® Se and Availa® Cr on Tilapia Growth Performance and Health-Related Parameters

Key Findings

- Supplementation of Nile tilapia diets with 0.5 ppm Cr as Availa Cr significantly improved final body weight (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 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.
- Antioxidant and anti-bacterial defense evaluated by glutathione peroxidase (Fig 2.) and lysozyme activities, respectively (Fig 3.), were not significantly affected by the 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 the short-duration of the study may have limited detection of an antioxidant and antibacterial response to Cr and Se supplementation, requiring further investigation.

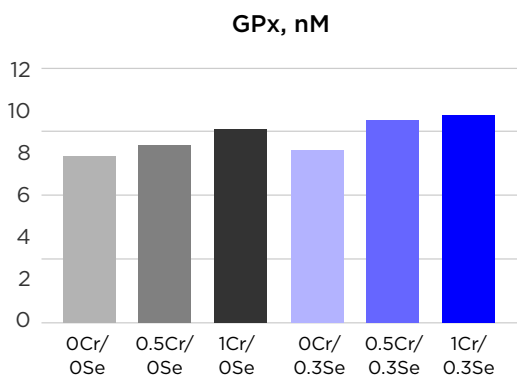
Growth Performance Fig. 1



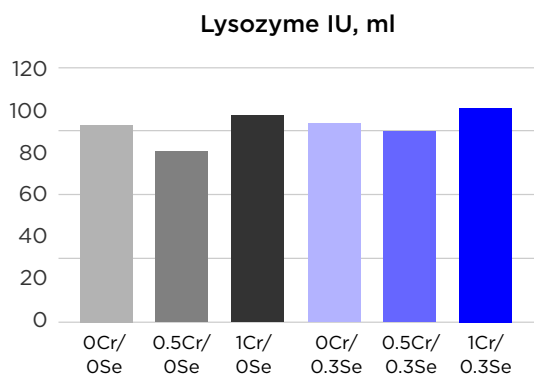
Source: Auepaiboon, S., Jintasataporn, O., Chumkam, S. 2020. Effect of zinc-L-selenomethionine and chromium-L-methionine on growth performance, blood glucose and digestive tract pH of Nile tilapia (*Oreochromis niloticus*). 11th International Academic Conference. Global Goals, Local Actions: Looking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



Health Fig. 2



Health Fig. 3



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 Availa Cr	Se, ppm 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



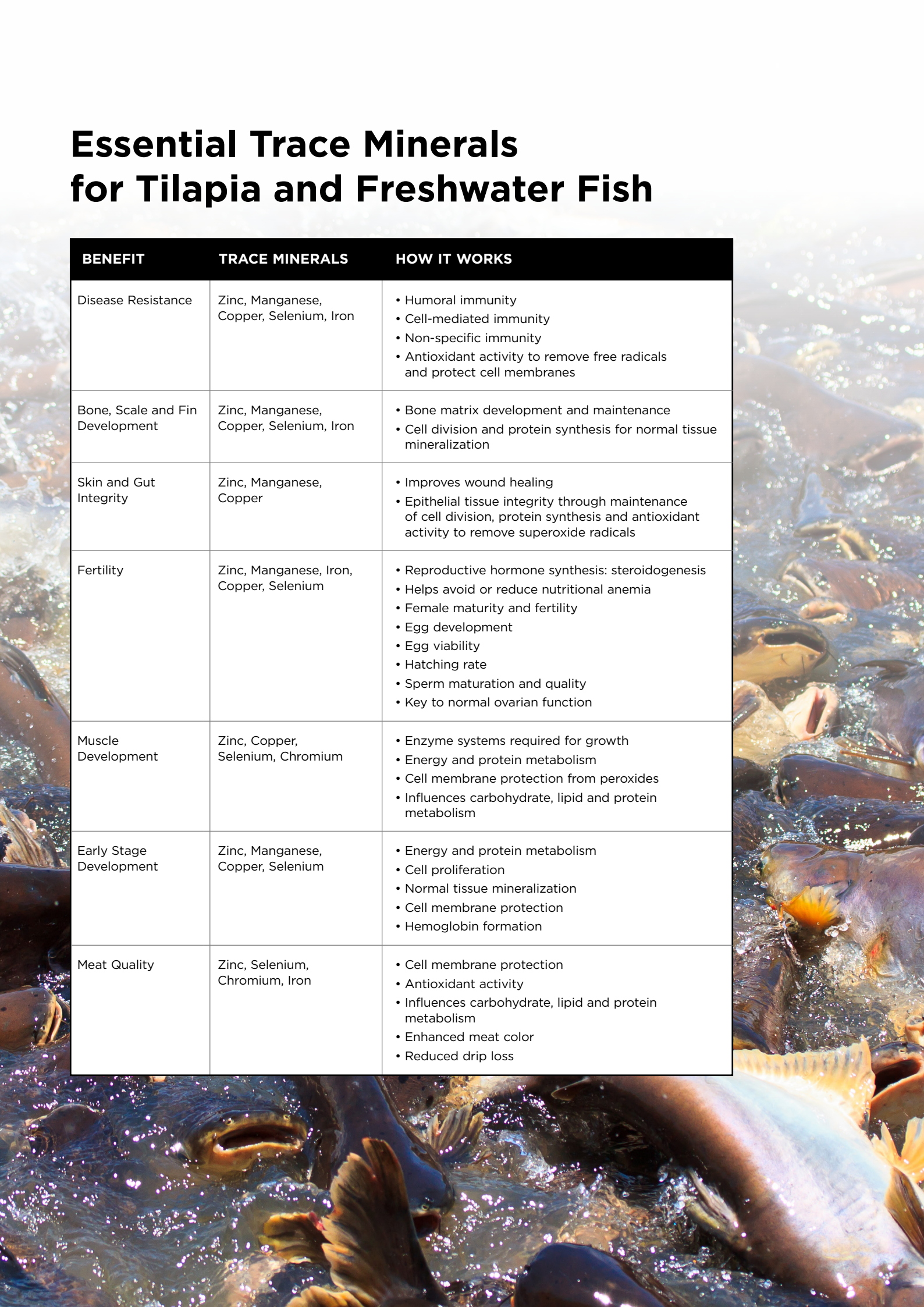
36% CP/6% fat
Feeding: 2 times/day, 3-4% BW



Location:
Kasetsart University, Bangkok,
Thailand

Essential Trace Minerals for Tilapia and Freshwater Fish

BENEFIT	TRACE MINERALS	HOW IT WORKS
Disease Resistance	Zinc, Manganese, Copper, Selenium, Iron	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Bone matrix development and maintenance • Cell division and protein synthesis for normal tissue mineralization
Skin and Gut Integrity	Zinc, Manganese, Copper	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Energy and protein metabolism • Cell proliferation • Normal tissue mineralization • Cell membrane protection • Hemoglobin formation
Meat Quality	Zinc, Selenium, Chromium, Iron	<ul style="list-style-type: none"> • Cell membrane protection • Antioxidant activity • Influences carbohydrate, lipid and protein metabolism • Enhanced meat color • Reduced drip loss



Feeding Recommendations

Mineral	Zinpro Performance Minerals® Products	Zinpro Recommendations
		Minimum Requirement ZPM, mg/kg diet
		Tilapia and Freshwater Fish
Zn	Availa® Zn ProPath® Zn	60
Cu	Availa® Cu ProPath® Cu	10
Mn	Availa® Mn ProPath® Mn	30
Fe	Availa® Fe ProPath® Fe	100
I ^a		1
Se ^b	Availa® Se	0.3
Cr ^c	MICROPLEX® Availa® Cr	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



Trace minerals are essential nutrients for tilapia and freshwater fish.



When animals and people experience better health and wellbeing, **we see a healthier, more productive and sustainable world for all.**



For more information:
contact your Zinpro
representative or visit
zinpro.com/aquaculture