

Abstracts and Links to Papers of Interest from Other Journals

This section contains links to recent papers, published in a number of Journals considered of interest to our readers.

Journal of the American Society of Brewing Chemists

Volume 68(1), 2010

Links to the full abstracts from the papers below can be found at

<http://www.asbcnet.org/Journal/>

High-gravity Brewing and Distilling—Past Experiences and Future Prospects. G. G. Stewart. JASBC, Vol. 68(1), 2010, pp. 1-9.

Detection of Aflatoxin B1 in Corn, Rice, and Barley by ELISA, Using a Heavy-chain IgG(2b) Isotype Monoclonal Antibody. S. C. Pei, Y. H. Li, Y. Y. Zhang, L. Cai, and W. J. Lee. JASBC, Vol. 68(1), 2010, pp. 10-14.

The Application of Beta-cyclodextrin to Separate *cis*- from *trans*-Iso-alpha-acids in an Isomerized Hop Extract. A. Khatib, E. G. Wilson, H. R. Zhang, M. Supardi, and R. Verpoorte. JASBC, Vol. 68(1), 2010, pp. 15-20.

Differential Yeast Gene Transcription During Brewery Propagation. B. R. Gibson, N. S. Graham, C. A. Boulton, W. G. Box, S. J. Lawrence, R. S. T. Linforth, S. T. May, and K. A. Smart. JASBC, Vol. 68(1), 2010, pp. 21-29.

Effects of Bordeaux Mixture (Copper Sulfate) Treatment on Blackcurrant/Muscat-like Odors in Hops and Beer. M. Morimoto, T. Kishimoto, M. Kobayashi, N. Yako, A. Iida, A. Wanikawa, and Y. Kitagawa. JASBC, Vol. 68(1), 2010, pp. 30-33.

Determination of the Influence of Malting Parameters on the Water-Extractable Arabinoxylan Content of Wheat (*Triticum aestivum*), Rye (*Secale cereale*), and Spelt Wheat (*Triticum aestivum* subsp. *spelta*). M. Krahl, M. Zarnkow, W. Back, and T. Becker. JASBC, Vol. 68(1), 2010, pp. 34-40.

A Single PCR Marker Predicting the Activity Levels of Various Enzymes Responsible for Malting Quality. I. Fechter, F. Rath, and M. Voetz. JASBC, Vol. 68(1), 2010, pp. 41-47.

Serial Repitching of Dried Lager Yeast. C. Powell and T. Fischborn. JASBC, Vol. 68(1), 2010, pp. 48-56.

Analyzing Foam Instability in Commercial Beers. J. R. Goldberg and C. W. Bamforth. JASBC, Vol. 68(1), 2010, pp. 57-62.

Relationship Between Matrix Foaming Potential, Beer Composition, and Foam Stability. P. Kosin, J. Savel, D. E. Evans, and A. Broz. JASBC, Vol. 68(1), 2010, pp. 63-69.

Master Brewers Association of the Americas Technical Quarterly

Volume 47(1), 2010

Links to the full abstracts from the papers below can be found at

<http://www.mbaa.com/TechQuarterly/>

Global Market Quality Assurance: Identifying Opportunities to Continuously Improve Product Integrity. Sakura Yanai. MBAA TQ, Vol. 47(1), 2010 doi:10.1094/TQ-47-1-0322-01

The Enzymology of Cell Wall Breakdown During Malting and Mashing: An Overview. C. W. Bamforth. MBAA TQ, Vol. 47(1), 2010 doi:10.1094/TQ-47-1-0309-01

Identification of Microbial Populations Associated with Sorghum Fermentation. E. D. Deenanath, S. E. Iyuke and D. Lindsay. MBAA TQ, Vol. 47(1), 2010 doi:10.1094/TQ-47-1-0224-01.

The Influence of Hop Harvest Date on Flavor Stability in Dry-hopped Beers. Georg Drexler, Benjamin Bailey, Christina Schönberger, Andreas Gahr, Rebecca Newman, Moritz Pöschl and Eberhard Geiger. MBAA TQ, Vol. 47(1), 2010 doi:10.1094/TQ-47-1-0219-01.

FT-NIR Spectroscopy—A Modern Tool for Quality Monitoring of Brewers' Raw Materials. A. Broz, P. Kosin, J. Savel, J. Sikola, D. Behmer, J. Prokes and F. Kroupa. MBAA TQ, Vol. 47(1), 2010 doi:10.1094/TQ-47-1-0217-01.

Malting Performance of a Millet Variety (*Pennisetum mawei*) Grown at the Same Site During Different

Growing Seasons. Cletus U. Aloha and Reginald C. Agu. MBAA TQ Vol. 47(1), 2010 doi:10.1094/TQ-47-1-0107-01.

Brewing Science – Monatschrift für Brauwissenschaft

Fachverlag Hans Carl, Nürnberg, Germany

Vol 63 (Nov–Dec), 2009

<http://www.brewingscience.de/>

Brewer's Yeast and "Omics" Technologies. L. Strack and U. Stahl. *Brewing Science (Monatschrift für Brauwissenschaft)*, Vol. 63, November/December 2009, pp. 187-190.

"Omics" technologies comprise genomics, transcriptomics, proteomics and metabolomics; the last three fields are pooled within the notion "functional genomics". In this review, these techniques which concentrate on aspects of the "course from gene to metabolites" are surveyed especially with regard to bottom-fermenting brewer's yeasts. With the aid of these global methods it is possible to combine a collective knowledge of an investigated organism which is necessary to understand the details of its metabolic system. Hence, the challenge is to introduce the above mentioned studies for the determination of targets and approaches for the improvement of yeast organisms. Herein, brewing yeasts are reviewed with concern to the determination of their "ome" levels. But because of the hybrid nature of the brewer's yeast's genome problems emerged regarding the "omics"-applicability which are depicted in this paper furthermore.

Suppression of Gushing by Hop Constituents. S. Hanke, M. Kern, M. Herrmann, W. Back, Th. Becker and M. Krottenthaler. *Brewing Science (Monatschrift für Brauwissenschaft)*, Vol. 63, November/December 2009, pp. 181-186.

Gushing is one of the most unsolved problems in brewing. This is a very severe quality defect. Efforts are being made to reveal the identity of gushing components. The beer defect of gushing is a temporary brewery problem that is primarily caused by fungi derived factors. In this work, the influence of humulones, pure linalool and hop oils on natural occurring gushing and an activated carbon (AC) induced gushing of commercial brews was tested. The experiments proved that linalool significantly reduces the gushing volume. Hop oils (linalool) decreased the gushing tendency of beer. Gushing, induced by activated carbon, is suppressed by the addition of linalool and humulones. These results suggest that some of the properties of the hop constituents, humulones and linalool, prevent beer from gushing especially when hops are added at late stages of wort boiling.

Loop-mediated Isothermal Amplification to Detect and Identify Beer Spoilage *Lactobacillus* spp. Bacteria. H. Murakami, T. Fujii and N. Hayashi. *Brewing Science (Monatschrift für Brauwissenschaft)*, Vol. 63, November/December 2009, pp. 172-180.

Primers for a loop-mediated isothermal amplification (LAMP) method to specifically identify beer spoilage

caused by *Lactobacillus* spp. including *Lactobacillus brevis*, *Lactobacillus lindneri*, *Lactobacillus backi* and *Lactobacillus paracollinoides* were developed. These LAMP primer sets were designed from target sequences in the 16S rRNA gene or the spacer region. To identify beer spoilage strains in the species, we also developed a LAMP primer set to detect highly specific genetic markers. The LAMP primer sets in this study distinguished the target species or beer spoilage strains from other lactic acid bacteria in 40–60 min. Moreover, using these primer sets in conjunction with the LAMP method enabled detection of approximately 1×10^2 cfu/mL lactic acid bacteria from suspensions in distilled water, beer and beer that contained large amounts of bottom-fermenting yeast cells. Thus, the LAMP method may be useful for direct detection and identification of *Lactobacillus* spp. in samples taken during the fermentation process and from final products.

New Ideas for Quantifying the Gushing Potential of Malt. M. Christian, V. Ilberg, J. Titze, H. Parlar and F. Jacob. *Brewing Science (Monatschrift für Brauwissenschaft)*, Vol. 63 November/December 2009, pp. 164-171.

In this work it was first shown how to quantify the gushing potential of malt with a modification of a common gushing test. Today there exist two acknowledged gushing tests for the brewing industry (Modified Carlsberg Test and Weihenstephaner Test). Both analytical methods use the overfoaming amount of a test-specific produced carbonated wort to determine the gushing potential of malt. Unfortunately the overfoaming amount can vary statistically in a way that this parameter can "only" be used for qualitative information if the malt has a potential for gushing or not and if one malt has a higher or lower gushing potential than another one; but a precise quantitative comparison for example between two malts which both have a gushing potential is difficult. This was the focus of this investigation. With two gushing-positive samples (malt A and B) it could be shown that with an increase of the concentration of malt solutes a certain point is reached where gushing appears the first time determined by the overfoaming amount applied the Modified Carlsberg Test. For malt A a frequently higher gushing potential ($f \geq 5$) than for malt B was identified. These results were verified by determining the amount of a gushing suppressing hop product that led gushing to zero by having a constant concentration of malt solutes. The results demonstrated enhanced gushing analyses to quantify the gushing potential reproducibly, not by the overfoaming amount but by the "zero point" where gushing begins (concentration of malt solutes) or is neutralized (amount of hop product). The introduced methods enable the chance for the first time to quantify the gushing potential of malt more precisely.

Kvasný Průmysl

Vol. 56, 2010

Links to the full papers can be found at
<http://www.beers.cz/kvas/>

Issue no. 1

The Content of Hop Prenylflavonoids in Czech and Foreign Beers. K. Krofta. *Kvasný Průmysl*, 2010, Vol. 56, No. 1, pp. 2-9.

The content of isoxanthohumol (IX) in most of Czech and foreign beer brands did not exceed the limit of 2,000 µg/L. The concentration of xanthohumol (XN) was up to 100 µg/L. The largest quantities of prenylflavonoids in all beers investigated were found in Czech dark 12% lager (2522 µg/L IX and 505 µg/L XN). On average less prenylflavonoids were found in draught and alcohol-free beer brands due to the lower hopping rate and the higher proportion of CO₂ extracts. Choosing a hop variety with a higher XN/ α -acids ratio can influence the level of IX in the beer. The amount of prenylflavonoids in beers increases if Sladek and Saazer are used for hopping. The monitoring of isoxanthohumol concentrations in intermediate products during the brewing process, in two industrial breweries confirmed that high losses occur in the course of beer production. The critical points are cooling of wort, fermentation and filtration. The total amount of xanthohumol remaining after the beer production in full operating scale is approximately 20–30%. Tracing of the stability of the IX and XN contents in bottled beers, which was done over a period of 3 months, showed that the concentration of IX was reduced by 10–15% depending on the storage temperature. Losses of XN were higher and reached about one third of the original content.

Quality of Malting Barley Crop 2009 in the Czech Republic. I. Hartman, J. Prokeš and A. Helánová. *Kvasny Prum.*, 2010, Vol. 56, No. 1, pp. 10-17.

The study evaluates quality of malting barley from harvest 2009 in the Czech Republic. It maps significant factors (weather conditions, occurrence of diseases and pests, varietal composition, barley yield) affecting the final quality of malting barley. Based on the evaluation of barley and malt produced under the laboratory conditions, it is possible to state that barleys from harvest 2009 indicate an average malting year.

Analysis of Polyphenols in Brewing Raw Materials by PSE (Pressurized Solvent Extraction)—and by HPLC Method with CoulArray Detection. M. Jurková, V. Kellner, J. Čulík, T. Horák, P. Čejka and P. Karásek. *Kvasny Prum.*, 2010, Vol. 56, No. 1, pp. 18-23.

The modern extraction technique PSE (Pressurized Solvent Extraction)—pressure solvent extraction coupled with HPLC with high sensitive electrochemical detector CoulArray—presents the progress in the analytics of polyphenols in brewer's raw materials. It could be simulated extraction processes malting and hop boiling by method PSE by force of "markers" which are extracted in both extraction procedures practically equally. The PSE method is better to estimation of entire content of polyphenols in malt and hops. The variability of extraction process enables to find the optimal extraction conditions for maximal yields. The most efficient temperature for the majority of the polyphenols studied by pressure 150 bar was 140°C, but for the most frequently found ferulic acid (in malt also in the highest concentrations) more suitable temperature is 40°C in malt and hops.

Brewery Radvanice. M. Starec. *Kvasny Prum.*, 2010, Vol. 56, No. 1, pp. 24-27.

The brewery in Radvanice was established by Josef Neumann in 1858. In 1871 cellars and fermenting cellar

with iceboxes were built, subsequently the brewery was reconstructed to a steam-driven facility. In 1887–1888 the malting floor was extended and a modern malthouse with a large two-floor kiln was built. The first known output in 1871 was 8,658 hL and gradually it was increased to approximately 25,000 hL at the beginning of the 1890s. In 1901 the malthouse was equipped with modern barley and malt cleaning machinery. In 1908 the brewery was bought by a Vienna workers' union named the "First Moravian-Silesian Workers' Brewery Skaret and comp. in Radvanice." The brewery was electrified, the brewhouse modernized. In the 1912/1913 campaign the output was 35,000 hL of beer. After the First World War, which meant a decline in production and change of the owner, the brewery's prosperous era began. In 1920/21 the output of 35,000 hL was again achieved. During 1925–1926 the system of artificial cooling was modernized, a fermenting cellar was furnished with new tubs, cellar was equipped with new storage vats and aluminum tanks. On October 17, 1925, this well-performing plant was transformed to the First Moravian-Silesian Brewery and Malthouse, a joint stock company. During the campaign of 1929/30 Radvanice beer achieved the absolute maximal output of 48,000 hL. Big economic crisis meant the beginning of the brewery's bankruptcy and closing down of the brewery in 1937.

Issue no. 2

Description of Localities and Methodology of the Field Experiment of the Project 1M0570 (in the Period of 2005 and 2007–2008). J. Ehrenbergerová, R. Cerkal, P. Hrstková, P. Elzner, J. Marková and K. Vaculová. *Kvasny Prum.*, 2010, Vol. 56, No. 2, pp. 54-59.

Field experiments with spring barley were established with the aim to obtain genetically homogenous experimental material for the solution of all activities of the Research Center for Study of Extract Compounds in Barley and Hops no. 1M0570 in all years of project period (2005-2008). The experiments were performed in two different localities: Žabčice School Farm of MUAF in Brno and Kroměříž (Agricultural Research Institute Kroměříž, Ltd.) with a set of seven hulled malting varieties, two hull-less varieties and three hull-less lines of spring barley. The study describes weather and soil conditions and variants of chemical treatment of stands in both localities together with the description of the varieties and lines.

After clean-up and screening, the grain samples were provided to the individual participating workplaces for the purposes of solving partial assignments leading to the fulfillment of the objectives of the Research Center.

The Effect of Location and Year on Mineral Content in Spring Barley Grain. K. Vaculová, M. Balounová, R. Cerkal and J. Ehrenbergerová. *Kvasny Prum.*, 2010, Vol. 56, No. 2, pp. 60-68.

The effect of location (Kroměříž, Žabčice) and year (2005, 2007 and 2008) on the content of mineral elements and basic grain chemical composition (N-substances, starch, fat, fibre) was studied in seven spring malting barley cultivars (Amulet, Bojos, Jersey, Malz, Prestige,

Sebastian and Tolar), grown under a cropping system with restricted chemical treatment. Considering the requirements for the content of macro- and microelements for good growth, development and fermentation activity of brewer's yeast, the best cultivars were Amulet and Prestige, cv. Bojos ranked among the cultivars with the lowest contents of all macroelements and the lowest content of microelements was characteristic for cv. Sebastian. The content of the examined nutrients, minerals and heavy metals was affected significantly by all factors studied, i.e. cultivar, location and year. There was a significant difference among cultivars in the content of P, B, Cu, Fe and Ca to Mg ratio. The content of minerals was significantly influenced by grain weight. Use of grain weight as a covariate resulted in decreasing a significance level of cultivar effect on the content of macroelements K, Ca as well as Mg, and the location \times cultivar interaction in all macro- and microelements, except Fe content. A higher concentration of some minerals in grain was related to increasing the content of N-substances (N-subst. \times Zn: $r = 0.50^{**}$ to 0.77^{**}) and fibre proportion (fibre \times Mg: $r = 0.24$ to 0.38^{*} ; fibre \times Ca: $r = 0.23$ to 0.78^{**}) and conversely decreasing the content of starch (starch \times Mg: $r = -0.54^{**}$ to -0.72^{**}).

Role of Sulphur in Formation of Grain Yield, Malting Quality Parameters, and PDMS in Spring Barley. L. Hřivna, T. Gregor, V. Šotníková, R. Cerkal, P. Ryant, J. Prokeš, T. Radoch, and P. Vavroušová. *Kvasny Prum.*, 2010, Vol. 56, No. 2, pp. 69-73.

Within the four-year small plot field trials, the effect of nitrogen fertilizers containing added sulphur on selected quality parameters of the barley grain and malt was tested. The combination of a lower nitrogen dose ($30 \text{ kg}\cdot\text{ha}^{-1}$) and sulphur increased the grain yield by $200\text{--}340 \text{ kg}\cdot\text{ha}^{-1}$ and when the N-dose applied alongside sulphur was higher ($50 \text{ kg}\cdot\text{ha}^{-1}$), the grain yield rose by $100\text{--}200 \text{ kg}\cdot\text{ha}^{-1}$. Positive impact of sulphur application on the grain quality was confirmed. Sulphur combined with a lower level of nitrogen fertilization contributed to the highest yield of the malting grain ($92.5\text{--}94.2\%$), it also stabilized the starch content in the barley grain. The sulphur addition did not lead to an immoderate increase of N-substances in the grain; neither did it increase the PDMS content in malt when higher doses of nitrogen were applied.

The Relationship Between β -glucanase, Chitinase, and Galactomannan and Selected Technological Parameters of Spring Barley Caryopses (*Hordeum vulgare* L.) and Malt. V. Psota, K. Benešová, L. Sachambula and P. Havlová. *Kvasny Prum.*, 2010, Vol. 56, No. 2, pp. 74-78.

Activity of chitinase, β -glucanase, the enzymes participating in the defense reaction of plants against the infestation, was studied in 99 samples of barley and malt produced from it. In addition, the presence of polysaccharide galactomannan was studied using the EPS test. This polysaccharide is present in cell walls of filamentous micromycetes. β -glucan content was studied in non malted caryopses of barley and subsequently in wort. Simultaneously, malt gushing potential and PDMS level in wort were followed. Contamination of wort with filamentous micromycetes determined by the EPS test was in a very

close relationship to activity of chitinase in malt (0.92^{***}) and in caryopses (0.92^{***}). β -glucan content in wort is not probably a parameter that is essentially affected by the caryopsis contamination. On the contrary, level of gushing in malt and PDMS content in malt are significantly associated with the parameters connected with the contamination of caryopsis with filamentous micromycetes.

Determination of Important Barley (*Hordeum vulgare*) Proteins by the Separation Methods and Mass Spectrometry. M. Laštovičková and J. Bobál'ová. *Kvasny Prum.*, 2010, Vol. 56, No. 2, pp. 79-82.

The changes of protein profile during the malting were monitored by a combination of gel electrophoresis (one-dimensional and two-dimensional; 1-D, 2-D GE) and mass spectrometry. Our attention was focused on the proteomic analysis of barley proteins, which were modified during the malting and can influence the properties of beer as a final product of malting.

Dehydrins as Stress Proteins Related to Frost Tolerance of Barley. L. Holková, P. Mikulková, P. Hrstková, I. T. Prášil, M. Bradáčová and O. Chloupek. *Kvasny Prum.*, 2010, Vol. 56, No. 2, pp. 83-87.

Dehydrins are stress proteins related to frost and dehydration tolerance. The aim of the paper was study of the polymorphism of the dehydrin genes (*Dhn*) in relation to the frost tolerance in barley. Primers specific for *Dhn4* and *Dhn7* gene sequences were used for length polymorphism analysis in 30 varieties. PCR products showed two different matrices; the first (*O* type sequence) was specific for six-rowed winter and intermediate varieties characterised by high frost tolerance and was typical of the *Okal* variety. The second type (*A* type sequence) was found only in two-rowed winter and spring varieties (e.g., *Akcent*) and was related to a lower level of frost tolerance. The length of the main polymorphic products corresponded to different alleles of the *Dhn4* and *Dhn7* genes. This difference in length was caused by the coincident presence of two specific mutations, i.e., an insertion of 6 bp in *Dhn4* and a deletion of 30 bp in *Dhn7* in *O* type barley varieties.

Variability and Activity of Vitamin E and its Isomers in a Barley Grain. N. Březinová Belcredi, J. Ehrenbergerová, K. Benešová and K. Vaculová. *Kvasny Prum.*, 2010, Vol. 56, No. 2, pp. 88-92.

Antioxidant activity of vitamin E and content of its individual isomers, tocopherols and tocotrienols, were determined in the set of 12 varieties/lines of barley grain, from which grain samples for the analyses were collected from the experiments performed in two localities—Žabčice and Kroměříž in 2005 and 2007–2008. The effect of the method used for the stand treatment (with the application of pesticides and without pesticides) was studied in the locality of Žabčice. The experiments in the locality of Kroměříž were carried out without chemical application, i.e., without the use of the pesticides. A statistically significant effect of the varieties/lines, year and treatment method on the activity of vitamin E was determined. The hull-less line KM 1057 ($15.71 \text{ mg}\cdot\text{kg}^{-1}$) had significantly higher vitamin E activity compared to the whole set

(10.23–13.74 mg.kg⁻¹) of the non-treated variants of growing. The varieties Prestige, Merlin, Sebastian, and Amulet (13.42–13.74 mg.kg⁻¹) also had a high vitamin E activity and they did not differ significantly from the malting variety Malz (13.20 mg.kg⁻¹) recommended for the production of Czech Beer.

Malt Quality During the Post-harvest Maturation of Barley. H. Fišerová, J. Prokeš, A. Helánová and J. Hartmann. *Kvasny Prum.*, 2010, Vol. 56, No. 2, pp. 93-99.

Within the period following immediately after the harvest, spring barley crops cannot produce malt of good quality. The main reason of this fact is that the kernels enter into the stage of dormancy, which causes their bad and unbalanced germination. Due to this fact the relation of dormancy to qualitative parameters of produced malt and physiological condition of malting barley kernels was followed immediately after the harvest and in intervals of three and six weeks after the harvest. Production of ethylene, ethane, and carbon dioxide as well as oxygen consumption during the period of malt production was studied in six varieties of malting barley (viz. Bojos, Jersey, Malz, Prestige, Sebastian, and Tolar). In produced malt the following parameters were estimated: activity of α -amylase, content of β -glucans, malt homogeneity, malt modification, and yield of malting.

Using the method of statistical stepwise regression, significant dependences existing between ethylene production and yield of malting were found out. During the period of barley steeping and germination, production of ethylene is dependent on the content of β -glucans and malt homogeneity and modification. At the beginning of germination, production of ethylene represents a highly significant indicator of α -amylase activity. Production of carbon dioxide is directly related to malt homogeneity and modification. The amount of consumed oxygen indicates indirectly the potential yield of the malting process and future malt modification even after the first steeping.

Yeast and Stress: From the Laboratory to the Brewery. K. Sigler, D. Matoulková, P. Gabriel, M. Dienstbier and D. Gášková. *Kvasny Prum.*, 2010, Vol. 56, No. 2, pp. 100-104.

Our research concerns the effects of various types of exogenously applied stress (oxidative, osmolarity and xenobiotic-induced) that can be encountered by yeast cells in the brewery on cell metabolic processes, energetics, membrane functions and structure and the function and efficacy of processes protecting the cells against the stress. These effects, and the response of cells to the stresses, can have a major influence on the technological processes and the quality of the final product. The experiments were performed both on laboratory strains in which individual types of response are easy to interpret and form a suitable basis for the processes observed in brewery yeast, and on brewery strains in laboratory (brewing trials) and actual brewery setting that directly point to the problems caused by modern brewing technology.

Allergens in Beer. P. Dostálek, J. Dvořák and P. Hulín. *Kvasny Prum.*, 2010, Vol. 56, No. 2, pp. 105-108.

This is a study about the content of allergens in beer, namely sulphur dioxide and gluten. The sulphur dioxide content was determined by using of chronopotentiometry. None of the beers analysed contained more than 20 mg/L of sulphur dioxide and in samples of Czech beers concentrations even lower than 10 mg/L were found. The gluten determination was accomplished using immunochemical methods. The method ELISA (competitive) with the antibody R5 was the best for beer and glucose syrups because it was possible to find even low molecular fragments of prolamin. The concentrations of gluten in the beers examined were mostly lower than the proposed legislative limit. However considering the maximum recommended daily allowance in the diet, the consumption of beer by people suffering from celiac disease is not advisable.

Issue no. 3

Possibility of Evaluation of Drought Tolerance in Barley. L. Holková, L. Melišová, M. Bradáčová, P. Mikulková and J. Ehrenbergerová. *Kvasny Prum.*, 2010, Vol. 56, No. 3, pp. 118-122.

Breeding of drought-tolerant varieties, which is steadily gaining in importance for improving crop yields and health condition of economically important crops, is based on evaluation and efficient selection of tolerant genotypes. The assessment of plant sensitivity to drought is not simple owing to the complex character of this trait. We compared the stress responses of five different barley genotypes with different sensitivity (*Tadmor*, *Malz*, *Amulet*, *Bojos* and *Jersey*) exposed to drought stress by using a molecular biological method based on evaluating the activity of two dehydrin genes, *Dhn1* and *Dhn4*. The efficiency of the method was verified in laboratory conditions and also in a pot experiment in which only watering was regulated. More detailed evaluation was done on plants grown hydroponically in a cultivation box under conditions of physiological drought (–0.3 MPa). Transcription activity of both genes, as dependent on stress sensitivity, was evaluated over 14 days in leaf tissue samples. The more tolerant genotypes (*Tadmor* and *Malz*) exhibited lower water losses from tissues and higher expression of both genes. Comparable results for individual varieties were obtained also in the pot experiment, which confirmed the relationship between the activity of these genes and drought sensitivity, especially in the phase of earing and grain formation. The activity of the two genes was further evaluated under the action of exogenously applied phytohormone ABA. ABA was found to activate only the expression of the *Dhn4* gene and a marked increase in expression was observed only in variety *Malz*. Comparison of results of all three experiments documented the usefulness of the method as a tool for determining drought tolerance of barley and revealed two different mechanisms of activation of stress protective responses in the two tolerant varieties *Tadmor* and *Malz*, which could reflect a different participation of the ABA phytohormone in their regulation.

Impact of Gene Expression of Chosen Genes Involved in the Biosynthetic Pathway of Vitamin E on the Total

Vitamin E Content and Composition in Grain of Spring Barley. M. Kosař, L. Holková, N. Březinová Belcredi and J. Ehrenbergerová. *Kvasny Prum.*, 2010, Vol. 56, No. 3, pp. 123-126.

Vitamin E has a very important role in human nutrition. Sources of vitamin E are oils, nuts and also cereals. The highest vitamin E content among cereals was detected in barley. There are two enzymes localized in the strategic location of biosynthetic pathway of vitamin E: 4-hydroxyphenylpyruvate dioxygenase enzyme (HPPD) and homogentisate geranylgeranyl transferase (HGGT). HPPD could be considered as one of the essential factors which could control activity of the whole biosynthetic pathway due to its localization in the beginning of biosynthetic pathway. HGGT is the only enzyme which differs in the biosynthetic pathway of tocopherols and tocotrienols and that is why it could cause changes in the composition of vitamin E. Seven barley cultivars with different vitamin E level were grown under controlled conditions and activity of HPPD and HGGT in ears was measured four, eight and twelve days after pollination. It was found that activity of HPPD gene corresponded with the final vitamin E content detected in grains ($r = 0.75^*$). Relationship was found between gene activity of HPPD eight and twelve days after pollination and vitamin E content which was typical for these cultivars in the field conditions ($r = 0.85^*$). Gene for HGGT had smaller correlation to tocotrienol content.

Antioxidant Activity of Superoxide Dismutase in Spring Barley Grain. N. Březinová Belcredi, J. Ehrenbergerová and K. Vaculová. *Kvasny Prum.*, 2010, Vol. 56, No. 3, pp. 127-130.

Activity of antioxidant enzyme superoxide dismutase (SOD) was assessed in grain samples of 12 varieties and lines of spring barley grown in two localities (Žabčice, Kroměříž). In 2005, 2007, and 2008 field experiments were established in the locality Žabčice in two growing systems (with the application of pesticides, without application of pesticides) and in the locality Kroměříž without the application of pesticide. Activity of SOD was significantly affected by the varieties/lines, localities, years and their interactions. The treatment method did not affect the SOD activity statistically significantly. Significantly higher activity SOD ($P = 0.05$) was in the hull-less line KM 1057 (143 U.g^{-1} in the dry matter) compared to the total set from both the growing localities. On the contrary, significantly lower activity was recorded in the hull-less variety Merlin (62 U.g^{-1} in the dry matter) compared to the other varieties/lines. Malting varieties recommended for production of Czech Beer, Bojos and Tolar, also had higher SOD activity in grain.

Fusarium Mycotoxins in Spring Barley and their Transfer into Malt. A. Malachová, J. Hajšlová, J. Ehrenbergerová, M. Kostelanská, M. Zachariášová, J. Urbanová, R. Cerkal, I. Šafránková, J. Marková, K. Vaculová and P. Hrstková. *Kvasny Prum.*, 2010, Vol. 56, No. 3, pp. 131-137.

Fusarium mycotoxins are secondary metabolites of microscopic filamentous fungi of *Fusarium* genus. This paper summarises current knowledge on the field of my-

cotoxin contamination of barley, mycotoxin transfer into malt and compares them with results achieved within the years 2005–2008 on the set of 12 spring barley cultivars grown in low-input and conventional agricultural systems in Žabčice a Kroměříž.

Seed Mycoflora of Malting Varieties and Lines of Spring Barley in Localities Kroměříž and Žabčice. I. Šafránková, M. Marková and M. Kmoch. *Kvasny Prum.*, 2010, Vol. 56, No. 3, pp. 138-144.

Determination of protective measures for grain destined for storage requires the knowledge of the way and time of colonization with individual microbial pathogens, most of which are fungi that strongly affect the quality of production. The most frequent species colonizing barley seeds are fungi of genera *Alternaria*, *Cladosporium*, *Epicoccum*, *Fusarium*, *Aspergillus* and *Penicillium*. The current fungicidal protection does not guarantee sufficient protection against fusarioses of seed and ears. The most efficient fungicides against ear fusarioses are formulas containing sterol demethylation inhibiting (DMI) fungicides; when using them it is important to know the most suitable term for their application, i.e., the period of maximum risk of infection. No directed protection against seed fusarioses is being carried out (no distinction is being made between seed and ear fusarioses, and also because of sanitary reasons), although seed infection can arise later, after flowering. The exact correlations between the occurrence of fusaria and mycotoxin production are not known, neither is the mechanism of fungicide action on mycotoxin production. The contradictory data in this field attest to the complexity of the problem and strongly point to the necessity of a complex protection involving previous crop, tillage, agricultural practices, resistant varieties, chemical protection, timely harvest and crop storage.

The Influence of Barley Origin and Malting Technology on Ferulic Acid Content in Barley and Malt. A. Mikyška, J. Prokeš, S. Běláková, J. Škach and D. Hašková. *Kvasny Prum.*, 2010, Vol. 56, No. 3, pp. 145-151.

Ferulic acid is an important phenolic acid contained in barley. It is an antioxidant with a potential impact on sensorial stability of beer. On the other hand, 4-vinyl guaiacol can be formed from free ferulic acid either by thermal decarboxylation in the course of kilning, mashing and wort boiling or by enzymic decarboxylation during beer fermentation. Six years trials proved dependence of ferulic acid in barley on its genetical properties and the important dependence on climatic circumstances during growth as well as during year crop. Free ferulic acid monitoring in laboratory wort approved dependence of its content on barley variety, year crop and growing locality. Neither of these factors was dominant. A rate of free ferulic content presented in malt and ferulic acid released by mashing was dependent on barley variety. Similarly a rate of total ferulic acid content in barley and free ferulic content in wort was varietal dependent. Free ferulic acid content in wort is markedly influenced by malting technology. Higher steeping degree, higher germination temperature and time lead to higher free ferulic content in wort. Free ferulic content in wort correlated with analytical param-

eters describing cytolytic and proteolytic modification of malt.

Zinc, Effect on the Spring Barley's Plant and Roots Growth, Grain Technological Quality, and Yeast Fermentation. R. Cerkal, L. Hřivna, P. Ryant, J. Prokeš, N. Březinová Belcredi, K. Vejražka, M. Michnová and T. Gregor. *Kvasny Prum.*, 2010, Vol. 56, No. 3, pp. 152-159.

In 2005–2008, the effect of zinc foliar application (0.5 kg.ha⁻¹ in DC 31 and 55 growth stage in the form of the Zinran fertilizer containing sulphate and zinc oxide: 19.8 and 52.3%) on the size of the plants' root system (its electric capacity in DC 23 and 57 was measured), the yield and quality of grain, and the course of the sweet wort fermentation process of six spring barley varieties (Bojos, Jersey, Kompakt, Malz, Sebastian, Tolar) was studied. Varietal differences were found in regard to the impact of zinc on the root system development. The grain yield rose by 3% on average after zinc application and so did grain over sieve 2.5 mm (by 9%) and weight of thousand grains (by almost 2%). Zinc application led to a higher starch synthesis in the grain, the extract content values increased by 0.3–0.5%. After the zinc fertilizer treatment, the native zinc content in grain increased by 3–11%. On average, 143 g.ha⁻¹ was taken up by the grain yield (from 126 g.ha⁻¹ – Kompakt to 159 g.ha⁻¹ – Bojos), a higher uptake was observed in stands after a foliar application of zinc fertilizer (by 10–17%). A negative correlation between the zinc content and N substances in grain (ranging from $r = -0.274$ to -0.525^{**}) was proved, and a positive correlation between this microelement and the starch content ($r = 0.014$ up to 0.367^{*}) was confirmed, too. Positive correlations between the zinc content and friability ($r = 0.329^{*}$ – 0.691^{***}), and MQI ($r = 0.274$ – 0.603^{***}), were found, while negative ones were established between the zinc content and β -glucans content in grain ($r = -0.265$ to -0.521^{**}). Faster sweet wort fermentation processes during the first 24 hours were found in variants treated by zinc (by 1–1.5%), however, this fact was not reflected in the resultant depth of fermentation (differences between the control and the treated variants were 0.1%).

Barley and Malt Polyphenols and their Antioxidant Properties. M. Dvořáková, P. Dostálek, Z. Skulilová, M. Jurková, V. Kellner and L. F. Guido. *Kvasny Prum.*, 2010, Vol. 56, No. 3, pp. 160-163.

Ten different barley cultivars and their corresponding malts were analysed for monomeric and oligomeric flavan-3-ols content by using high-performance liquid chromatography ultraviolet detection-electrospray ion trap mass spectrometry. The Folin-Ciocalteu and the vanillin spectrophotometric assays were used for the assessment of the total polyphenol and total flavan-3-ol content respectively, and the antioxidant activity was determined by DPPH and FRP. Catechin and prodelphinidin B3 were respectively the major monomeric and dimeric flavan-3-ols. Moreover, prodelphinidin B3 was shown to be the main contributor for the radical scavenging activity both for barley and malt. The same samples were used to obtain different fractions. The contribution of bound phenolics to the total polyphenol content was significantly higher than that of free and esterified fractions. Catechin and ferulic acid, quantified by HPLC-DAD, were the most

abundant phenolics in the free and bound fractions, respectively. The antioxidant activities of phenolic fractions were investigated using the radical scavenging assay (DPPH) and the ferricyanide reducing power (FRP). Further, the hot water extracts of barley cultivars and corresponding malts were analyzed. The ferric reducing antioxidant power (FRAP) and radical scavenging activity (ABTS) and indicator time test (ITT) were compared. The total polyphenol content, as measured according to Folin-Ciocalteu's method, was positively correlated with all antioxidant methods used. Free phenolic compounds were measured by HPLC with CoulArray detector. The dominant phenolic compound was ferulic acid.

Simultaneous Determination of Iso-alpha Acids in their cis- and trans-forms and Tetrahydroiso-alpha Acids. M. Jurková, T. Horák, J. Čulík, P. Čejka and V. Kellner. *Kvasny Prum.*, 2010, Vol. 56, No. 3, pp. 163-166.

The elaborated method enables the simultaneous determination of stereoisomers forms of iso-alpha acids and tetrahydroiso-alpha acids using very modest way on C18 column and easy mobile phase without buffers. The groups of analysed compounds eluate separately. The rest of untransformed alpha acids to iso-alpha acids do not obstruct the analysis.

Study of an Influence of Beer Colloidal Stabilization by Sorbent Polyclar AT on Polyphenolic Antioxidants and Sensorial Stability of Beer. A. Mikyška, D. Hašková, J. Čulík, M. Jurková and P. Čejka. *Kvasny Prum.*, 2010, Vol. 56, No. 3, pp. 167-174.

The influence of beer colloidal stability by polyphenols sorbent treatment on polyphenols composition, antioxidant activity of beer, carbonyls content and sensorial quality of fresh and three months stored beer was studied in trial brews (200 L) hopped either by aroma or bitter hops. A part of each brew was stabilized by the use of two different doses of sorbent Polyclar AT. Content of both complex polyphenols and content of some free phenol compounds, flavanoids and p-hydroxybenzoic acid derivatives decreased by stabilizing action. It was found out ESR-DPPH antioxidant activity decrease only in 5–15% after 15–40% polyphenols of investigated groups removing by stabilization. Antiradical activity ESR-lag time had not practically changed by stabilizing action. Slightly lower content most of carbonyl markers as well as lower sulfur dioxide content was determined in fresh stabilized beers compared with non stabilized beer. After three months of beer storage there was not distinct influence of stabilization by Polyclar AT on content of carbonyls originated from amino acids and higher alcohols found out. An influence of stabilization on carbonyls originated from fatty acids was apparent. These carbonyls content increase in the course of beer storage was higher for stabilized beers, especially for brew hopped by aroma hops. After beer storage stabilized beers were sensorial evaluated to be better compared to non stabilized beers, they had low age and oxidized off flavors intensity. Especially undesirable polyphenol compounds have been removed by beer colloidal stabilizing by polyphenols sorbent Polyclar AT. This technology has a positive effect from the point of view both colloidal haze formation and beer flavor staling deceleration.