



ZINPRO®

**ADVANCING
PERFORMANCE
TOGETHER**



**Essential Trace
Minerals** for
Exceptional
Freshwater Fish
Performance



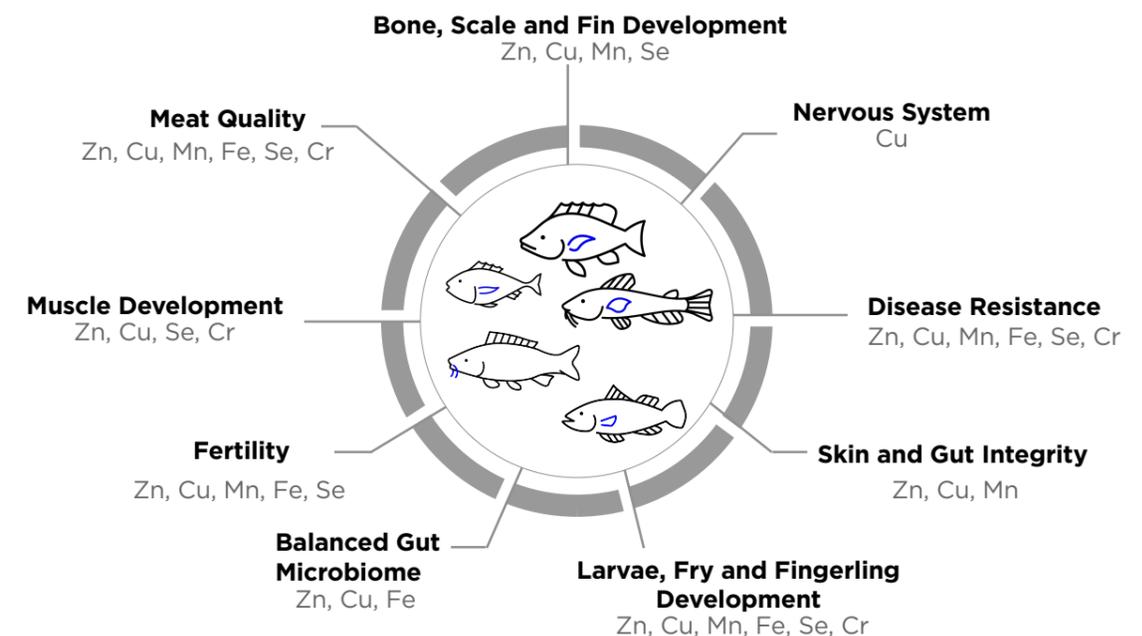
Zinpro® Performance Minerals® Deliver Proven Benefits for Freshwater Fish Performance, Health and Meat Quality

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

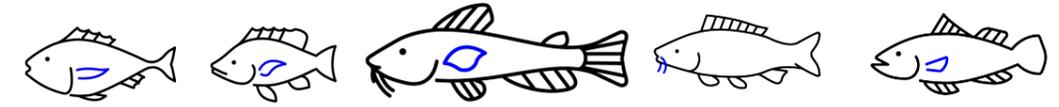
The source and availability of trace minerals are the key to satisfy the needs of finfish in an efficient and sustainable way through their life cycle.

Trace Mineral Benefits in Finfish



Study 1

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



Key Findings

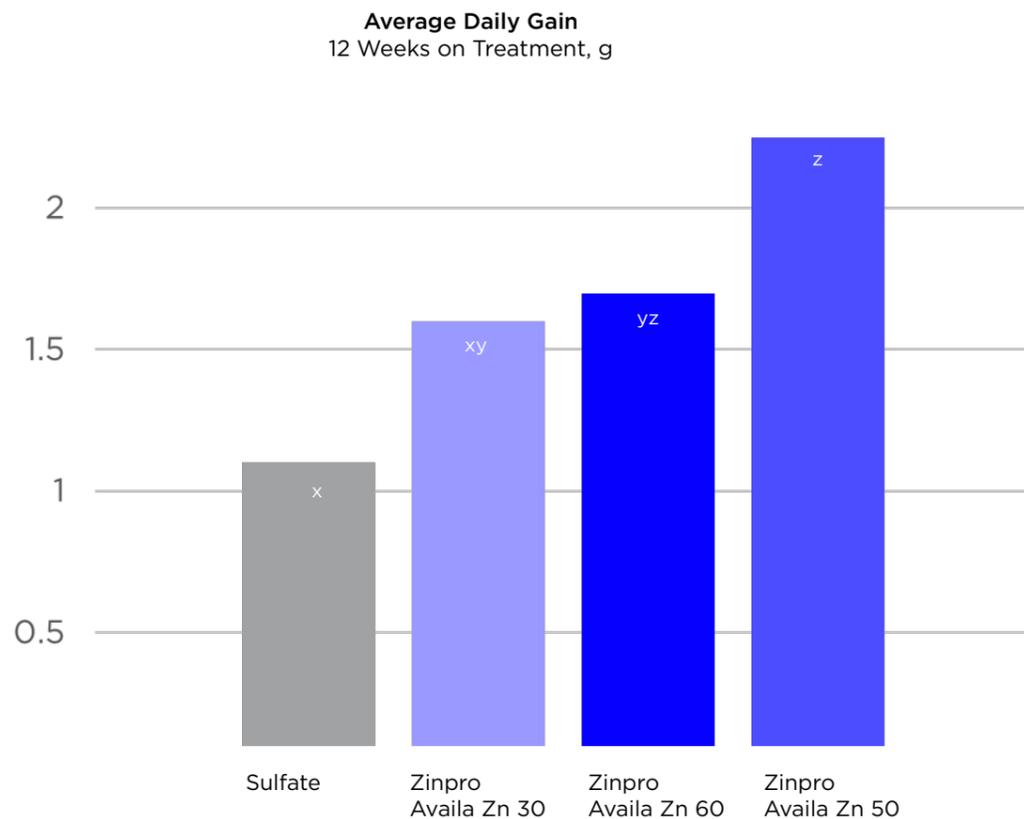
Supplementing Zinpro Availa Zn in diets of Pangasius catfish significantly ($P < 0.05$) improved fish average daily gain. Adding 50 ppm zinc from Zinpro Availa Zn as the sole source showed the best growth performance (Fig. 1).

Gradual replacement of inorganic zinc with Zinpro Availa Zn significantly ($P < 0.05$)

improved fish immunity parameters, such as red and white blood cell count, and serum protein (Fig. 2).

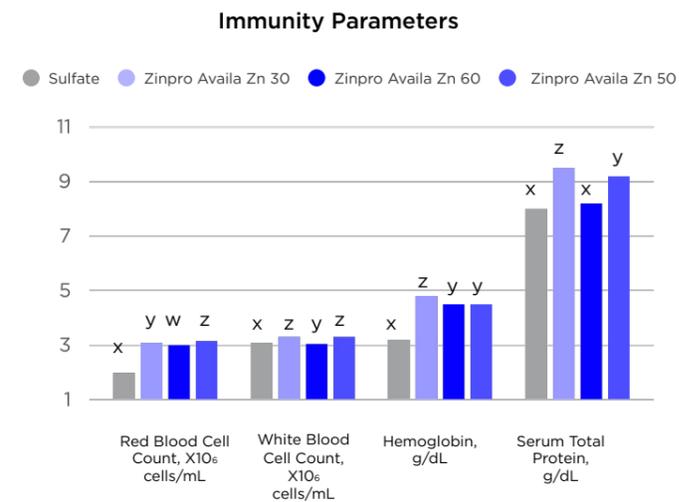
- Gradual replacement of inorganic zinc with Zinpro Availa Zn significantly ($P < 0.05$) decreased fillet drip loss on week 4 and 8 (Fig. 3).

Growth Performance Fig. 1

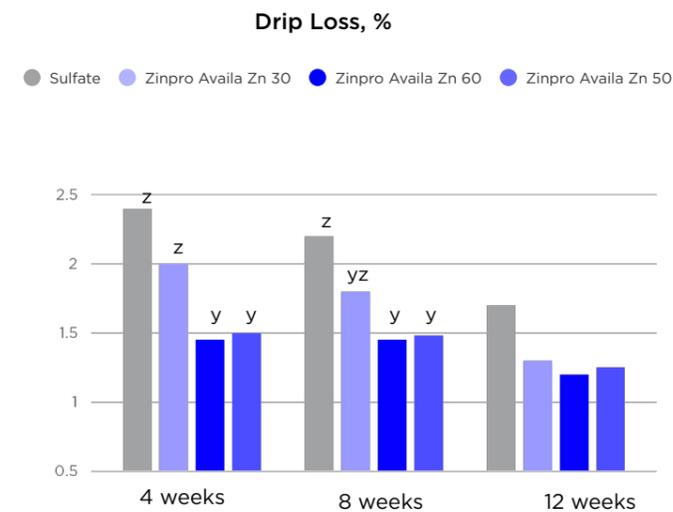


^{w,x,y,z} bars without a common superscript indicate significant differences ($P \leq 0.05$)

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 Zinpro Availa Zn, or as a combination of the two sources.



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

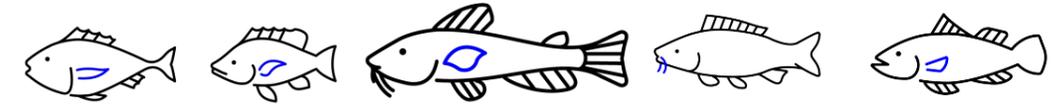


Location:
Kasetsart University,
Bangkok, Thailand

Source: Orapint Jintasatoporn, 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.

Study 2

Zinpro® Performance Minerals® Improves Pangasius Growth Performance and Survival of *Edwardsiella ictaluri* During Nursery Phase

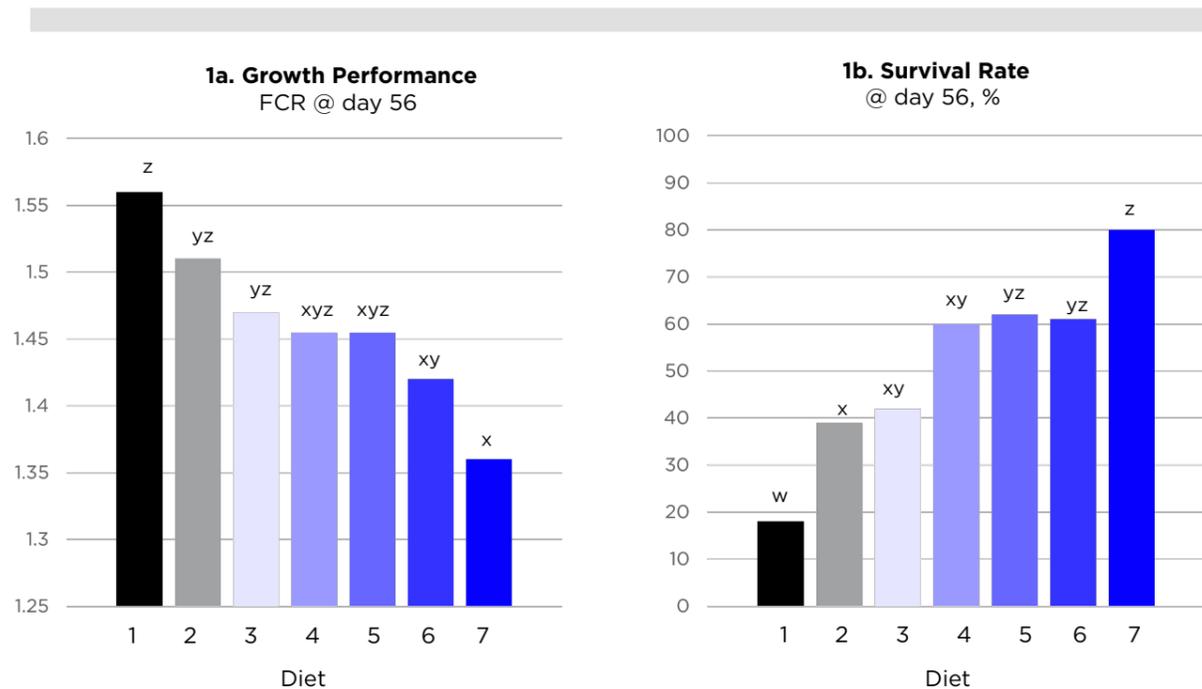


Key Findings

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

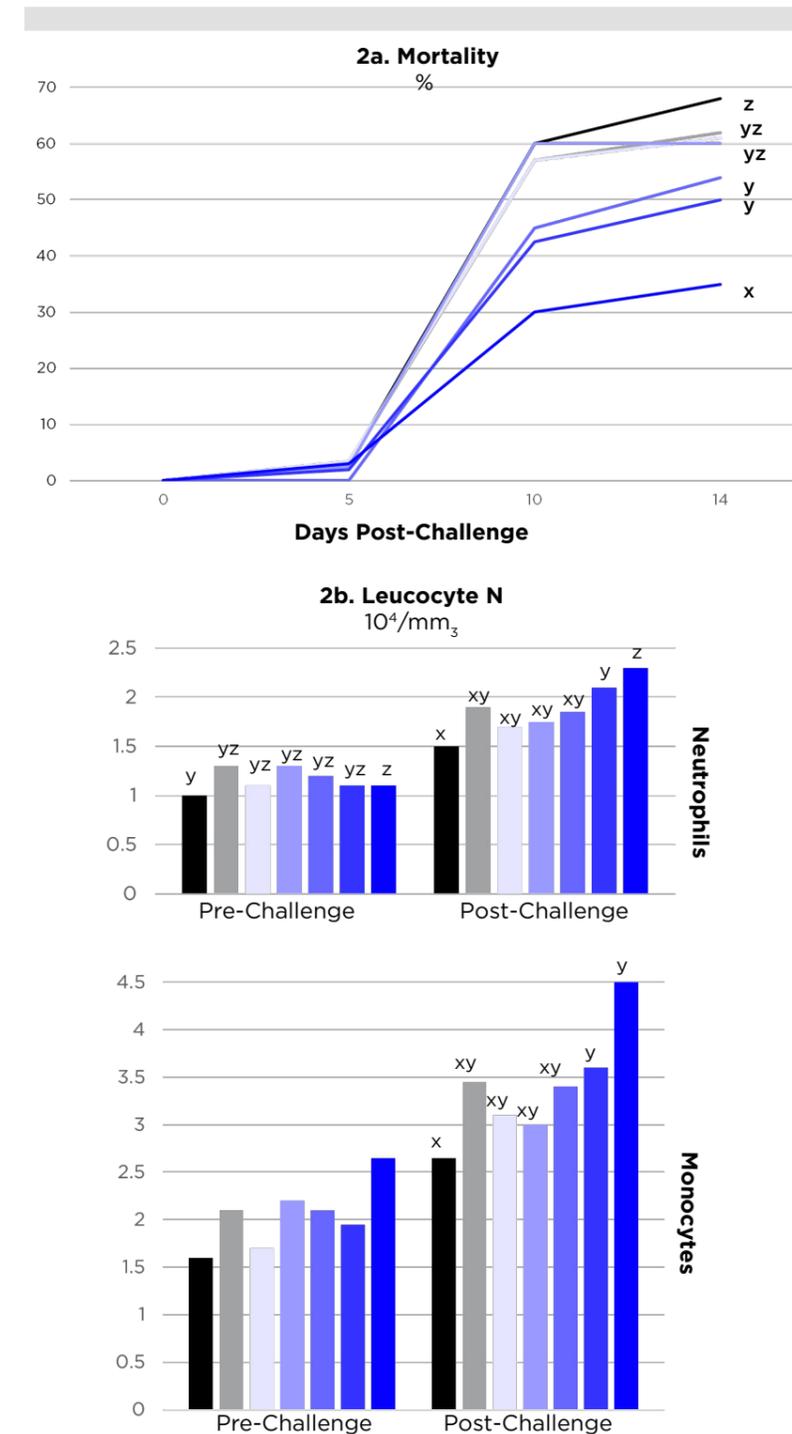
*Zinpro Availa Cr is also known as Zinpro® MICROPLEX® in some regions.

Growth Performance Fig. 1



*yz bars without a common superscript indicate significant differences (P ≤ 0.05)

Health Fig. 2



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.



Inorganic Mineral (mg/kg feed)

Zinpro Performance Minerals(mg/kg feed)

Treatment	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
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

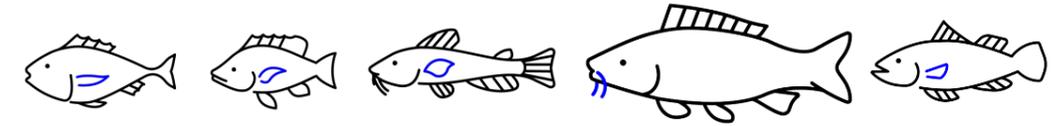


Location:
Nong Lam University, Vietnam

Zinpro® Corporation 2021. ZPM Improves Pangasius Growth Performance and Survival of *Edwardsiella ictaluri* During Nursery Phase. Research Brief, RB-A-002

Study 3

Effects of Chromium Methionine Supplementation on Carp Growth Performance, Glucose Utilization and Cortisol Levels

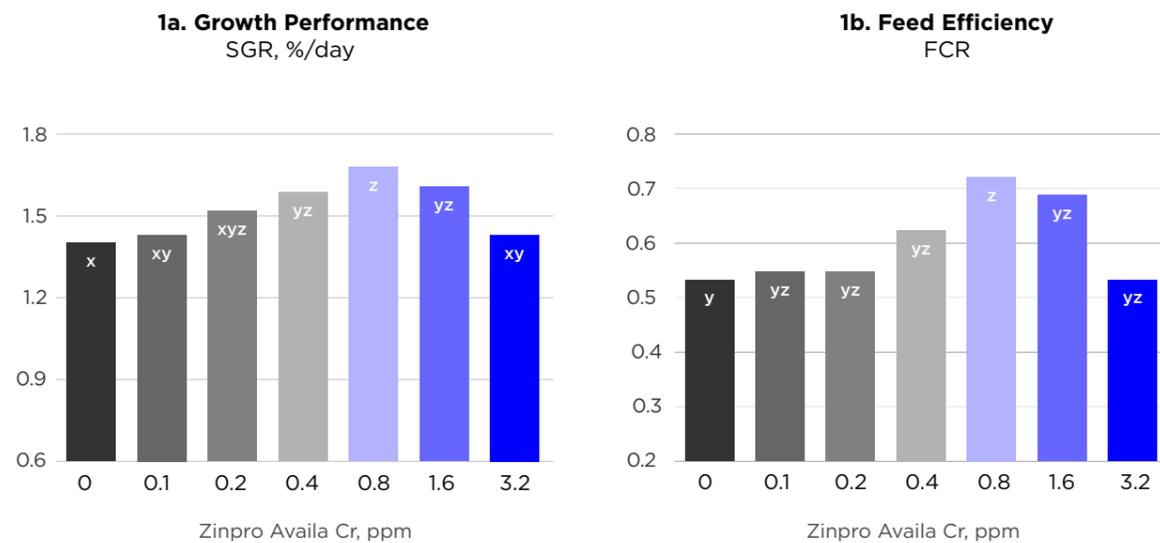


Key Findings

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

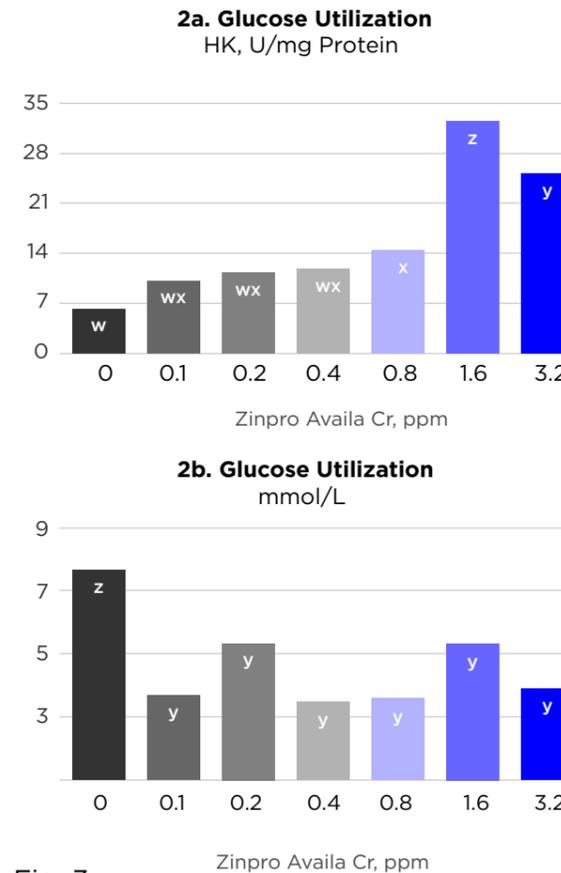
*Zinpro Availa Cr is also known as Zinpro® MICROPLEX® in some regions.

Growth Performance Fig. 1

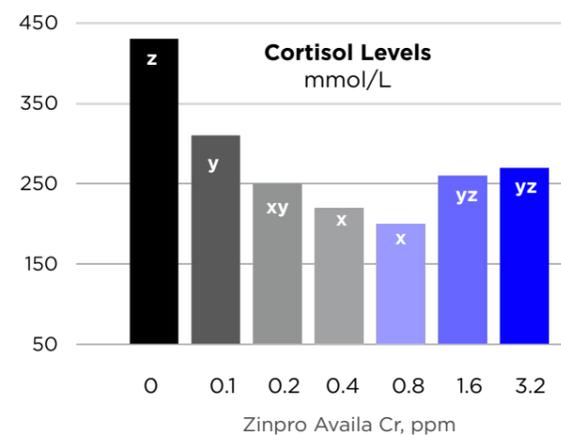


^{w,x,y,z} bars without a common superscript indicate significant differences (P ≤ 0.05)

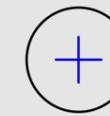
Health Fig. 2



Health Fig. 3



Study Criteria



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



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



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



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

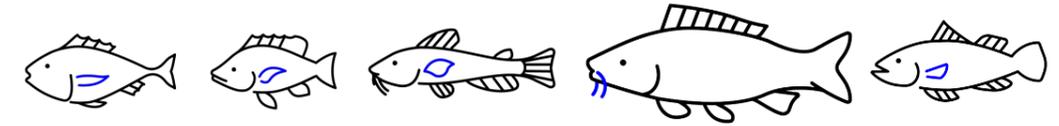


Location:
Tianjin Chenhui Feed Co., LTD, China

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 - Bamidgeh 69:1524

Study 4

Effect of Chromium Source on Growth Performance and Glucose Utilization in Common Carp



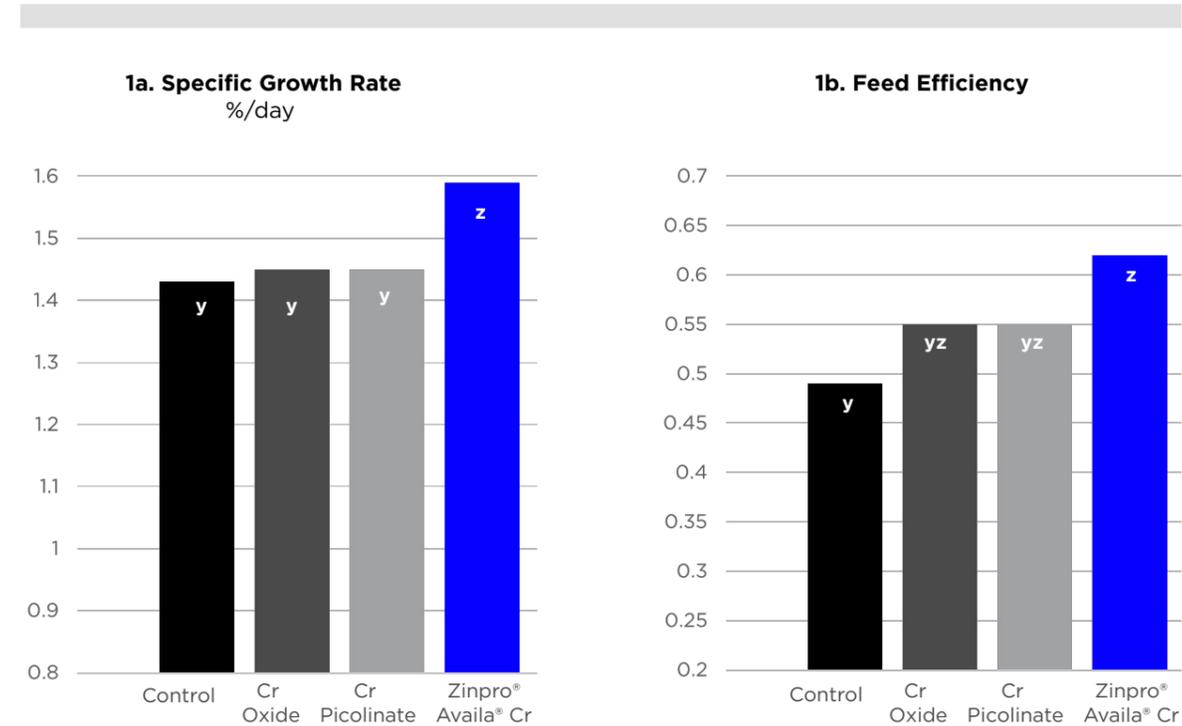
Key Findings

- Supplementation with chromium oxide or chromium picolinate did not affect growth (Fig. 1a) or feed efficiency (Fig. 1b) in common carp.
- Independently of the source, Cr supplementation reduced serum glucose levels in common carp.
- Supplementation with chromium methionine or chromium picolinate reduced serum cortisol levels.
- Supplementation with chromium methionine complex (Zinpro® Availa® Cr*):
 - Increased specific growth rate by 11.2% (Fig. 1a) and feed efficiency by 26.5% (Fig. 1b).
 - Increased protein efficiency by 18.3% although not statistically significant when compared to the other chromium sources (data not shown).
- Increased insulin sensitivity as shown in insulin receptor concentration (Fig. 2a), along with hepatopancreas IR and GLUT2 expression (data not shown).
- Reduced serum cortisol levels (Fig. 2b) indicating an important effect of chromium on stress levels.
- Increased glucose utilization measured as reduction of serum glucose levels (Fig. 3a) and associated increased activity of HK (Fig. 3b) and PK (data not shown), key regulatory enzymes of glycolysis.

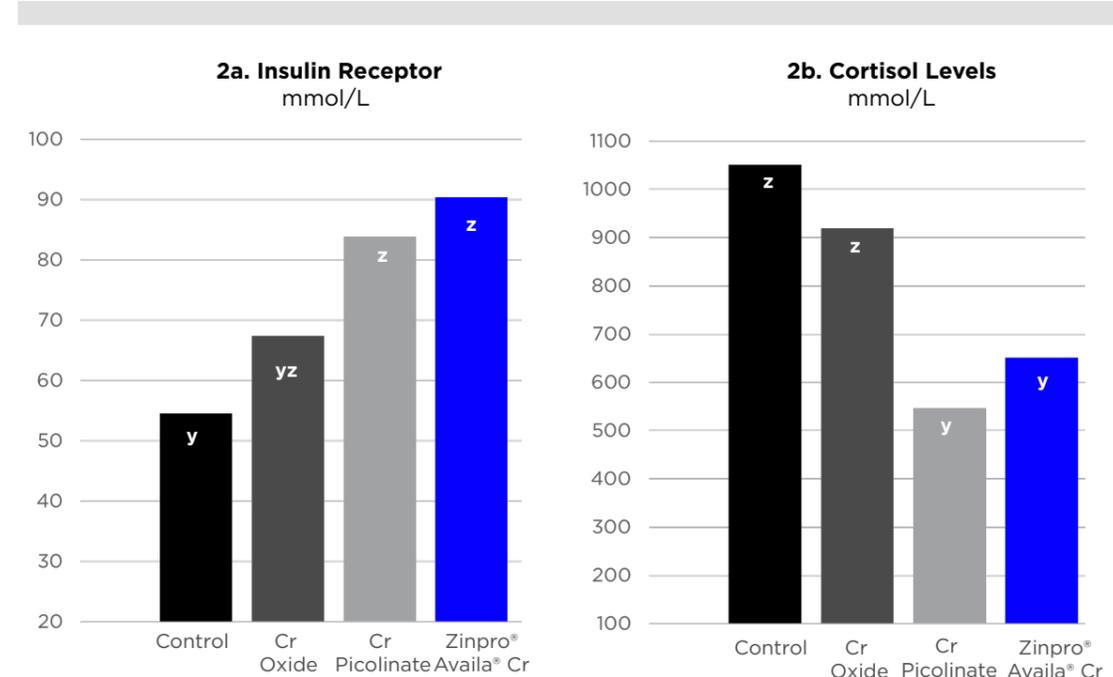
*Zinpro Availa Cr is also known as Zinpro® MICROPLEX® in some regions.

^{yz} bars without a common superscript indicate significant differences (P ≤ 0.05)

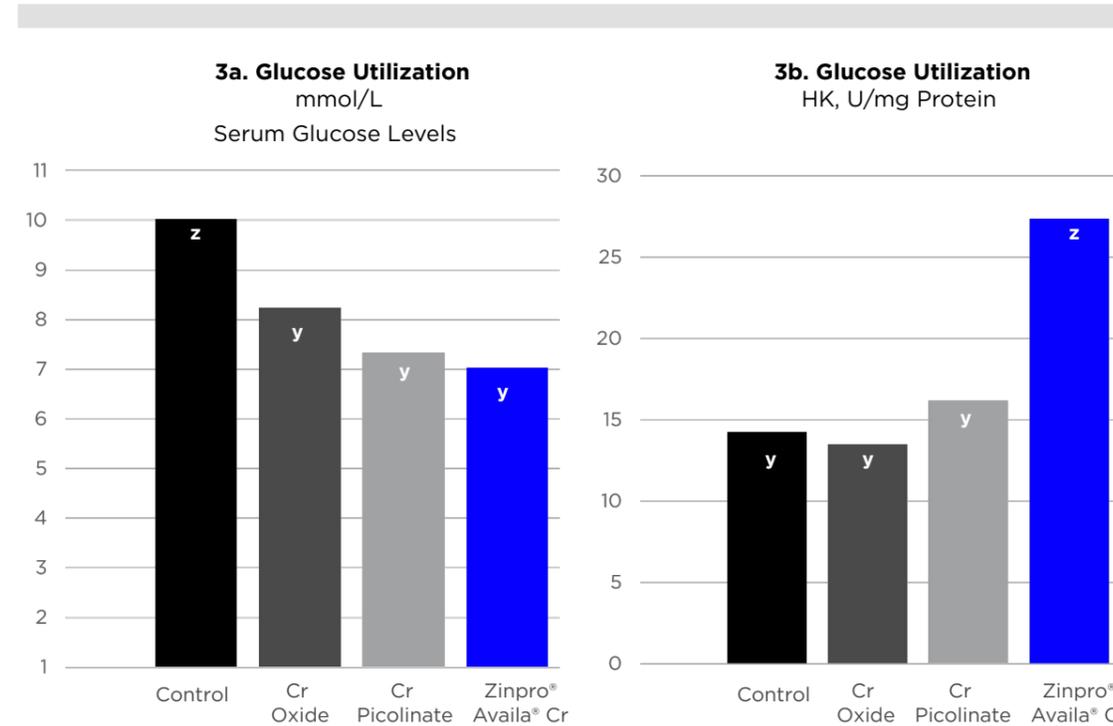
Growth Performance Fig. 1



Health Fig. 2



Health Fig. 3



Study Criteria

This study was designed to evaluate the effect of chromium source on performance and glucose utilization in common carp.

Treatment	Cr, ppm
Control	0
Cr Oxide	2.0
Cr Picolinate	2.0
Chromium Methionine	2.0

Initial body weight: 41 g
Density: 60 fish/tank, 800 L
Replications: 3
Duration: 60 days

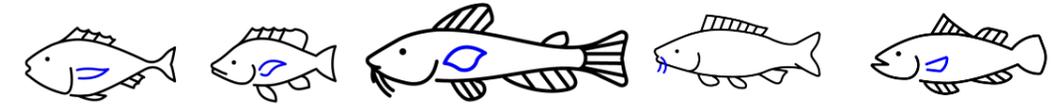
32% CP/6% fat
Feeding: 2 times/day

Tianjin Agricultural University, China

Source: Cui, P., Z. Cheng, J. Sun. 2021. Effects of different chromium sources on growth performance, serum biochemical, hepatopancreas glycometabolism enzymes activities, IR, GLUT2 and SGLT1 gene expression of common carp (*Cyprinus carpio*). *Aquac. Res.* 53:1573-1581

Study 5

Dietary Supplementation of Chromium Methionine Complex Improves Growth Performance of African Catfish

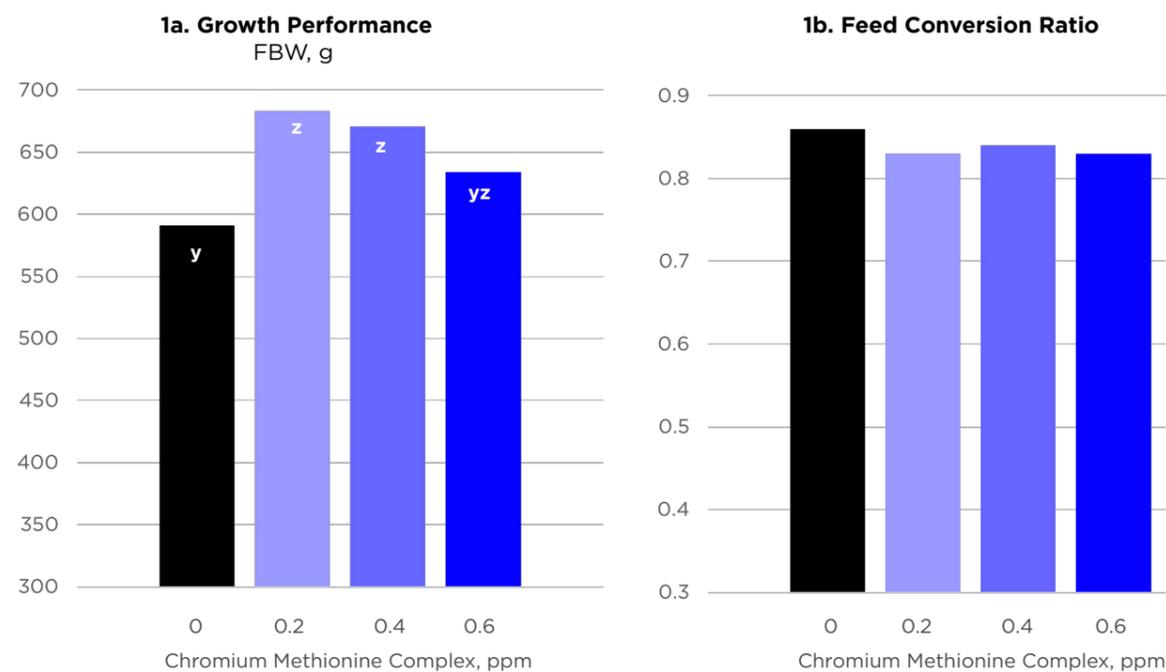


Key Findings

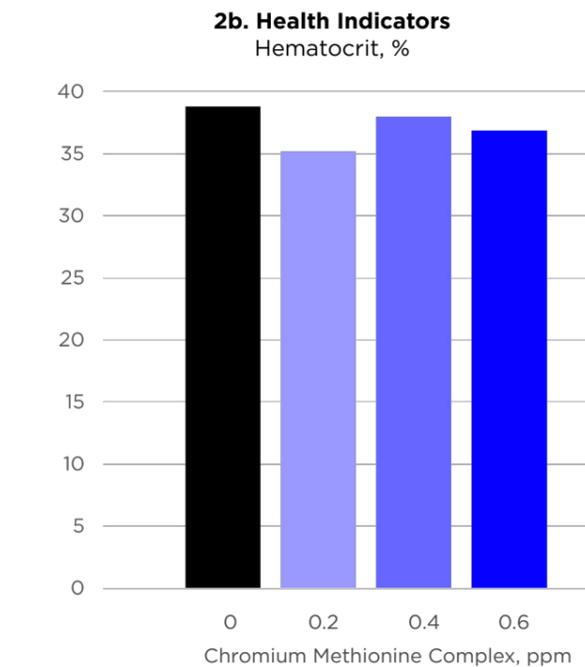
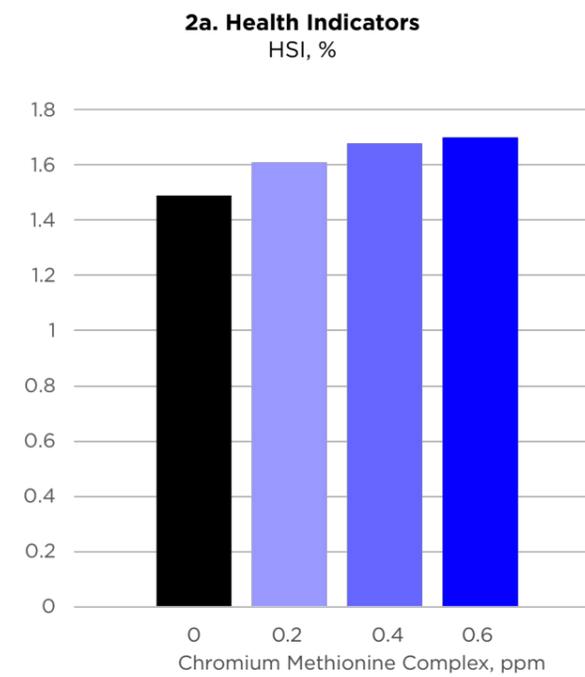
- Supplemental chromium methionine complex (Zinpro® Availa® Cr*) increased final body weight (FBW, Fig. 1a) by 15.7% and 13.4% at 0.2 and 0.4 ppm and numerically decreased feed conversion ratio (FCR) (Fig. 1b) by 3.5% at 0.2 ppm in African catfish.
- Importantly, supplementation with only 0.2 ppm Zinpro Availa Cr increased body weight of African catfish by 93 g in 84 days.
- Regression analysis estimated 0.33 ppm Zinpro Availa Cr as the supplemental level to optimize African catfish growth (data not shown).
- Importantly, none of the Zinpro Availa Cr supplemented levels affected health indicators such as hepatosomatic index (HSI) (Fig. 2a) or hematocrit (Fig. 2b).

*Zinpro Availa Cr is also known as Zinpro® MICROPLEX® in some regions.

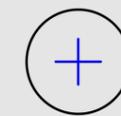
Growth Performance Fig. 1



Health Fig. 2



Study Criteria



This study was designed to evaluate the efficacy of Zinpro Availa Cr on growth performance and health status of juvenile African catfish.



Supplemental Chromium Methionine Complex, ppm Cr			
0	0.2	0.4	0.6



Initial body weight: 54 g
Density: 50 fish/tank
Replications: 34
Duration: 12 weeks



48% CP/13.5% fat
Feeding: 2 times/day + auto-fed overnight



Gesellschaft für Marine Aquakultur, Germany

Source: Kaiser, F., M. Schlachter, C. Schulz, C. Figueiredo-Silva. 2023. Dietary Supplementation with Chromium DL-Methionine Enhances Growth Performance of African Catfish (*Clarias gariepinus*). *Aquaculture Nutrition*, Article ID 7092657, <https://doi.org/10.1155/2023/7092657>

^{yz} bars without a common superscript indicate significant differences ($P \leq 0.05$)

Essential Trace Minerals for Freshwater Fish

BENEFIT	TRACE MINERALS	HOW IT WORKS
Disease Resistance	Zinc, Copper, Manganese, Iron, Selenium, Chromium	<ul style="list-style-type: none"> 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	<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 Optimize goblet cells, villus height and intestinal barrier
Fertility	Zinc, Copper, Manganese, Iron, 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"> Insulin signaling pathway activation Energy and protein metabolism Cell membrane protection from peroxides Influences carbohydrate, lipid and protein metabolism
Larvae, Fry and Fingerling Development	Zinc, Copper, Manganese, Iron, Selenium, Chromium	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Influences lipid and protein content Enhanced meat color Reduced drip loss Improved product shelf-life
Balanced Gut Microbiome	Zinc, Copper, Iron	<ul style="list-style-type: none"> Reduction of pathogenic bacteria Shift the balance of intestinal bacteria in favor of bacterial species

Feeding Recommendations

Mineral	Zinpro Performance Minerals Products	Zinpro Recommendations
		Minimum Requirement ZPM, mg/kg diet
Zn	Zinpro® Availa® Zn Zinpro® ProPath® Zn	60
Cu	Zinpro® ProPath® Cu	10
Mn	Zinpro® Availa® Mn Zinpro® ProPath® Mn	30
Fe	Zinpro® ProPath® Fe	100
Ia		1
Seb	Zinpro® Availa® Se	0.3
Cr _c	Zinpro® MICROPLEX® Zinpro® 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 freshwater fish.



Zinpro® Performance Minerals® Fulfill

Today's Demands and Anticipate Tomorrow's Challenges.



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

