EXAMINATION OF ORGANIC EINKORN WHEAT (TRITICUM MONOCOCCUM) AND ORGANIC EINKORN WHEAT BEER HEALTHCARE POTENTIAL

Attila-Levente Fogarasi - Zsuzsanna Kiss - Szilárd Kun - Beáta Vecseri-Hegyes
Corvinus University of Budapest, Faculty of Food Science, Department of Brewing and Distilling,
H-1118, Ménesi út 45, attila-levente.fogarasi@uni-corvinus.hu

SUMMARY

The using of einkorn wheat (Triticum monococcum L.) in brewing technology has been occurred at the Corvinus University of Budapest, Department of Brewing and Distilling in 2009. The possibility of growing the einkorn wheat organically give us a possibility for making an organic healthcare beer. After measurements we could confirm, that einkorn wheat antioxidant capacity is higher than other examined grain samples, and the final product antioxidant capacity in most case is higher than the others. The einkorn wheat, its malt and the einkorn beer samples mineral content was higher than other examined samples one.

1. INTRODUCTION

Einkorn (*Triticum monococcum ssp. monococcum* L.) is an ancient wheat and is potential cropped in environmentally friendly organic farming. Compared to common wheat, einkorn is generally more resistant to diseases, and has the ability to withstand drought.

Antioxidants (AO) are ‘‘any substance that, when present at low concentrations compared with those of an oxidizable substrate, significantly delays or prevents oxidation of that substrate” (Halliwell, 2007). Antioxidants act in various ways, which include complexation of redox-catalytic metal ions, scavenging of free radicals, and decomposition of peroxides. The intensity of these effects depends on the chemical structure and concentration of the AO present. Natural antioxidants may also protect DNA, protein, and membrane lipids from oxidative damage in biological systems, and provide additional health benefits for disease prevention and health promotion (Halliwell, 2007).

Today the einkorn is used for making of pasta, flour, bread and for animal feeding. The researches regarding using einkorn in malting and beer making has been started at Corvinus University of Budapest, at the Brewing and Distilling Department in 2008. Our aim was to make an organic beer, which contains malted or/and unmalted organic einkorn in proportion of at least 51% of dry matter and to prove its healthcare potential. First we studied the mechanical and chemical properties for malting and brewing aspect, after that we optimized the malting parameters, and we made a preliminary analyze of antioxidant content of einkorn wheat against normal wheat.

2. MATERIALS AND METHODS

We measured winter cultivation (labeled WCW) and optional winter cultivation (OWCW) wheat and its malt (labeled WCM and OWCM) for reference and unhulled einkorn (labeled W.E.) and hulled einkorn wheat (labeled H.E.) obtained from Kőrös Maros Biofarm Ltd., Hungary. All chemicals were purchased from Sigma-Aldrich (Hungary). All reagents used were of analytical grade.

2.1. Determination of mineral contents

The whole and hulled einkorn seeds mineral contents determination was defined with inductively coupled plasma atomic emission spectrometry (ICP-AES) (Thompson, 1983).

2.2. Antioxidant assay

Sample preparation

Seed samples were milled to a particle size of less than 0.5 mm in a centrifuge milling. Beer samples were analyzed after degassing and dilution (if needed). The extraction of antioxidants was made according to (Pérez-Jiménez, et al., 2008) with slight modifications. The extraction was carried out in two principal steps, both step was made twice for better extraction.

Spectrophotometric antioxidant determination assays:

The Ferric Reducing Ability of Plasma (FRAP): The measurements was made according to Benzie and Strain (1996). At low pH, reduction of ferric tripyridyl triazine (Fe III TPTZ) complex to ferrous form (which has an intensive blue color) can be monitored by measuring the change in absorption at 593nm which is therefore, directly related to the combined or "total" reducing power of the electron donating antioxidants present in the reaction mixture. The results were given like µM ascorbic acid/g dry matter.

Total Phenolic Content (TPC) assay: The total phenolic content of extracts was determined using to the Folin-Ciocalteu method (Singelton et al. 1965). We used galic acid (GA) as standard, total phenolic content was expressed as µM GA equivalent/g dry matter.

Determination of free radical scavenging activity by DPPH method: Free radical scavenging activity of the sample extracts was determined spectrophotometrically using the method of Blois (1958). This method is based on the measurement of the reducing ability of antioxidants toward the DPPH radical. The results were expressed in µM Trolox equivalent (TE)/g dry matter.

Trolox equivalent antioxidant capacity (TEAC): The method of Miller et al. (1993) is based on oxidation of ABTS (2,2'-azino-bis-(3-ethylbenzothiazoline)-6-sulphonic acid), what can be measured on 734 nm. The results were expressed in µm TE/g dry matter.

3. RESULTS AND DISCUSSIONS

3.1. Results of mineral content measurement

In table 1 are presented the einkorn's mineral content. As can be seen in the table, the content of calcium is very high, which element is very important in brewing, because the calcium is an important cofactor for brewing enzymes and has an important role in fermentation process. It is similar in case of potassium and magnesium too. By consuming einkorn beer the result reflect that einkorn beer can cover a significant percent of daily mineral needs.

Table 1: Results of mineral content measurement

Mineral	Hulled einkorn calculated on dry weight	Barley calculated on dry weight * *Hopulele (1972)	Unfiltered, unpasteurized einkorn beer	RDA%
	µg/mg	µg/mg	mg/L	%
Ca	997	71,7	24	3
Cu	1,83	0,59	<0,15	-
Fe	49,9	4,86	0,16	2,21
K	1073	346	630	31,5
Mg	573	126	108	28,8
Mn	28,6	1,38	0,22	11
Na	49,4	3,32	70	-
P	330	NA	700	47,2
Zn	17,4	3,57	0,16	1,8

3.2. Results on antioxidant capacity measurements

Seed sample measurements

Examining the einkorn antioxidant capacity against different wheat samples we can conclude that einkorn has a higher antioxidant capacity than other examined wheat samples, as it is reflected in figure 1.

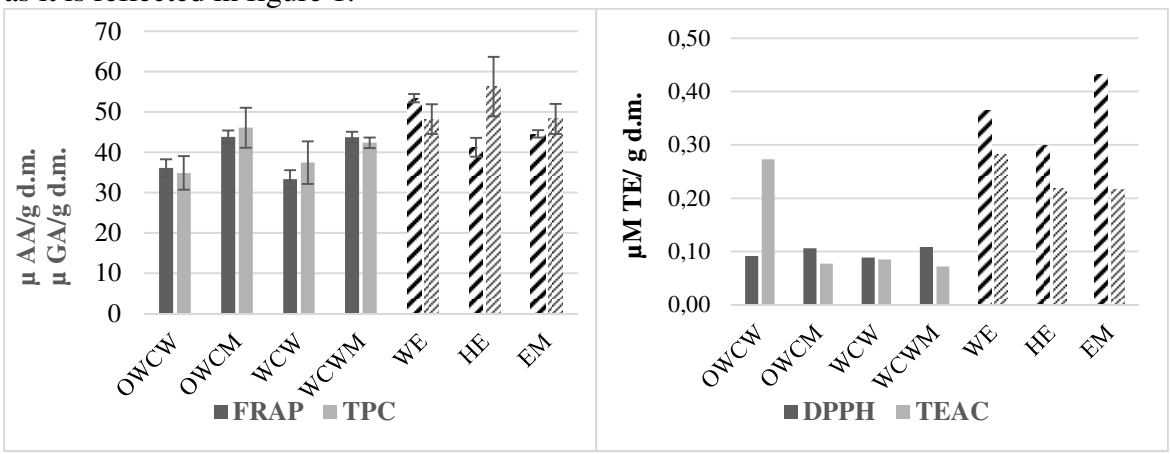

Figure 1 (a,b): Antioxidant measurement results of seed samples

By using different antioxidant assays we got a complex properties of the samples antioxidant capacity. Some antioxidant compound are forming during the malting process, as is shown in figure 1a during the examination of FFRAP and TPC assays. In contrast, the inhibitory compound decrease during the malting process (DPPH and TEAC assays, Fig. 1b).

Examining the final product antioxidant capacity we could conclude, that einkorn beer total phenolic content was the highest against other beer samples. Examining the inhibitory capacity with DPPH antioxidant assay, the einkorn beer has the second highest results.

Beer samples measurement

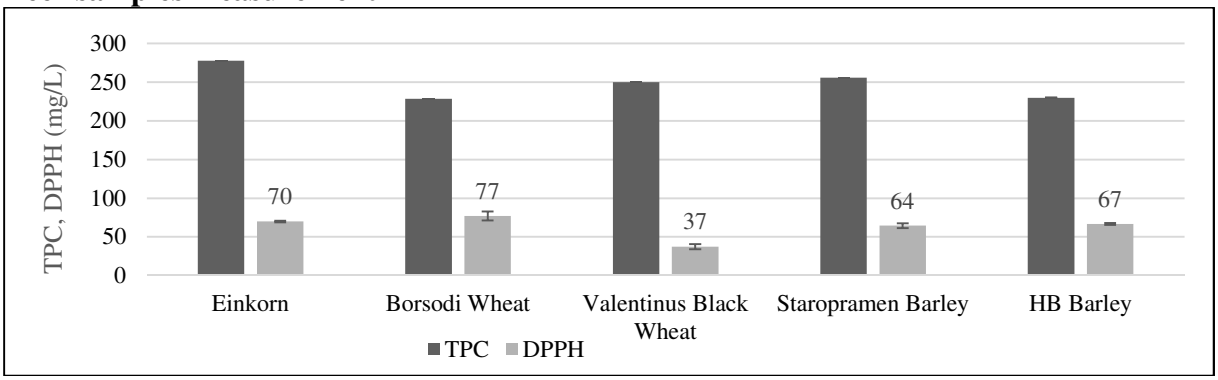

Figure 2: Antioxidant measurement results of einkorn beer and commercial beer samples

4. CONCLUSION

The einkorn wheat tend to have high possibility for use in organic healthcare beer making. The results shown, that einkorn wheat and its malt antioxidant capacity was the highest in all four compared methods against other samples. Having these results, we optimized a brewing receipt, with the usage of 51 % of einkorn wheat and 49 % of barley malt. The final product examination results proved, that the got new product has a higher antioxidant capacity than the other examined Hungarian beer samples from the market. With the use of einkorn in beer making besides generating a new product for the beer lovers, we can increase the healthcare properties of beer.

ACKNOWLEDGE*: We acknowledge for the financial support of the New Széchenyi Plan named ALKOBEER OH-00364/2008, founded by the National Development Agency, and for the TÁMOP-4.2.1/B-09/1/KMR-2010-0005, TÁMOP-4.2.2/B-10/1-2010-0023 project, Hungary.*

5. REFERENCES

- Benzie I.I.F., Strain J.J.(1966): The ferric reducing ability of plasma (FRAP) as a measuring of "antioxidant power": The FRAP assay. Analytical Biochemistry, (239):70-76.
- Blois, M.S.: Antioxidant determination by the use of a stable free radicals. *Nature*, 1958, (4617): 1198-1200.
- Halliwell, B. (2007). Biochemistry of oxidative stress. Biochem Soc Trans, 35(Pt 5), 1147-1150.
- Hopulele, P. (1972): Zum Verhalten verschiedener Mineralstoffe in der Brauereitechnologie. Dissertation TU München, Weihenstephan.
- Miller N.J., Rice-Evans C., Davies M.J., Gopinathan V., Milner A.: A novel method for measuring antioxidant capacity and its application to monitoring the antioxidant status in premature neonates. Clinical Science,1993, (84):407-412.
- Pérez-Jiménez, J., Arranz, S., Tabernero, M., Díaz- Rubio, M. E., Serrano, J., Goñi, I., & Saura-Calixto, F. (2008). Updated methodology to determine antioxidant capacity in plant foods, oils and beverages: Extraction, measurement and expression of results. *Food Research International, 41*(3), 274-285
- Singleton V.L. és Rossi J.A.: Colometry of total phenolics with phosphomolibdicphosphotungstic acid reagents. American Journal of Enology and Viticulture, 1965 (161):144-158.
- Thompson, M.; Walsh, J. N. (1983): A handbook of inductively coupled plasma spectrometry, Chapman and Hall.