**Course Title: Human Physiology**

**Instructor: Dr. Sara Naeem**

**Total Marks: 30**

**Question 1**

Explain homeostatic mechanism regarding the control of calcium in the body with reference to parathyroid hormone and calcitonin.

**Control of calcium:**

Calcium metabolism or calcium homeostasis is the mechanism by which the body maintains adequate calcium levels.

* Calcium release from bone is regulated by parathyroid hormone.
* Calcitonin stimulates incorporation of calcium in bone

This mechanism effects the kidneys and the bones.

**Effects of parathyroid hormone:**

When blood calcium level is low then the parathyroid hormone is secreted.

The kidneys are also effected by the low levels of calcium as it starts the reabsorption of calcium, so as to not let it be excreted in the urine.

Calcium receptors: A specific receptors is present in the parathyroid cell plasma membrane which senses the change in the concentration of calcium levels in the extracellular fluid even at small levels.

It responds to the small alteration within seconds when it occurs.

**Effects of calcitonin:**

Calcitonin effects are opposite to that of the Parathyroid hormone.

When the calcium levels are high then the calcitonin is secreted.

**Rise of Calcium levels:**

When blood calcium concentration rises, the secretion of calcitonin increases in the blood by the parafollicular cells of the thyroid gland.

At the same time, the parathyroid glands reduce parathyroid hormone secretion into the blood.

The resulting high levels of calcitonin in the blood stimulate the bone to remove calcium from the blood plasma, and deposit it as bone. Removal of calcium from the bone is also inhibited.

**Decrease of calcium levels:**

When the blood calcium level is too low, calcitonin secretion is inhibited and parathyroid hormone secretion is stimulated. This results in the removal of calcium from the bone to correct blood calcium levels.

Parathyroid hormone decreases the phosphate levels and increases the plasma calcium levels.

It also stimulates the kidneys to start the reabsorption of calcium in the distal tubules.

QUESTION 2

Give clinical differentiation between hypothyroidism and hyperthyroidism.

|  |  |
| --- | --- |
| **Hyperthyroidism:** | **Hypothyroidism:** |
| In hypothyroidism the gland produces excessive hormones i.e thyroxine (T4) and triiodothyronine (T3), | In hypothyroidism the gland produces deficient amount of hormones. |
| Indicates sign of increased metabolism. | Indicates signs of slow metabolism. |
| Grave’s disease is a common cause. | Hashimoto’s disease is a common cause. |
| Decreased weight despite increased appetite. | Increased weight despite poor appetite. |
| Heat intolerance. | Cold intolerance. |
| Thyroid stimulating hormone level will be reduced or be normal. | Thyroid Stimulating Hormone level will be increased. |
| The patient will experience insomnia and restlessness. | The patient will experience tiredness and sleepiness. |
| High blood cholesterol. | Low blood cholesterol. |
| Hyperactivity. | Depression. |
| Hair fall. | Coarse, dry hair. |
| Increased heart rate. | Decreased heart rate. |
| Varying degrees of diarrhea | Constipation. |
| Muscle weakness | Muscle sluggishness. |

Question 3

Classify enzymes and their function in digestion.

**Enzymes:**

Digestive enzymes speed up the breakdown of food. Digestive enzymes are found inside the digestive tracts.

**Classification:**

Digestive enzymes are classified based on their target [substrates](https://en.wikipedia.org/wiki/Enzyme_substrate):

* [**Lipases**](https://en.wikipedia.org/wiki/Lipase) split [fatty acids](https://en.wikipedia.org/wiki/Fatty_acid) off of [fats](https://en.wikipedia.org/wiki/Fat) and [oils](https://en.wikipedia.org/wiki/Oil).
* [**Proteases**](https://en.wikipedia.org/wiki/Protease) and [**peptidases**](https://en.wikipedia.org/wiki/Peptidase) split [proteins](https://en.wikipedia.org/wiki/Protein) into small [peptides](https://en.wikipedia.org/wiki/Peptides) and [amino acids](https://en.wikipedia.org/wiki/Amino_acid).
* [**Amylases**](https://en.wikipedia.org/wiki/Amylase) split [carbohydrates](https://en.wikipedia.org/wiki/Carbohydrate) such as [starch](https://en.wikipedia.org/wiki/Starch) and [sugars](https://en.wikipedia.org/wiki/Sugar) into [simple sugars](https://en.wikipedia.org/wiki/Monosaccharide) such as [glucose](https://en.wikipedia.org/wiki/Glucose).
* [**Nucleases**](https://en.wikipedia.org/wiki/Nuclease) split [nucleic acids](https://en.wikipedia.org/wiki/Nucleic_acid) into [nucleotides](https://en.wikipedia.org/wiki/Nucleotides).

**Pancreatic digestive enzymes:**

Pancreatic secretions consists of multiple types of enzymes for digesting all three major types of food particles i.e. proteins, carbohydrates and fats.

**Enzymes for digestion of Proteins:**

* Trypsin (most abundant)
* Chymotrypsin
* Carboxypolypeptidase

**Trypsin** and **Chymotrypsin** split the digested proteins into peptides of different sizes but do not cause the release of the amino acids.

**Carboxypolypeptidase** splits some peptides into amino acids due to which the digestion of some proteins is completed to amino acid state.

The proteolytic enzymes i.e. trypsinogen, chymotrypsinogen and Carboxypolypeptidase when they are synthesized they are present in an inactive form. They become active after they are secreted in the intestinal tract. It is important that they become active after being secreted into the intestines because if not they would digest the pancreas.

**Enzymes for the digestion of Carbohydrates:**

* Pancreatic amylase

**Pancreatic amylase** hydrolyzes starch, glycogen and other carbohydrates except cellulose to form mostly disaccharides and some disaccharides.

**Enzymes for the digestion of Fats:**

* Pancreatic lipase
* Cholesterol esterase
* Phospholipase

**Pancreatic lipase** hydrolyzes neutral fats into fatty acids and monoglycerides

**Cholesterol esterase** causes hydrolysis of cholesterol esters

**Phospholipase** splits fatty acids from phospholipids

**Enzymes for the digestion of nucleic acid:**

* Ribonuclease
* Deoxyribonuclease

**Ribonuclease and Deoxyribonuclease** splits nucleic acid into free mononucleotides.