Frequently asked questions:

1. What are lipids? Define lipids.

Ans: The term lipid is applied to a group of natural substances characterised by their insolubility in water and their solubility in such “fat solvents” as ether, chloroform, boiling alcohol and benzene. Chemically, the lipids are either esters of fatty acids or substances capable of forming such esters. The word ‘Lipid’ is used when discussing the metabolism of fats in the body whereas the term ‘Fats’ is used the fatty component of foods and diets.

The novel definition of Lipid is chemically based and defines lipids as small hydrophobic or amphipathic (or amphiphilic) molecules that may originate entirely or in part through condensations of thioesters and/or isoprene units.

2. What are lipids composed of and where are they present?

Ans: Lipids are composed of three elements carbon, hydrogen and oxygen. The amount of oxygen is lower in relation to the other two elements. Therefore, fat is more concentrated source of energy than carbohydrates. Lipids are wide spread in nature among all vegetable and animal matter. Some compounds of this group, such as phosphatide and sterols are found in all living cells. Lipids, with the proteins and carbohydrates form an essential part of the colloidal complex of protoplasm. Complex lipids are also found in large quantities in brain and nervous tissue.

3. List the importance of Fats and oils in Indian cookery.

Ans: Fat is used to shallow, pan-fry and deep fry foods. Foods fried in fats get caramelized, gelatinized and dextrinised. Fats are an integral component in bakery products and they act as leavening agents in cakes, pastries and breads. Fats and oils are important constituents of emulsions. Fats affect the smooth texture of products by interfering with sugar crystallization. They retard crystallization in crystalline candies. They also retard gelatinization in starch in mixtures thickened by starch. Fats improve the taste and palatability of foods cooked in it. They improve the flavour and aroma of foods and give them a characteristic taste.

4. What are the changes observed during deep-frying of food?

Ans: Deep-frying causes smoking and there is a direct transfer of heat from hot to cold food till food cooks. This causes loss of moisture from food surface and makes the food lighter. This leads to cooking of the entire food by heat transfer to the interior. Therefore, the outer surface becomes crisp and brown due to rapid evaporation of water from the surface.

5. How are lipids classified based on their structure?

Ans: Lipids are classified into three groups based on structure. They are simple, compound and derived lipids.

a. Simple lipids: These are esters of fatty acids with various alcohols. They are usually further classified according to the nature of the alcohols.

Eg's: **Fats and Oils, Waxes**

b. Compound Lipids: The compound lipids are esters of fatty acids containing groups other than and in addition, to an alcohol and fatty acids, phosphorous, carbohydrate or protein.

Eg's: **Phospholipids, Glycolipids, Aminolipids, sulpholipids, Lipoproteins**

c. Derived Lipids: These are substances liberated during hydrolysis of simple and compound lipids which still retain the properties of lipids. The important members of this group are sterols, fatty acids and alcohol.

Eg's: **Sterols, Fatty acids**

6. What are sterols?

Ans: Sterols are derived lipids and are solid alcohols which form esters with fatty acids. In nature they occur in the free state in the form of esters. Based on their origin sterols are classified as cholesterol (animal origin) and phytosterol (in plants). Cholesterol is a complex type of lipid that is regularly synthesized by and stored in the liver. It is present in all animal products.

7. What are fatty acids? How are they classified?

Ans: Fatty acids are the main building blocks of fat. They have a methyl group (CH_3) at one end and a carboxyl group (COOH) at the other end with a chain of carbon and hydrogen atom in the middle. They have a basic formula $CH_3(CH_2)_nCOOH$. Where 'n' denotes the number of carbon atoms which may vary from 2 to 2l.

Fatty acids can be classified into three broad classes according to the degree of unsaturation;

i. saturated fatty acids (SFA) have no double bonds,
ii. monounsaturated fatty acids (MUFA) have one double bond and
iii. polyunsaturated fatty acids (PUFA) have two or more double bonds.

8. What are saturated fatty acids? How are they classified?

Ans: Saturated fatty acids (SFA) are those that are unable to absorb more hydrogen, usually stiff, hard fats. They are further classified into four subclasses according to their chain length:

i. **Short - chain fatty acids**: Fatty acids with from 3 - 7 carbon atoms.
   Sources: Dairy fat (Butter)
ii. **Medium - chain fatty acids**: Fatty acids with from 8 - 13carbon atoms.
   Sources: dairy fat, coconut and palm kernel oils
iii. **Long - chain fatty acids**: Fatty acids with from 14 - 20 carbon atoms.
   Sources: most fats and oils
iv. **Very - long-chain fatty acids**: Fatty acids with twenty - one or more carbon atoms.
   Sources: peanut oil

9. What are unsaturated fatty acids? How are they classified?

Ans: Unsaturated fatty acids have one or more double bond in their molecule. Thus they are not saturated with hydrogen. They are liquid at room temperature.

Eg. Sunflower oil.

Unsaturated fatty acids may be monounsaturated or polyunsaturated depending on the number of double bonds. The unsaturated fatty acids are further classified into three sub - groups according their chain lengths.

- **Short - chain unsaturated fatty acids**: Fatty acids with 19 or fewer carbon atoms.
- **Long - chain unsaturated fatty acids**: Fatty acids with 20 - 24 carbon atoms.

- **Very – long - chain unsaturated fatty acids**: Fatty acids with 25 or more carbon atoms.

10. Discuss about Monounsaturated and polyunsaturated fatty acids.

Ans: **Monounsaturated fatty acids (MUFA):** MUFA have only one double bond in their molecule.

Eg. olive oil, mustard oil, sunflower, safflower oil, fish oils

Polyunsaturated fatty acids (PUFA): PUFA have more than one double bond in their molecule. PUFA can be divided into 12 families, ranging from double bonds located at the n-1 position to the n-12 position. The most important families, in terms of extent of occurrence and human health and nutrition, are the n-6 and n-3 families. Linoleic (ω-6) and α-linolenic (ω-3) acids are the simple PUFA, which attain major proportions in most vegetable oils. Soyabean, rapeseed, green-leafy vegetables and mustard oils contribute significant proportion of α linolenic (ω-3) acid.

11. Why lipids are not digested easily. Explain?

Ans: The digestion of fats and other lipids poses a special problem because of (a) their insolubility in water, (b) lipolytic enzyme solubility in an aqueous medium has limits. However, in the gut this problem is solved by emulsification of fats. Particularly by bile salts, present in bile and phospholipids. This emulsification greatly increases the surface area of the dietary lipid targeted for digestion. Consequently, the accessibility of the fat to digestive enzymes is greatly increased by bile salt action.

12. Discuss about digestion of triacylglycerols in stomach.

Ans: The digestion of triacylglycerols (TAG) begins in the stomach with lingual lipase released by the serous gland and gastric lipase produced by the chief cells of the stomach. These lipases account for much of the limited digestion (10% – 30%) of TAG that occurs in the stomach. The lipase activity is made possible by the enzymes at the low pH of the gastric juices. Both lingual and gastric lipases act on triacylglycerols containing medium- and short- chain fatty acids. They hydrolyze fatty acids, releasing a fatty acid and 1,2-diacylglycerols as products. Dietary fat in the stomach will be hydrolyzed by lingual, gastric lipases and emulsification. Emulsification takes place through muscle contractions and shearing forces, which squirt the

surface of a fat. Along with the muscle contraction, some of the emulsifiers in the acid medium include complex polysaccharides, phospholipids, and peptic digests of dietary proteins.

13. Discuss about digestion of triacylglycerols in small intestine.

Ans: Most TAG digestion occurs in the small intestine. Hydrolysis of the long chain fatty acids, require less acidity, appropriate lipases, more effective emulsifying agents (bile-salts). These conditions are provided in the lumen of the upper small intestine. The partially hydrolyzed lipid emulsion leaves the stomach and enters the duodenum as fine lipid droplets. Effective emulsification takes place with continuation of mechanical shearing and bile. Triacylglycerol breakdown products with bile salts acts as emulsifying agents. The action of pancreatic lipase on ingested triacylglycerols results in a complex mixture of diacylglycerols, monoacylglycerols, and FFAs. Therefore, the main path of this digestion progresses from triacylglycerols to 2,3-diacylglycerols and to 2-monoacylglycerols. Only a small percentage of the triacylglycerols is hydrolyzed totally to free glycerol.

14. How are lipids transported and absorbed in the body?

Ans: Lipids are transported and absorbed in the body in two forms- as small molecules and large molecules. Small molecules of digested triglycerides (glycerol, short & medium chain fatty acids) are absorbed directly into the blood stream. They bind with albumin and are transported directly to the liver. Larger molecules merge into spherical complexes known as micelles. The lipid contents of the micelles diffuse into the intestinal cells. Within the intestinal cells, micelles are placed into transport vehicle called chylomicrons. The intestinal cells then release chylomicrons into the lymphatic system. The lymph circulation empties the chylomicrons into the blood stream. The blood transport lipids to the rest of the body and cells absorb them and utilize for energy. Majority of lipids enter via the lymph to the liver where the protein and lipid (cholesterol, triglycerides) are bound together to form lipoproteins. They are chylomicrons, VLDL, LDL and HDL. Chylomicrons, VLDL and LDL serve to transport and deposit lipids from the intestine and liver to the tissues for absorption.

15. Explain the concept of Bad and Good cholesterol.

Ans: There are four types of transport lipids. They are chylomicrons, VLDL, LDL and HDL. LDL serves to transport and deposit lipids from the intestine and liver to the tissues. LDL favours lipid deposition in tissues including blood vessels and hence termed ‘bad’ cholesterol. HDL cholesterol removes the lipids from the tissues and transports it back to liver for disposal. Hence, it is termed as ‘good cholesterol’. High levels of LDL cholesterol indicates a high risk of cardiovascular disease.