FACULTY OF ENGINEERING & TECHNOLOGY

Topic -5th

PRODUCTION OF 2-3 BUTANEDIOL

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Introduction

- 2,3-Butanediol is the organic compound with the formula $(CH_3CHOH)_2$.
- IUPAC Name-**butane-2,3-diol**
- 2,3-butanediol has many industrial applications and its product can produce, the levo isomer of butanediol has a low freezing point of -60 °C, which allows it to work as an antifreeze agent. 0.1% butanediol will kill most pathogenic bacteria due to its antiseptic properties.
- It is used in the resolution of carbonyl compounds in gas chromatography.
- It is use as a precursors to various plastics and pesticides
- It is found naturally in cocoa butter, in the roots of *Ruta graveolens*, sweet corn, and in rotten mussels.
- Natural or synthetic source of a chemical, Endogenous Food
- Biological source; Plant, Microbe; Serratia, Serratia marcescens, Bacillus; Bacillus polymyxa.

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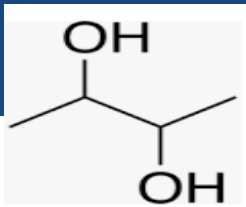
- Species belonging to the genera Escherichia , Salmonella and Shigella ferment sugars to a mixture of products consisting of lactate, acetate, succinate and formate (mixed acid fermentation). In addition are formed CO 2 , H 2 and ethanol (Little amount of lactate only is produced during the butanediol fermentation).

- **Voges-Proskauer test**; the Voges-Proskauer test detects the presence of 2,3 butanediol (acetoin) in the fermentation products.

- *Escherichia coli* are perform mixed acid fermentation it is a facultatively anaerobic bacterium.

- With glucose if no external electron acceptors are available, ATP is produced by substrate level phosphorylation. The intracellular redox balance is maintained by mixed-acid fermentation, that is, the production and excretion of several organic acids.



- 2,3-Butanediol is an isomer of butanediol. The 2R,3R stereoisomer of 2,3-butanediol is produced by different type of microorganisms in a process known as butanediol fermentation.

2,3-Butanediol is prepared by hydrolysis of 2,3-epoxybutane.

$$(CH_3CH)_2O + H_2O \rightarrow CH_3(CHOH)_2CH_3$$

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- 2,3-Butanediol (2,3-BDL) also called 2,3-Butylene glycol, 2,3-Dihydroxybutane, Dimethylene glycol, Dimethylethylene glycol, Pseudobutylene glycol, Sym-dimethylethylene glycol is the promising bulk chemical that exhibits a wide range of potential utilization.

- d 1,3-Propanediol and 2,3-Butanediol Fermentations 2,3-Butanediol is available through fermentation with aeration of 15% wheat mash with *Aerobacillus polymyxa.*

- The aeration inhibited the parallel formation of ethanol. Generally, under aerobic conditions, the ratio of 2,3-butanediol to ethanol is 3:1. Under anaerobic conditions, the ratio of the two alcohols changed to 1.3:1.0, and the process accelerated.

(W. Sabra et al., 2011)

$C_4H_{10}O_2$

- 2,3-Butanediol fermentation is the anaerobic fermentation of glucose with 2,3-butanediol as one of the end products.

- The overall stoichiometry of the reaction is

2 pyruvate + NADH --> 2CO2 + 2,3-butanediol

- Butanediol fermentation is typical for Enterobacter species or microbes found in the gut. 2,3-butanediol has been identified in the sera of alcoholics and it may be a specific marker of alcohol abuse.

- In humans, 2,3-butanediol is oxidized to acetyl-CoA via acetoin. Diacetyl (2,3-butanedione) and its reduced forms (acetoin and 2,3-butanediol) are produced by the metabolism of sugars via pyruvate. it is an additional source of pyruvate, citrate, or acetate.

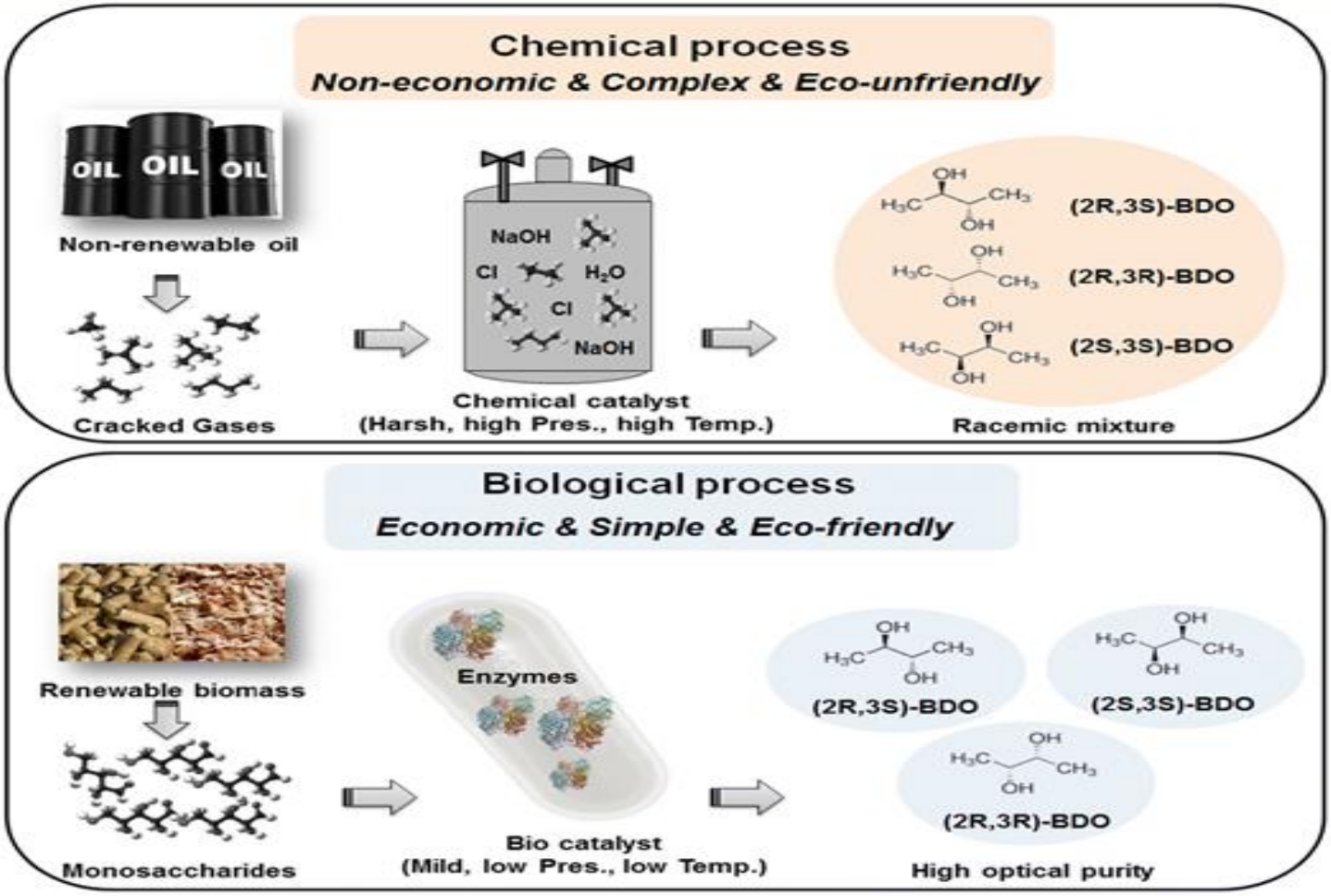
(V.M. Dillon, 2014)

$C_4H_{10}O_2$

- Some fermentative organism catabolize glucose by the butanediol pathway, in which acetoin occurs as an intermediate in the formation of 2,3-butanediol. In the presence of KOH and O_2, the acetoin is oxidized to diacetyl, which in turn reacts with the guanidine group associated with arginine and other molecules contributed by peptone in the medium to form a pink- to red-coloured product.

- Most studies on 2,3-butanediol production by microbial fermentation have been carried out using *Klebsiella oxytoca* and *Bacillus polymyxa*. In these fermentations there is a significant conversion of carbon source into ethanol, glycerol and various organic acids as by-products. On the other hand, this investigation has shown that the major products of fermentation by *Bacillus amyloliquefaciens* are 2,3-butanediol and some minor acids.

(F. Mozzi et al.,2016)



Production of 2,3-BD by the chemical and biological processes, Racemic mixture of isomers is obtained from crack gases using a chemical catalyst. Optically pure 2,3-BD isomers are derived from monosaccharides using microorganism

Applications of 2,3-BD

- ✓ 2,3-Butanediol (2,3-BD) has great potential for diverse industries, including chemical, cosmetics, agriculture, and pharmaceutical areas.
- ✓ Several bio-based 2,3-BD production processes have been developed and their economic advantages over petro-based production process have been reported.
- ✓ In particular, many 2,3-BD-producing microorganisms including bacteria and yeast have been isolated and metabolically engineered for efficient production of 2,3-BD.
- ✓ Recently, the production of high added-value chemicals by LAB has been reported, including lactic acid, 2,3-butanediol (2,3-BDO), 1,3-PDO, bioethanol, and butanol.
- ✓ Physiological importance in health effect.

(Chan Woo Song, 2019)

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- ✓ The pharmaceutical industry it has been reported that 2,3-BD can trigger enhanced innate immunity and result in clearance of damaged liver cells by activating natural killer cell activity.

- ✓ It has been shown that 2,3-BD has anti-inflammatory effects according to an earlier report.

- ✓ 2,3-Butanediol (2,3-BDL), which is very important for a variety of chemical feedstocks and liquid fuels, can be derived from the bioconversion of natural resources.

- ✓ One of its well known applications is the formation of methyl ethyl ketone, by dehydration, which can be used as a liquid fuel additive.

THANK YOU