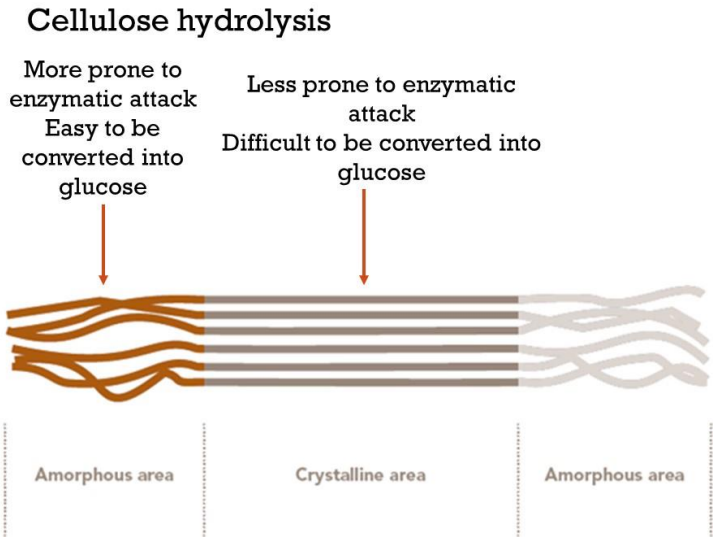
Cellulose hydrolysis



Conversion of cellulose to glucose by means of enzymatic reactions involves utilization of the cellulolytic enzymes. Enzymatic hydrolysis of cellulose is fundamentally a heterogeneous reaction in which insoluble cellulose is cleaved through the β-1,4 glycosidic linkages via cellulases. The conversion of cellobiose which is a disaccharide, to glucose, is a homogeneous reaction and conducted by the enzyme, β-glucosidase.

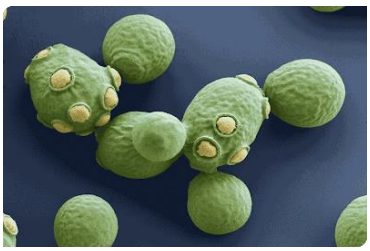
Hydrolysis indicates water addition to the structure.

Besides being utilized for cellulosic ethanol production, cellulose applications are extensive. Owing to its biocompatible and chiral structure, cellulose has been shown to form composites with synthetic polymers and biopolymers. Thus, the major products that involve utilization of cellulose derivatives are coatings, laminates, optical films, pharmaceuticals, foods, and textiles.

Fermentation

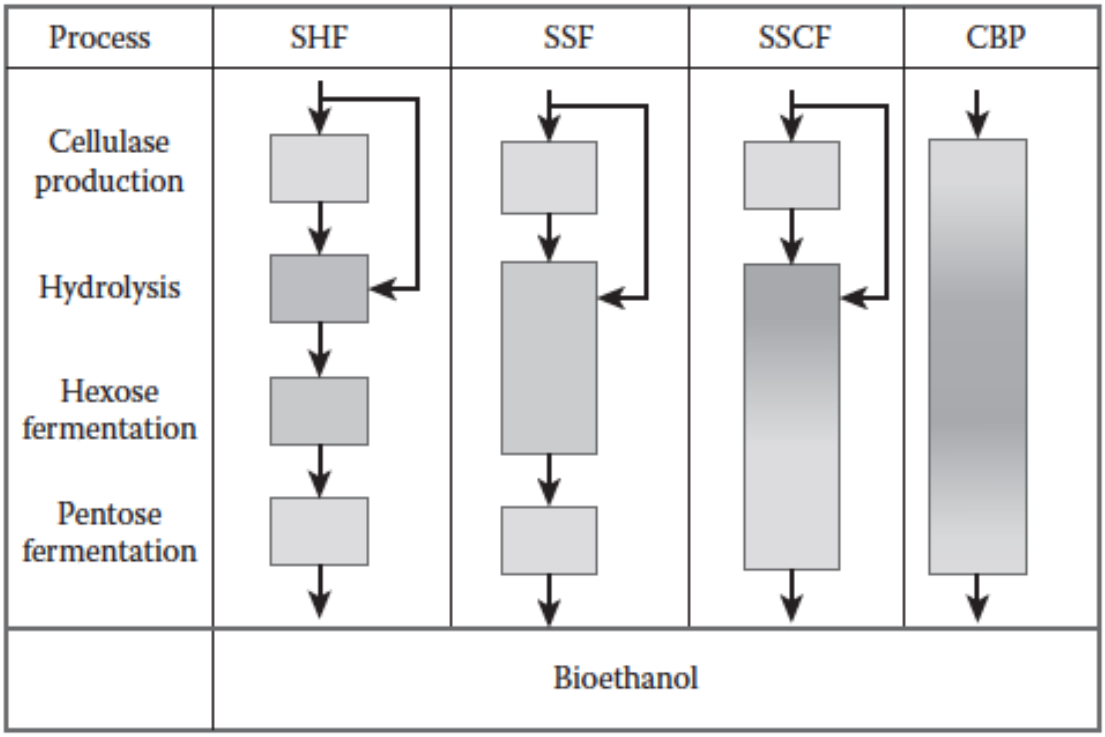
Saccharomyces cerevisiae is traditionally used for alcoholic beverage and bioethanol production; however, its performance during fermentation is compromised by the impact of ethanol accumulation on cell vitality.

The enzymatic hydrolyzate will be used for fermentation. Yeast fermentation is always accompanied by the formation of CO_2 by-products. The optimum temperature for fermentation of conventional yeast strain is 30◦C, and this strain resists high osmotic pressure. *S. cerevisiae* can produce a high yield of ethanol (90% of theoretical) from hexose sugars.



(https://www.micropia.nl/nl/ontdek/nieuws/2018/2/2/opruimen-van-radioactief-afval-met-gist/)

Various strategies for biomass ethanol production



Ethanol from neolithic times - HISTORY

- The fermentation of sugar into ethanol is one of the earliest organic reactions.
- Ethanol is a powerful solvent and alcoholic beverage.
- Ethanol can also be used as a fuel additive and fuel directly.
- Ethanol as a universally available, chemically available and widely used chemical has been discovered a million years ago.
- Fruit falls and decomposes and releases a strong smell.
- Dried ethanol residue have been found on 9 000 year old pottery in China which indicates that Neolithic people in this part of the world may have consumed alcoholic beverages.
- Fruit falls on the ground and decomposes which makes apes easier to find. This process began 10 million years ago.
- Ethanol is the least toxic alcohol, the only one used in beverages.
- Ethanol is made by the yeast. Yeast consume sugar and convert it into ethanol and CO_2.
- So our ancestors discovered this process by coincidence.
- 4500 BCE – First evidence of grape wine in Iran and alcohol appeared the first time in Scotland in Europe.
- 3500 BCE - Barley beer in Iran.
- Early benefits of beer was nutritional –delivering hydration in a more sterile way.
- 5000 years ago – Construction of over 100 enormous pyramids – the greatest structures in ancient history –Hard work
- 4000 years ago – Greeks helped spread viniculture in Mediterranean.
- 1500 BCE - Pottery was being used to store fermented food in Honduras.
- Pottery and wood – why?
- Distillation- the first time in Salerno, Italy -12th century. Why do we need distillation? Dİstillation yields 95% ethanol by volume which has a BP – 78.15°C.
- Simply crushing grapes initiates the fermentation process with the wild type yeast that is already in the fruit itself. In a closed container, soon oxygen levels decrease and the yeast produces ethanol at 5-10%.
- Pure ethanol has a BP of 78.5°C and density of 0.789 g/ml.
- As a chemical known to alchemists and medicinal chemists in Europe and Asia, it is also found uses as a solvent for materials poorly soluble in water.
- Its key property is its flash point which is 13 °C .