

# Protein Requirements of fish



# Protein

- Composed of amino acids
  - Ten can be synthesized by vertebrates, including fish
    - Essential: Must supply = protein quality
- Important component in diet
  - Expensive
    - Small quantity of good protein produces large amount of fingerlings
- Used for FISH GROWTH
  - A fish does not have a minimum protein requirement; it has a minimum amino acid requirement
    - Nutritionist should know AA composition and digestibility
  - Poor quality protein is burned for energy or deposited as fat

# Factors Affecting Protein Requirement

- Size of fish: Small fish require more protein than larger fish
- Protein quality: Protein needs to be of good quality (such as from grain amaranth or black soldier fly larvae)
- Natural foods: Some fish use natural foods effectively.
  - Depends on stocking density

# Factors Affecting Protein Requirement

- Protein: Energy Ratio:
  - If energy level of diet low, you will waste protein to meet metabolic needs. Inefficient and expensive.
  - If protein level low and energy moderate, then fish will get fat.
  - If energy level too high, it suppresses food intake and fish don't meet protein requirement. Results in low growth rate over time and undersized fish.

## Factors affecting protein requirement

- ❖ Size and age
- ❖ Fertility of the culture systems
- ❖ Levels of anagement and intensification
- ❖ Seasons
- ❖ Geographic location



# What is the role of protein in fish nutrition?

- First major component required for proper nutrition of fish is protein.
- ***Protein***
  - Formed from compounds known as amino acids.



# What is the role of protein in fish nutrition?

- ***Amino acids***

- Building blocks of protein.
- Needed by animals for proper nutrition.
- 10 amino acids are essential.
- Broken down during digestion.
- Used to produce new tissue or reproduce damaged tissue.



## **Amino Acids Essential to Fish and the Minimum Percentage Required for Rainbow Trout**

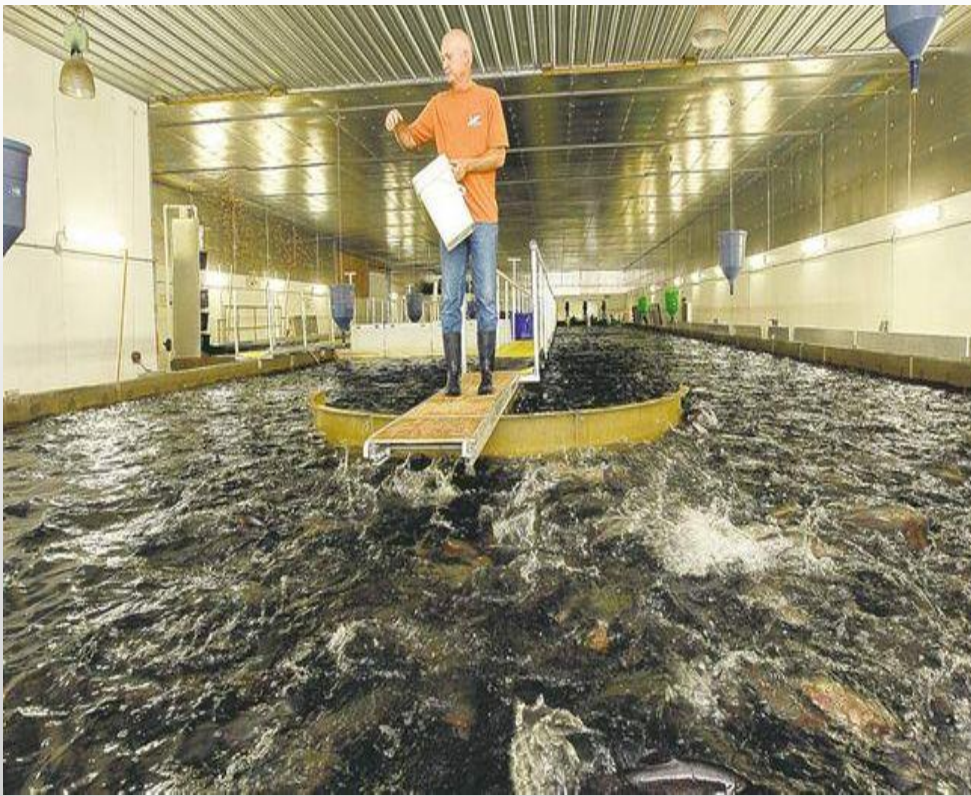
<b>Amino Acid</b>	<b>Percentage Required</b>
Arginine	2.5
Lysine	2.1
Isoleucine	1.5
Valine	1.5
Cystine	1.0
Leucine	1.0
Threonine	0.8
Histidine	0.7
Methionine	0.5
Tryptophan	0.2

Source: W.O. McLarney, *The Freshwater Aquaculture Book*. Point Roberts, Washington: Hartley & Marks, Inc., 1987, p. 156.



# Protein

- Most critical component of fish feed.
- Prepared fish feed will contain between 25 and 40 percent protein.



## Protein sources – Predominantly used

### Animal proteins

- Fish meal
- Squid meal
- Clam meal
- Mussel meal
- Crab head meal
- Prawn head meal
- Squilla meal
- Silkworm pupae
- Poultry waste meal
- Slaughter house waste



Squid liver meal

## Plant sources

- Soybean meal
- Wheat products
- Yeast
- Cotton seed meal
- Peanut meal
- Corn glutens meal
- Rice bran
- Wheat bran
- Ground nut oil cake
- Tapioca flour



# Sources of protein

## – ***Fish meal***

- High protein feed derived from fish.

## – Animal waste products

### • ***Blood meal***

- High protein feed derived from blood collected during the slaughter process.

- Meat scraps

## – ***Soybean meal***

- High protein feed produced from soybeans.

# Protein requirements

- ***Carnivore*** fish
  - Fish that eat meat.
  - Require 50% of its protein from animal sources.
- ***Herbivore*** fish
  - Fish that eat plants.
  - Need only about 30% of the protein in their feed from animal sources.
- ***Omnivores***
  - Fish that eat both plants and animals.
  - Need only about 30% of the protein in their feed from animal sources.

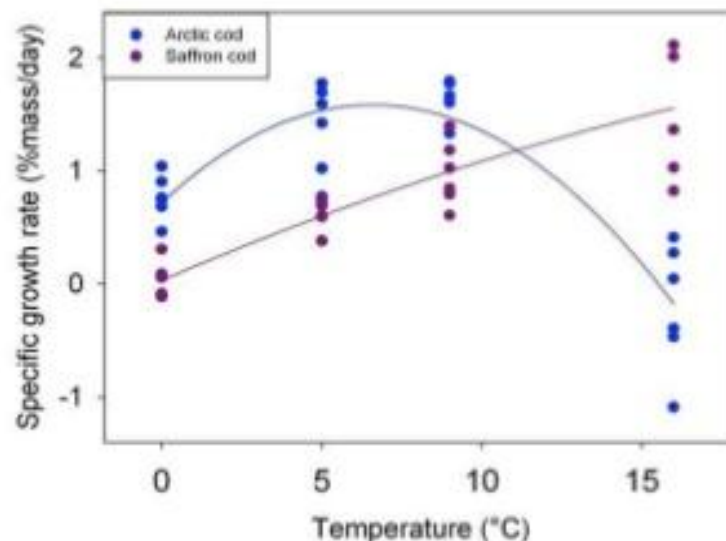
❖ Carnivorous fish needs 40-50%

❖ Omnivorous fish needs 25-35%

❖ Warm period and tropical climate require lesser protein and carbon and vice- versa

❖ **Linear relationship between dietary protein requirement and Specific Growth Rate exists**

❖ **Warm water fish have faster SGR than temperate fish**



# Typical Protein Requirements For Tilapia

First feeding fry	45-50%
0.02-2.0 g	40%
2.0-35.0 g	35%
35.0 g - Harvest	30-32%

## Protein requirement in teleost

Protein level in aquaculture feeds generally average

- ❑ 18-20% for marine shrimp
- ❑ 28-32% for catfish
- ❑ 38-42% for striped bass
- ❑ 32-38% for tilapia



Protein requirements usually lower for herbivorous fish and omnivorous fish than carnivorous fish.



Protein requirements are higher for fish reared in high density than low density systems

Protein requirements are **higher for smaller fish.**

As fish grows larger, their protein requirements usually decrease.

Protein requirements also varies with

- rearing environment**
- Water temperature**
- Water quality**
- Feeding rates of fish**
- Genetic composition**



## **Nutritional value of proteins**

Used as guide to the effectiveness of a particular protein sources in supplying animals required

3 main methods

- PER**
- NPU**
- Essential amino acid index.**

## PER-Protein Efficiency Ratio

Relates weight gained to g of crude protein fed

$$\text{PER} = \frac{\text{g wet wt gain}}{\text{g crude protein fed}}$$

- ❑ This method makes no allowance for protein used for maintenance
- ❑ But **widely used as method of determining appropriate protein sources for fish diets**

## NPU-Net Protein Utilization

most satisfactory method.

$$\text{NPU} = \text{biological value} \times \text{digestibility}$$

Several technical difficulties occur when determining biological value and digestibility.

This was rewritten as

$$\text{NPU} = \frac{\text{final body wt} - \text{initial body wt}}{\text{Total protein fed}} \times 100$$

## Essential Amino Acid Index

EEA index = geometrical average of 10 essential amino acid

This is used only if the AA requirement for the given sp is known

## Pathologies resulting from defeciencies

- ❑ Decrease in amino acid- cause reduction in weight gain
- ❑ **Methionine and tryptophan** – not only incorporated into proteins but also used for the synthesis of other essential compounds.

**Cataracts- methionine deficiency** in salmonids  
lens become opaque after 2-3months



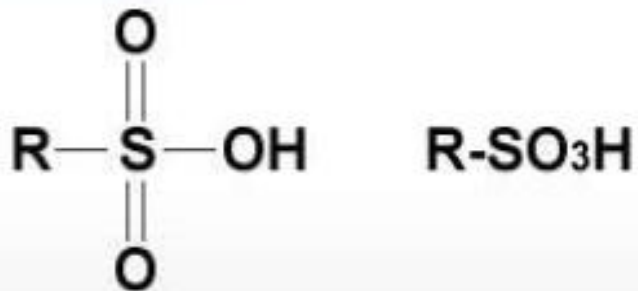
Sulfo -amino acids deficiency

Increases lens opacity and gradually progress causing large reduction in light transmission.

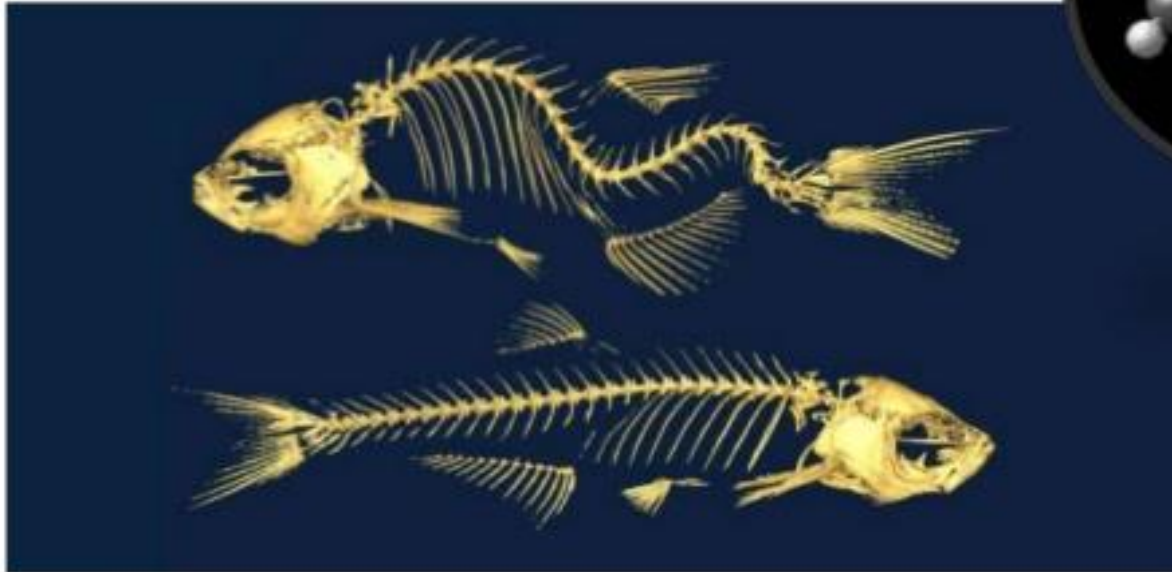
Cataracts – due to tryptophan deficiency in rainbow trout(same pattern as in methionine deficiency)



Sulfonic acid



□ **Tryptophan deficiency** – changes **mineral metabolism in Rainbow trout**



□ **Increase in calcium ,sodium, potassium** in kidney over 4 fold than control trout was observed.

□ **This leads to scoliosis**

□ In chum salmon scoliosis can be reversed by restoring tryptophan to normal condition in diet.



## References

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# Review / Summary

- What is the role of protein in fish nutrition?
- What is the role of fats in fish nutrition?