DIFFERENT PROPERTIES OF MALTING BARLEY VARIETIES DURING LAUTERING AND FILTRATION.

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AIM OF STUDY

- Screening of different malt behavior during brewing process at the same conditions with aim on lautering and filtration.
- Using of standard filtration methods of plate filters and new method of membrane filtration at pilot scale filter.

INTRODUCTION

Filterability of beer and lautering of sweet wort is one of the most critical step in the production of beer, mainly for the reason that even the best analytical methods do not allow accurate prediction of whether the process is right or problematic. It is given a set of many substances that are represented primarily beta-glucans, pentosans, nitrogen compounds, oxalates, polyphenols and other high molecular substances. It is very frequent a synergistic effect of these components. Therefore, it is very demanding a prediction of lautering of wort and filterability using analytical parameters.

Filtration generally refers to clarification of beer through several stages to produce a crystal-clear product. The purpose is to remove suspended material and residual yeast, which would otherwise cause a haze of beer. The particle size of suspended material in beer is ranging from 0.5 to 4 mm. Particle size information is necessary for the brewer for the correct setting of filtration parameters.

First, filtration stage removes the bulk of yeast and suspended material [1] [2]. Second, final filtration removes any additional suspended solids resulting from lagering at cold temperatures and any adsorbents added for stabilization.

Plate filters are one traditional type used in the industry. They consist of a series of parallel plates covered with filter sheets used to support the filter bed. The frames between the plates control the bed depth. Different numbers of plates can be used, depending on requirements. Most filters allow beer to pass through both sides of the plates, thus doubling the surface area per plate. [1] [2]

OVERVIEW

The most problematic copmounds for lautering and filtration in beer except yeast

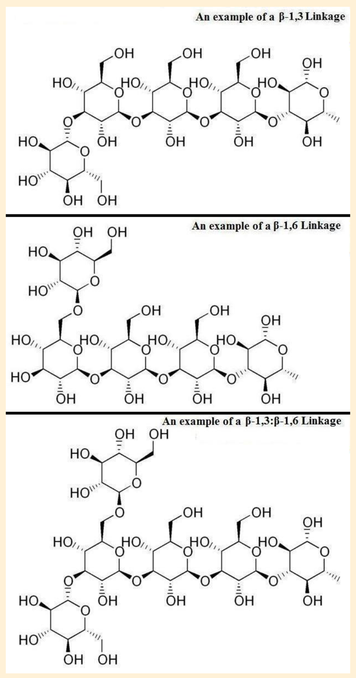


Figure 1: Molecular structure and bond types of the β-glucans.

β-Glucans (beta-glucans) are polysaccharides of D-glucose monomers linked by β-glycosidic bonds. β-glucans are a diverse group of molecules that can vary with respect to molecular mass, solubility, viscosity, and three-dimensional configuration. They occur most commonly as cellulose in plants, the bran of cereal grains, the cell wall of yeast, certain fungi and bacteria. Some forms of β-glucans are useful in human nutrition as texturing agents and as soluble fiber supplements, but can be problematic in the process of brewing.

Polyphenols are a structural class of mainly natural, synthetic or semisynthetic, organic chemicals characterized by the presence of large multiples of phenol structural units. The number and characteristics of these phenol structures underlie the unique physical, chemical, and biological (metabolic, toxic, therapeutic, etc.) properties of particular members of the class. The historically important chemical class of tannins is a subset of the polyphenols. [3] [4]

Proteins are large biomolecules, or macromolecules, consisting of one or more long chains of amino acid residues. Proteins differ from one another primarily in their sequence of amino acids, which is dictated by the nucleotide sequence of their genes, and which usually results in protein folding into a specific three-dimensional structure that determines its activity. For filtration are most important molecules of wieght 5000 kDa and more.

METHODS and EXPERIMENTS

Two groups of single-varietal malts were used. First group was malt for Czech Beer (CB) according to P*rotected Geographical Indication,* the used varieties were Malz, Francin, Bojos and Laudis 550. Second group was malt for all beer types (N) and varieties were Sunshine, Pionier, Wintmalt, SY Tepee and KWS Ariane.

Brewing process. Brewing trials were performed on a computer-controlled brewhouse with a nominal volume of 250 l. The double decoction was performed as follows: Mashing in at temperature 37°C, fast heating to the temperature of 52°C, first part mash transferring after 10 min. rest. Saccharification at 63°C and 73°C, boiling for 15 minutes, first part mash returning. Second part transferring and mashing with same diagram as the first one. Lautering was controlled by differential pressure, maximal values 16 cm of water column and turbidity of sweet wort, for first wort maximal 30 u. EBC and for second wort max. 60 u. EBC. Boiling was set for 70 minutes as low pressure dynamic boiling with max pressure 200 mBar and five peaks. Furthermore two brews (Pionier, Sunshine) were prepared by infusion mashing with mashing in temperature at 52°C and rests at 63°C and 72°C for 30 minutes.

Filtration process

Filtration tests were performed as follows:
- Plate filtration at plate filter with nominal retentiveness 0.8 µm.S (volume 50 L)
- Membrane filtration was performed using two steps:
  - ✓ prefiltration at plate filter with nominal retentiveness 0.6 µm (volume 60 L)
  - ✓ Final membrane filtration with pores size 0.45 µm PES (polyethersulfone) (volume 55 L)

RESULTS AND DISCUSSION

Pic 1: Research brewhouse (250 L)

Pic 2: Pilot scale membrane filter

The content of substances affecting lautering and filterability such as β-glucans, proteins and viscosity of wort corresponded with respective group CB or N. Malts of varieties from CB group (Malz, Francin, Bojos and Laudis 550) had slightly higher concentration of β-glucans (from 97 to 152 mg/l); the content of other varieties (group N) was ranging from 13 to 48 mg/l except sample Tepee SY (218 mg/l).

Majority of samples were lautered in the range of 74 - 118 minutes, while the sample Wintmalt showed unexpected result, where this sample was lautered for 171 min.

Fig 2: Lenghts of lautering

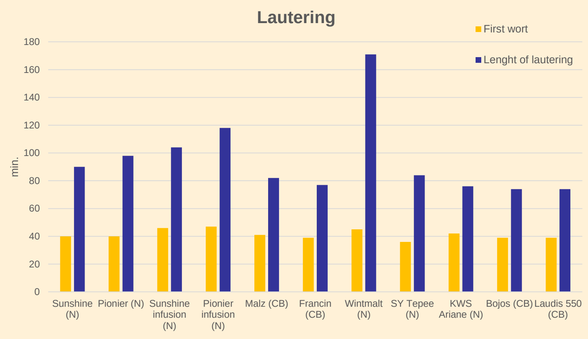
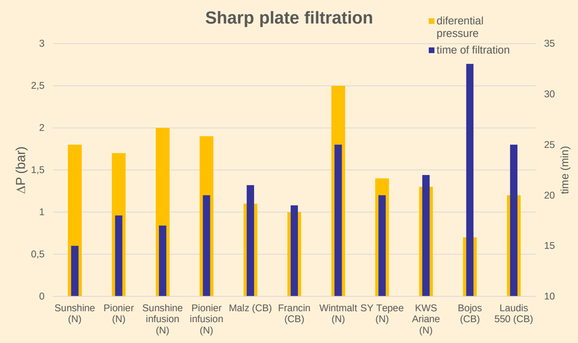
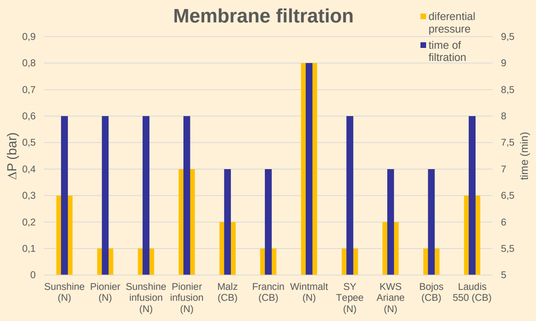


Fig 3: Plate filtration – times and pressure elevation



Inlet pressure for all of the filtration was the same, so the differences during the filtration are the result of properties of different malts. The results of all filtration indicate a rise in pressure similar for all types of filtration. Always highest pressure rise had varieties Wintmalt, Pionier and Sunshine. Low pressure increases were indicated for the varieties Bojos, Francin and Malz. It is interesting that the malt variety Malz had low pressure rise at the plate filtration with nominal retensivness 0.6 microns while a very long time filtering (33 min.)

Figure 4: Membrane filtration – times and pressure elevation.



Contents of investigated compounds during filtration showed no significant decrease for all samples. Decreases of individual compounds are within tolerance inaccuracies of the methods. As an example there are shown the values of the worst-rated malt in terms of filtration the variety Wintmalt at Table 1. Neither for this sample there are no abnormal values for the Czech type of lager. And that probably implies the interaction between individual components for filtration of beer.

Table 1: Example of content of problematic compounds at malt variety Wintmalt

Whitmalt	units	filtration	value
Betaglucans	mg/l	unfiltred	102,6
		plate	101,8
		sharp plate	101,9
		membrane	101,7
Pentosanes	mg/100 ml	unfiltred	76
		plate	76
		sharp plate	75,6
		membrane	76,3
Polyphenols	mg/l	unfiltred	219
		plate	219
		sharp plate	218
		membrane	218
Nitrogen compounds over 5000 kDa	mg/100 ml	unfiltred	45,7
		plate	45,5
		sharp plate	45,4
		membrane	45,5

In conclusion we can say that there is still no comprehensive method or set of methods that could predict whether malt goes well or badly lautered or filtered. The only one possibility for prediction filterability and lautering conditions is a test batch of the raw material.

The aim of the project is to identify compounds that most slows down filtration at membrane filters and reduce its content to a minimum value without changing the character of the final product by changes at the technology.

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