

## INFLUENCE OF UNMALTED GRAIN ON THE PROPERTIES OF THICKENED MALT WORTS

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**Summary.** In this work there were determined properties of worts obtained by the congress mashing of the Pilzen type malts with the addition of 50% of unmalted grain, in the form of gelatinised grist of barley or Triticale grain, and with the addition of enzymatic preparation Ceremix 2XL. It was observed that the addition of 50% of grain with preparation Ceremix 2XL allows to obtain worts with the properties similar to those obtained from the malt without additives. The addition (50%) of the traditional unmalted grain in the form of barley grain changes the properties of thickened worts in a lesser degree than the addition of the same amount of Triticale grain.

**Keywords:** barley, Triticale grain, malt, malt extract.

### INTRODUCTION

The malt concentrations obtained under industrial conditions by thickening in a vacuum evaporator malt worts obtained from the Pilzen or diastatic types, with or without the addition of unmalted grains, are valuable products used in many branches of food industry [4,8]. Polish food industry is interested in using dry malt extracts without preservatives. Investigations concerning possibilities of using other methods of malt worts preservation are conducted [9].

The traditional technology of obtaining malt worts permitted the addition of not more than several per cent of unmalted grain. This is because increasing amount of unmalted grain causes more difficult filtration, and worsening at

extractivity of mashing mixture [10]. Easy access to relatively cheap (as far as the cost of malting is concerned) enzymatic preparations permits a significant increase of the amount of unmalted grain in the process of malt worts production [11]. Worts obtained from the malt without adjuncts or from the malt with the addition of unmalted grain are – after thickening – used in manufacturing of many food products [4]. Application of enzymatic preparations, during mashing of the mixture of malt and unmalted grain, allows to increase the percentage of unmalted grain without a significant quality worsening of the worts [5,7]. The use of enzymatic preparations allows to obtain worts from such raw materials as Triticale grain or Triticale malt. These worts are characterised by a little different properties [2,3,5].

The purpose of this work was to determine changes in selected properties of congress worts as well as of worts obtained from malt extracts thickened in a vacuum evaporator, arising from the type of added unmalted grain and the use of enzymatic preparation Ceremix 2XL.

#### MATERIALS AND METHODS

Congress worts were obtained from two Pilsen type malts coming from two different malthouses (Sierpc and Cargill) under laboratory conditions by mashing malts without additives, and with the addition of 50% of unmalted barley or Triticale grains and using enzymatic preparation Ceremix 2XL during mashing.

The malt and unmalted grain were ground in a laboratory mill adjusted to malt grinding. Unmalted grain starch was gelatinized at the temperature of 90°C for 5 minutes in the ratio of grain to water 1:5. After cooling, unmalted grain was mixed with malt in the ratio 1:1 w/w. During congress mashing [1] at the temperature of 45°C enzymatic preparation Ceremix 2XL, containing balanced amounts of  $\alpha$ -amylase,  $\beta$ -glucanase, proteinase and enzymes hydrolysing non-starch polysaccharides, was added. The dose recommended by manufacturer ranges from 1.4 to 1.8 kg/ton of barley grain [11]. In the experiment, because of application of Triticale grain, a triple dose of preparation Ceremix 2XL was applied. Worts were thickened in a vacuum evaporator (Büchi), at the temperature of 70°C of water bath and pressure of  $0.1 \times 10^5$  Pa. The process of thickening was terminated when the consistency of a dense paste containing from 70 to 75% of dry substance was obtained.

Worts obtained as a result of congress mashing (8-9 Blg), malt extracts (70-75 Blg) and worts obtained as a result of dilution of malt extracts (12 Blg) were analyzed according to analytical methods recommended by EBC [1] and MEBAK (Mittel-Europäische-Brautechnische-Analisen-Komitee).

In congress worts there were determined: time of flow and volume of worts, content of the extract, colour and viscosity. In malt extracts thickened in a vacuum evaporator there were determined: the content of glucose, fructose, maltose and maltotriose. In malt worts obtained from malt extracts diluted with water there were determined: colour, viscosity, content of nitrogen compounds and pH of the wort. Comparison of the properties of congress wort (obtained according to procedure defined by European Brewery Union at the International Brewery Congress in Viena in 1898 [6]) with the properties of that wort thickened in a vacuum evaporator allows to determine the influence of concentration of the wort on its physical and chemical properties.

## RESULTS AND DISCUSSION

The data shown in Tables 1-3 give information of the influence of 50% addition of unmalted barley or Triticale grains and enzymatic preparation Ceremix 2XL on: the parameters of mashing and filtration of worts (Tab. 1); on the content of products of enzymatic hydrolysis of carbohydrates in thickened malt worts (Tab. 2); as well as on the basic properties of malt worts obtained from diluted dense extracts (Tab. 3).

The addition of unmalted barley or Triticale grain in the amount of 50% of malt together with the enzymatic preparation Ceremix 2XL caused decreasing of volume and the extract content and increasing of viscosity of malt wort (Tab. 1). This is a typical result associated with the addition of a large amount of unmalted grain to a mashing substance [10]. Decreasing the content of the extract in worts by 1% on the average or increasing viscosity of worts by 0.13 mPa.s on the average when 50% of malt is replaced by unmalted barley or Triticale grains seem to be of no importance as far as the properties of wort are concerned. Such slight differences in properties of worts were possible due to the application of enzymatic preparation Ceremix 2XL. During mashing malts with unmalted barley grain there was applied a recommended by the manufacturer dose of the preparation of 1.5 kg per one ton of unmalted grain. To obtain worts from a mixture of barley malt and unmalted Triticale grain there was applied a dose of 4.5 kg of preparation per one ton of unmalted grain. The purpose of increasing the dose of the preparation was to eliminate the eventual negative influence of too small a dose on the properties of worts. There are no recommendations of manufacturer of the preparation concerning the doses used in the processing of Triticale grain. This aspect requires some extra research.

**Table 1.** Properties of worts obtained as a result of congress mashing of barley malts without additives and with the addition of 50% of unmalted grain in the form of barley or Triticale grains and enzymatic preparation Ceremix 2XL

Feature of congress malt	The Pilzen type barley malt from the malthouse					
	SIERPC			CARGILL		
	with addition of preparation Ceremix 2XL and			with addition of preparation Ceremix 2XL and		
	Malt			Malt		
	Barley grain*	Triticale grain**		Barley grain*	Triticale grain**	
Saccharification time (min)	10.0	20.0	20.0	10.0	20.0	20.0
Wort flow time (min)	120	120	120	120	120	120
Volume of wort (cm <sup>3</sup> )	320	258	222	313	217	224
Extract content (% wag)	8.9	7.5	7.6	8.9	7.5	8.2
Colour of wort (j.EBC)	3.9	4.3	3.6	3.6	4.6	3.4
Viscosity of wort (mPa.s)	1.52	1.56	1.62	1.53	1.56	1.66

\*1.5 kg of preparation Ceremix 2XL per one ton of barley grain.

\*\* 4.5 kg of preparation Ceremix 2XL per one ton of Triticale grain.

Contents of the products of enzymatic hydrolysis of carbohydrates in thickened malt worts (Tab. 2) obtained as a result of mashing malts without additives, and malts with the addition of 50% of unmalted grain, are so close that it can be assumed that enzymatic preparation Ceremix 2XL fully compensated for the shortage of amylolytic enzymes in unmalted barley and Triticale grain. Similar effects of enzymatic hydrolysis of barley and Triticale starch with different doses of preparation Ceremix 2XL indicate the need of determination of its optimal dose while processing Triticale grain.

**Table 2.** Content of carbohydrates in malt worts thickened in a vacuum evaporator

Features of malt extracts	Malt extracts obtained from barley malt from the malthouse					
	SIERPC			CARGILL		
	Malt	with addition of preparation Ceremix 2XL and		Malt	with addition of preparation Ceremix 2XL and	
		Barley grain*	Triticale grain**		Barley grain*	Triticale grain**
Content of glucose ( g/100g extract)	8.2	5.9	4.3	8.9	9.5	8.3
Contents of fructose ( g/100g extract)	1.3	0.7	0.7	1.8	1.7	1.5
Content of maltose ( g/100g extract)	50.0	47.6	50.4	50.1	50.9	50.1
Content of maltotriose ( g/100g extract)	12.1	11.3	11.5	12.1	11.5	11.6

\*1.5 kg of preparation Ceremix 2XL per one ton of barley grain.

\*\* 4.5 kg of preparation Ceremix 2XL per one ton of Triticale grain.

The properties of 12 Blg malt worts obtained as a result of dilution of extracts thickened in a vacuum evaporator are affected by the process of thickening (Tab. 3). As a result of thickening in a vacuum evaporator malt extracts containing products of enzymatic hydrolysis of unmalted grain were characterised by: darker colour and higher viscosity than congress worts before thickening as well as by higher viscosity than worts obtained from the malt without additives.

Determination the reasons of the stronger influence of unmalted grain on changes of colour and viscosity of thickened malt worts demands some extra, more detailed investigation.

**Table 3.** Selected properties of 12 Blg of malt worts obtained as a result of dilution with water malt extracts thickened in a vacuum evaporator

Features of 12 Blg worts obtained from malt extracts	Malt extracts obtained from barley malt from the malthouse					
	SIERPC			CARGILL		
	Malt	with addition of preparation Ceremix 2XL and		Malt	with addition of preparation Ceremix 2XL and	
		Barley grain*	Triticale grain**		Barley grain*	Triticale grain**
Colour of wort (j.EBC)	7.1	8.0	7.2	7.4	6.9	10.2
Viscosity of wort ( mPa.s )	1.39	1.68	2.15	1.96	1.99	2.02
Content of nitrogen compounds gN/100g of wort	0.092	0.095	0.110	0.095	0.140	0.080
pH of wort	5.8	5.4	5.9	5.8	5.7	6.0

\* 1.5 kg of preparation Ceremix 2XL per one ton of barley grain.

\*\* 4.5 kg of preparation Ceremix 2XL per one ton of Triticale grain.

## CONCLUSIONS

1. It is possible to obtain malt worts with properties close to standard as a result of mashing the Pilsen type barley malts with the addition of 50% of unmalted barley or Triticale grains with the use of enzymatic preparation Ceremix 2XL.
2. Contents of glucose, fructose, maltose and maltotriose in the malt extracts obtained from the malt without additives and from the mixture of malt and barley or Triticale grains mashed with the addition of preparation Ceremix 2XL are similar.
3. Application of Triticale grain in the form of unmalted grain results in greater changes of the properties of worts and malt extracts than the use of barley grain.

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## WPLYW UDZIAŁU SUROWCA NIESŁODOWANEGO NA WŁAŚCIWOŚCI ZAGĘSZCZONYCH BRZECZEK SŁODOWYCH

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**Streszczenie.** W pracy określono właściwości brzeczek uzyskanych w wyniku zacierania kongresowego sładów typu pilzneńskiego z 50% udziałem surowca niesłodowanego w formie skleikowanego ziarna jęczmienia lub pszenżyta oraz z dodatkiem preparatu enzymatycznego Ceremix 2XL. Stwierdzono, że użycie 50% dodatku ziarna wraz z preparatem Ceremix 2XL pozwala na otrzymywanie brzeczek o cechach zbliżonych do otrzymywanych z samego sładów. Duży (50%) dodatek tradycyjnego surowca niesłodowanego w formie ziarna jęczmienia w mniejszym stopniu zmienia właściwości zagęszczonych brzeczek słodowych niż dodatek takiej samej ilości ziarna pszenżyta.

**Słowa kluczowe:** jęczmień, pszenżyto, sład, ekstrakt słodowy.