Short answer type questions

Q.1. Define the term simple sugar.

Ans: The simple sugars, or monosaccharides, are the building blocks of carbohydrate chemistry. They are polyhydroxy aldehydes or ketones with five, six, seven, or eight carbon atoms that are classified appropriately as pentoses, hexoses, heptoses, or octoses, respectively. They can be designated by more specific names, such as aldohexose or ketohexose, to denote the kind of carbonyl compound they represent. As such, they provide the body with the energy that our organs and muscles need to function. Sugars are typically named in relation to their size and chemical structure.

Q.2. Distinguish between mono, di and polysaccharides.

Ans: *Monosaccharides* are single unit sugars with 'mono' meaning 'one' and 'saccharide' meaning sugar molecule. Monosaccharides commonly found in food are glucose, fructose and galactose. *Disaccharides* consist of two monosaccharides joined together. Disaccharides commonly found in food are sucrose (glucose + fructose), lactose (glucose + galactose) and maltose (glucose + glucose). Oligosaccharides contain 2-10 monosaccharide units and polysaccharides contain more than 10 monosaccharides joined together. Starch is a well known polysaccharide. *Oligo - and polysaccharides* are sometimes called 'complex carbohydrates' in recognition of their size difference from mono- and disaccharides, which are classed as 'simple sugars' due to their small size.

Q.3. Write a short note on affination.

Ans: The first step of sugar refining is called affination (a French word meaning refining). The process consists of mixing the sugar with a saturated syrup to soften the adhering film of molasses, then spinning and washing off as much of this adhering impure syrup as possible in centrifugal machines. The centrifugal machine utilizes the considerable gravitational force at the periphery of a basket spinning at high speed. This means minimum contact time between wash water and sugar, thus reducing the amount of sugar dissolved in this process. The impure syrup is recycled but an excess is produced. This material contains recoverable sugar and is processed separately in the boilout section of the refinery. Recovered boilout sugars are returned for remelting with the washed sugar. The impurities are concentrated into *molasses* which can be

regarded as a final by-product. The “washed” or “affined” sugar is then dissolved, utilizing “sweet” water from parts of the refinery process. At this stage the melted liquor is temperature and density controlled. The liquor is screened to exclude fibrous material.

Q.4.What is a chiral carbon?

Ans: Carbohydrates contain chiral carbon atoms. A chiral carbon atom is one that can exist in two different spatial arrangements (configurations). Chiral carbon atoms are those that have four different groups attached to them. The two different arrangements of the four groups in space (configurations) are nonsuperimposable mirror images of each other. In other words, one is the reflection of the other that we would see in a mirror, with everything that is on the right in one configuration on the left in the other and vice versa.

Q.5. Write a short note on production of sugar from sugarcane.

Ans: The processing of sugar cane is very similar. Sugar cane tends to be extracted in sugar mills in the country where it is grown through the following processes:

1. Cutting, shredding and crushing between heavy rollers.

2. Hot water spray and lime to clarify the juice.

3. Filtering of the brown juice produced.

4. Boiling of juice under vacuum to form thick syrup.

5. Separation of crystals (raw sugar) and syrup (molasses) in a centrifuge.

6. Brown raw sugar or crystals is then exported around the world for local refining.

Q. 6. Write short note on refining of sugars.

Ans: Raw sugar is the name applied to sugar crystals from the juice of sugar cane or sugar beet plants. Apart from sucrose, raw sugar contains reducing sugars, inorganic ash and other organic matter which includes gums, amino acids and colour components, essentially from the cane. These impurities must be removed from the sucrose during refining.

(i) Affination

The raw sugar is mixed with a saturated syrup and then centrifuged to extract the crystals.

Surface impurities (molasses) dissolve in this syrup and are removed.

(ii) Carbonatation

The sugar is redissoved and calcium hydroxide and carbon dioxide are added to the solution. These react according to the following equation

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

Colour, gum and amino acid impurities precipitate out with the calcium carbonate.

(iii) Char filtration

Activated charcoal is added to the syrup, removing colour and inorganic ash.

(iv) Crystallisation

The solution is boiled under vacuum and the crystal growth monitored to produce particular sizes of crystal.

Q.7. Write a short note on function of sugar in foods?

Ans: Sugars play an important role in different foodstuffs. As well as bringing sweetness, they also have important biological, sensory, physical and chemical properties. For example, sugars help provide the taste, texture and colour of foods, extend their shelf-life, which preserves the safety and quality of the food. Sugars can in some cases be reduced/replaced, but no other single ingredient can replace all the functions of sugars.

• Taste - Sugars generate flavours by interacting with proteins when heating; a process known as the Maillard Reaction.

• Texture - Sugars contribute to the texture of foods, providing sensations of crispiness in biscuits, for example.

• Colour -Again through the actions of the Maillard Reaction, sugars interact with food proteins giving certain foods a ‘golden colour’ e.g. bread and pastries.

• Shelf-life - Sugars improve the shelf-life of foods by lowering the water activity. Sugars reduce the amount of available water that supports the growth of micro-organisms

(bacteria, mould and yeast) so they cannot multiply and cause food spoilage. This preserves the safety and quality of the food.

Q.8.Write a short note on role of sugar in obesity?

Ans: Excessive consumption of calories, regardless of their source, can lead to weight gain and obesity. It is unlikely that any one food group is responsible for this complicated metabolic state. However, sugar offers “empty” calories, devoid of other nutritional benefits. By reducing the amount of sugar, and thus calories, in your diet, it is possible to lose weight without compromising intake of essential nutrients.

Additionally, eating foods with significant sugar content can create large swings in blood glucose, leading to subsequent overconsumption of food. Furthermore, multiple studies have examined the reward pathways associated with sugar consumption, noting that it is possible that sugar may be an addictive substance for some individuals. This may further contribute to overeating, leading to excessive weight gain.

Q.9. What is Invert sugar?

Ans: Invert sugar is an equal mixture of glucose and fructose. Invert sugar is sweeter than white sugar. It is used mainly in food products to retard crystallization of sugar and it also retains more moisture as compared to glucose.

Q.10.What is Caramelization?

Ans: When sugar is heated above its melting point caramelization occurs, adding flavor and leading to surface browning. At about 175°C (or 347°F), melted dry sugar takes on an amber color and develops an appealing flavor and aroma. This amorphous substance resulting from the breakdown of sugar is known as caramel. In baking a batter or dough containing sugar, caramelization takes place under the influence of oven heat. The golden-brown, flavorful and slightly crisp surface of breads, cakes, and cookies is due to caramelization. It not only improves taste but also helps retain moisture in the baked product.

Q.11. Give the role of sugar in diabetes?

Ans: Data from multiple studies suggests that the consumption of sugar-sweetened beverages may increase risk of developing diabetes. Approximately half of the US population consumes sugar sweetened beverages each day. Studies have observed an association between the consumption of high glycemic index foods, such as sugar,

and the development of type 2 diabetes. Nonetheless, one of the biggest risk factors for type 2 diabetes is being overweight or obese. Reducing sugar consumption can aid in healthy weight loss, which can be very beneficial for individuals with prediabetes or diabetes. It is crucial to monitor sugar intake to successfully manage diabetes. Sustained elevated blood sugar can cause a myriad of health concerns, including the vision loss, kidney problems, neuropathy, and circulation issues. A balanced diet and regular physical activity can be very advantageous for the management of this condition.

Q.12. Give the new WHO Consumption recommendations of sugar.

Ans: Recent evaluations commissioned by the WHO have concluded that limiting the amount of sugar added to foods and decreasing the intake of sugar sweetened beverages (which are a major source of added sugars) would be beneficial in promoting public health, particularly with regard to reducing the risk of dental caries, type 2 diabetes and cardiovascular disease. Consequently, the WHO released a new guideline in March 2015 which recommends that “adults and children reduce their daily intake of free sugars to less than 10% of their total energy intake. A further reduction to below 5% or roughly 25 g (6 teaspoons) per day would provide additional health benefits” (WHO., 2015). Overall, there seems to be a consensus among government agencies and regulatory bodies that sugars should be targeted as a potential means of reducing energy intakes and thereby curbing obesity rates. Indeed, the main sources of sugars consumed in the UK population are soft drinks and fruit juices, which together contribute on average 30% of sugars intake for those aged 4-64 years. The amount of sugars that is added to products during food processing has therefore come under particular scrutiny; hence, the food industry is now under pressure to reduce the sugar content of their processed products.

Q.13. What do you know by lactose intolerance?

Ans: If for some reason the ingested lactose is only partially hydrolyzed, that is, only partially digested, or is not hydrolyzed at all, a clinical syndrome called lactose intolerance results. If there is a deficiency of lactase, some lactose remains in the lumen of the small intestine. The presence of lactose tends to draw fluid into the lumen by osmosis. This fluid produces abdominal distention and cramps. From the small intestine, the lactose passes into the large intestine (colon) where it undergoes anaerobic bacterial fermentation to lactic acid (present as the lactate anion) and other

short-chain acids. The increase in the concentration of molecules, that is, the increase in osmolality, results in still greater retention of fluid. In addition, the acidic products of fermentation lower the pH and irritate the lining of the colon, leading to an increased movement of the contents. Diarrhea is caused both by the retention of fluid and the increased movement of the intestinal contents. The gaseous products of fermentation cause bloating and cramping. Lactose intolerance is not usually seen in children until after about 6 years of age. At this point, the incidence of lactose-intolerant individuals beings to rise and increases throughout the life span, with the greatest incidence in the elderly. Both the incidence and the degree of lactose intolerance vary by ethnic group, indicating that the presence or absence of lactase is under genetic control.

Q.14. Suggest some ways to control lactose intolerance.

Ans: There are two ways to overcome the effects of lactase deficiency. One is to remove the lactose by fermentation; that produces yogurt and buttermilk products. Another is to produce reduced-lactose milk by adding lactase to it. However, both products of hydrolysis, D-glucose and D-galactose, are sweeter than lactose, and at about 80% hydrolysis, the taste change becomes too evident. Therefore, most reduced-lactose, milk has the lactose reduced as close as possible to the 70% government-mandated limit for a claim. In a technology under development, live yogurt cultures are added to refrigerated milk. The bacteria remain dormant in the cold and do not change the flavor of the milk, but upon reaching the small intestine, release lactase.

Q.15. Sugars are the major contributors to tooth decay. Explain?

Ans: Sugars and starches are major contributors to tooth decay. Risk for developing dental caries (cavities) increases with the frequency of consumption of foods with sugar and the longer they remain in the mouth without brushing the teeth. Sugars in the mouth are digested by bacteria on the tooth's surfaces. Acid produced by the bacteria causes the enamel to break down, leading to cavities and gum disease. Sugar that remains on the teeth is actually of more concern than amount of sugar consumed. The acid produced by the bacteria lasts for about 20 minutes each time carbohydrate is eaten. This is true regardless of which carbohydrate-containing food is eaten. Bacterial acid production is present whether the carbohydrate is glucose from concentrated sweets, starches, lactose from milk, or fructose from fruit. The stickiness of the sugar also supports bacterial growth. Oral health can be promoted by limiting between-meal snacks (especially those high in sugar or starch), brushing with fluoride toothpaste, and flossing regularly.