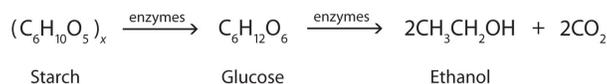


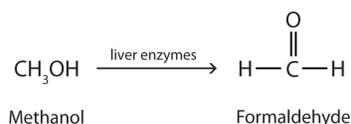
9.13: Interesting Alcohols, Ethers, and Epoxides

Alcohols Produced by Fermentation

In addition to its preparation from ethylene, ethanol is made by the fermentation of sugars or starch from various sources (potatoes, corn, wheat, rice, etc.). Fermentation is catalyzed by enzymes found in yeast and proceeds by an elaborate multistep mechanism. We can represent the overall process as follows:



Methanol is quite poisonous to humans. Ingestion of as little as 15 mL of methanol can cause blindness, and 30 mL (1 oz) can cause death. However, the usual fatal dose is 100 to 150 mL. The main reason for methanol's toxicity is that we have liver enzymes that catalyze its oxidation to formaldehyde, the simplest member of the aldehyde family:

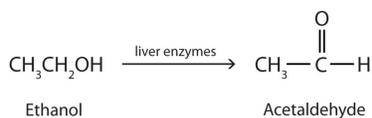


Formaldehyde reacts rapidly with the components of cells, coagulating proteins in much the same way that cooking coagulates an egg. This property of formaldehyde accounts for much of the toxicity of methanol.

Note

Organic and biochemical equations are frequently written showing only the organic reactants and products. In this way, we focus attention on the organic starting material and product, rather than on balancing complicated equations.

Alcohols Produced by Fermentation

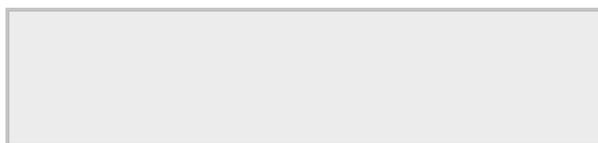


Alcohols Produced by Fermentation

Alcohols Produced by Fermentation

Ethylene Glycol

Polyhydric alcohols in which the hydroxyl groups are situated on different carbons are relatively stable, and, as we might expect for substances with multiple polar groups, they have high boiling points and considerable water solubility, but low solubility in nonpolar solvents:



1,2-Diols are prepared from alkenes by oxidation with reagents such as osmium tetroxide, potassium permanganate, or hydrogen peroxide. However, ethylene glycol is made on a commercial scale from oxacyclopropane, which in turn is made by air oxidation of ethene at high temperatures over a silver oxide catalyst.

Ethylene glycol has important commercial uses. It is an excellent permanent antifreeze for automotive cooling systems because it is miscible with water in all proportions and a 50% solution freezes at -34° (-29°F). It also is used as a solvent and as an intermediate in the production of polymers (polyesters) and other products.

Ethylene oxide

The most important and simplest epoxide is ethylene oxide which is prepared on an industrial scale by catalytic oxidation of ethylene by air.



Ethers as General Anesthetics

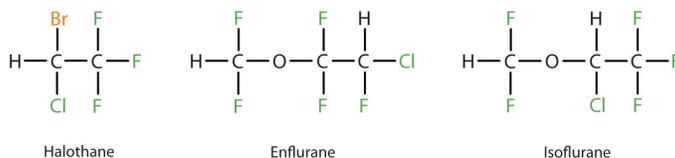
A *general anesthetic* acts on the brain to produce unconsciousness and a general insensitivity to feeling or pain. Diethyl ether ($\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$) was the first general anesthetic to be used.



William Morton, a Boston dentist, introduced diethyl ether into surgical practice in 1846. This painting shows an operation in Boston in 1846 in which diethyl ether was used as an anesthetic. Inhalation of ether vapor produces unconsciousness by depressing the activity of the central nervous system. Source: Painting of William Morton by Ernest Board, from

http://commons.wikimedia.org/wiki/File:Ether_1846.jpg.

Diethyl ether is relatively safe because there is a fairly wide gap between the dose that produces an effective level of anesthesia and the lethal dose. However, because it is highly flammable and has the added disadvantage of causing nausea, it has been replaced by newer inhalant anesthetics, including the fluorine-containing compounds halothane, enflurane, and isoflurane. Unfortunately, the safety of these compounds for operating room personnel has been questioned. For example, female operating room workers exposed to halothane suffer a higher rate of miscarriages than women in the general population.



These three modern, inhalant, halogen-containing, anesthetic compounds are less flammable than diethyl ether.

Crown Ethers

Ethers as General Anesthetics

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