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**

- **Bone, Scale and Fin Development**: Zn, Mn, Cu
- **Meat Quality**: Zn, Mn, Cu, Fe, Se
- **Nervous System**: Cu
- **Muscle Development**: Zn, Se, Cr, Cu
- **Disease Resistance**: Zn, Mn, Cu, Fe, Se
- **Fertility**: Zn, Mn, Fe, Cu, Se
- **Epithelial Tissues**: Zn, Mn, Cu
- **Fry and Fingerling Development**: Zn, Mn, Cu, Se
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.

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

**Diet A-Inorg**  
**Diet B-Inorg/ZPM**  
**Diet C-ZPM 0.5x**

### Growth Performance

- 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.

### Key Findings

- 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.

**Study Criteria**

**Study 1**

- **Monthly Specific Growth Rate**
  - Diet A-Inorg
  - Diet B-Inorg/ZPM
  - Diet C-ZPM 0.5x

- **Gut Health**
  - Number of Goblet Cells

- **Skin Health**
  - Number of Goblet Cells

- **Antioxidant Defense**
  - Hepatic GPx Activity, nmol/min/mg protein

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**Source:** A.C. Figueiredo-Silva, C. Boggino, M. Sun, Maria Mastroik, I. Papadaki, A. Themsiotou, 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.

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**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).

**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**

**Body and Tissues Zinc Deposition**

**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.

**Location:** Kasetsart University, Bangkok, Thailand
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 ($P < 0.05$) decreased fillet drip loss on week 4 and 8 (Fig. 3).
- 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).

Growth Performance  Fig. 1

Health  Fig. 2

Immunity Parameters

Meat Quality  Fig. 3

Drip Loss %

## Essential Trace Minerals for Finfish

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

<table>
<thead>
<tr>
<th>Mineral</th>
<th>ZPM Products</th>
<th>Coldwater Fish and Salmonids</th>
<th>Warmwater Fish</th>
</tr>
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<tbody>
<tr>
<td>Zn</td>
<td>ZINPRO® zinc methionine Availa®Zn</td>
<td>80</td>
<td>60</td>
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<tr>
<td>Cu</td>
<td>CuPlex® Availa®Cu</td>
<td>10</td>
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<tr>
<td>Mn</td>
<td>MANPRO® Availa®Mn</td>
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<tr>
<td>Fe</td>
<td>Availa®Fe</td>
<td>100</td>
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<tr>
<td>I</td>
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<td>1</td>
</tr>
<tr>
<td>Se</td>
<td>Availa®Se</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Cr</td>
<td>MiCrPlex® Availa®Cr</td>
<td>0.4</td>
<td>0.4</td>
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*Not a current ZPM source<br>aNote upper limit allowed in EU is of 0.2 ppm, provided as organic source<br>bUse 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.

Or contact your local Zinpro representative.