Although there are various ways ethanol fuel can be produced, the most common way is via fermentation.

The basic steps for large scale production of ethanol are: microbial (yeast) fermentation of sugars, distillation, dehydration (requirements vary, see Ethanol fuel mixtures, below), and denaturing (optional). Prior to fermentation, some crops require saccharification or hydrolysis of carbohydrates such as cellulose and starch into sugars. Saccharification of cellulose is called cellulolysis (see cellulosic ethanol). Enzymes are used to convert starch into sugar.

Fermentation:

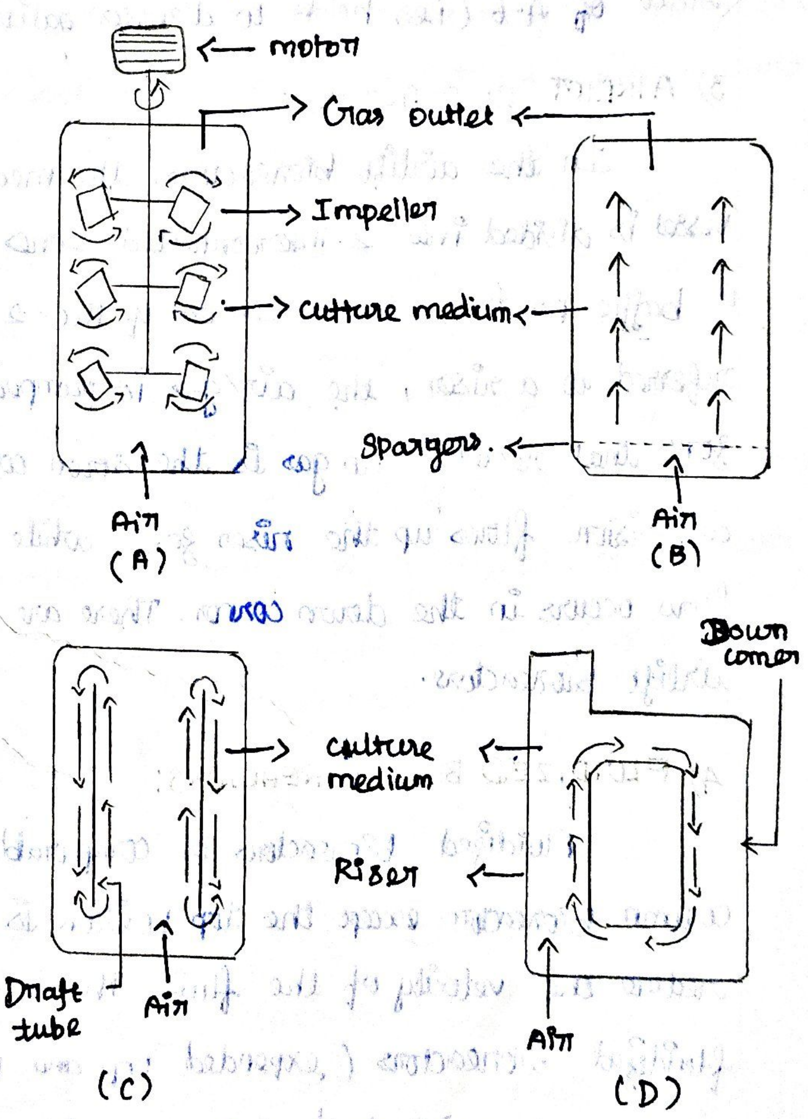
Ethanol is produced by microbial fermentation of the sugar. Microbial fermentation currently only works directly with sugars. Two major components of plants, starch and cellulose, are both made of sugars- and can in principle, be converted to sugars for fermentation. Currently only the sugars for fermentation, currently (eg. sugar cane) and starch (eg corn) portions can be economically converted.

Reference: ①. B.D. Singh (2017), Biotechnology Kalyani Publication.
②. Mahmoud Abdul (2016). Biotechnology Net source.

TYPES OF BIOREACTORS

1. Continous stirred Tank Bioreactors:

A continous stirred tank bioreactor consist of a cylindrical vessel with motor driven central shaft that supports one or more agitators (impellers). The shaft is fitted at the bottom of the bioreactor. The number of impellers is variable and depends on the size of the bioreactor i.e., height to diameter ratio, referred to as aspect ratio.



(A) continous stirred tank bioreactor (B) Bubble column bioreactor (C) Internal - loop airlift bioreactor. (D) External - loop airlift bioreactor.

2) BUBBLE COLUMN BIOREACTORS:

In the bubble column bioreactor, the air of gas is introduced at the base of the column through perforated pipes or plates, or metal microporous spargers. The flow rate of the air/gas influences the performance factors - O_2 transfer, mixing. The bubble column bioreactors may be fitted with perforated plates to improve performance. The vessel used for bubble column bioreactors is usually cylindrical with an aspect ratio of 4-6 (i.e., height to diameter ratio).

3) AIRLIFT BIOREACTORS:

In the airlift bioreactors, the medium of the vessel is divided into 2 interconnected zones by means of a baffle or draft tube. In one of the 2 zones referred to a riser, the air/gas is pumped. The other zone that receives no gas is the down corner. The disperision flows up the riser zone while the down flow occurs in the down corror. There are two types of airlift bioreactors.

4) FLUIDIZED BED BIOREACTORS:

Fluidized bioreactors is comparable to bubble column bioreactor except the top position is expanded to reduce the velocity of the fluid. The design of the fluidized bioreactors (expended top and narrow reaction coloumn) is such that the solids are retained in the reactor while the liquid flows out. These bioreactors are suitable for use to carry out reactions involving fluid suspended biocatalysts

Such as immobilized enzymes, immobilized cells, and microbial flocs.

5) PACED BED BIOREACTORS:

A bed of solid particles, with biocatalysts on or within the matrix of solids, packed in a column constitutes a packed bed bioreactor. The solid used may be porous or non porous gels, and they may be compressible or rigid in nature. A nutrient broth flows continuously over the immobilised biocatalyst. The products obtained in the packed bed bioreactor are released into the fluid and removed. While the flow of the fluid can be upward or down ward. down flow under gravity is preferred.

6) ~~TYP~~PHOTO BIOREACTORS:

These are the bioreactors specialised for fermentation that can be carried out either by exposing to sunlight or artificial illumination. Since artificial illumination is expensive, only the outdoor photo-bioreactors are perferred. Certain important compounds are produced by employing photo-bioreactors. eg:- β-carotene, asthaxanthin.

Reference : ① B.D. Singh (2017), Biotechnology
Kalyani publication,
② deyasetty (2017). Biotechnology
Net source.

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PRIMARY AND SECONDARY METABOLITES

Primary and secondary metabolites are often used in industrial microbiology for the production of food, amino acids, and antibiotics.

KEY POINTS:

Primary metabolites are considered essential to microorganisms for proper growth.

Secondary metabolites do not play a role in growth development and reproduction, and are formed during the end or near the stationary phase of growth.

These metabolites can be used in industrial microbiology to obtain amino acids, develop vaccines and antibiotics and isolate chemicals necessary for organic synthesis

PRIMARY METABOLITES:

Primary metabolites are involved in growth, development and reproduction of the organism. The primary metabolite is typically a key compenent in maintaing normal physiological process; thus, it is often reffered to as a central metabolite. Primary metabolites are typically formed during the growth phase as a result of energy metabolism, and are deemed essential for proper growth. Examples of primary metabolites include alcohols such as ethanol, lactic acid, and certain amino acids. Within the field of industrial microbiology, alcohol is on of the most common primary metabolites used for large-scale production. specifically, alcohol is used for processes involving fermentation which produce products like beer and wine. Additionally, primary metabolites such as amino acids - Including L-glutamate and L-lysine, which are commonly used as supplements - are isolated via the mass production of a specific bacterial species, corynebacteria glutamicum. Another example of lysin, which are commonly used as supplements - are isolated via the mass production of a specific bacterial species corynebacteria glutamicum. Another example of a primary metabolic commonly used in industrial microbiology includes citric acid. Citric acid, produced by Aspergillus niger, is one of the most widely used ingredients in food production. It is commonly used in pharmaceutical and cosmetic industries as well.

SECONDARY METABOLITES:

Secondary metabolites are typically organic compounds produced through the modification of primary metabolite synthases. Secondary metabolites do not play a role in growth, development, and reproduction like primary metabolites do and are typically formed during the end or near the stationary phase of growth. Many of the identified secondary metabolites have a role in ecological function, including defense mechanism, by serving as antibiotics and by producing pigments. Examples of secondary metabolites with importance in industrial microbiology include atropine and antibiotics such as erythromycin and bacitracin. Atropine, derived from various plants, is a secondary metabolite with important use in the clinic. Atropine is a competitive antagonist for acetylcholine receptors specifically those of the muscarinic type, which can be used in the treatment of bradycardia. Lastly, another example of an antibiotic which is classified as a secondary metabolite is bacitracin. Bacitracin, derived from organisms classified under Bacillus subtilis, is an antibiotic commonly used a topical

Reference : ①. B.D. Singh (2017), Biotechnology Kalyani publication.

②. Maulikpatel 180 (2018), Biotechnology Net source.

BIOPOLYMER

It is a polymer that is developed from living beings. It is a biodegradable chemical Compound that is regarded as the most organic Compound in the ecosphere. The name "Biopolymer" Indicates that it is a bio-degradable polymer.

BIOPOLYMER HISTORY:

This polymer has been present on earth for billions of years. It is older than synthetic polymers such as plastics.

EXAMPLE OF BIOPOLYMERS:

Some biopolymer examples are.

Proteins

Carbohydrates

DNA

RNA

Lipids

Nucleic acids

Peptides

Polysaccharides (such as glycogen, starch and cellulose).

BIOPOLYMER CLASSIFICATION

There are four main types of biopolymers. These are,

SUGAR BASED BIOPOLYMERS:

Starch or sucrose is used as input for manufacturing polyhydroxibutyrate. Sugar based polymers can be produced by blowing, injection, vacuum forming and extrusion. Lactic acid polymers (polyacides) are created from milk sugar (lactose) that is extracted from potatoes, maize, wheat and sugar beet. polyacitdes are resistant to water and can be manufactured by methods like vacuum forming, blowing and injection molding.

STARCH BASED BIOPOLYMERS:

Starch acts as a natural polymer and can be obtained from wheat, tapioca, maize and potatoes. The material is stored in tissues of plants as one way Carbohydrates. It is composed of glucose and can be obtained by melting starch. This polymer is not present in animal tissues. It can be found in vegetables like tapioca, corn, wheat and potatoes.

BIOPOLYMERS BASED ON SYNTHETIC MATERIALS:

Synthetic compounds that are obtained from petroleum can also be used for making biodegradable polymers such as aliphatic aromatic copolyesters. Though these polymers are manufactured from synthetic components, they are completely compostable and bio-degradable.

CELLULOSE BASED BIOPOLYMERS:

These are used for packing cigarettes, CDs and confectionary. This polymer is composed of glucose and is the primary constituent of plant cellular walls. It is obtained from natural resources like cotton, wood, wheat and corn.

The production of biopolymer may be done either from animal products or agricultural plants.

BIOPOLYMER TYPES:

There are primarily two types of biopolymer. One that is obtained from living organisms and another that is produced from renewable resources but require polymerization. Those created by living beings include proteins and carbohydrates.

BIOPOLYMER STRUCTURE;

Unlike synthetic polymers, Biopolymers have a well-marked structure. These polymers have a uniformly distributed set of molecular mass and appear as a long chain of worms or a curled up string ball under a microscope. This type of polymer is differentiated based on their chemical structure.

Reference ①. B.D. Singh (2017). Biotechnology
Kalyani publication.

②. Kishorsalvatore (2018). Biotechnology
Net source.

① Biopesticide :

Biopesticides, a contraction of biological pesticides, include several types of pest management intervention: through predatory, parasitic, or chemical relationships. The term has been associated historically with biological control - and by implication - the manipulation of living organisms. Regulatory positions can be influenced by public perceptions, thus:

In the EU, biopesticides have been defined as "a form of pesticide based on micro-organisms or natural products".

The US EPA states that they "include naturally occuring substances that control pests (biochemical pesticides), microorganisms that control pests (microbial pesticides), and pesticidal substances produced by plants containing added genetic material (Plant incorporated protectants) or PIPs".

They are obtained from organisms including plants, bacteria and other microbes, fungi nematodes, etc.

Reference : ①. B.D. Singh (2017). Biotechnology Kalyani publication.

②. ruchirani022 (2018), Biotechnology Net source.