Production of Ethanol

a The starch containing materials include molasses, potatoes, cereals and on warming the malt to 60°c for a specific period of time are converted into maltose by the enzyme diastase contained in the malt.

$$2(C_6H_{10}O_5)_n + nH_2O \longrightarrow nC_{12}H_{22}O_{11}$$

b The maltose is broken down into glucose on addition of yeast which contains the enzyme maltase and at a temperature of 15°C

$$C_{12}H_{22}O_{11} + H_2O \longrightarrow 2C_6H_{12}O_6$$

maltose — 15°c/maltase — glucose

c The glucose at const. temperature of 15°c is then converted into alcohol by the enzyme zymase contained also in yeast. $C_6H_{12}O_6 \xrightarrow[15°C/\text{zymase}]{} 2CH_3CH_2OH + 2CO_2$ (glucose → ethanol)

a Product obtained from the Reduction of Alkanone

$$4R\text{-}C(=O)\text{-}R' + Li^+AlH_4^- \longrightarrow \left(R\text{-}\underset{H}{\overset{R'}{C}}\text{-}O\right)_4 Al^-Li^+$$

$$\left(R'\text{-}\underset{H}{\overset{R}{C}}\text{-}O\right)_4 Al^- + 4H^+_{(aq)} \longrightarrow 4R'\text{-}\underset{H}{\overset{R}{C}}\text{-}O\text{-}H + Al^{3+}_{(aq)}$$

b Product Obtained from the Reduction of Alkanal

$$CH_3\text{-}C(=O)\text{-}H + 2[H] \xrightarrow[LiAlH_4/(C_2H_5)_2O]{} CH_3\text{-}\underset{H}{\overset{OH}{C}}\text{-}H$$

→ Reduction of Alkanone produces a secondary alcohol
→ Reduction of Alkanal gives a primary alcohol
→ Reduction of Alkanone or Alkanal is done by using reducing reagent such as:
1) Lithium tetrahydridoborate (III) in ethoxyethane ($LiBH_4/(C_2H_5)_2O$)
2) Lithium tetrahydridoaluminate (III) in ethoxyethane ($LiAlH_4/(C_2H_5)_2O$)
3) Sodium tetrahydridoborate (III) in water or methanol ($NaBH_4/H_2O$)

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Assignment

1a This is based on the number of hydrogen atoms attached to the carbon atoms containing the hydroxyl group. If the number of hydrogen atoms attached to the carbon bearing the hydroxyl group are three or two, it is called a primary alcohol (1°). If it is one hydrogen atom, it is called secondary alcohol (2°) and if no hydrogen atom is attached to the carbon atom bearing the hydroxyl group, it is called a tertiary alcohol (3°) e.g. CH_3OH Methanol (1°), CH_3CH_2OH Ethanol (1°).

b 2 ~~Thus~~ This is based on the number of hydroxyl groups they posses. Monohydric alcohols one hydroxyl group present in the alcohol structure. Dihydric alcohol's are also called Glycols have two hydroxyl groups present in the structure while trihydric alcohols or triols — have three hydroxyl groups present in the structure of the alcohol. Polyhydric alcohols or polyols have more than three hydroxyl groups.

e.g: $CH_3CH_2CH_2OH$ Propanol (Monohydric alcohol)

$HOCH_2CH_2OH$ Ethane-1,2-diol (Dihydric alcohol)

2 In the Grignard Synthesis of Alkanols, reacts a named Grignard reagent with $CH_3CH_2CH_2CH=OCH_2CH_2CH_3$. Show the reaction steps

Solution

The named Grignard reagent is Ethyl Magnessium chloride, CH_3CH_2MgCl

&

$$CH_3CH_2CH_2CH=OCH_2CH_2CH_3 + CH_3CH_2MgCl \rightarrow CH_3CH_2CH_2CH(CH_2CH_2CH_3)(CH_2CH_3)OMgCl$$

Octan-4-ene; ethyl magnesium halide

$$CH_3CH_2CH_2CH(CH_2CH_2CH_3)(CH_2CH_3)OMgCl \xrightarrow{H^+\ OH^-} CH_3CH_2CH_2CH(CH_2CH_2CH_3)(CH_2CH_3)OH + Mg(OH)Cl$$