

FDE 437

FERMENTATION TECHNOLOGY

Instructor:

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Course Content

- ▶ Definition and importance of fermentation
- ▶ Basic principles of food fermentation
- ▶ Fermentation microorganisms
- ▶ Fermentation biochemistry
- ▶ Beer technology
- ▶ Vinegar technology
- ▶ Lactic acid fermentations and technologies
- ▶ Alcohol fermentation and other fermentations
- ▶ Wine technology
- ▶ Distilled spirits technology
- ▶ Quality analysis in fermented food products

Weekly Course Outline

Week	Topic
1	Introduction to fermentation technology, basic principles of food fermentation
2	Malt chemistry and technology
3	Beer chemistry and technology
4	Vinegar chemistry and technology
5	Pickle production
6	Table olive production
7	Boza production
8	Mid-term exam
9	Wine chemistry and technology
10	Principles of distillation
11	Cognac and armagnac production and technology
12	Liquor and cordial production
13	Wine spoilage and defects
14	Raki, vodka, gin production and technology/Fruit wines and specialty wines technology

Learning Objectives

- ▶ **An ability to have a knowledge on the definition and importance of fermentation technology.**
- ▶ **An ability to gain knowledge about the basic principles of fermentation and technologies of fermented food products.**
- ▶ **An ability to learn the characteristics and production technologies for different types of fermented food products.**
- ▶ **An ability to describe the production processes and properties of alcoholic beverages.**
- ▶ **An ability to learn role of microorganisms in fermentation and to gain skills to control of fermentation processes.**
- ▶ **An ability to explain the problems that may occur in fermented and distilled beverages and to offer solutions.**

Suggested References

- ▶ Hui, Y.H., Meunier-Goddik, L., Hansen, A.S., Josephsen, J., Nip, W-K., Stanfield, P.S., Toldrá, F. (2004). **Handbook of Food and Beverage Fermentation Technology**. Marcel Dekker, Inc., New York, USA.
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- ▶ Özçelik, F., Bağder Elmacı, S. (2020). **Turşu Üretimi**. In: **Fermente Ürünler Teknolojisi ve Mikrobiyolojisi**. Editörler: Osman Erkmén, Hüseyin Erten, Hidayet Sağlam, Nobel Akademik Yayıncılık, 293-314, ISBN:978-625-406-665-8 (in Turkish).
- ▶ Özçelik, F., Bağder Elmacı, S. (2020). **Sirke Üretimi**. In: **Fermente Ürünler Teknolojisi ve Mikrobiyolojisi**. Editörler: Osman Erkmén, Hüseyin Erten, Hidayet Sağlam, Nobel Akademik Yayıncılık, 267-291, ISBN:978-625-406-665-8 (in Turkish).

Introduction to Fermentation Technology

- ▶ **Fermentation** is one of the most ancient forms of food preservation technologies in the world that uses microorganisms to convert perishable and sometimes inedible raw materials into safe, shelf-stable and palatable foods or beverages.
- ▶ **Fermentation** can be described as a biochemical change, which is induced by the anaerobic or partially anaerobic metabolism of carbohydrates by microorganisms with the production of acids that result in decrease in pH, or with the production of alcohols.

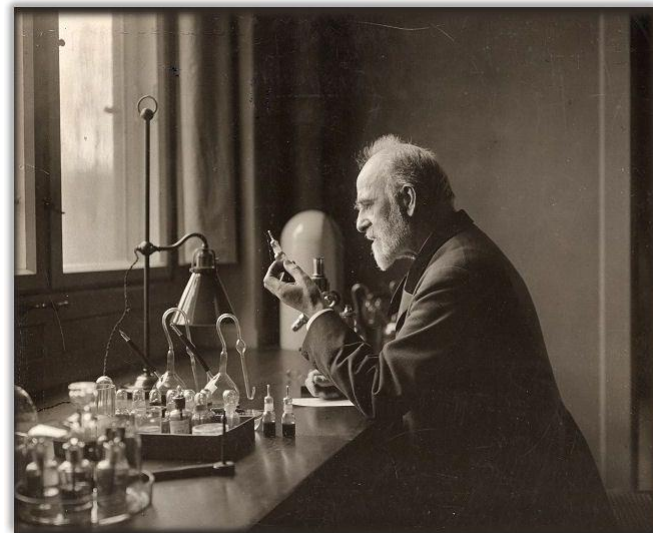
Introduction to Fermentation Technology

- ▶ The nature of the fermentation reaction did not become clearly understood until the late part of the nineteenth century when Louis Pasteur discovered the relationship between living cells and fermentation.
- ▶ In 1854, Pasteur demonstrated the relationship between yeast and this reaction. The word fermentation became associated with microorganisms. Pasteur also showed that true fermentation occurs only in the absence of free oxygen. He called life without air anaerobiosis.
- ▶ **The definition of fermentation in biochemistry** is the extraction of energy from carbohydrates and other organic substrates without using O_2 as an electron acceptor. Hence fermentation is an energy-yielding catabolic pathway that proceeds with no net change in the oxidation state of the products compared to that of the substrate.
- ▶ **The common usage of the word fermentation** frequently overlooks the strict biochemistry definition. A broad sense was adopted, that is, a process in which microorganisms produce chemical changes in organic substrates through the action of enzymes produced by these microorganisms.

- ▶ A breakthrough in the history of wine occurred when **Louis Pasteur** described «life without oxygen» and of brewing fermentation when **Emil Christian Hansen** at Carlsberg brewery in the late 19th century isolated a pure yeast culture from single cells.



Louis Pasteur



Emil Christian Hansen

Introduction to Fermentation Technology

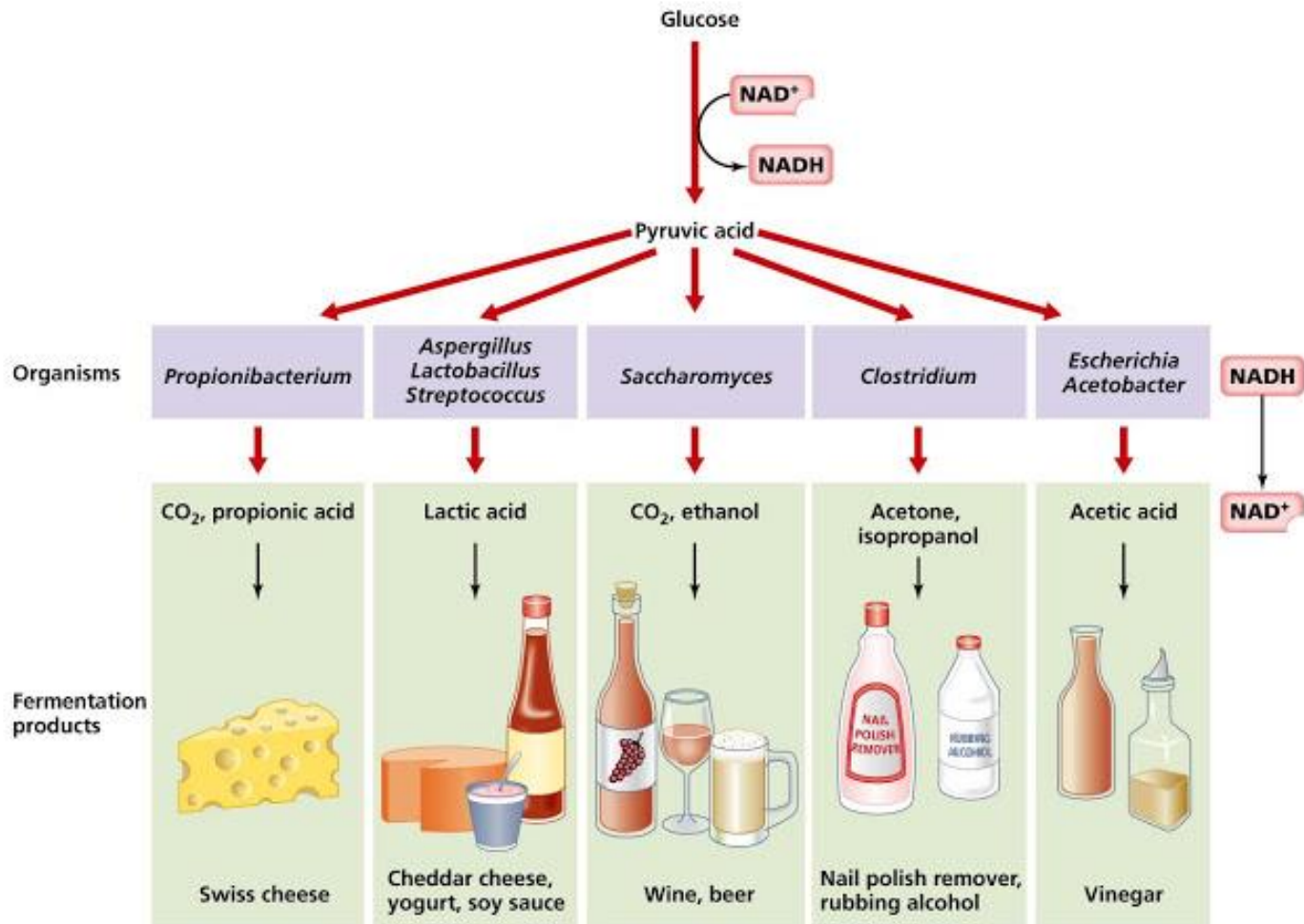
- ▶ Preservation of foods by fermentation has been used since ancient times. Especially, fresh vegetables and fruits are important groups of fermented foods since they are very perishable.
- ▶ Besides preservation, fermentation also increases nutritional value of the foods. Functionality and sensory properties of end products are enhanced by fermentation.
- ▶ Fermented foods including plant-based foods are produced on a large scale in industry besides the production on a small scale at homes.
- ▶ The word fermentation has derived from the Latin word *fevere*, which means to boil. This word is related to the beginning of wine fermentation in which released gas bubbles give the impression of boiling.
- ▶ As a milestone, **Louis Pasteur** established the role of microorganisms during fermentation in the middle of the nineteenth century and showed that fermentation is a microbial process. Pasteur demonstrated that fermentation occurs without oxygen with the words “life without air” (*la vie sans l’air*).

What is fermentation?

- ▶ The term «**fermentation**» is derived from the Latin verb *fervere*, to boil, thus describing the appearance of the action of yeast on extracts of fruit or malted grain.
- ▶ The boiling appearance is due to the production of carbon dioxide bubbles caused by the anaerobic catabolism of the sugars present in the extract.

What is fermentation?

- ▶ Fermentation has come to have different meanings to biochemists and to industrial microbiologists.
- ▶ Its biochemical meaning relates to the generation of energy by the catabolism of organic compounds, whereas its meaning in industrial microbiology tends to be much broader.
- ▶ **Fermentation** is a metabolic process that produces chemical changes in organic substrates through the action of enzymes.
- ▶ In biochemistry, it is narrowly defined as the extraction of energy from carbohydrates in the absence of oxygen.
- ▶ In food production, it may more broadly refer to any process in which the activity of microorganisms brings about a desirable change to a foodstuff or beverage.
- ▶ The science of fermentation is called zymology and the first zymologist was Louis Pasteur identifying and applying yeast in fermentation.



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