ASSIGNMENTS 30th December 2018

1. **Describe functions of each region of the gastro intestine tract.**

**gastrointestinal (GJ) tract**

**Mouth**

starch hydrolysis catalysed by amylase, secreted by the salivary glands; fat hydrolysis catalysed by lingual lipase, secreted by the tongue; absorption of small amounts of vitamin C and a variety of non-nutrients (including nicotine).

**Stomach**

denaturation of dietary proteins and the release of vitamin B12, iron and other minerals from

protein binding, for which gastric acid is important; protein hydrolysis catalysed by pepsin; fat hydrolysis catalysed by lipase. secretion of intrinsic factor, required for the absorption of vitamin B12

**Small intestine (duodenum, jejunum and ileum)**

starch hydrolysis catalysed by amylase secreted by the pancreas; hydrolysis of disaccharides within the brush border of the intestinal mucosa; fat hydrolysis catalysed by lipase secreted by the pancreas; protein hydrolysis catalysed by a variety of exo- and endopeptidases secreted by the pancreas and small intestinal mucosa; hydrolysis of di- and tripeptides within the brush border of the intestinal mucosa; absorption of the products of digestion; absorption of water (failure of water absorption, as in diarrhoea, can lead to serious dehydration

• **Large intestine** (caecum and colon)

bacterial metabolism of undigested carbohydrates and shed intestinal mucosal cells; absorption of some of the products of bacterial metabolism; absorption of water.

• **Rectum**

storage of undigested gut contents prior to evacuation as faeces;

1. **Explain the digestion and absorption of lipids, the role of bile salts and the formation of chylomicrons.**

The final emulsification of dietary lipids into micelles (droplets that are small enough to be absorbed across the intestinal mucosa) is achieved by the action of the bile salts. The bile salts

are synthesized from cholesterol in the liver, and secreted, together with phospholipids and cholesterol, by the gall bladder. As shown in Figure 4.15, some 2 g of cholesterol and 30 g of bile salts are secreted by the gall bladder each day, almost all of which is reabsorbed, so that the total faecal output of steroids and bile salts is 0.2–1 g/day.

The primary bile salts (those synthesized in the liver) are conjugates of chenodeoxycholic acid and cholic acid with taurine or glycine (Figure 4.16). Intestinal bacteria catalysedeconjugation and further metabolism to yield the secondary bilesalts, lithocholic and deoxycholic acids. These are also absorbed from the gut, and are reconjugated in the liver and secreted in the bile.

**Lipids absorption and Chylomicrons**

The finely emulsified lipid micelles, containing free fatty acids with small amounts of intact triacylglycerol, monoacylglycerol, phospholipids, cholesterol and fat-soluble vitamins are absorbed across the intestinal wall into the mucosal cells. Here, fatty acids are re-esterified to form triacylglycerols (see Figure 5.28), and are packaged together with proteins synthesized in the mucosal cells to form chylomicrons. These are secreted into the lacteal in the centre of the villus (see Figure4.2), and enter the lymphatic system, which drains into the bloodstream at the thoracic duct. In the fed state, in response to the action of insulin lipoprotein lipaseis active at the surface of cells in adipose tissue. It catalyses the hydrolysis of triacylglycerols in chylomicrons, and most of the resultant free fatty acid is taken upby adipose tissue for re-esterification to triacylglycerol for storage. The chylomicronremnants are taken up by the liver, by a process of receptor-mediated endocytosis, and most of the residual lipid is secreted, together with triacylglycerol synthesised in the liver, in very low-density lipoproteins

1. **Describe the absorption of minerals, especially iron.**

The Most minerals are absorbed by carrier-mediated diffusion into intestinal mucosal cells and accumulated by binding to intracellular proteins. There is then sodium-dependent active transport from the epithelial cells into the bloodstream, where again they are usually bound to transport proteins. Genetic defects of the intracellular binding proteins or the active transport systems at the basal membrane of the mucosal cell can result in functional deficiency despite an apparently adequate intake of the mineral. The absorption of many minerals is affected by other compounds present in the intestinal lumen. A number of reducing compounds can enhance the absorption of iron, and a number of chelating compounds enhance the absorption of other minerals.

**For iron**:

Only about 10% of dietary iron is absorbed, and only as little as 1–5% of that in many plant

foods. As discussed in section 11.15.2.3, iron deficiency is a serious problem; some 10–15% of

women of child-bearing age have menstrual iron losses greater than can be met from a normal

dietary intake. **Haem iron** in meat is absorbed better than is inorganic iron from plant foods, and

by a separate transport system.

Inorganic iron is absorbed only in the Fe2+ (reduced) form. This means that avariety of reducing

agents present in the intestinal lumen together with dietary iron will enhance its absorption. The

most effective such compound is vitamin C and, although intakes of 40–60 mg of vitamin C per

day are more than adequate to meet requirements, an intake of 25–50 mg per meal is sometimes.

recommended to enhance iron absorption. Alcohol and fructose also enhance iron absorption.

Like other minerals, iron enters the mucosal cells by carrier-mediated passive diffusion and is

accumulated in the cells by binding to a protein, ferritin. Once all the ferritin in the mucosal cell

is saturated with iron, no more can be taken up from the gut lumen. Iron can leave the mucosal

cell only if there is free transferrin in plasma for it to bind to and, once plasma ferritin is

saturated with iron, any that has accumulated in the mucosal cells will be lost back into the

intestinal lumen when the cells are shed at the tip of the villus.

The mucosal barrier to the absorption of iron has a protective function. Iron overload is a serious

condition, leading to deposition of inappropriately large amounts of iron in tissues, and about

10% of the population are genetically susceptible to iron overload. Once the normal tissue iron-

binding proteins are saturated, free iron ions will accumulate in tissues. This raises the interesting problem of whether or not it is desirable to recommend high intakes of

iron for women of child-bearing age in order to raise their iron reserves to the same level as seen

in men. This would prevent the development of iron deficiency but might also put them at risk of

iron overload and increased risk of atherosclerosis.

1. **Describe and explain the classification of amino acids according to their chemical and nutrition al properties.**

**The amino acids**

The Twenty-one amino acids are involved in the synthesis of proteins, together with a number that occur in proteins as a result of chemical modification after the protein has been synthesized. In addition, a number of amino acids occur as metabolic intermediates but are not involved in

proteins.

**Chemically the amino acids** all have the same basic structure – an amino group

(–NH2) and a carboxylic acid group (–COOH) attached to the same carbon atom (the a-carbon).

As shown in Figure 4.18, what differs between the amino acids is the nature of the other group

that is attached to the a-carbon. In the simplest aminoacid, glycine, there are two hydrogen

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atoms, while in all other amino acids there isone hydrogen atom and a side-chain, varying in

chemical complexity from the simple methyl group (–CH ) of alanine to the aromatic ring

structures of phenylalanine,tyrosine and tryptophan. Figure 4.18 does not show the structure of

the 21st amino acid, the selenium analogue of cysteine, selenocysteine

**The amino acids can be classified according to the chemical nature of the side-chain**.

whether it is hydrophobic (on the left of Figure 4.18) or hydrophilic (on the right of Figure 4.18), and the nature of the group:

* small hydrophobic amino acids: glycine, alanine, proline;
* branched-chain amino acids: leucine, isoleucine, valine;
* aromatic amino acids: phenylalanine, tyrosine, tryptophan;
* sulphur-containing amino acids: cysteine, methionine;
* neutral hydrophilic amino acids: serine and threonine
* basic amino acids: lysine, arginine, histidine.