

Microbes in Industries (continued.....)

C. Vitamins (Bisen PS, 2014)

Two main vitamins produced by microbial fermentations are Vitamin B12 and Vitamin B2.

1. Vitamin B12 (Cyanocobalamin)

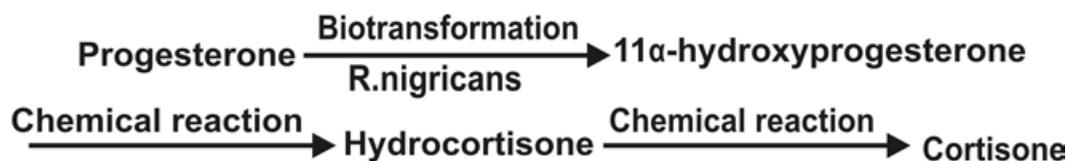
Bacteria *Propionibacterium shermanii* or *Pseudomonas denitrificans* are used for fermentation under anaerobic culture for 3 days at 30°C with fermentation medium having glucose, corn steep liquor, ammonia and cobalt chloride. It is also produced as a by-product during fermentation of aureomycin and streptomycin.

2. Vitamin B2 (Riboflavin)

Yeasts *Eremothecium ashbyii* and *Ashnua gossypii* are used to commercially produce this vitamin by direct fermentation. It is also recovered by various *Clostridium* species as the by-product of during acetone butanol fermentation. *Ashbya gossypii* is also for the production where fermentation is carried out in aerobic conditions for 4-6 days at 36°C using glucose, corn oil, soy oil, and glycine as medium.

D. Biotransformations (To reshape molecules)

Rhizopus nigricans (zygomycetous fungus) use to hydroxylate progesterone (extracted from soybeans) for the synthesis of cortisone hormone.

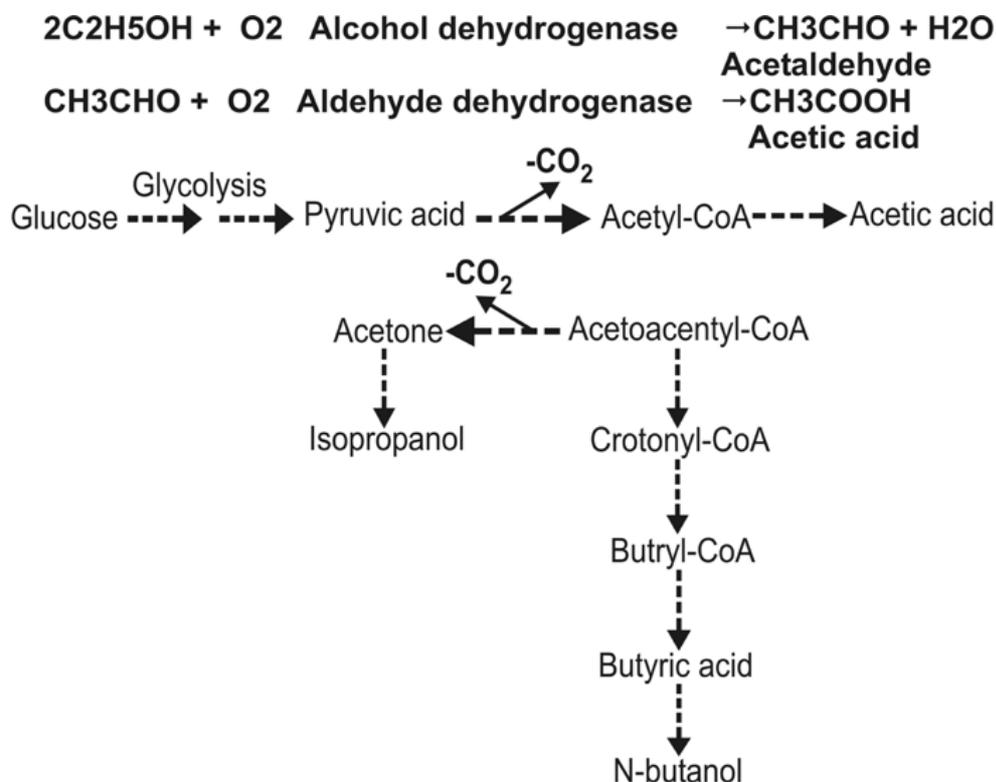


Zygomycetes, Deuteromycetes, Actinomycetes and a few species of yeasts and unicellular bacteria are involved in microbial transformation of steroids through the process of hydroxylation and dehydrogenation etc.

E. Vinegar

Alcoholic fermentation and acetification by yeasts and by bacteria of the genus *Acetobacter* result in fermentation of vinegar (acetic acid) from fruit juice.

Vinegar is actually produced in two stage: the first utilizing a yeast such as *Saccharomyces cerevisiae* to produce ethanol from plant sugar. The second stage involves an aerobic fermentation carried out by acetic acid bacteria such as *Acetobacter* and *Gluconobacter*



Steps during acetone butanol fermentation for the production of n-butanol, acetone, isopropanol, acetic acid (Bisen PS, 2014)

F. Beverages

Ethanol is the alcohol present in an alcoholic beverage. Various alcoholic beverages are made through fermentation process for eg. Wines are made from a variety of fruits, such as grapes, peaches, plums or apricots. Beer formed by a liquid mix, called wort, which is prepared by combining yeast and malted cereal, such as corn, rye, wheat or barely. Whisky is made by distilling the fermented juice of cereal grains like rye, corn or barley. Rum is a distilled beverage made

from fermented molasses or sugarcane juice and aged. Brandy is distilled from fermented fruit juices aged in oak casks. Gin is a distilled beverage.

G. Enzymes

The major commercial utilization of microbial enzymes is in the food and beverage industries in pharmaceutical textile and leather industries, in analytical processes as well as in detergent (proteases) and dairy industry. Most of the enzymes in industrial use are extracellular proteins produced by *Aspergillus* sp. or *Bacillus* sp. and include α -amylase, β -glucanase, cellulase, dextranase, lactase, lipase, pectinase, proteases and others. *Bacillus stearothermophilus* produces amylases as secondary metabolites. Microbial enzymes are also used for production of synthetic polymers like alkene (for plastic industries) with three enzymes: pyranose-2-oxidase from the fungus *Oudemansiella mucida*, a haloperoxidase from the fungus *Caldariomyces*, and an epoxidase from a *Flavobacterium* sp.

Microbial enzymes and source microbes: (Bisen PS, 2014)

Source (genus)	Enzymes	Reaction	Application
<i>Bacillus</i>	α -Amylase	Starch hydrolysis	Converts starch to glucose or dextran in food industry
	Proteases	Protein digestion	Help laundering
<i>Escherichia</i>	Penicillin Acylase	Benzoyl cleavage	Production of 6-APA
	L-Asparaginase	Removal of L-asparagine involved in tumour growth	Leukaemia/cancer treatment
<i>Aspergillus</i>	Amyloglucosidase	Dextrin hydrolysis	Glucose production
	β -Galactosidase	Lactose hydrolysis	Lactose hydrolysis in milk or whey
	Aminoacylase	Hydrolysis of acylated L-amino acids	Resolution of racemic mixtures
	Glucose oxidase	Oxidation of glucose	Glucose detection in blood
<i>Streptomyces</i>	Glucose isomerase	Conversion of glucose of fructose	Production of high fructose syrups
Several marin bacteria	Luciferase	Bioluminescence	Assay for ATP
Several bacteria and cyanobacteria	Nucleases (restriction endonucleases)	Hydrolysis of phospho-diester bonds in nucleic acids	Genetic engineering

H. Solvents:

Acetone and butanol are produced through fermentation of carbohydrates. These organic solvents are used as a paint thinner (e.g. toluene, turpentine), as glue and as nail polish removers (acetone, methyl acetate, ethyl acetate), in detergents (citrus terpenes), in perfumes (ethanol), in dry cleaning (e.g. tetrachloroethylene), in spot removers (e.g. hexane, petrol ether), and in chemical synthesis.

I. Ensilage:

An alternative method for drying of green crops for cattle feeding. Lactobacilli and Streptococci, used in fermentation of the plant material and produces lactic, butyric, propionic, and acetic acids and esters which imparts flavours to feed. It takes three or four weeks to complete the fermentation.

Reference link:

https://www.researchgate.net/publication/299978072_The_Industrial_Uses_Of_Micro-Organisms?enrichId=rgreq-0b60834f2e49cc2404fe2d61d9109937-XXX&enrichSource=Y292ZXIjQYWdlOzI5OTk3ODAzMjUzNDg1NDUxMDMyMjA3NDBAMTQ2MDExMTAzNzAwOA%3D%3D&el=1_x_2&_esc=publicationCoverPdf

<https://appscgroup.blogspot.com/2011/02/vitamin-b2-production-appsc-g1-mains.html>