Alcohol

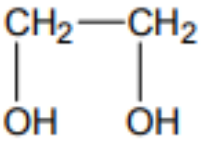
Lecture-2

Rifat Bin Amin
Dept. of Biochemistry
National Institute of Science & Technology

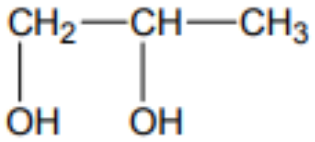
Alcohol

Some Important Alcohols

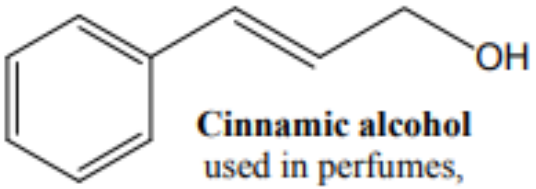
Some Important Alcohols



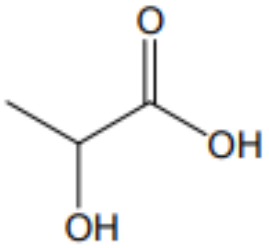
Ethylene glycol
antifreeze — pure ethylene glycol freezes at 11°F, but a 50:50 mixture of ethylene glycol and water freezes at -37°F; airplane de-icer; humectant (keeps other substances moist), used in ball point pen inks



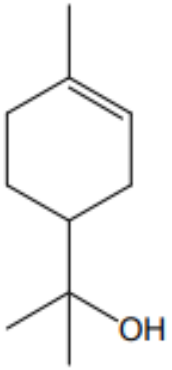
Propylene glycol
antifreeze, moisturizer in lotions and foods



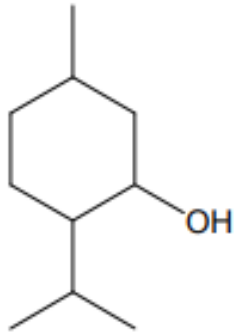
Cinnamic alcohol
used in perfumes, particularly in lilac and other floral scents; flavoring agent, soaps, cosmetics



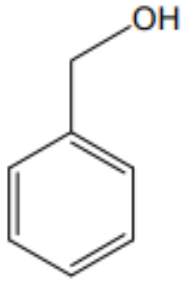
Lactic acid
produced from fermentation of sugars during anaerobic conditions; sour taste, found in sourdough bread, pickles, sauerkraut, sweat, etc.



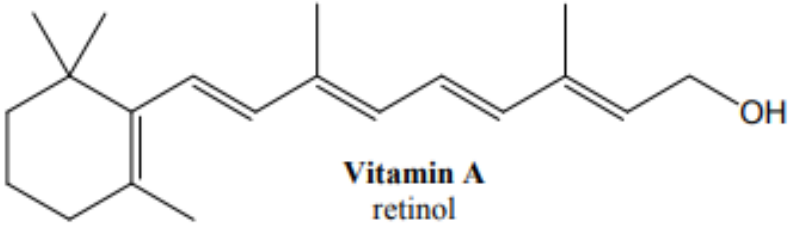
α-Turpineol
pine oil; perfume and bactericide used in domestic cleaners



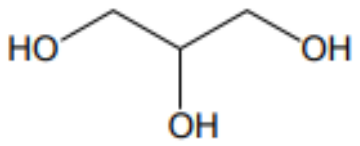
Menthol
oil of mint; has a cooling taste; found in cough drops, shaving lotion, and mentholated tobacco



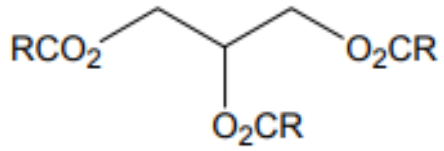
Benzyl alcohol
used in perfumes and flavors, cosmetics, ointments, ball point pen inks



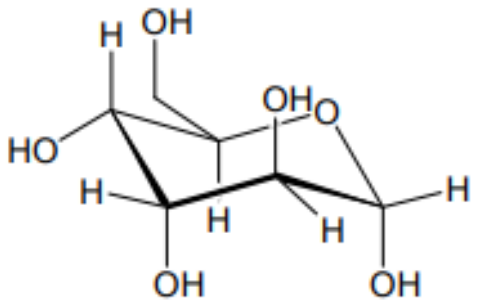
Vitamin A
retinol



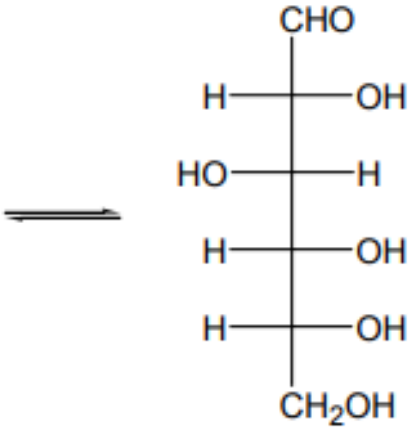
Glycerol / glycerin
softening agent and moisturizer
found is cosmetics and many foods;
used to keep toothpaste moist



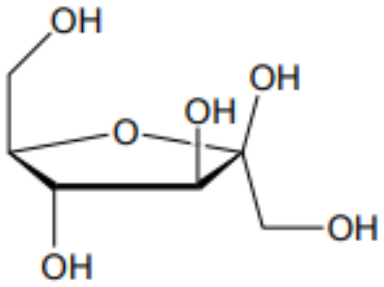
A **triglyceride**
fats and oils



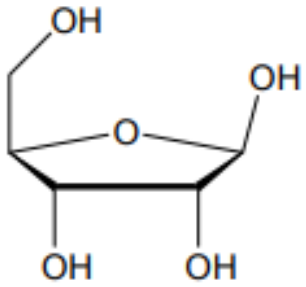
α-D-glucose



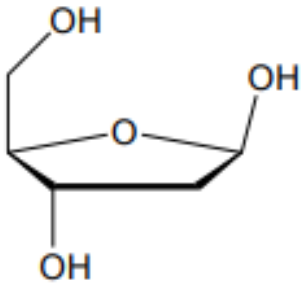
A Few Sugars



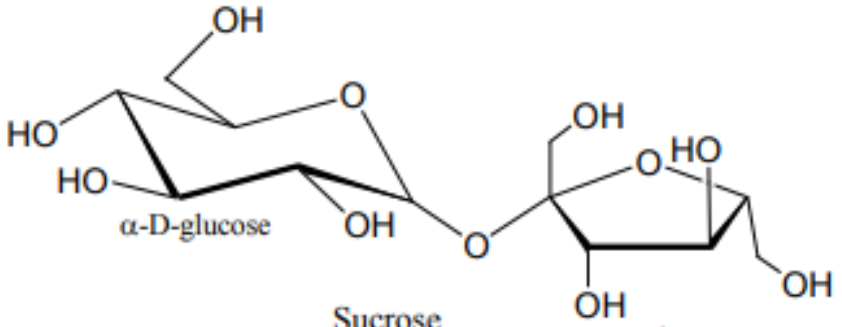
β-D-fructose



β-D-ribose



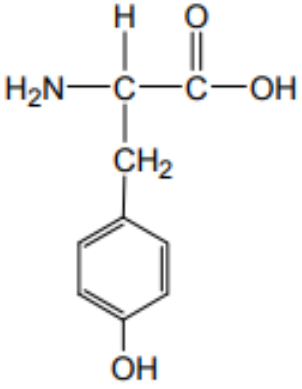
β-D-deoxyribose



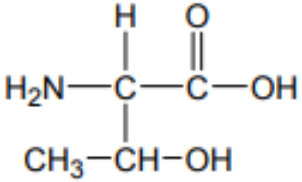
Sucrose
(a **disaccharide**)

Polyoxyethylene
a *nonionic detergent*; produces less foam, and is more effective at lower temperatures than many other detergents

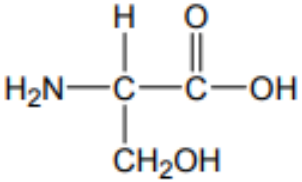
Amino Acids containing alcohols



Tyrosine (Tyr)



Threonine (Thr)

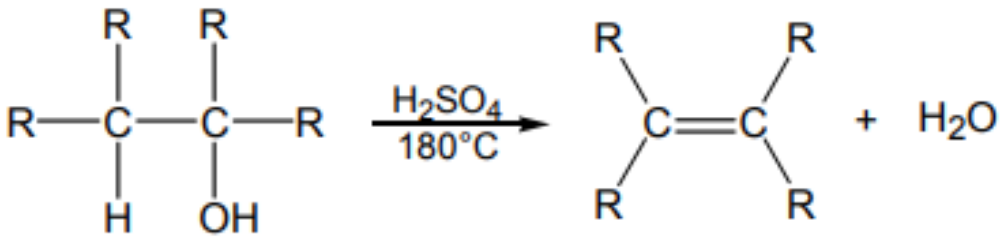


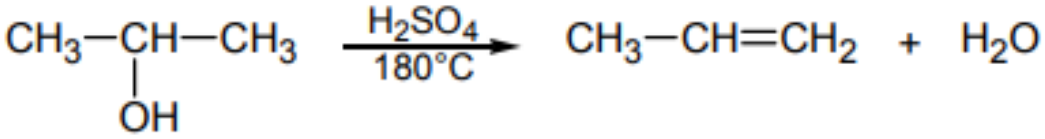
Serine (Ser)

Reactions of Alcohols

Dehydration of Alcohols to Produce Alkenes :

Heating alcohols in concentrated sulfuric acid (H2SO4) at 180°C removes the OH group and a H from an adjacent carbon to produce an alkene, with water as a by-product. Since water is "removed" from the alcohol, this reaction is known as a dehydration reaction (or an elimination reaction):

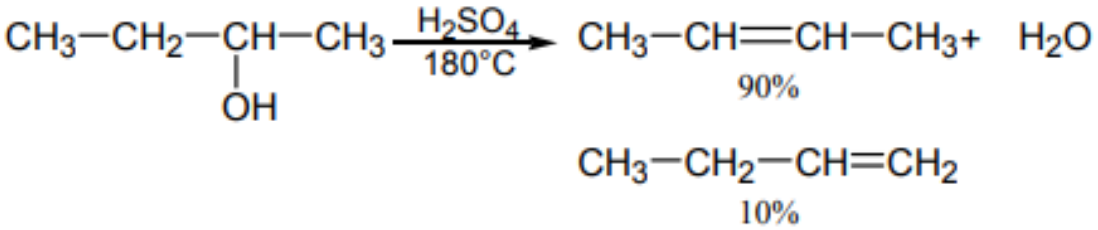


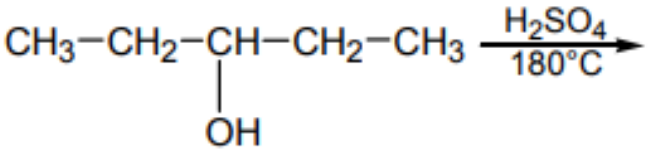


Dehydration of Alcohols to Produce Alkenes :

• If there is more than one possible product of a dehydration reaction, the major product can be predicted from Zaitsev's Rule:

• Zaitsev's Rule — when an alkene is produced in an elimination reaction, the major product is the one with the more highly substituted double bond.





Oxidation of Alcohols to Carbonyl Compounds

• An oxidation reaction occurs when a molecule loses electrons. This is usually manifested as an increase in the number of oxygen atoms or a decrease in the number of hydrogen atoms.

• Some common oxidizing agents include potassium permanganate (KMnO4), chromic acid (H2CrO4), sodium dichromate (Na2Cr2O7), and other Cr6+ salts.

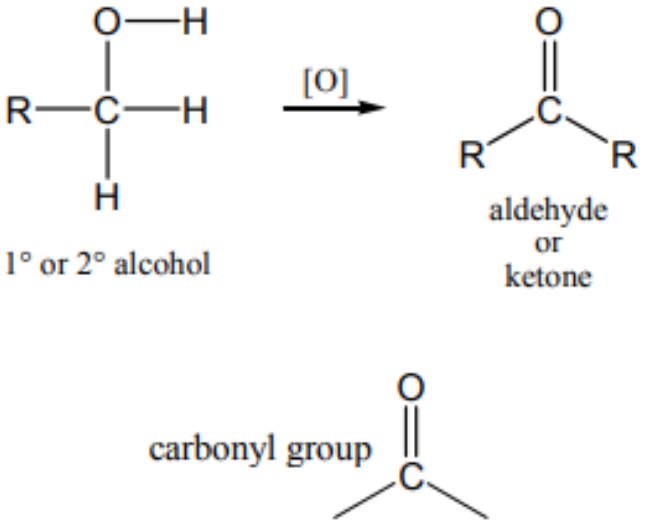
• Alcohols can be oxidized by removing two H atoms from the molecule; the exact products of the reaction will depend on the type of alcohol.

$$R_2CHOH + (O) \rightarrow R_2C{=}O + H_2O$$

[O] = oxidation

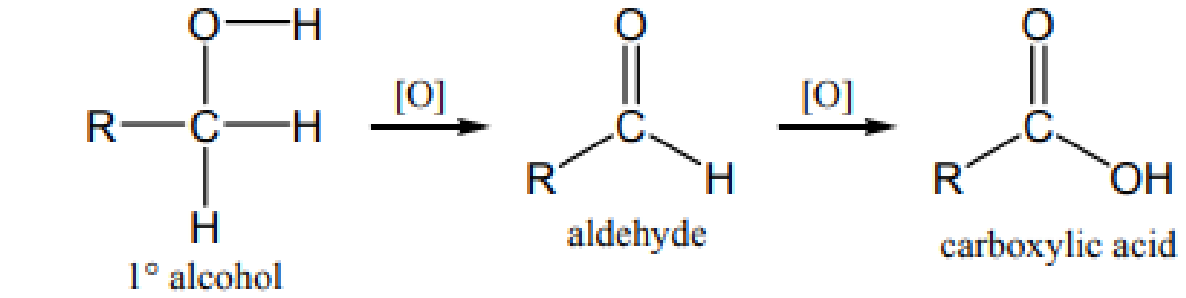
Oxidation of Alcohols to Carbonyl Compounds

Primary or secondary alcohols can be oxidized to produce compounds containing the carbonyl group (a carbon-oxygen double bond, C=O):



Oxidation of 1° Alcohols

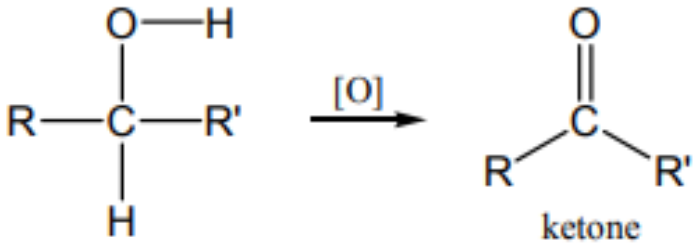
Primary alcohols are oxidized first to aldehydes, but the aldehydes are then usually oxidized into carboxylic acids.



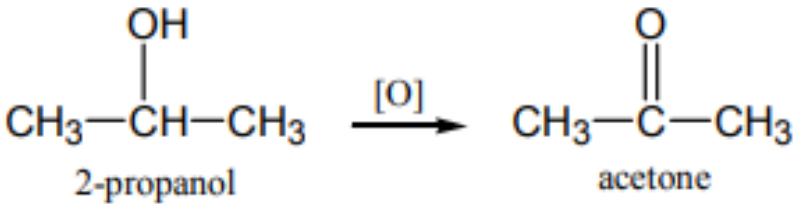
In the body, oxidation of ethanol to acetaldehyde takes place in the liver; the acetaldehyde is further oxidized to acetyl coenzyme A, which can be used to synthesize fat or eventually be oxidized to water and carbon dioxide.

Oxidation of 2° Alcohols

Secondary alcohols are oxidized to **ketones**, which cannot be oxidized any further:



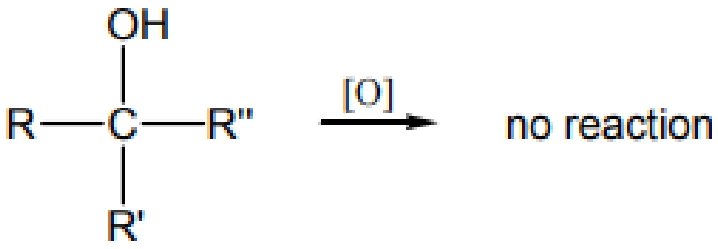
2° alcohol ketone



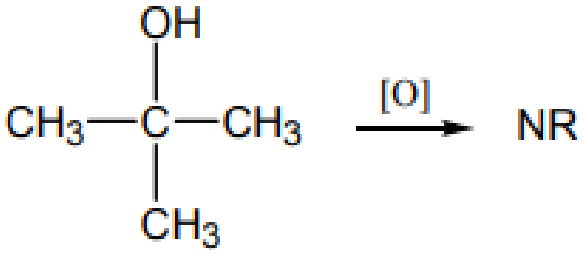
2-propanol acetone

Oxidation of 3° Alcohols

Tertiary alcohols, because there is by definition no hydrogen on the alcoholic carbon, cannot be oxidized:



3° alcohol



t-butyl alcohol