

# **Endocrinology of Fish**

**MS I (Semester-II)**

**Maj/Zoo-S-406**

# **Lecture – 06**

## **Growth Hormone**

# Growth Hormone (GH)

somatotropic hormone or somatotropin

- A small protein molecule, that contains 191- aa in a single chain.
- Has great effect in growth and metabolism.
- Acts on all cells of the body throughout life.

# Synthesis, transport, & mechanism of action of GH

Synthesized in ER of glandular cells as preprohormone; and stored in secretory vesicles in its active form until stimulated.

Dissolve freely in the blood.

Its receptors are found on or in cell membrane of target cells.

Stimulates G-proteins in the membrane of target cell, which stimulate (2) second messenger systems

1. adenylyl cyclase → cAMP.

2. phospholipase C →  $IP_3$ /  $Ca^{2+}$

# Functions of growth hormone:

## **A) Promotion of growth:**

increases cellular sizes and increase mitosis  
increases tissue growth and organ size.

IGF-1

IGF-2

are secreted by liver

# Functions of growth hormone

## B) Short- term metabolic effects:

1. Protein metabolism: Anabolic,

↑ rate of protein synthesis in all cells.

2. Fat metabolism: Catabolic,

↑ mobilization of FFAs from adipose tissue stores to provide energy.

3. CHO metabolism: Hyperglycemic,

↓ rate of glucose utilization throughout the body and ↓ glucose uptake by cells.

GH enhances body protein, uses up fat stores, and  
conserves carbohydrates

# Role of GH in promoting protein synthesis

GH has 4 effects to ↑ rate of protein synthesis in all cells of the body:

1. Enhancement of aa transport through cell membranes.
2. Enhancement of RNA translation to cause protein synthesis by the ribosomes.
3. ↑ nuclear transcription of DNA to form RNA.
4. ↓ catabolism of protein & aa.

The net result is more intracellular protein

# Role of GH in Fat metabolism:

GH enhances fat utilization for energy

1. GH acts on fat cells (adipocytes) to release fatty acids from the triglycerides to the blood.

2. GH produces several 2 carbon fragments (acetates).

Since fatty acid is a stearic acid ( $C_{14}H_{35}COOH$ ). GH acts on stearic acid → several 2-carbon fragments (acetate  $CH_3COOH$ ).

3. Formation of acetyl- CoA.

[acetate + Co-enzyme A (Co-A) → acetyl-CoA].

4. Acetyl-CoA enters Krebs cycle to produce  $CO_2 + H_2O +$  Energy.



# Role of GH in Carbohydrate metabolism

GH ↓ CHO utilization:

1. Enhancement of glycogen deposition in the cell.
2. Diminished uptake of glucose by the cells & ↑ blood glucose concentration – “ Pituitary Diabetes”.
3. ↓ use of glucose for energy.
4. ↑ secretion of insulin – Diabetogenic effect of growth hormone.

## Role of GH in Carbohydrate metabolism

GH ↓ CHO utilization:

Usage of fat by Krebs's cycle reduces glucose breakdown.

Cells build up glycogen up to certain limit.

Glucose concentration ↑ intracellularly until equilibrium with ECF.

This blocks glucose entry into the cell.

Blood glucose will ↑ with next meal, which promotes insulin secretion till exhaustion of  $\beta$  cells of pancreas.

GROWTH HORMONE

MUSCLE

- ↑ Amino acid uptake
- ↑ Protein synthesis
- ↓ Glucose uptake

Increased muscle mass

LIVER

- ↑ Protein synthesis
- ↑ RNA synthesis
- ↑ Gluconeogenesis
- ↑ Somatomedin production

ADIPOSE

- ↓ Glucose uptake
  - ↑ Lipolysis
- Decreased adiposity

SOMATOMEDINS

IGF-I IGF-II

CHONDROCYTES OF BONE

- ↑ Collagen synthesis
- ↑ Protein synthesis
- ↑ Cell proliferation

Increased linear growth

MANY ORGANS AND TISSUES

- ↑ Protein synthesis
- ↑ RNA synthesis
- ↑ DNA synthesis
- ↑ Cell size and number

Increased tissue growth  
Increased organ size

Insulin-like effects of GH

Anti-insulin effects of GH

# Control of GH secretion:

1. The hypothalamus:

a. GHRH  $\rightarrow$   $\uparrow$  GH secretion.

b. GHIRH (somatostatin)  $\rightarrow$   $\downarrow$  GH secretion.

2. Hypoglycemia  $\rightarrow$   $\uparrow$  GH secretion.

(N.B. glucose intake  $\rightarrow$   $\downarrow$  GH secretion).

3. Muscular exercise  $\rightarrow$   $\uparrow$  GH secretion.

4. Intake of protein or amino acids  $\rightarrow$   $\uparrow$  GH secretion.