

**B.Sc ZOOLOGY (HONS)**

**DEGREE III**

**PAPER V**

**ISLETS OF LANGERHANS**

**Dr.Anjali Gupta**

**Associate professor**

**Department of zoology**

**H.D.Jain College**

## ISLETS OF LANGERHANS

The groups of ductless cells located in the spaces between the lobules of pancreas are designated as **Islets of langerhans**. This was discovered by langerhans in 1869; being ductless these pour their secretion directly into the blood, represent the endocrine portion of the pancreas. The number of islets within the pancreas of man is about 2 million and constitutes about 1% of the weight of pancreas. The diameter of each Islet is about 20- 30  $\mu\text{m}$  and all Islets collectively weigh about 1 gram. Islets of langerhans comprised of three distinct type of cell which lies in the highly vascularised bed.

1. **Alpha cells:** These cells constitute about 15 to 20% of the Islet cells. It contains alcohol soluble blue staining granules. These are also designated as oxyphils and secrete hormone known as **Glucagon**.
2. **Beta cells:** These constitute about 72- 75% of the islet cells. These are smaller in size. These have granular protoplasm which stains bluish purple. Granules are insoluble in alcohol and secrete the hormone **Insulin**.
3. **Gamma cells:** These constitute about 5% of the islet cells. These secrete **Somatostatin** that inhibits secretion of Insulin, Glucagon and GH.



- ii. It is a proteinous hormone and is secreted by  $\beta$ - cells of islets of langerhans. It consists of 51 amino acids arranged in two chains, namely, A-chain and B-chain.
- iii. A- Chain contains 21 amino acids. B-chain contains 31 amino acids. Both A-chain and B-chain are held together by two disulfide bonds. Cys7 and Cys 20 of A-chain are joined to Cys 7 and Cys19 of B- Chain respectively. There is also a third intra sulphide bridge between 6th and 11th amino acids of A- chain.
- iv. Insulin protein is albumin in nature having a molecular weight of 35000. It is hydrolyzed by proteolytic enzymes. Hence it is not effective when taken orally
- v. Reducing or alkali agents breakdown the disulfide bonds and can inactivate the Insulin. But it is relatively stable in slightly acids solution.
- vi. It is prepared in crystalline form. Its crystallization requires  $Zn^{++}$ . Insulin remains stored in islet cells as Zinc salt. **Abert** prepared pure crystalline Insulin in 1926.

## PHYSIOLOGICAL ACTION OF INSULIN:

- **Actions on cell permeability membrane:**

1. Insulin promotes the entry of glucose in to all cells of the body except liver, brain and RBC.

2. As it increases  $\text{Na}^+$ ,  $\text{K}^+$  ATPase activity of cells, hence it facilitates the entry of  $\text{K}^+$  inside the cell.

- **Action on metabolism:**

1. **Carbohydrate:** The net effect is lowering of blood glucose level and increases glycogen storage. This can be achieved by several mechanism such as:

- i. Increases glucose uptake into the cell.
- ii. Increases Glycolysis i.e, accelerates the Phosphorylation of glucose by the enzyme Glucokinase or Hexokinase
- iii. Stimulates Glycogenesis i.e, it promotes the formation of glycogen from glucose in the liver and muscles.
- iv. Prevents Gluconeogenesis i.e, it reduces the production of glucose from non carbohydrate substances such as proteins and fats.
- v. Prevents formation of Ketone by increasing conversion of pyruvate into acetyl CoA.

2. **Protein:** It increases Protein synthesis by promoting incorporation of amino acids into peptides. It promotes growth by nitrogen retention, bone formation etc.

3. **Fat:** Insulin decreases the free fatty acid level and increases the triglyceride.

4. **Nucleic acid:** Insulin promotes the synthesis of DNA and RNA.

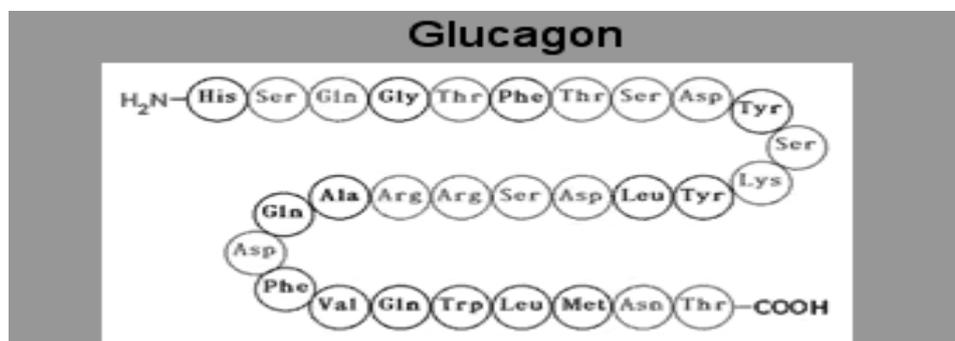
5. **Mineral:** Insulin increases the concentration of intracellular potassium ion.

High blood sugar level stimulates production of insulin while low level of blood sugar depresses the secretion of Insulin.

Irregularity in insulin secretion disturbs the proper utilization of glucose. This results in increase of glucose in blood in too excess which passes out ultimately in urine. This condition is recognized as a disease known as **Diabetes mellitus**.

## B: GLUCAGON

### 1. Structure and chemical nature:



- I. The presence of Glucagon in the cells of Islets of langerhans was demonstrated by Kimball and Murlin in 1923.
- II. Glucagon is a polypeptide hormone. It is produced by  $\alpha$ - cells of Islets of langerhans. It consists of 29 amino acids of 15 different kinds. Its molecular weight is about 3485.
- III. Unlike insulin it does not contains cysteine, proline or isoleucine, but it contains tyrosine, methionine or tryptophan.
- IV. It does not need zinc for crystallization.

## 2. **PHYSIOLOGICAL ACTION OF GLUCAGON:**

I. **Carbohydrate metabolism:** Glucagon increases the blood glucose by increasing (a) glycogenolysis and (b) gluconeogenesis in liver.

### II. **Lipid metabolism:**

(a) Glucagon increases breakdown of triglyceride to produce free fatty acid and glycerol.

(b) By anti lipogenic action it reduces synthesis of fatty acid.

III. **CALOROGENIC ACTION:** It increases heat production, hence increases the BMR.

IV. **Action on heart:** It has the inotropic effect on heart.

V. **On mineral metabolism:**

a) **Potassium:** It increases Potassium ion release from the liver.

b) **Calcium:** It lowers down Calcium as it increases the release of Calcitonin from the thyroid.

The secretion of Glucagon is controlled by the blood sugar itself. Low blood sugar stimulates and high blood sugar diminishes its secretion.

### **C. Somatostatin**

Somatostatin (SS) is a 14-and 28- amino acid peptide discovered in 1973, which is synthesized in neurons and in delta cells of the pancreas. Somatostatin inhibits the release of numerous hormones in the body.

\*\*\*\*\*