

3. Concentration and crystallisation of the juice - The clarified juice is then concentrated by boiling under reduced pressure in multiple effect evaporators. In these, the steam produced in the first evaporator is used to boil the juice in the second kept at a lower pressure the steam produced in the second being used to boil the juice in the third maintained at a still lower pressure, and so on.

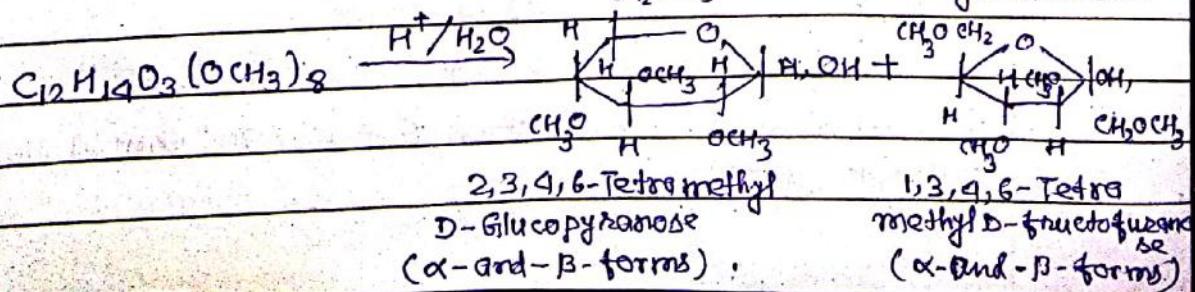
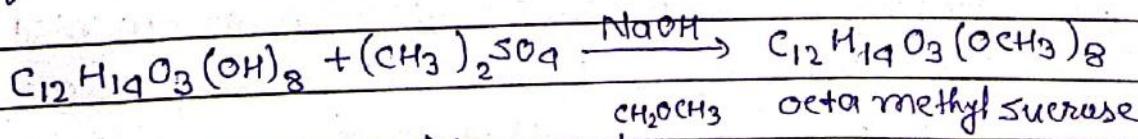
The concentrated juice is finally passed to the vacuum pans where further evaporation reduces the water content from 6 to 8%. Here partial separation of sugar crystals takes place. The contents of the pan, known as massecuite are discharged into a tank where crystals grow in size and form a thick crop.

4. Separation and Drying of crystals :- The massecuite is then charged into centrifugal machines by means of which sugar crystals are separated from the mother liquor. The crystals are here sprinkled with a little water to wash away any impurities sticking to their surface. The crystals are finally dried by dropping through a revolving cylinder where they meet a current of hot air coming up. The sugar thus obtained is about 95% for further purification it may be dissolved in hot water and recrystallised.

The mother liquor obtained after the removal of crystals is called molasses. It still contains large amounts of sugar and may be concentrated to get a fresh crop of crystals molasses which also contains glucose and fructose, is fermented to obtain alcohol. More recently glycerol and citric acid have been prepared from molasses.

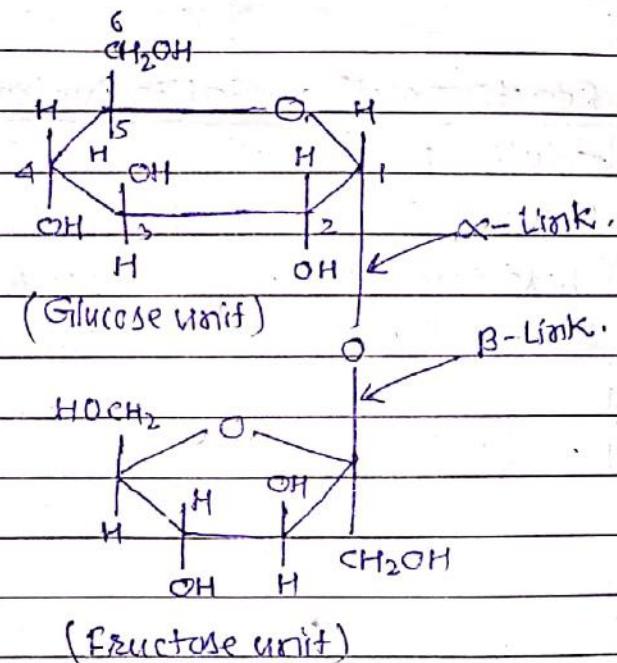
Structure of sucrose :- The structure of sucrose has been derived from a consideration of facts and conclusions such as the following -

- Elemental analysis and molecular weight determination show that the molecular formula of sucrose is $C_{12}H_{22}O_{11}$.
- Sucrose reacts with acetic anhydride in the presence of sodium acetate to form sucrose octaacetate. This reaction indicates the presence of eight hydroxyl groups in a sucrose molecule. Since sucrose is a stable compound, the eight hydroxy groups must be present on separate carbon atoms.
- Hydrolysis of sucrose with dilute acids yields an equimolecular mixture of D-glucose and D-fructose. This indicates that the sucrose molecule is made up of one unit of each of these monosaccharides.
- Sucrose does not reduce Tollen's reagent or Fehling's solution, does not form an ozonide, does not form methyl glycosides, and does not undergo mutarotation. All these observations indicate that the cyclic forms of glucose and fructose are joined together through glycosidic bond linkage at points where the carbonyl groups would otherwise become available, that is C₁ in glucose and C₂ in fructose.
- Sucrose reacts with dimethyl sulphate in an alkaline solution to form octamethylsucrose, which on hydrolysis yields a mixture of 2,3,4,6-tetramethyl-D-glucopyranose and 1,3,4,6-tetra-methyl-D-fructofuranose. The formation of these compounds indicates that the glucose unit in sucrose has a pyranose form (6-membered ring), and the fructose unit the furanose form (5-membered ring).



6. Sucrose is hydrolysed by maltase, an enzyme that hydrolyses only α -glycosides. It is also hydrolysed by invertase, an enzyme that hydrolyses B-but not α -fructofuranosides. These observations indicate that sucrose is both an α -glucoside and a B-fructoside.

The above evidence clearly indicates that sucrose has the following structure.

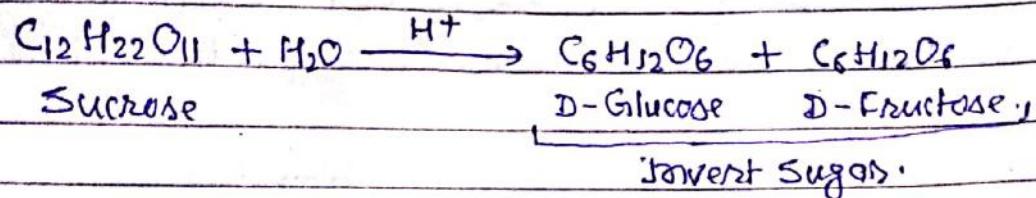


Physical properties of Sucrose :- Sucrose is a colourless, tasteless, odourless, crystalline solid. It is very soluble in water but only slightly soluble in alcohol. An aqueous solution of sucrose is dextrorotatory and does not exhibit mutarotation.

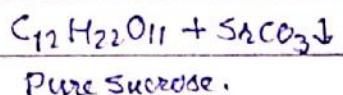
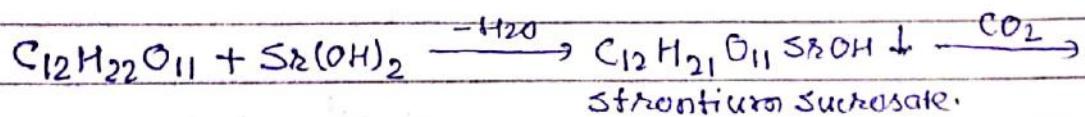
Chemical properties - Sucrose is non-reducing sugar. Sucrose gives the following reactions -

1. Action of heat :- When sucrose is heated to 210°C, it forms a brown mass known as caramel. At higher temp., sucrose chars to almost pure carbon and gives vapour of CO₂, carbon monoxide, methane, ethylene, acetylene, acetone, formic acid, acetic acid, ethanol and acrolein.
2. Hydrolysis - Hydrolysis of sucrose with hot dilute acid yields D-glucose and D-fructose. Sucrose is dextrorotatory. D-glucose is also dextrorotatory but D-fructose is levorotatory.

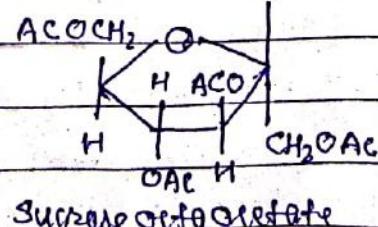
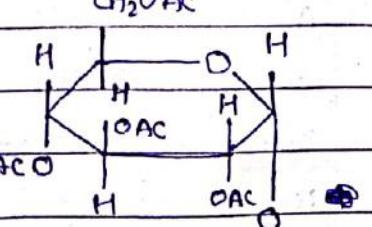
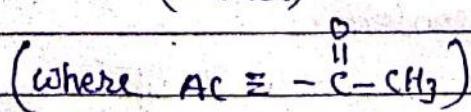
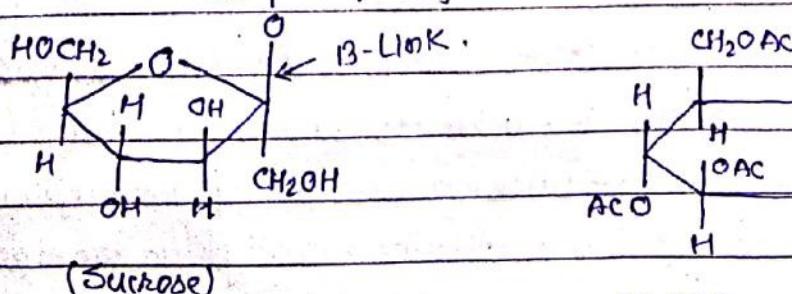
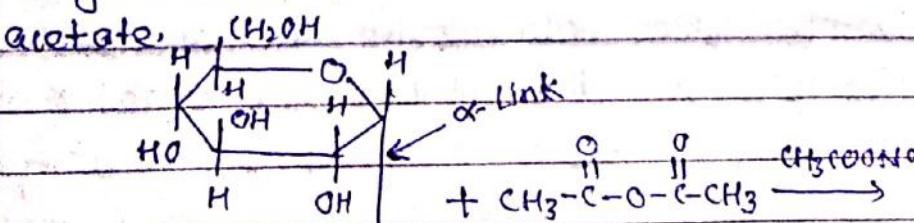
This due to hydrolysis of sucrose is known as the inversion of sucrose and equimolecular mixture of glucose and fructose is known as invert sugar or invertase.



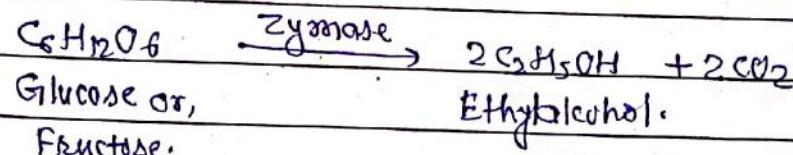
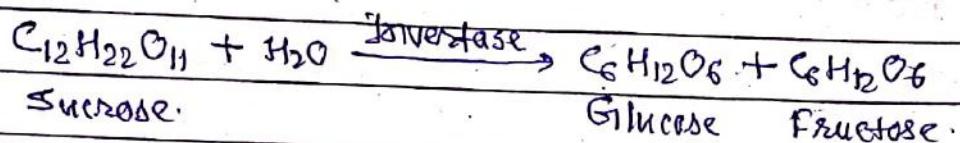
3. Reaction with metallic hydroxides :- Sucrose in aqueous solution reacts with hydroxides of calcium, strontium and barium to produce insoluble compounds called sucrosates. These compounds are readily decomposed when carbon dioxide is passed into their aqueous suspensions.



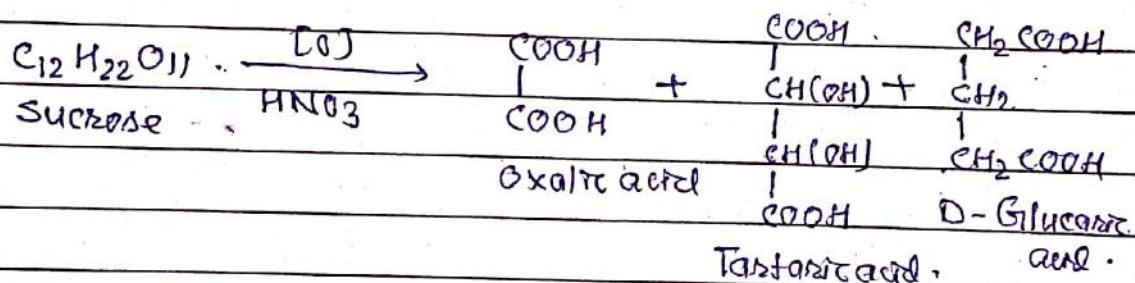
4. Reaction with acetic anhydride :- Sucrose reacts with acetic anhydride in the presence of sodium acetate to form sucrose octaacetate, $\text{C}_2\text{H}_3\text{OCH}_2\text{COOC}_6\text{H}_{10}\text{CO}_2\text{CH}_2\text{OCH}_3$



5. Fermentation - An aqueous solution of sucrose is readily fermented by yeast to give ethyl alcohol and carbon dioxide. The enzyme invertase present in yeast first converts sucrose into glucose and fructose. These sugars are then decomposed by the enzyme zymase to give ethyl alcohol and carbon dioxide.



6. Oxidation - Oxidation of succinic acid with conc. HNO_3 yields a mixture of oxalic acid, tartaric acid and D-glutaric acid.



Uses of Sucrose :- Sucrose is used as a food. It is an ingredient of jellies, jams, canned fruits, preserves, confections, condensed milk and other foods. It is used in the manufacture of sucrose octoacetate which is employed to denature alcohol; to render paper transparent, to stiffen textiles and as an ingredient or nonaqueous adhesives.