

# **MODULE 6 : Gastrointestinal System**

## **Biochemistry – Undergraduate Programme**

**Faculty of Medicine and Allied Sciences**

**Rajarata University of Sri Lanka**

### ***Broad Objectives***

At the end of this course a student is expected to know the,

1. Digestion and absorption of food.
2. Disorders related to indigestion and tests done to diagnose such disorders
3. GI hormones and their action.
4. Structure and functions of the liver.
5. Structure and the exocrine functions of the pancreas.

### ***Specific Objectives***

#### ***1 Digestion and Absorption***

##### **1.1 Mouth**

- 1.1.1 Explain the constituents of saliva that aid in food digestion.
- 1.1.2 State the dietary constituents that are absorbed in the mouth.

##### **1.2 Stomach**

- 1.2.1 Recall the three most important constituents released by gastric mucosa and explain their functions.
- 1.2.2 Explain the activation of pepsinogen and its role in milk clotting and protein digestion.
- 1.2.3 State the dietary constituents that are absorbed in the stomach.

##### **1.3 Small Intestine**

- 1.3.1 Recall the organization of the intestinal brush border to promote maximum absorption of nutrients.
- 1.3.2 List enzymes secreted by the intestinal mucosa.
- 1.3.3 Recall the channels through which pancreatic and biliary secretions are delivered.
- 1.3.4 List the constituents of pancreatic secretion.
- 1.3.5 List the constituents of bile and explain their functions.
- 1.3.6 Explain digestion of carbohydrate, protein and fat in the intestine.
- 1.3.7 Recall that cells lining the small intestine are sloughed off every 2-5 days and these are digested and used.
- 1.3.8 Explain the importance of the architecture of the small intestine in the maintenance of the nutritional status of the body.
- 1.3.9 Recall the sites of absorption of nutrients.
- 1.3.10 Recall the importance of
  - (a)  $\text{Na}^+$  in glucose and amino acid absorption
  - (b)  $\text{B}_6$  in amino acid metabolism
  - (c) bile salts and phospholipids in fat absorption
  - (d) intrinsic factor in  $\text{B}_{12}$  absorption
  - (e) vit. D in  $\text{Ca}^{2+}$  absorption
  - (f) vit. C in  $\text{Fe}^{2+}$  absorption

- 1.3.11 State the products of protein digestion that enter the absorptive cell.
- 1.3.12 List the carriers known to transport groups of amino acids in to the absorptive cell.
- 1.3.13 Recall that essential amino acids in excess could retard absorption of other essential amino acids of the same class
- 1.3.14 Explain why the composition of amino acids appearing in the blood differ from those in the ingested protein.
- 1.3.15 Recall that the uptake of micelles is dependent on the size.
- 1.3.16 Describe the alteration to the lipid constituents in the enterocytes before entering the blood via the lymphatic and the portal systems.
- 1.3.17 Describe the structure of a chylomicron and its fate in the blood.
- 1.3.18 Describe the enterohepatic circulation and its importance in fat digestion.

#### 1.4 Large Intestine

- 1.4.1 Recall that water and volatile fatty acids, vitamin K and ammonia arising from bacterial action are absorbed in the large intestine.

## 2. *Digestive Disorders*

- 2.1 Explain the digestive disorders resulting from achlorhydria, intrinsic factor deficiency, biliary deficiency, lactase deficiency, protein energy deficiency, folate and B<sub>12</sub> deficiency, pancreatic exocrine insufficiency and coeliac disease.
- 2.2 Explain the alteration of the constituents present in the blood, urine and the faeces in the disorders stated in 4.1.
- 2.3 Recall the change in the lactase activity with age and the variation in activity and the type in adults of the different ethnic groups.
- 2.4 State the clinical signs and symptoms of lactose intolerance.
- 2.5 Explain the biochemical tests that can be done to investigate disorders stated in 4.1.

## 3 *Gastrointestinal Hormones*

- 3.1 Recall the names of the GI hormones and their sites of release (Physiology).
- 3.2 Recall the functions of the GI hormones (Physiology).

## 4 *Liver*

- 4.1 Draw a cross section of the liver to show the arrangement of the lobules, the bile canaliculi and cholangioles, the hepatic sinusoid and portal canal.
- 4.2 Describe the biliary secretory apparatus.
- 4.3 Explain the functions of the liver in the following activities.
  - 4.3.1 Synthesis of bile and its excretion.
  - 4.3.2 Synthesis of proteins and secretion.
  - 4.3.3 Synthesis of lipoproteins.
  - 4.3.4 Synthesis of glucose, glycogen and ketone bodies.
  - 4.3.5 Detoxication.
- 4.4 Recall that liver dysfunction may be determined by tests based on
  - a) excretory, b) biosynthetic, c) metabolic functions, and d) blood levels of liver specific enzymes.

- 4.5 Describe the metabolic derangements resulting from the deficiency [Glycogen storage disease] of a) glycogen synthetase b) debranching enzyme c) phosphorylase and d) glucose-6-phosphatase in the liver.
- 4.6 Explain the biochemical basis of the following 'excretory test'.
  - a) serum level of conjugated and unconjugated forms of bilirubin.
- 4.7 Explain how the biosynthetic capacity may be tested by estimating the following:
  - 4.7.1 Carbohydrate metabolism by the fasting blood glucose level and the glucose tolerance test.
  - 4.7.2 Lipid metabolism by the lipid profile.
  - 4.7.3 Protein metabolism by the blood urea and the ammonium concentration.
- 4.8 Correlate the degree of cell damage with change in the serum enzyme levels.
  - 4.8.1 An elevation of serum alkaline phosphatase (heat stable form) in hepatobiliary dysfunction.
  - 4.8.2 An elevation of amino transferases (AST, ALT) in liver damage.
  - 4.8.3  $AST / ALT < 1$  in acute liver damage and  $AST / ALT > 1$  in chronic liver damage.
  - 4.8.4 An elevation of lactate dehydrogenase ( $LD_5$  or  $M_4$ ) in liver damage.
  - 4.8.5 A persistent higher elevation of the total serum LDH relative to serum ALT level in acute hepatitis.
- 4.9 Explain the factors that promote the formation of gall stones.
- 4.10 Recall the composition of the different types of gall stones commonly found.
- 4.11 Analyse the gall stones.

## **5 Pancreas**

- 5.1 State the constituents of exocrine secretion and their role in carbohydrate, protein and fat digestion.
- 5.2 List the conditions that result in exocrine dysfunction and explain how each affects digestion.
- 5.3 Describe the laboratory tests for diagnosis of exocrine dysfunction.

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