

ENZYMES IN THE BREWING PROCESS

Assist.prof.dr.ing. Mihaela NISTORAN BOTIS
Mechanical Technology Department, "Politehnica"
University of Timisoara



REZUMAT. În procesul de fabricare a berii, enzimele au un rol important, în special amidonul din aluat, care generează unele transformări în timpul procesului de zaharificare. Lucrarea analizează principalele procese și enzime care au un rol important pentru aceste transformări în procesul de preparare.

Cuvinte cheie: fabricare, enzyme, amilază, maltoză, drojdie, malt

ABSTRACT. In the brewing process enzymes have an important role especially starch from leaven that promotes some transformations during the saccharification process. This work analyses the main processes during brewing and the enzymes that have an important role for these transformations.

Key words: brewing, enzymes, amylase, maltose, leaven, grist

1. INTRODUCTION

Beer technology involves some biotechnological processes the most important are brewery, primary and secondary fermentation and beer maturation.

Brewery (leaven and saccharification) is the operation for must obtaining. The substances that pass from malt into must achieved the must extract in which are soluble substances from malt as well as substances that became soluble under the influence of enzymes from malt.

The main enzymes from barley with a significant importance in beer obtaining are:

- β - *amylase* from the barely bean. During germination increases intensely in the first days and then the content of β - *amylase* is reduced;

- *dextrinase* hydrolyses α bonds and achieved malto-triose, malto-tetrose and glucose. Dextrinase content increases during germination until the process ending. It is completely destroyed in the boiling process.

- *maltase*, hydrolyzed maltose to glucose; in the germination process its activity increases but it became inactive at drying.

- *invertase* hydrolyzed saccharose to glucose and fructose; its activity increases at the end of watering process until the 3-th day of germination.

- β -*glucosidase* are called citaze and includes enzymes that destroyed the cellular walls of barely bean in which are starch granules. Degradation of β -glucans decreases the viscosity of leaven.

-*proteolytic enzymes* hydrolyses substances with nitrogen from barley bean and are represented by to main groups:

- *endo-peptidase*
- *exo-peptidase*

- *lipases* belong to esterases group and hydrolyses more triglycerides and less diglycerides from the barley bean. At germination activity of lipases increases with 50-80% toward that's of the barley bean and is more intensely as the watering degree is greater and the germination time is longer

- *oxido-reductase enzymes* are very important at the malt and beer obtaining. These enzymes influence the barley germination, oxidation of malt components, with an important influence on the taste, flavor and stability of beer.

2. BREWING (LEAVEN AND SACCHARIFICATION)

Leaven consists from mixing of grist with hot water (in case of dried grinding) or mixing with water during the grinding process (wet grinding).

Saccharification is a biochemical process in which starch from the grinded malt, mixed with water, by chemical and biochemical reactions is transformed in soluble products. It is the main process from the leaven kettle.

Inputs and out puts from the brewing process are represented in figure 1

In the second phase takes place starch liquefaction that is characterized by viscosity decreasing of jellified starch under the action of α -amilase.

Saccharification consists from bonds splitting of α -1,4 amilose and amilopectine by α -amilase resulting linear and branched dextrines as well as maltose and glucose.

Saccharification action of enzymes from leaven could be influenced by temperature, time, and pH and leaven concentration.

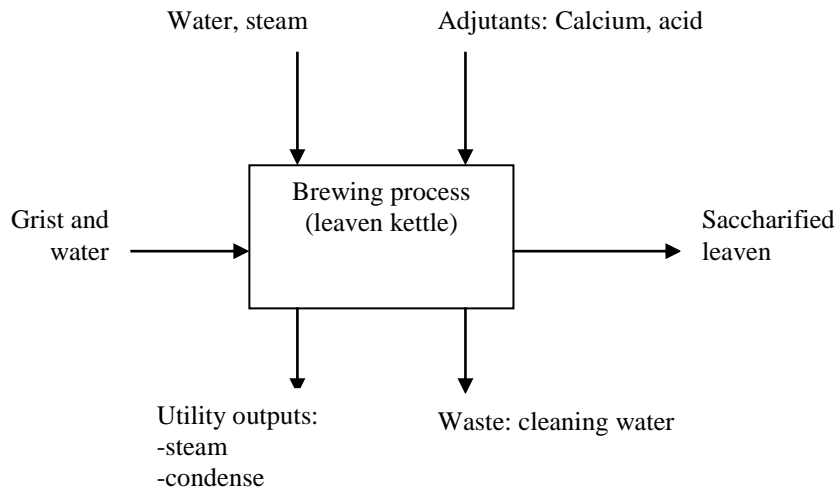


Fig.1: *Brewing process scheme*

A good saccharification of starch has to lead towards musts with a final degree of fermentation at least 80%.

In the brewing process starch undergoes the following phases:

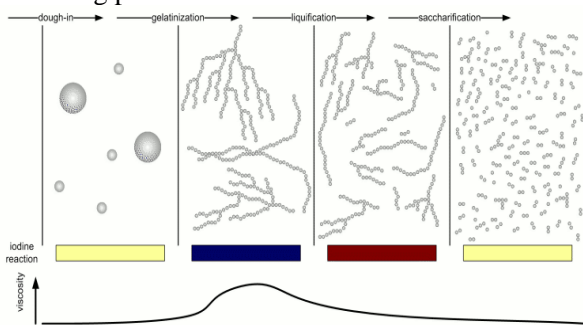


Fig.2 *Starch transformations during brewery process*

During leaven process on the starch acts two enzymes:

-*amylase* that provokes a rapid decomposition of the starch granule by splitting the bonds 1,4 α -glucosidic

-*amilopeptine* that already exists in the barely bean, during maltification it pass into active shape and interfered in the process only after α - amylase attack.

In the saccharification process takes place the splitting of bonds from 1, 4 α amylase, resulting linear and branched dextrines with a smaller molecular mass as well as small quantities of maltose and glucose. This process is represented in figure 3:

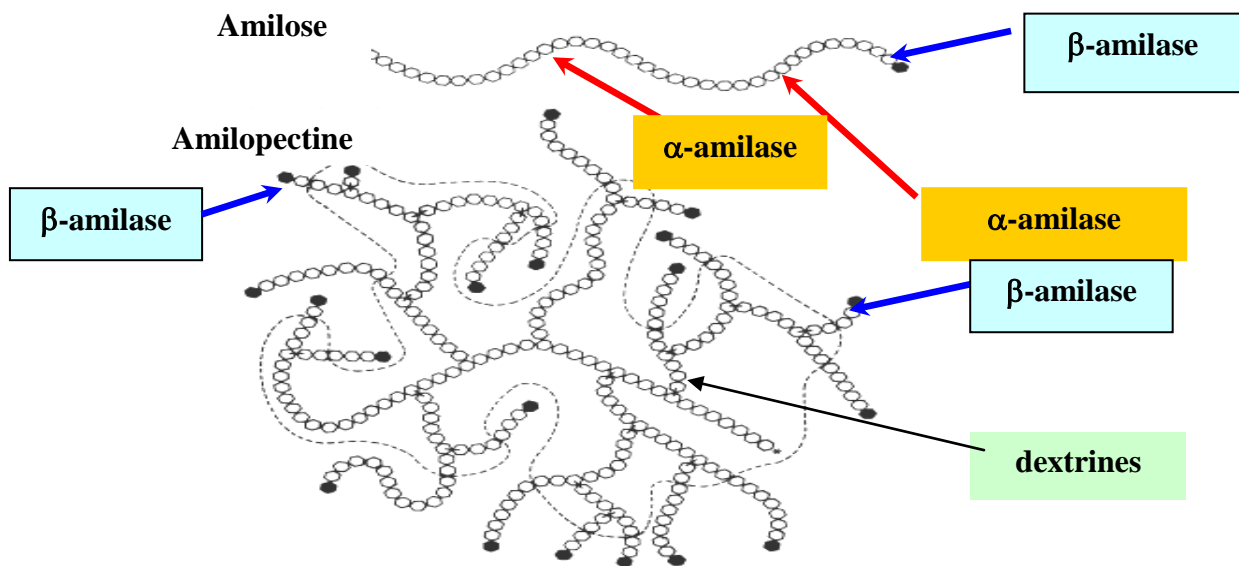


Fig.3 *Starch structure and the main amylolytic enzymes*

The main enzymes that act during brewing process are presented in table 1:

Table 1 *Main enzymes from leaven and their characteristics*

Enzyme	pH	Optimal temperature, °C	Inactivation temperature, °C	Hydrolyzed bond	Hydrolyzed products
α -amylase	5.6-5.8	70-75	.80	$-\alpha$ -1,4 from any place inside amylose and amylopectine	-linear dextrans from amylose -branched dextrans from amylopectine -maltose and glucose
β - amylase	5.4-5.6	60-65	70	α -1,4 from the non-reducing end of the catena not only at amylose but also at amylopectine	-branched dextrans -maltose
Dextrinase	5.1	55-60	65	α 1,6 from amylose and amylopectine	-linear dextrans with small molecular mass
Maltase	6	35-40	40	Maltose	2 Glucose
Invertase	5.5	50	55	Saccharose	-Glucose -Fructose

3) CONCLUSIONS

In the brewing process act many enzymes that provoke decomposition of starch and substances with nitrogen, transformations of polifenols and substances with phosphor and degradation of cellulose. This work analyzed the starch decomposition by gelatinization, liquefaction and saccharification and the main enzymes amilose and amilopectine that undergo these transformations. Finally are presented enzymes that hydrolyzed the starch from leaven, the hydrolyzed bond and products.

REFERENCES

- [1] **Banu C.**, *Biotechnologies in food industry*, Ed. Tehnica, Bucuresti,2000;
- [2] **Botis Nistoran Mihaela**, *Biotechnologies in food industry*, Ed. De Vest, Timisoara, 2009;
- [3] **Briggs D.E.**, *Malting and brewing science*, vol.1 and vol.2, Chapman et Hall, London, 1995;
- [4] **Jurcoane Stefana**, *Biotechnologies, bioreactors, enzymes*, Ed.Tehnica, Bucuresti,2000.