Oct 31st, 3:15 PM - 4:45 PM

The Study of Mashing Methods and Features of Fermentations Products

Mybeshir Pajaziti
University for Business and Technology - UBT

Kastriot Pehlivani
University for Business and Technology - UBT

The Study of Mashing Methods and Features of Fermentations Products

Mybeshir Pajaziti, Kastriot Pehlivani

UBT – Higher Education Institution, Department of Food Science and Biotechnology,

Lagjja Kalabria, Prishtina 10000, Kosovo

{Mybeshir.Pajaziti, Kastriot.Pehlivani}@ubt-uni.net

Abstract

If mashing is conducted at 62 to 64˚C, a higher maltose composition is obtained and the limit is of fermentation rate is higher. The wort, which has a lot of maltose ferments quickly, and the yeast is kept suspended for a long time. Continuous mashing at 62 to 64˚C yields beer with a high fermentation limit; if these temperatures are exceeded, and continuous mashing is carried out at 72 to 75˚C, beers with high dextrin content and low fermentation limit are obtained.

To produce beer, primary and secondary fermentation are performed. During primary fermentation, the obtained sugars are converted into alcohol, CO_2, and lasts up to 7 days; during secondary fermentation, the beer matures and this process lasts up to 21 days.

This paper will address the importance of achieving the right temperatures during the malt heating process, as well as their importance in the development of the fermentation process.

Keywords: Wort, Basic Extract, Beer, KEB, MEBAK

1. INTRODUCTION

These processes in which we conducted this study take place in the phase of obtaining the sweet solution. There are two separate processes in terms of how to apply. In both ways a sweet solution is obtained but with different characteristics. If the fermentation is conducted at 62 to 64˚C, the highest maltose composition is obtained and the limit is the higher the fermentation rate. The must, which has a lot of maltose, ferments quickly, and the yeast is kept suspended for a long time. Continuous fermentation at 62 to 64˚C yields beer with a high fermentation limit; if these temperatures are exceeded, and continuous fermentation is carried out at 72 to 75˚C, beers with high dextrin content and low fermentation limit are obtained.
The influence of the fermentation temperature is very large, so that in the case of fermentation there are always pauses at the optimum temperatures for the action of amylase.[1]
These breaks are:
Maltose break at 62 to 64˚C (= optimum temperature for β-amylase)
Sugar break at 72 to 75˚C (= optimum temperature for α-amylase)
Final drilling temperature at 76 to 78˚C.[1]
During fertilization the enzymes no longer act at the same rate. Moreover, during fertilization two phases of enzyme activity can be observed as a function of time:
1. Maximum enzyme activity is realized after 10 to 20 minutes. Maximum enzyme activity is at temperatures between 62 and 68˚C higher.[5]
2. After 40 to 60 minutes the activity of enzymes first rapidly decreases, but the reduction of their activity continues further.
As the fermentation time increases, the concentration of the extract in the digestion also increases. This action slows down more and more.
With the prolongation of the fermentation time (especially at temperatures 62 to 64˚C) the maltose content increases, as well as the limit fermentation rate increases.[9] During this the fermentation of the must can be expected to be more intense.
When it comes to enzymes, we have seen that their action is highly dependent on pH.
However, we have seen that in cider for β-amylase is pH 5.4 to 5.5.
Fermentation at pH in the range 5.5 to 5.6, which can be considered optimal for the action of both amylases, improves the penetration of the extract into the solution depending on the fermentation with higher pH values. Larger amounts of fermentable sugars are formed, and the limit fermentation rate increases.
In dilute beads more extract passes into the solution, but in dense beads the enzymes are more protected from very rapid thermal inactivation (= the protective action of colloids and dissolved compounds of the must). For this reason in dense cider is the largest composition of fermentable sugars,

and is the increased rate of fermentation limit. The influence of beeswax concentration on starch decomposition, however, less than the influence of other factors.

In conclusion, everything that was said about starch control can be summarized: During fertilization, starch must be translated into the ace state, to give a normal reaction with iodine.

At the end of the drilling, the starch decomposition control is performed with the help of iodine test. Since the color of iodine in starch and dextrins of the largest molecular mass is reported only in the cold beaker, the beaker sample must be cooled. After cooling a drop of must on the porcelain tile or gypsum block is mixed with a drop of iodine solution. In this way, the yellow color change of 0.02 N iodine solution must not be reported.

We have previously noted hemicelluloses, from which the barley endosperm cell walls are constructed, consist of β-glucan and small amounts of pentosan.

We know that β-glucan is very important in beer production because it can cause a lot of difficulty during beer filtration. Thus especially important is the macro molecular β-glucan gel, which should not correlate with the overall β-glucan content. We know that β-glucan consists of unbranched glucose residue chains which are interconnected by β-1,4 and β-1,3 bonds compared to 3/4: 1/4. These β-glucans in cider are found in unregulated form.[5]

Important controlling factors for evaluating the success of obtaining low-β-glucan malt are the phrybimetric value of malt and the viscosity of congressional must. The correlations of these two factors with the β-glucan content in the cider are large, while the β-glucan content is, in turn, correlated with the filtrability of the beer.

The friabilimetric value of malt is tended to be above 80.

Under the influence of β-glucanase, β-glucan is optimally degraded at 45 to 50°C.

Despite this, β-glucan passes into the solution even at 60 to 65°C, under the influence of β-glucan-solubiase, which is very thermo-resistant, and is significantly inactivated over time. It also releases β-glucan from albumin compounds at temperatures of 65 to 70°C; this β-glucan, however, can no longer be degraded because endo-β-glucanases are inactivated at 52 to 55°C. Thus, whole β-glucan which is not decomposed during malting in the boiling compartment causes difficulties.[1]

By the time the wort is cooked at the latest, all proteins (macro-molecules) are depleted, except for very small amounts which remain in the wort. Thus, in the beer pass only the decomposition products of albumin, which are necessary for the multiplication of yeast and the rapid development of fermentation. Enzymatic degradation of albumin mainly takes place at 45 to 55°C, but it is not interrupted even at high temperatures. If the pause is maintained at 45°C more decomposed products of small molecular mass are formed, and if the pause is maintained at 55°C, more macro molecular components are formed.

During the decomposition of albumin, proteins first pass into macro-molecular degradable products, which then pass into small molecular-mass degradable products, and finally, into amino acids. Since the decomposable macromolecular products during the decomposition of albumin are formed to the same mass with which they further decompose, it is of no use to hold the pause for their formation, rather at the same temperature the gum components that are responsible for the formation would decompose of beer foam. Thus, the extended break at 50˚C results in weaker beer foam.

It is different in the amount and importance of amino acids. Yeast requires at least 10 to 14 mg of α-aminoazot per 100ml of wort. Since the amino acid proline yeast can not be used as a source of amino nitrogen, the concentration of α-amino nitrogen in cider should be at least 20mg / 100ml. If this is not done,

- yeast multiplication is reduced,
- slows down the fermentation and maturation of beer, and thus,
- in the ready beer pass the undesirable ingredients responsible for the sensory properties of the new beer.

During digging 75 to 80% of the ration mass is digested, until the rest remains undigested and separated as waste. Most of the extract formed during fertilization consists of sugars (maltose, maltotriose, glucose), as well as sugars carried by the initial barley (sucrose, fructose). The share of these fermentable sugars in cider from 11 to 12% of the extract is 61 to 65% of the total extract, and it is approximately the same as the limit fermentation rate which corresponds to the apparent degree of fermentation with which you bring in the ward from 75 to 80%. Other extract ingredients that yeast could not ferment are most dextrins, albuminous ingredients, gummy ingredients and mineral compounds.

Classic double-deck drilling begins with drilling at 50°C. After a short pause the dense beaker is separated, which with short heating pauses until boiling, is boiled for 15 to 20 minutes, and returned to the beaker residue, during which the temperature in the whole beaker rises to 64°C; then follows the pause for maltose formation. After a short time, the second decoction is separated, and heated until it boils. The second decoction is usually taken a little shorter, and the whole beak at about 76°C, after which it is carried to the drain. Two-decoction drilling takes about 3 to 3.5 hours.

If the digestion diagram is examined with this procedure, it is observed that the temperature of 50°C is exaggerated, and as a result the decomposition of albumin and β-glucan is very deep. The consequence is the benefit of beer with empty taste and poor foam stability; the empty taste of the beer can somehow be improved with the addition of closed malt.

To correct this deficiency, fermentation can be done at 50°C and fermentation immediately indirectly and / or with the addition of hot water is heated to 64°C, as the break for albumin decomposition would be controlled.

The other option is to drill at 35°C and split the first decoction. Of course, efforts should be made to ensure controlled decomposition of albumin, which is most often done today by controlling the content of free amino acid nitrogen (FAN).[4]

The special type of two-decoction drilling is short-term drilling at increased temperature. The drilling is performed at 64°C, and the whole procedure lasts only two hours, hence the name for this procedure, which can also be performed as drilling with a decoction. If this procedure is used, the malt should be very decomposable.

The drilling temperature of 64°C is above the optimum temperature for albumin decomposition; despite this, the decomposition of albumin is still intense, and it flows in such a way that one can expect the benefit of beer with good foam characteristics.

Decomposition of β-glucan, however, no longer exists, so it is a prerequisite for implementing the action of using very well degradable malt.

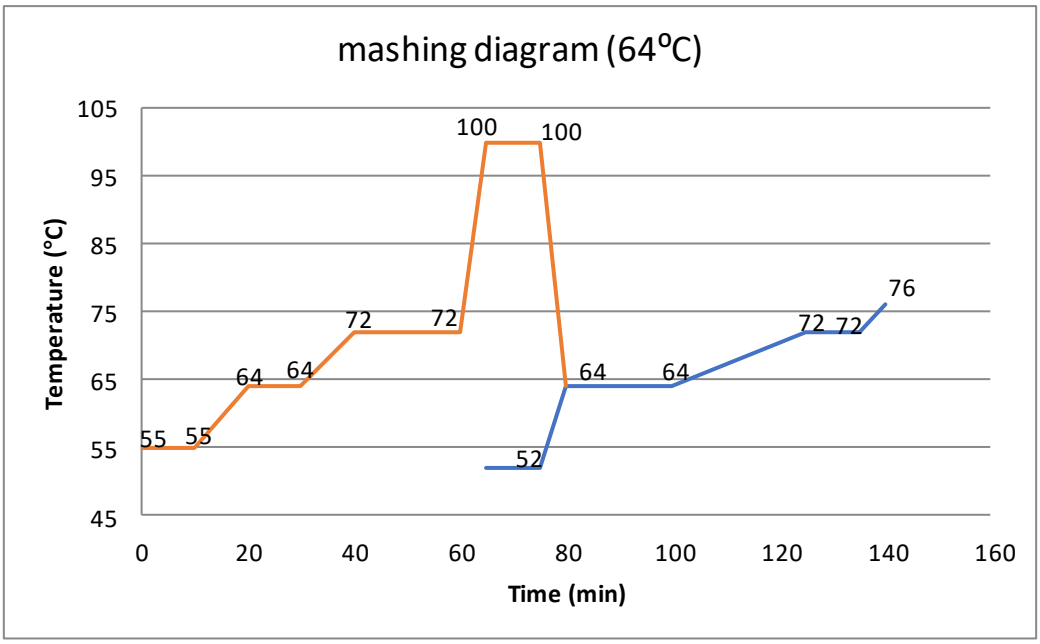

Figure 1. Mashing diagram with 62-64ºC

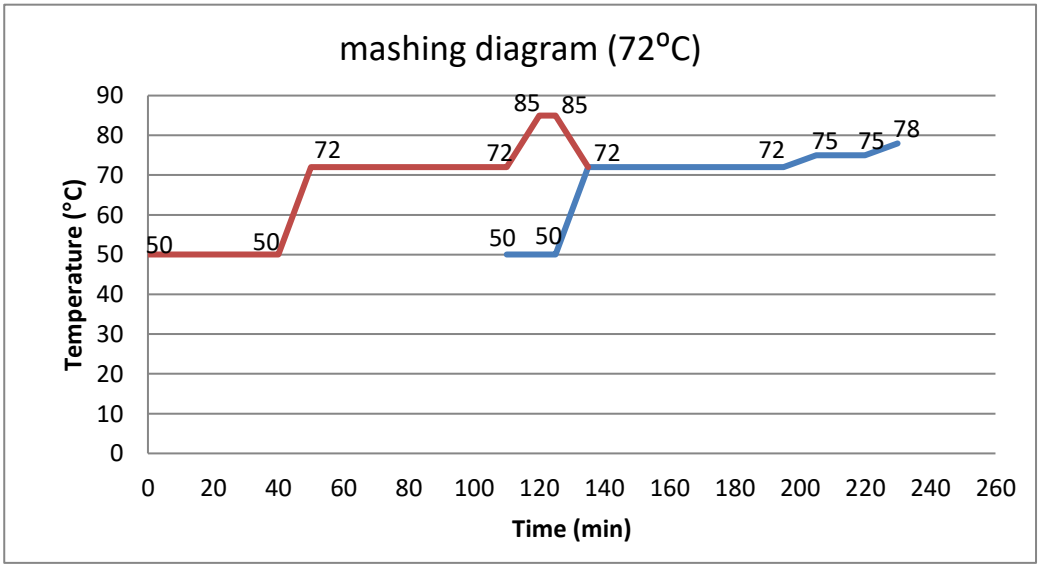

Figure 2. Mashing diagram with 72-75ºC

2. MATERIAL AND METHODS

Beer was obtained as the final product of the study in both cases. In the first case beers with high alcohol concentration (4.5%), as well as in the second case beers with low alcohol concentration (0.15%). To carry out this study it was necessary to use as a raw material malt produced from spring barley water from the source of the white Drini with a hardness of 9.5 ° dGH, lupulus type Aurora (bitter) and Golding (aromatic) in participation 70: 30%. The yeast which is used for the production of these beers is Saccharomyces carlsbergensis with the previously mentioned concentration of yeast cells per ml.[6]

3. RESULTS AND DISCUSSION

In conclusion, all that was said about starch control can be summarized: During fertilization, starch must be translated into the ace state, to give a normal reaction with iodine.

At the end of the drilling, the starch decomposition control is performed with the help of iodine test. Since the color of iodine starch and dextrins of the largest molecular mass is reported only in the cold beaker, the beaker sample must be cooled. After cooling a drop of must on the porcelain slab or gypsum block is mixed with a drop of iodine solution. In this way, the yellow color change of 0.02 N iodine solution must not be reported.

We have previously noted hemicelluloses, from which the barley endosperm cell walls are constructed, consist of β-glucan and small amounts of pentosan.

We know that β-glucan is very important in beer production because it can cause a lot of difficulties during beer filtration. Thus especially important is the macro molecular β-glucan gel, which should not correlate with the overall β-glucan content. We know that β-glucan consists of unbranched glucose residue chains which are interconnected β-1,4 and β-1,3 bonds compared to 3/4: 1/4. These β-glucans in cider are found in unregulated form.

Under the influence of forces which are announced in the cider, e.g. shear forces, β-glucan molecules stretch and bring into contact with each other. With the help of hydrogen bridges, the β-glucan helix is formed which tends to pass into gel form which can challenge very large filtration difficulties.

Beer barley breeders have managed to acquire barley varieties with low β-glucan content, but for the benefit of low macro molecular β-glucan content the greatest responsibility lies with the malt producers.

Important controlling factors for evaluating the success of obtaining low-β-glucan malt are the phrybimetric value of malt and the viscosity of congressional must. The correlations of these two factors with the β-glucan content in the cider are large, while the β-glucan content is, in turn, correlated with the filtrability of the beer.

The friabilimetric value of malt is tended to be above 80.

Under the influence of β-glucanase, β-glucan is optimally degraded at 45 to 50°C. Despite this, β-glucan passes into the solution even at 60 to 65°C, under the influence of β-glucan-solubiase, which is very thermo-resistant, and is significantly inactivated over time. It also releases β-glucan from albumin compounds at temperatures of 65 to 70°C; this β-glucan, however, can no longer be degraded because endo-β-glucanases are inactivated at 52 to 55°C. Thus, whole β-glucan which is not decomposed during malting in the brewing unit causes difficulties.

By the time the wort is cooked at the latest, all proteins (macro molecules) are depleted, except for very small amounts which remain in the cider. Thus, in the beer pass only the decomposition products of albumin, which are necessary for the multiplication of yeast and the rapid development of fermentation. Enzymatic degradation of albumin mainly takes place at 45 to 55°C, but it is not interrupted even at high temperatures. If the pause is maintained at 45°C more decomposed products of small molecular mass are formed, and if the pause is maintained at 55°C, more macro molecular components are formed.

During the decomposition of albumin, proteins are first converted into macro-molecular degradable products, which are then converted into small molecular-weight degradable products, and finally into amino acids. Since the decomposable macromolecular products during the decomposition of albumin are formed to the same mass with which they further decompose, it is of no use to hold the pause for their formation, rather at the same temperature the gum components that are responsible for the formation would decompose of beer foam. Thus, the prolonged break at 50˚C results in weaker beer foam.

During digging 75 to 80% of the ration mass is digested, until the rest remains undigested and separated as waste. Most of the extract formed during fertilization consists of sugars (maltose, maltotriose, glucose), as well as sugars carried by the initial barley (sucrose, fructose). The share of these fermentable sugars in cider from 11 to 12% of the extract is 61 to 65% of the total extract, and it is approximately the same as the limit fermentation rate which corresponds to the apparent degree of fermentation with which you bring in the ward from 75 to 80%. Other extract ingredients that yeast could not ferment include most dextrins, albuminous ingredients, gummy ingredients, and mineral compounds.

Table 1. Analysis of the final product by mashing at a temperature of 62-64ºC[2]

Date of work	Basic extract %	Real extract %	Apparent extract %	Real rate of fermentation %	Appar. rate of ferment. %	Alcohol %v/v	Density 20/20	CO_2 g/l	pH	Color EBC	Bitter EBC	O_2 total mg/l	Polyphenols mg/l
14.08.2020	10.42	6.62	2.00	66.44	80.76	4.43	1.0078	5.0	4.74	6.20	19.0	0.24	191.00
22.10.2020	10.77	3.90	2.26	65.09	81.03	4.49	1.0080	5.2	4.30	5.80	16.0	0.32	167.00
min/max	6.0-6.2					0.0-0.30		4.7-5.7	5.0-5.3	6.5-8.0	18-20	0-0.5	

Table 2. Analysis of the final product by mashing at a temperature of 72-75ºC[2]

Date of work	Basic extract %	Real extract %	Apparent extract %	Real rate of fermentation %	Appar. rate of ferment. %	Alcohol % v/v	Density 20/20	CO_2 g/l	pH	Color EBC	Bitter EBC	O_2 total mg/l	Polyphenoles mg/l
17.08.2020	6.56	6.18	6.09	5.84	7.06	0.24	1.0024	5.1	5.27	5.4	24	0.15	72.04
22.10.2020	6.34	6.12	6.06	3.60	4.35	0.14	1.0023	5.3	5.21	5.00	16	0.22	69.06
Min/max	6.0-6.2					0.0-0.30		4.7-5.7	5.0-5.3	6.5-8.0	18-20	0-0.5	

4. CONCLUSIONS AND FINDINGS

This study was done in the period May 2020 - September 2020 and by comparing the results it was concluded that the method of brewing at temperatures of 62-64ºC (longer time interval) gives us as a final product beer with high fermentation activity and higher amounts of ethyl alcohol (depending on the concentration of fermentable sugars up to 4.5%), while believing at a temperature of 72ºC (and longer time interval) gives us beer with high amounts of dextrins, or with low fermentation rate and smaller amounts of ethyl alcohol (0.00-0.20%).

The whole production process during the technological process is followed by analysis and microbiology.

LITERATURE:

1. Kunze, Wolfgang. Technology Brewing And Malcer , VLB Berlin, Germany, 2004.
2. Dr,Heinz-Michael Anger, Dr. Karl Glas, Dr.Peter Jager, Dipl.-Ing, Michael Natter, Dr. Reinhard Orth, Dr. Annette Schwill-Miedaner. Methodensammlung der Mitteleeuropaischen Brautechnischen Analysenkommission (MEBAK), 2005.
3. Narziss, Ludwig: Die Technologie der Malzbereitung, 1976.
4. Schuster/Weinfurtner/Narziss. Die technologie der Würzebereitung, 1985.
5. . Nguyen, T. H. and Viet Man, L. V. Using high pitching rate for improvement of yeast fermentation performance in high gravity brewing, 2009.
6. White Chris, and Zainasheff Jamil, Yeast – The Practical Guide to Beer Fermentation, Boulder, Colorado, 2010.
7. Dennis E. Briggs, Chris A. Boulton, Peter A. Brookes and Roger Stevens, Brewing Science and practice, Cambridge England, 2004.
8. Narziss, L.: Die Technologie der Würzebereitung, Stuttgart, Deutschland, 1985.
9. Dr. Mybeshir Pajaziti. The Study of Technological Parameters of Some Malts from Territories of Europe, With the Purpose of Beer Optimization, 2014.