

**INFLUENCE OF YEAST MORPHOLOGY ON THE PROPERTIES OF CELL WALL GLYCOPROTEINS****MARTA BRLEJOVÁ, MILAN ČERTÍK, PETER RAPTA, and VLASTA BREZOVÁ**

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The work was focused on characterization of properties of cell wall glycoproteins from three yeast strains (*Candida albicans* CCY 29-3-162, *Rhodotorula glutinis* CCY 20-2-26, *Pichia pastoris* CCY 34-29-2) growing on different cultivation media. Effect of these environmental conditions on protein/saccharide ratio of glycoproteins was analysed.

Antioxidant capacities as well as radical scavenging properties of isolated glycoproteins were measured by ABTS method and EPR technique, respectively.

**NEW METHOD FOR PREPARATION OF CROSSLINKED HYALURONIC ACID DERIVATIVES WITH DIETHYLENTRIAMINE-PENTAACETIC ACID AND THEIR METAL COMPLEXES. SYNTHESIS, EVALUATION AND STRUCTURE ANALYSIS****RADOVAN BUFFA and VLADIMIR VELEBNY**

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Macromolecular conjugates of hyaluronic acid with diethylenetriaminepentaacetic acid (DTPA) – metal complexes have been synthesized and characterized by FTIR, NMR, SEC-MALLS and ICP analysis. Several parameters of crosslinking reaction as molecular weight of starting HA, temperature, equivalent of DTPA bis anhydride and reaction time have been studied. Relations between the molecular weight assigned by SEC-MALLS method, reaction parameters and rheological properties of final crosslinking products were investigated.

**EXPERIENCE WITH THE ASSESSMENT OF BASIC SUGARS IN CEREAL GRAIN****PETR BUCHER<sup>a</sup> and PETR MARTINEK<sup>b</sup>**

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Contents of saccharose, glucose and fructose in grain and flour of various cereal species were determined using HPLC. These components together with asparagine are precursors of acrylamide (potential carcinogen) production via Maillard reaction. The effect of solvents (water, acetonitrile, acetone, ethanol and methanol), possibility of centrifugal separation and problems with changes in analyte concentration during the analysis are discussed. In wheat grain, the content of saccharose varies from 5000 to 10 000 mg kg<sup>-1</sup>, glucose from 70 to 2000 mg kg<sup>-1</sup> and fructose from 80 to 450 mg kg<sup>-1</sup>.

*The study was supported by the Ministry of Education, Youth and Sports of the Czech Republic, project MSM6046137305.*

**ISOLATION AND CHARACTERIZATION OF ARABINOXYLAN FROM CEREALS****KRZYSZTOF BUKSA**

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Arabinoxylan isolated from cereals, especially from rye bran consists of  $\alpha$ -L-arabinofuranose residues attached as branch-points to  $\beta$ -(1,4)-linked D-xylopyranose polymeric backbone chains; it is a hydrocolloid with interesting properties (high water-holding capacity, forming viscous solutions culminating in gels with high surface activity). Water soluble arabinoxylan e.g. improves bread quality leading to higher bread volume, softer bread crumb structure, longer shelf life and higher fibre content.

## AN ARABINO GALACTAN-PROTEIN ISOLATED FROM INSTANT COFFEE POWDER OF *Coffea arabica*

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It is known that polysaccharides – cellulose, galactomannan and arabinogalactan-proteins (AGPs) represent a dominant part of mature coffee beans. AGPs constitute about 15–17 % of dry weight of beans. These macromolecules exist as an extremely heterogeneous mixture of acidic arabinogalactan-proteins. They have a highly branched structure, are glycosylated and possess a large scale of functions in biological processes. They have been recognized as roasted coffee aroma precursors and play an important role in determining some functional properties of coffee brews. Due to their highly branched structures, AGPs can be easily extracted from coffee beans. However, drastic industrial processing conditions during the instant coffee powder preparation causes significant structural modifications in AGP macromolecules including depolymerization of the main and side chains. The extent of degradation depends on industrial conditions used, i.e. roasting, extraction and spray drying processes. Up to now little attention has been dedicated to the study of AGPs modifications in instant coffee prepared from roasted *Coffea arabica* beans<sup>1,2</sup>.

In the present work we reports on the isolation and structural characterization of AGP from instant coffee powder prepared from roasted *Coffea arabica* beans. Chemical and spectroscopic analyses revealed a high degree of AGP destruction in comparison with AGP from the green coffee. Its native average molecular mass (~ 650 000) was markedly reduced to about 5400. Structural studies on AGP indicated the presence of longer segments of non substituted 1,3-linked  $\beta$ Galp units in the backbone and lower degree of substitution by Ara<sub>f</sub> residues in side chains in comparison with the native AGP. The intensity of signals in NMR spectra due to terminal 1,3-linked  $\beta$ Galp units of the backbone as well as  $\alpha$ , $\beta$ Galp residues of the reducing ends confirmed the presence of lower molecular mass fragments of AGP in instant coffee powder.

This work was supported by the Illy Caffè grant, VEGA Grant No. 2/0155/08, and APVV Grant No. 0030/08.

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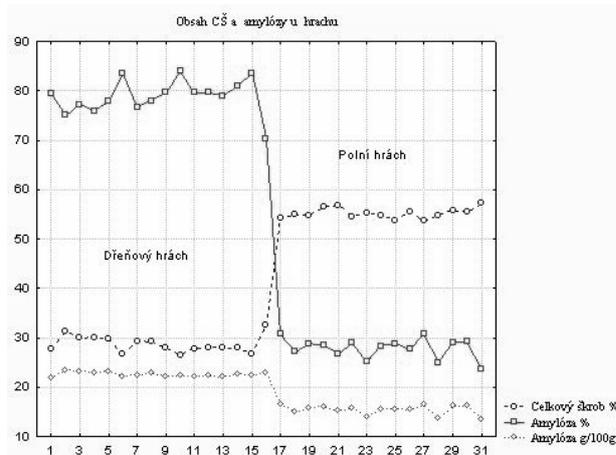
## SLEDOVÁNÍ ZMĚN OBSAHU ŠKROBU A REZISTENTNÍHO ŠKROBU U HRACHU

RADMILA DOSTÁLOVÁ a JIŘÍ HORÁČEK

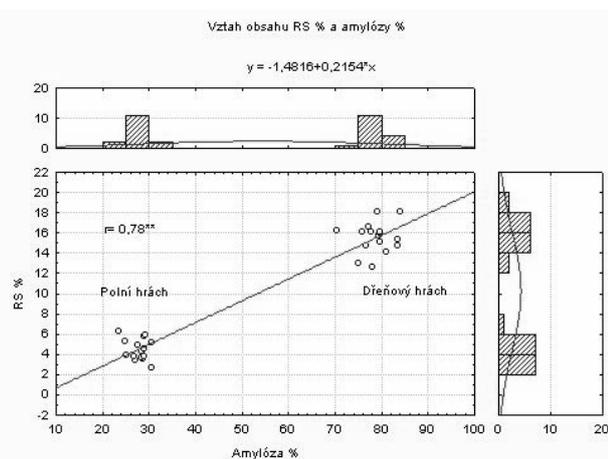
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U hrachu zaujímá největší podíl semene škrob. Hrách je možno rozdělit na skupiny: 1. Hrách polní – *Pisum sativum* L. ssp. *sativum* var. *sativum*, který se sklízí v plné zralosti, se vyznačuje kulatými hladkými semeny a oválnými škrobovými zrny 2. Hrách dřevňový – *Pisum sativum* L. ssp. *sativum* var. *medullare* se svrasklými semeny má škrobová zrna paprscitě rozštěpena, sklízí se v technologické zelené zralosti. K složkám, které pozitivně ovlivňují trávicí procesy, patří rezistentní škrob (RS). Englyst a spol.<sup>1</sup> ho definuje jako škrob a jeho degradační produkty, které zdravý člověk není schopný strávit a vsřebat v tenkém střevě. Z literárních zdrojů je zřejmé, že obsah RS závisí na množství amylosy a právě dřevňový hrách má vyšší obsah amylosy, než obilniny nebo pseudoobilniny<sup>3</sup>. V AGRITEC je k dispozici kolekce genových zdrojů hrachu (kulatosemenného, hrachu se svraštělým povrchem semen a intermediárního hrachu), u kterých byly zjišťovány korelace mezi obsahem škrobu a amylosy, amylopektinu a hrubého proteinu<sup>2</sup>.

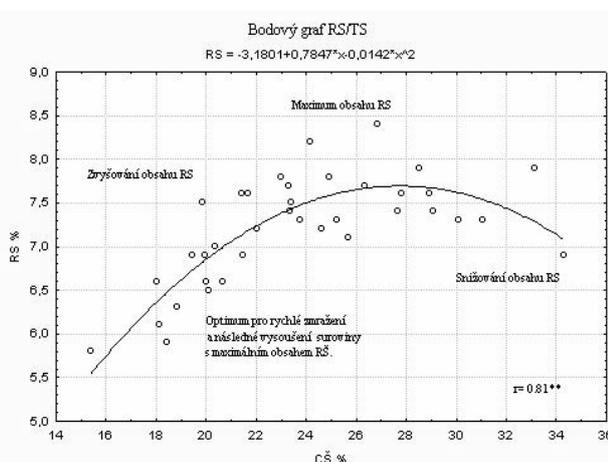
Cílem práce bylo zjistit obsah celkového škrobu, amylosy a rezistentního škrobu v semenech polního a dřevňového hrachu, zjistit a postihnout změny obsahu RS u dřevňového hrachu v různých termínech technologické sklizně.



Obr. 1. Grafické znázornění obsahu celkového škrobu %, amylosy % a v g/100 g sušiny



Obr. 2. Závislost obsahu RS na amylose



Obr. 3. Změny obsahu RS v průběhu dozrávání dřeňového hrachu – 3 termíny sklizně

Obsah celkového škrobu v semenech hrachu byl stanoven metodikou NIRS (Near Infra-Red Spektroskopie). Kalibrace přístroje byla ověřena pomocí série standardních vzorků hrachu se známým obsahem škrobu. Obsah škrobu v těchto standardních vzorcích byl stanovován pomocí komerčního kitu Megazyme (AOAC metoda 996.11).

Stanovení rezistentního škrobu (tj. škrobu, který nepodléhá enzymatické hydrolyze) bylo prováděno pomocí komerčního kitu Megazyme (AOAC metoda 2002.02).

Stanovením obsahu škrobu (2006–2007) polního hrachu byly zjištěny hodnoty v rozmezí 53,61–57,23 %. Tento obsah je dle klasifikační stupnice pro kulatosemenný hrách klasifikován stupněm 7-8-9 (vysoký-velmi vysoký). Průměrný obsah amylosy byl 27,87 % (obr. 1). Obsah RS se pohyboval od 2,68–6,25 %. U dřeňového hrachu byl zjištěn obsah škrobu v rozmezí 26,57–32,55 %. Dle klasifikační stupnice pro dřeňový hrách je klasifikován stup-

něm 4-5-6 (nízký-střední). Průměrný obsah amylosy byl 76,82 % z celkového obsahu škrobu (obr. 1). Obsah rezistentního škrobu se pohyboval v rozmezí 12,64–18,05 % v plné zralosti. V roce 2008 byly obsahy rezistentního škrobu (RS %) ve vzorcích dřeňových hrachů výrazně nižší než v předchozích ročnících. Obsah rezistentního škrobu v osivu kolísal v rozmezí 4,45–5,4 % RS v sušině.

Byly sledovány vztahy mezi obsahem amylosy a obsahem rezistentního škrobu u polního a dřeňového hrachu. Pomocí korelační analýzy byla zjištěna vysoce průkazná závislost obsahu amylosy a rezistentního škrobu u obou typů hrachů. Obsah RS na amylose lze vyjádřit vysoce průkazným korelačním koeficientem  $r = 0,74^{**}$ , což odpovídá mnoha literárním zdrojům<sup>4,5</sup> (obr. 2). Podobně byla zjištěna i závislost celkového škrobu a RS, kdy korelační koeficient dosáhl hodnoty  $r = -0,94^{**}$ .

U dřeňového hrachu byly porovnávány obsahy RS ve třech termínech technologické sklizně.

Obsah RS nejdříve stoupá a dosahuje u některých kultivarů maximálních hodnot. Dále jeho obsah zřejmě stagnuje a později výrazně poklesne. Ve zralém semenu pak až na průměrnou hodnotu 4,84 % (obr. 3).

*Tato práce byla podpořena grantem Ministerstva školství mládeže a tělovýchovy ČR MSM 2B06085 a MSM 2678424601.*

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#### INFLUENCE OF AGEING ON PROPERTIES OF STARCH – CLAY NANOCOMPOSITES

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Nanocomposites based on thermoplastic cationized starches and sodium montmorillonite were prepared. Both mechanical properties of the product and its structure

proved that cationization of the starch matrix lowers the tensile strength and the modulus. On the contrary, ageing of the thermoplastic starch itself and its low-cationized derivative improves its mechanical properties expresively. The clay nanofiller generally increases the strength of the material even at low concentrations.

*The authors wish to thank the Ministry of Industry and Trade of the Czech Republic (TIP grant No. FR - TII/566) for financial support.*

#### LIGHT MICROSCOPY AND IMAGE ANALYSIS AS A SUITABLE SCREENING METHOD FOR CHARACTERIZATION OF WHEAT STARCH GRANULES

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The light microscopy with subsequent image analysis was used for characterization of starch granules in two model doubled haploid wheat lines (*Triticum aestivum* L.) differing in the presence or the absence of 1B/1R rye translocation. There were analyzed more than 12 000 starch granules of each sample and verified an optimal number of starch granules for obtaining of representative results about size and shape distribution of starch granules. There were found out that the optimal number of analyzed starch granules should exceed more than 4000 granules. We confirmed the typical bimodal starch distribution in the wheat samples as well. In spite of high genetic similarity between the both lines there were detected the significantly higher value of circularity in the translocated wheat line (L110) and the trend of higher diameter average of starch granules in the wheat line (L159) characterized by the absence of 1B/1R translocation.

*Supported by the Ministry of Agriculture of the Czech Republic, Projects No. 1G58076.*

#### FAKTORY OVLIVŇUJÍCÍ PRODUKCI ŠKROBU U TRITIKALE

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Tritikale je plodinou s vysokým obsahem škrobu. Výrobky ze škrobu se uplatňují při nejrůznějších potravi-

nářských a nepotravinářských průmyslových výrobcích. Vzhledem ke špatné vypíratelnosti lepku u tritikale bude jeho uplatnění spíše pro kvasné technologie, především pro výrobu ethanolu. Zvýšená spotřeba ethanolu je vyvolána zavedením přidávání ethanolu do automobilového benzínu.

V maloparcelkových pokusech (sklizeň 2007 a 2008) s odrůdami tritikale ozimého (Kitaro, Lamberto, Lupus, Ticino, Tricolor) byly uplatněny 2 intenzity pěstování: úsporná (90 kg N ha<sup>-1</sup>) a intenzivní (120 kg N ha<sup>-1</sup> a 1 fungicid). Pokusy byly založeny na třech stanovištích v bramborářské výrobní oblasti (Humpolec, Lukavec, Pernolec) a na jednom stanovišti v pčinnářské výrobní oblasti (Vysoké n. Jiz.).

Podmínky pro tvorbu škrobu v zrně tritikale byly v obou ročních příznivé a bylo dosahováno obdobného obsahu škrobu v zrně, v roce 2007 v průměru 68,6 %, v 2008 69,0 %. Mezi zkoušenými odrůdami byly zjištěny rozdíly mezi dvěma skupinami odrůd. V průměru celého pokusu dosahovaly vyššího obsahu škrobu Lupus 69,4 %, Ticino 69,3 % a Tricolor 69,1 %. Odrůdy Lamberto 68,3 % a Kitaro 68,2 % měly o 1 % hodnoty nižší, a to jak při nižší, tak i při zvýšené dávce dusíkatého hnojení. Dvě varianty pěstitelské technologie se lišily především dávkou dusíku. Projevil se protiklad s dusíkatými látkami v zrně. Zvýšené dusíkaté hnojení (intenzivní technologie) snižovalo v obou letech obsah škrobu o 0,4 %. Nejvíce se tento trend projevil na nejméně úrodném stanovišti ve Vysokém, kde rozdíl činil 1,2 % ve prospěch nižšího hnojení dusíkem. Mezi dalšími pokusnými místy nebyl zjištěn průkazný rozdíl 68,4 % (Lukavec) až 69,0 % (Pernolec a Humpolec).

Také výnosově dopadly v průměru oba ročníky podobně – 2007 8,15 t ha<sup>-1</sup> a 2008 8,10 t ha<sup>-1</sup>. Významně se lišily technologie pěstování. Zvýšená dávka dusíku podpořila výnos zrna o 0,91 t ha<sup>-1</sup>. Nevýznamně vyšší výnosy poskytly odrůdy Lamberto a Lupus 8,66 t ha<sup>-1</sup>, dále Kitaro 8,50 t ha<sup>-1</sup>, Ticino 8,47 t ha<sup>-1</sup>. Nejnižší výnos byl u odrůdy Tricolor 6,50 t ha<sup>-1</sup>.

Při hodnocení hektarového výnosu škrobu byl rozhodující výnos zrna u jednotlivých variant pokusu, protože rozdíly obsahu škrobu v zrně byly malé. Průměrné hektarové výnosy škrobu byly proto vyšší u variant s vyšší dávkou dusíku o 0,49 t ha<sup>-1</sup>. Významně se odlišila odrůda s nízkým výnosem zrna Tricolor 4,39 t ha<sup>-1</sup> škrobu. U ostatních odrůd byl výnos škrobu v užším rozmezí 0,14 t ha<sup>-1</sup>, Lamberto 5,92 t ha<sup>-1</sup>, Ticino 5,86 t ha<sup>-1</sup>, Lupus 5,81 t ha<sup>-1</sup>, Kitaro 5,78 t ha<sup>-1</sup>.

*Práce vznikla za podpory projektu NAZV č. 1G57056 a výzkumného záměru MSM 6046070901.*

### SORPTION PROPERTIES OF PLUM PUREE EDIBLE FILMS: EFFECT OF APPLE PUREE AND WHEY PROTEIN ISOLATE

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An edible film is defined as a thin layer of edible material formed on a food as a coating or between food components.

Edible films, by regulating transfer of moisture, oxygen, carbon dioxide, lipid, aroma and flavor compounds in food systems, can increase food product shelf-life and improve food quality. Although the use of edible films in food products may seem new, the idea of edible films and coatings has intrigued packaging and food scientists for a long time. For instance, during the twelfth and thirteenth centuries, dipping of oranges and lemons in wax to retard water loss was practiced in China. Edible films and coatings find use in variety of applications including casings for sausages, chocolate coatings for nuts and fruits, and wax coatings for fruits and vegetables.

The use of fruit puree is increasing because of its functional properties in food processing and storage. High fruit production, to be low cost source, to be easy to process and to use as natural, healthy food additive are increasing its importance.

Objectives of this research were to (1) obtain edible film that increased shelf life from plum puree, (2) determine the effect of apple puree and whey protein isolate addition (10, 30 and 50 % of plum puree's dry matter) on sorption properties of films.

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### MODIFIED HYALURONIC ACID HYDROGELS

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Tyramine-substituted hyaluronan is a promising substance for tissue engineering and other applications. Hydrogel is formed after enzyme and hydrogen peroxide is added. Present results indicate that tyramine substitution of about 5 % is sufficient for preparation of material with interesting mechanical and biological properties. Cells encapsulated within hydrogel during cross – linking reaction remain metabolic active for at least 10 days of culture.

### THE MULTIVARIATE ANALYSIS OF VIBRATIONAL SPECTRA OF WOOD MUSHROOMS OF GENERA *Phellinus* AND *Inonotus*

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A set of samples (fruit bodies and submersion cultures) originated from wood mushrooms of genera *Phellinus* and *Inonotus* were analysed by FT-IR (transmittance of KBr pellets, ATR) and FT-NIR (diffuse reflectance) spectroscopy. Purification of some samples by washing with dilute HCl in 80% ethanol led to some spectroscopic changes, which were more pronounced for submersion cultures. Normalised spectra were used for hierarchy cluster analysis (HCA), and second derivatives (SD) of these spectra for principal component analysis (PCA). Fruit bodies and submersion cultures were successfully discriminated by HCA (Ward method, Manhattan distances) and by a principal component (PC) 1, which accounted for 46 % (FT-IR transmittance), 61 % (FT-IR ATR) and 78 % (FT-NIR) of the variation in all variables. The major PC1 extremes contributing to discrimination were assigned to proteins, aromatics and polysaccharides. Raw and purified submersion cultures of genus *Phellinus* were discriminated by PC2. The combination of PC1 and PC3 allowed fruit bodies of genera *Phellinus* and *Inonotus* to be discriminated mainly due to the differences in the contribution of aromatics and polysaccharides, while discrimination of *Phellinus* species was unsuccessful.

This work was supported by the by the Czech Science Foundation (project 52 /07/J03) and the Ministry of Education, Youth and Sports of the Czech Republic (project MSM 6046137305).

### CHARACTERIZATION OF STARCH-CONTAINING CERAMIC SUSPENSIONS AND CERAMIC GREEN BODIES PREPARED BY STARCH CONSOLIDATION CASTING

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This work deals with the characterization of unfired bodies (so-called green bodies) of alumina (Al<sub>2</sub>O<sub>3</sub>) ceramics prepared by the starch consolidation casting technique. Three native starch types (potato, corn and wheat starch) have been used and the influence of the type and amount of starch on the strength and shrinkage of the as-prepared samples is studied. Part of the work is a rheological study of ceramic suspensions with different starch types.

### ANALYSIS OF MIXED-LINKED (1→3)(1→4)-β-D-GLUCAN IN WHEAT CULTIVARS (*Triticum aestivum* L.) AND POSSIBILITIES OF ITS UTILIZATION

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On the field experiment in the locality of the Slovak Agricultural Research Centre-Research Institute of Plant Production Piešťany (Slovak Republic) a set of both Slovak landraces and Slovak modern cultivars of wheat (*Triticum aestivum* L.) was grown in the year 2008. Grain samples of 16 landrace cultivars (Šamorínska, Bučianska červenoklasá, Bučianská V.T. 16, Bučianská 316, Košútská, Radošinská Dorada, Radošinská Karola, Radošinská Norma, Radošinská poloranná 562, Radošinská ranná 594, Slovenská B, Slovenská 2, Slovenská 777, Trebišovská 76,

Vígľašská červenoklasá, and Vrakúnská) and 15 modern ones (Ilona, Ignis, Viador, Pavlína, Torysa, Zerda, Veldava, Markola, Stanislava, Venistar, Verita, Solara, Vanda, Alacris, and Genoveva) were analyzed in two duplications for the β-D-glucan content enzymatically by Megazyme assay kits.

The average content of β-D-glucan was in Slovak wheat cultivars 0.71 %. Modern cultivars disposed of 0.58 % of β-D-glucan. Higher amounts (0.84 % in average) were showed in landraces, what was 31 % more than in modern cultivars. Cultivars with the highest content of β-D-glucan (Košútska, Radošinská Dorada, and Radošinská Karola with the content > 1.00 %) can be used in breeding programme and seed processing in food industry as a convenient raw material for production of functional foods.

In view of consumers' requirements for healthy nutrition, the food industry regulates the development of new products directed to functional foods and ingredients. Functional foods are eatables which provide besides their initial function (satiation and nutrition of the organism) also the health benefit to a consumer. The functional food must fulfil the following requirements: it must be a food consisting of natural components and not a tablet or powder; it can and should be consumed as part of the daily meals; its special regulation lies in regulating the particular process ongoing in the human organism. A certain portion in the production of functional foods should be created by foods, which are naturally enriched with vitamins, minerals, antioxidants, suitable enzymes, etc.

For preparation of functional foods either the addition of natural raw material with beneficial quality parameters or supplementation of isolated parts (β-D-glucan hydrogels for example) is possible. The aim of our next experiments was the microbiological and sensoric evaluation of food (bread and ketchup) with the addition of β-D-glucan hydrogels isolated from wheat. The sensoric evaluation of bread was done by six evaluators. In addition to the positive sensoric and microbiological influence of β-D-glucan, the rheological behaviour and water activity was monitored with the results that the addition of the given hydrogels moderately decreased the water activity. The tomato ketchup was warehoused at laboratory temperature for 180 days and subsequently a sensoric evaluation of the influence of hydrogels addition on warehousing and the sensoric quality was done. Lastly, the microbiological purity of the food was controlled.

The results showed that cereal hydrogels addition to food does not influence the food quality negatively and therefore it is perspective in further exploitation for preparing new, health-beneficial forms of food. Based on the experimental results, it can be concluded that the addition of β-D-glucan can contribute to improve not only the sensoric quality but also the health aspect of the types of food mentioned in this work. Moreover, the addition of β-D-glucan positively affected the rheological properties of the bread dough and also contributed to softening of the acid taste of ketchup, which could be exploited in producing

new innovated products. Consumption of these innovated products, especially bread, could have a preventive effect on the civilization diseases linked with food.

*This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0770-07 and No. APVV-SK-CZ-0028-07.*

## CONTENT OF (1→3)(1→4)- $\beta$ -D-GLUCAN IN WHEAT CULTIVARS AFTER ARTIFICIAL INFECTION WITH FUNGI *Fusarium culmorum* SACC.

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The wheat spikes of 16 landrace cultivars (Šamorínska, Bučianska červenoklasá, Bučianská V.T. 16, Bučianská 316, Košútská, Radošinská Dorada, Radošinská Karola, Radošinská Norma, Radošinská poloranná 562, Radošinská ranná 594, Slovenská B, Slovenská 2, Slovenská 777, Trebišovská 76, Vigľašská červenoklasá, and Vrakúnská) and 15 modern ones (Ilona, Ignis, Viador, Pavlína, Torysa, Zerda, Veldava, Markola, Stanislava, Venistar, Verita, Solara, Vanda, Alacris, and Genoveva) were inoculated with conidial suspensions of *Fusarium culmorum* isolate in the field during flowering in the year 2008. The inoculation of cultivars contained a highly pathogenic isolate from the area of Radošina, *Fusarium culmorum* (RA/02), and originates from the microorganism collection held at the Research Institute of Plant Production in Piešťany. At anthesis, twenty-five spikes from each cultivar were sprayed (block 1) with *Fusarium culmorum* and were covered for 24 hours with a yellow bag. The spikes were visually evaluated on a 0–100 % scale at 10, 15, and 20 days after inoculation. After ripening, twenty-five spikes were harvested manually from each plot of blocks (block 1. inoculated, block 2. uninoculated). The areas under disease progress curves (AUDPC) were computed,  $\beta$ -D-glucan and deoxynivalenol (DON) content in grains were determined using Megazyme and Ridascree® Fast DON assay kits.

The average content of  $\beta$ -D-glucan was in Slovak wheat cultivars from uninoculated block 0.71 % and from inoculated block 0.46 %, respectively. Modern cultivars disposed of 0.58 %  $\beta$ -D-glucan from uninoculated block and 0.40 % from inoculated block. The content of  $\beta$ -D-glucan was in landraces cultivars 0.84 % from uninoculated block and 0.51 % from inoculated variant. The modern cultivars had 21.6 % less of monitored polysaccharide than landraces cultivars from inoculated block. Cultivar

Šamorínska disposed of the highest content of  $\beta$ -D-glucan (0.66 %). The lowest  $\beta$ -D-glucan contents were in modern cultivars, mostly in Verita, Veldava, and Markola. The highest reduction in  $\beta$ -D-glucan content was in landrace cultivar Košútská (59 %) and the minimal reductions (< 5 %) were in modern cultivars, mainly in Vanda, Alacris, and Genoveva.

The mean AUDPC value for tested cultivars was 470. The mean AUDPC value was lower (308.6) for landraces than for modern cultivars, where the mean value was 642.2. The average kernel contamination with DON was 34.4 mg kg<sup>-1</sup>. The landrace cultivars accumulated 67.4 % less DON than modern ones. The DON accumulation in landrace cultivars was in the range from 1.6 mg kg<sup>-1</sup> to 48.6 mg kg<sup>-1</sup>. The low DON contents were in Radošinská Norma, Radošinská ranná 594, and Radošinská Dorada. On the other hand, high DON contents were in Vigľašská červenoklas and Bučianska 316 detected. The range of DON accumulation was in landrace wheat cultivars between 23.2 mg kg<sup>-1</sup> and 143.1 mg kg<sup>-1</sup>. High DON contents were in cultivars Veldava, Ignis, and Vanda and low in Solara and Genoveva.

The explanation for the  $\beta$ -D-glucan decreasing in infected material is that most parasitic biotrophs derive nutrients from shoot tissue and have no alternative energy sources<sup>1</sup> and therefore they appear to absorb nutrients from the host plant, mostly  $\beta$ -D-glucan, a storage polysaccharide used as a source of energy and material<sup>2</sup> in mature cereal grains. Another explanation could be that in cereal grains  $\beta$ -glucanases are involved in a variety of physiological processes such as the defense against pathogens<sup>3</sup> and this enzyme is able to degrade the (1→3)(1→4)- $\beta$ -D-glucan present in the cell walls of the Gramineae grass species.

These preliminary results obtained from the grain analysis of wheat landrace and modern cultivars showed that content of  $\beta$ -D-glucan decrease after artificial inoculation with fungi (*Fusarium culmorum*). There was also a positive relationship between the content of  $\beta$ -D-glucan and resistance to *Fusarium culmorum* in AUDPC values and DON accumulation observed. Landraces dispose of higher  $\beta$ -D-glucan content and showed higher resistance in comparison to modern wheat cultivars what is compared to the association of avenantramide<sup>4</sup> and  $\beta$ -D-glucan<sup>5</sup> concentration in oat grain with crown rust incidence and genetic resistance.

*This work was supported by the Slovak Research and Development Agency under the contract No. „APVV-SK-CZ-0028-07“.*

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## DEFORMATION CURVES IN TENSILE TESTS OF $\beta$ -GLUCAN FILMS

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Mechanical properties of  $\beta$ -Glucan (hereafter  $\beta$ -glucan) foils were studied in tensile tests, using the testing machine Instron. The basis of these tests is deformation curve, obtained at constant deformation rate. A considerable portion of nonelastic deformation was observed in all cases. Basic parameters derived from the curves as the tensile strength, elongation and moduli were examined. The deformation curves were analysed by the Bluehill software and by Excel. Various methods of Young's modulus computation were discussed.

This work was supported by the Czech Science Foundation (project 525/09/1133) and by the Ministry of Education, Youth and Sports of the Czech Republic (MSM 6046070905).

## LIEHOVARNÍCKE VYUŽITIE FRAKCIÍ KUKURICE

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Kukurica má v rámci obilnín významné postavenie. Má vysoký potenciál úrodnosti a je vhodná pre izoláciu škrobu i výrobu liehu. Z pohľadu svetovej i domácej produkcie sa zaradila medzi najdynamickejšie sa rozvíjajúce plodiny. Etanol sa dá z kukurice vyrobiť zo zrnovej aj lignocelulózovej časti, avšak predfermentačná úprava je rôzna<sup>1-3</sup>. Práca sa zaoberá výrobou etanolu z vlákniny vznikajúcej ako odpad pri výrobe kukuričného škrobu (5% obsah škrobu) a zo zošrotovaného kukuričného zrna (61% obsah škrobu). 10% suspenzia sušiny týchto substrátov bola hydrolyzovaná prípravkom termostabilnej  $\alpha$ -amylázy pri 120 °C, pululanázou a glucoamylázou pri 60 °C. Enzy-

movou hydrolyzou kukuričného šrotu sme získali 716,3 mg glukózy/g sušiny, hydrolyzou vlákniny z 1 gramu sušiny to bolo 69,2 mg glukózy. Zo škrobového hydrolyzátu, ktorý sa podrobil etanolovej fermentácii za použitia kvasiniek *Saccharomyces cerevisiae* CCY-11-3 sme získali 0,46 g etanolu/g glukózy v prípade kukuričného šrotu a 0,48 g etanolu/g glukózy v prípade vlákniny. Tuhý podiel po enzymovej hydrolyze bol pred fermentáciou oddelený filtráciou a spracovaný: (1) kyslou hydrolyzou koncentrovanou H<sub>2</sub>SO<sub>4</sub> alebo HCl pri 120 °C, (2) hydrolyzou pôsobením multienzymového prípravku (zmes celulózy, arabinázy,  $\beta$ -glukanázy, hemicelulózy a xylanázy) a (3) predhydrolyzou koncentrovanou H<sub>2</sub>SO<sub>4</sub> alebo HCl pri 120 °C s následnou hydrolyzou pôsobením multienzymového prípravku. Najvyšší výtťažok redukujúcich sacharidov – 586,7 mg g<sup>-1</sup> sušiny vlákniny a glukózy – 116,7 mg g<sup>-1</sup> sušiny vlákniny bol dosiahnutý po kyslej predúprave s HCl. Na fermentáciu lignocelulózových hydrolyzáto boli použité kvasinky *Pichia stipitis* CCY 39-50-1 alebo *Candida shehatae* CCY 29-68-4. V prípade kvasiniek *Pichia stipitis* CCY 39-50-1 sa množstvo etanolu pohybovalo v intervale od 0,38 do 0,43 g bezvodého etanolu na 1 g redukujúcich sacharidov. V prípade kvasiniek *Candida shehatae* CCY 29-68-4 sa množstvo získaného etanolu pohybovalo v intervale od 0,10 do 0,16 g bezvodého etanolu na 1 gram redukujúcich sacharidov.

V tejto práci bola taktiež uskutočnená simultánna sacharifikácia a fermentácia kukuričného šrotu. 10% suspenzia bola v prvom kroku stekutená termostabilnou  $\alpha$ -amylázou pri 120 °C, v druhom kroku prebehlo 30 minútové predscukrenie pululanázou, glucoamylázou a multienzymovým celulózovým prípravkom pri 60 °C. Množstvo bezvodého etanolu dosiahnuté po fermentácii hydrolyzátu kvasinkami *Saccharomyces cerevisiae* bolo 0,51 g na 1 g sušiny kukuričného šrotu, použitím kvasiniek *Pichia stipitis* CCY 39-50-1 to bolo 0,44 g a kvasinkami *Candida shehatae* CCY 29-68-4 sa získalo 0,34 g etanolu/g sušiny kukuričného šrotu.

Práca vznikla za finančnej podpory projektu APVV LPP-0251-07.

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## POTENTIAL ANTIOXIDANT CAPACITY OF WATER SOLUBLE POLYSACCHARIDES OF THE OIL PUMPKIN BIOMASS

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Polyphenols and carotenoids exhibit potent radical scavenging activity. Carotenoids<sup>1</sup>, fat-soluble plant pigments, are commonly found in fruits and vegetables, those with the strongest colors being the healthiest. In human organism, carotenoids play two primary roles: exert antioxidant activity, but some are also converted into vitamin A. Considerable antioxidant activity has been also reported with polyphenols and those conjugated with polysaccharides<sup>2</sup>.

Pectic polysaccharides, cell-wall components, have recently been shown to exert an antioxidative effects<sup>3,4</sup>. The polysaccharide conjugate extracts from green tea possessed antioxidant activity even after most of the components that produce interference were removed<sup>5</sup>. The uronic acid content of different fractions was quantified, and polysaccharides with high uronic acid content had stronger reactive oxygen species scavenging activities. Rao et al.<sup>6</sup> suggested, that apart from phenolic acids, the presence of sugars with >C=O (uronyl/acetyl) groups and degree of polymerization impart strong antioxidant activity to the polysaccharides.

The pumpkin belongs to the family Cucurbitaceae. Three of these, *Cucurbita maxima* Duchense, *Cucurbita moschata* Duchense and *Cucurbita pepo* L. represent economically important species. The most important technological indices of pumpkin fruits are dry matter, the content of soluble solids and carotenoids<sup>1</sup>. Strong correlation between the total carotenoids content of pumpkin fruits and antioxidative activity was found<sup>7</sup>. The fruit biomass of pumpkins, after removing seeds, contains next to pectin a large variety of other biologically active compounds<sup>8</sup>. Nara et al.<sup>3</sup> evaluated the antioxidant activity of water soluble polysaccharides extracted from *Cucurbita maxima* Duchense. The samples contained no polyphenols, suggesting that the DPPH radical scavenging activity was caused by polysaccharides rather than antioxidative polyphenols. The antioxidant efficiency was enhanced proportionally to the total sugar content.

The standard pumpkin (*Cucurbita pepo* L) and the hull-less oil pumpkin (*Cucurbita pepo* L. var. *Styriaca*) are economically important horticultural plants in Slovakia. The scope of this work was to study antioxidant activities of the polysaccharide fractions isolated from the seeded pumpkin of both fruits. The biomasses were dewatered by drying on air and by solvent exchange with ethanol. The

polysaccharide fractions were extracted using sequential extraction (water and 1 % NaOH) and/or by three-step extraction procedure using 0.1M EDTA, 1 % and 5 % NaOH as extractants. Short ultrasound treatments at various conditions were applied in the first step. Fractions extracted by alkali showed the highest antioxidant activity by the ferric reducing antioxidant power (FRAP) assay. These samples possessed also significant antioxidant effects in the DPPH radical scavenging test. This work will focus on the main components and structure of extracted polysaccharides from pumpkin in connection with their antioxidant activity.

*Grant SAV-FM-EHP-2008-03-05 and the Slovak Grant Agency VEGA, grant No. 2/0062/09 financially supported this work.*

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### KOMPOSITNÍ MOUKY – CHARAKTERISTIKY ŠKROBU A PEČIVA

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Pšeničná mouka světlá jako základní surovina pro výrobu pečiva může být upravena přidávkou netradičních plodin (vytvoří tzv. kompozitní mouky) s cílem získat cereální výrobky srovnatelné kvality s vyšší nutriční hodnotou. V pekařské technologii patří škrob k důležitým složkám pšeničné mouky a jeho chování při zahřívání závisí na mnoho vnějších a vnitřních faktorech. Změny vlastností škrobové suspenze ve třech fermentačních fázích pekařského procesu mají vliv na vlastnosti finálního vý-

robku a uplatňují se také v procesu pečení. Přidavky 10 a 20 % prosa, kukuřice, pohanky, sóji, lupiny, amarantu a quinoi k pšeničné mouce světlé vznikají různé druhy kompozitní mouky s nutričním přínosem pro výrobu netradičních pekařských výrobků.

Amylograf jako uzanční rotační viskozimetr firmy Brabender (ICC 126/1) popisuje změny chování moučné suspenze v rotující nádobě při konstantním zvyšování teploty. Pekařský pokus podle interní metodiky umožňuje připravit pečivo za standardních podmínek a posoudit jeho objektivní (měrný objem, plocha řezu, penetrace) i smyslové charakteristiky (model pro senzoričnou analýzu). Získané amylografické křivky zachycují průběh změny viskozity kompozitní mouky v závislosti na množství a druhu netradiční plodiny. Ve srovnání s pšeničnou moukou světlou byl zjištěn příznivý vliv 10% přídavku sledovaných plodin na vlastnosti finálního výrobku. Vyšší koncentrace prosa, sóji, lupiny, amarantu a quinoi naopak negativně ovlivnila amylografické maximum i senzoričké charakteristiky pečiva.

#### FIRST EXPERIENCE WITH CULTIVATION OF HIMEMATSUTAKE MUSHROOM (*Agaricus brasiliensis*) IN THE CZECH REPUBLIC

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This mushroom was found in Brazil in 60ties last century and later on it became matter in issue of taxonomic studies. Originally the fungus was named *Agaricus blazei* Murill, however, the identification was changed by Wasser et al. (2002) as *A. brasiliensis* Wasser et al. Nevertheless, Kerrigan (2005) insisted on the name *A. subrufescens* Peck. However, the most widely used name now is *Agaricus brasiliensis*.

Glucans isolated from fruit bodies of the mushroom are sources for preparation of different nutraceuticals. The structure of glucans and their significant health effects were published in series of papers (e.g. Mičková and Synytsya et. al. 2006).

Because of the shortage of information dealing with cultivation of this mushroom, we established a series of growing experiments. Based on existing information, that the fungus can be grown on the same compost with the same casing soils that are used for *A. bisporus* cultivation. In the period of spawn running the temperature was kept at 24–26 °C and for fructification support the temperature fluctuation between 22 °C and 25 °C was set at 12 hour intervals; the illumination was set to 50–100 Lux.

To determinate optimal fruit body setting condition and the yield, three variants were carried out. In the first variant colonized casing soil was ruffled, in the second variant the patches of mycelia on casing surface were covered by low layer of casing soil, while control plot was untreated. Date of the first harvest and total yields on different variants were compared. The ruffling showed to have significantly negative effect on the mushroom production.

It was also found out, that *A. brasiliensis* differs from *A. bisporus* in the way of pinning. Whereas in *A. bisporus* visible nodules develops on mycelium and subsequently smooth primordia are formed, on *A. brasiliensis* culture disorganized primordia under the casing surface. The wrinkle-shaped primordia of *A. brasiliensis* are gradually turning to fruit bodies with regular shape and smooth pileus surface.

This work was supported by NAZV Agency (Project QH 82173).

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#### CONTENT OF CARBOHYDRATE COMPOUNDS IN CANNED EDIBLE MUSHROOMS

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The contents of total carbohydrates, total sugars, dietary fibre—including soluble and insoluble fractions, chitin, chitosan and beta-glucanes in the canned pilei of *Agaricus bisporus*, *Pleurotus ostreatus* and *Boletus edulis* were compared. The total carbohydrates constituted 63–72 % of dry matter with the highest contribution of total dietary fibre together with its insoluble fraction and chitin. Except for chitosan content, these values were the highest in the canned *P. ostreatus*.

**THE CONTENT OF SELECTED CARBOHYDRATES IN THE FRESH AND COOKED SEVERAL VARIETIES OF IMMATURE SEEDS FLAGEOLET BEANS TYPE**

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The aim of the work was the evaluation of total sugars, starch and dietary fiber contents in immature flageolet type bean seeds. The beans were harvested when the dry matter was 40%. The seeds were cooked to consumption consistency in water. Fresh bean seeds contained 1.42–1.63 g of total sugars, 21.85–22.39 starch and 12.44–12.49 g fiber. Cooking resulted in a decrease of all the analyzed components by 42–49 %, 11–12 % and 34–37 % respectively.

**THERMAL AND RHEOLOGICAL PROPERTIES OF ACETYLATED DISTARCH ADIPATE PRODUCED FROM CASSAVA STARCH**

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The effect of dual chemical modification on thermal and rheological properties of cassava starch was investigated. The modification decreased phase transition temperatures ( $T_O$ ,  $T_P$ ,  $T_E$ ) and pasting temperature but has no effect on gelatinization enthalpy ( $\Delta H$ ). The obtained starch derivatives were characterized by higher viscosities of pastes after cooling, apparent viscosities during flow and higher values of storage ( $G'$ ) and loss ( $G''$ ) moduli.

**EFFECT OF SUGAR TYPE ON HIGH-METHOXY AND LOW-METHOXY PECTIN GELS**

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The effect of sucrose and fructose on physical properties of model high-methoxy (HM) and low-methoxy (LM) pectin gels (pectin concentration 0.5, 0.4, 0.1 wt.% and 0.8, 0.6, 0.3 wt.% for HM and LM pectin gels, respectively) was studied. The gels were characterised by back extrusion test, low amplitude oscillatory measurements of storage and loss moduli, as well as by colour description. Replacement of sucrose by fructose caused changes in the above characteristics.

**EFFECT OF PECTIN ADDITION ON THERMAL DENATURATION OF WHEY PROTEINS**

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The influence of addition of different types of pectins on thermal denaturation of whey proteins was observed by both dynamic light scattering (DLS) and differential scanning calorimetry (DSC). The addition of high esterified pectin successfully prevent to huge aggregation at denaturation temperatures of pure  $\beta$ -lactoglobulin as well as proteins in rennet whey. The DSC was used for characterization of differences in thermodynamic behavior of whey proteins in presence of structurally different pectins.

**RELATIONSHIP BETWEEN CONTENT OF SOIL POLYSACCHARIDES AND SOME SOIL DIAGNOSTIC PARAMETERS**

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This paper has evaluated the relationship between the soil polysaccharides (PS) content and other parameters commonly used for soil diagnostics (oxidizable carbon ( $C_{ox}$ ), total nitrogen ( $N_t$ ), total sulphur ( $S_t$ ),  $pH_{H_2O}$ , cation

exchange capacity (CEC) and also plant nutrients (K, Ca, Mg).

Tested soils were collected from 30 sites of The Czech Republic (Haplic Luvisol, Eutric Cambisol). Samples were taken from the topsoil (0–30 cm). Sieved air-dried samples were used for analyses.

The strong positive correlation of soil polysaccharide content and oxidizable carbon ( $R_{0.05} = 0.81$ ), total nitrogen ( $R_{0.05} = 0.80$ ) and total sulphur content ( $R_{0.05} = 0.82$ ) was found. According to presented results the soil polysaccharide content can be a suitable parameter for diagnostics of soil environment as well as oxidizable carbon, total nitrogen or sulphur contents. In the contrary, there was no significant correlation between PS and  $pH_{H_2O}$  ( $R_{0.05} = -0.15$ ), CEC ( $R_{0.05} = -0.31$  plant nutrients (Mg:  $R_{0.05} = -0.03$ , Ca:  $R_{0.05} = 0.27$ ), except potassium content (value of this correlation coefficient was statistically significant ( $R_{0.05} = 0.39$ ) but it was very low).

## COMPLEX STARCH TRANSFORMATION IN POTATO AS DETERMINED BY DMA

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Principle of Dynamic Thermo Mechanical Analysis (DMA, DMTA) is based on the specimen loading by definite force (strain, stress) and by the measurement of strain response at stress temperature. These data allow us to create dependencies of elasticity module and loss angle on time, on the force frequency, on the deformation etc.

DMA was applied to potato cortex tissue of 5 cultivars in the temperature range of 30–90 °C and constant air humidity of 90 %. The scan parameters used were: rate of temperature change 1 °C per minute, deformation in bending at frequency of 1 Hz. The obtained scans indicate the peak in both parts (real and imaginary) of modulus of elasticity as the main process of heating at temperatures higher than 70 °C. The peak was observed at temperatures higher than the corresponding peak for extracted potato starch. Characteristic temperatures of the peak were well obtained in replicated experiments whereas the peak characteristic values were very variable.

The specimen was mechanically fixed into two points so that the longitudinal axis is perpendicular to the fixing jaws and free length of the specimen between jaws was 10 mm. The height of the fixed specimen was appr. 3 mm. Gained behaviours are used for the characteristic material properties determination, for material damages, measurement of creep, for crystallization degree or for gel point determination. The peak is identified and discussed with the process of starch complex starch transformation in potato cellular structure (CSTPC) as result of starch gelatinization and induced pasting process. Results of DMA

analysis showed possibility of its usage for gel point observation. For better reproduction of results is necessary to repeat measurements on the same experimental conditions. Next measurements will be based on the smaller temperature step.

The potato tissue expresses similar temperature dependent deformation as the extracted starch. DMA applied to the potato tissue indicates either gelatinization or pasting starch processes similarly as the extracted starch. The starch pasting is the strongest process indicated in a potato cellular structure during its heating.

*This work was supported by the Ministry of Education, Youth and Sports of the Czech Republic (project MSM 6046070905).*

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## FRUCTANS: OCCURANCE, STRUCTURE AND HEALTHY PROPERTIES

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Fructans are fructose-based oligo- and polymers that occur as reserve carbohydrates in about 15 % plant species. The inulin-type fructan consisting of  $\beta(2\rightarrow1)$  linked fructofuranosyl units is found in composites such as chicory and jerusalem artichoke. The levan-type fructan, consisting of  $\beta(2\rightarrow6)$  linked fructofuranosyl units, and the mixed-type fructan, consisting of  $\beta(2\rightarrow1)$  and  $\beta(2\rightarrow6)$  linked fructofuranosyl units with more or less branched structures, is found in monocots such as cereals, *allium* L. species (onion, garlic) or agave. Fructans from different crops are applied in daily diet products as well as raw materials for novel food (organic products) and spirituous beverages.

The reason of the explosion of fructan application in food products is the health promoting effects of fructo-oligo- and polysaccharides for the human body. Fructans are soluble non-digestible carbohydrates promoting formation of microflora population in colon system with healthy bifidogenic effects (prebiotics). Additionally, they interfere with glucidic and lipidic metabolism and the facilitation of mineral absorption. With respect to this back-

ground, products with well-defined technological properties, such as improved solubility or increased thermal stability or better pH-resistance, were developed.

These new materials may be obtained for instance by membrane filtration and/or chromatography which 'cut' sections of interest from native fructan distribution profiles. Another possibility is the application of enzymes to modify inulin and sucrose for production of 'tailored' fructooligosaccharides (FOS).

Utilization of jerusalem artichoke powders and chickory inulin in bakery products and the use of *Agave tequila* Weber var. Azul as feedstock for the Tequila production and basic material for functional food or organic products will be discussed in detail.

### ÚČINEK AMIDOVANÉHO PEKTINU A CHOLESTYRAMINU NA HOMEOSTÁZI CHOLESTEROLU U POTKANŮ

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V pokusech s potkany jsme srovnali amidovaný pektin, cholestyramin, a kombinaci obou sorbentů cholesterolu. Krmivo potkanů obsahovalo 1 % cholesterolu a 5 % palmového tuku. Krmivo pokusných potkanů bylo doplněno o 5 % amidovaného pektinu či 2 % cholestyraminu, dále i o jejich kombinaci. Pektinamid, cholestyramin a jejich kombinace snížily sérový cholesterol z 2,63  $\mu\text{mol ml}^{-1}$  na 1,56, 1,70 a 1,62  $\mu\text{mol ml}^{-1}$ . Obdobně byl snížen obsah cholesterolu v játrech z 4,91  $\text{mg g}^{-1}$  na 2,41, 2,52 a 2,43  $\text{mg g}^{-1}$ . Uvedené koncentrace byly v pokusných skupinách sníženy téměř na úroveň negativní kontroly (bez cholesterolu v krmivu). Pektinamid, cholestyramin a jejich kombinace zvýšily koncentraci neutrálních sterolů v exkrementech z 40,6  $\mu\text{mol g}^{-1}$  na 51,2, 43,5 a 50,9  $\mu\text{mol g}^{-1}$ . Podobně byla zvýšena koncentrace žlučových kyselin z 3,2  $\mu\text{mol g}^{-1}$  na 6,0, 12,0 a 12,4  $\mu\text{mol g}^{-1}$ . Celkové množství sterolů v exkrementech potkanů přijímajících pektinamid, cholestyramin a kombinaci obou sorbentů činilo 57,2, 55,5 a 63,3  $\mu\text{mol g}^{-1}$ . Výsledky lze shrnout do konstatování, že pektinamid v trávicím traktu sorbuje především neutrální steroly (cholesterol, koprostanol) a cholestyramin žlučové kyseliny. U kombinace obou sorbentů bylo celkové množství vyloučených sterolů signifikantně vyšší než v případě samotného pektinamidu nebo cholestyraminu. Potvrdil se tak předpoklad, že účinky látek s různým mechanismem působení mohou být aditivní. Nežádoucí vedlejší účinky cholestyraminu při léčbě hypercholesterolemie jsou známy<sup>1-3</sup>. V našem pokuse měly obě skupiny potkanů přijímajících cholestyramin zvýšenou

hladinu sérových aminotransferas. Sorbenty neutrálních sterolů by možná pomohly terapeutické dávky cholestyraminu snížit.

*Finančně podpořeno projektem MZE 0002701404.*

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### GENETICKY PODMIENENÁ ADHÉZIA ŠKROBU NA BIELKOVINY V ZRNE OZIMNEJ PŠENICE

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Jedným z hlavných ukazovateľov chlebo-pekárskej kvality pšenice je tvrdosť endospermu zrna. Je daná stupňom adhézie škrobových granúl na bielkovinový matrix, ktorá je sprostredkovaná friabilinom<sup>1</sup>. Podstatnú časť tejto bielkoviny tvoria puroindolín a (Pina) a puroindolín b (Pinb), ktoré sú podmienené puroindolínovými gémi, lokalizovanými na krátkom ramene 5D chromozómu<sup>2</sup>. Divý typ pšenice má mäkký endosperm, má dominantné funkčné alely pre oba puroindolínové gény<sup>3</sup> (*Pina-D1a* a *Pinb-D1a*) a nachádza sa v ňom friabilín, lokalizovaný medzi škrobom a bielkovinou. V tvrdej pšenici v dôsledku mutácie puroindolínových génov tento proteín chýba, prípadne je nefunkčný (má zmenenú štruktúru, preto stratil schopnosť väzby medzi bielkovinovou a škrobovou zložkou endospermu).

Vzhľadom nato, že sa u nás zatiaľ neštudovala tvrdosť zrna na molekulárnej úrovni, cieľom práce bolo pomocou vhodných markerov polymerázovej reťazovej reakcie (PCR)<sup>4,5</sup> monitorovať výskyt funkčných aj mutovaných alel puroindolínových génov *Pina* a *Pinb* v 100 registrovaných a 24 historických slovenských odrodách ozimnej pšenice.

V hodnotených odrodách pšenice sme identifikovali 3 kombinácie alel puroindolínových génov: 1) dominantné funkčné alely oboch génov (divý typ s mäkkým endospermom) – *Pina-D1a/Pinb-D1a*, 2) funkčná alela *Pina* génu a nulová alela *Pinb* génu – *Pina-D1a/Pinb-D1b* a 3) nulová alela *Pina* génu a funkčná alela *Pinb* génu – *Pina-D1b/Pinb-D1a*. V žiadnej odrode pšenice sme nepotvrdili prí-

tomnosť nulovej alely oboch puroindolínových génov.

V súčasných slovenských odrodách bol najviac zastúpený (61,0 %) divý typ pšenice s mäkkým endospermom s dominantnými funkčnými alelami oboch puroindolínových génov. Pomerne častý bol však aj výskyt recesívnej nulovej alely *Pinb-D1b*. Táto alela *Pinb-D1b* má bodovú mutáciu<sup>6</sup> v prvej báze tripletu GGC→AGC (zámena aminokyselín glycín→serín) v polohe 46 puroindolínového génu *Pinb*. Jej výskyt bol v súčasných odrodách 38,0 %, v historických dokonca až 91,7 %. Táto nulová alela bola častejšia v odrodách oz. pšenice s dobrou chlebopekárskou kvalitou (Alacris, Alana, Axis, Balada, Blava, Bona Dea, Bruta, Charger, Hana, Ilona, IS Karpatia, Ludwig, Sulamit). Preukázala sa aj v historických odrodách Slovenská 777 (I–V), Stupická Bastard (I–V), Kaštická bezosinatá (I–III), Radošínska Dorada (I–V), Slovenská 200/I, Slovenská B (I–II) a Bučianska červenoklasá (I–II). Nulová alela *Pina-D1b*, ktorá spôsobuje väčšiu tvrdosť endospermu<sup>7</sup> než nulová alela *Pinb-D1b*, sa našla iba v odrode Rheia. Uvedené odrody môžu slúžiť ako donory nulovej alely *Pina* a *Pinb* génov pre molekulárne šľachtenie za účelom zvýšenia tvrdosti zrna ako jedného z ukazovateľov kvality oz. pšenice.

Genotypy s nulovou alelou *Pinb-D1b* mali oproti divému typu *Pinb-D1a* významne ( $P < 0,05$ ) dlhšie zrná a významne ( $P < 0,01$ ) väčší pomer dĺžky zrna k šírke. Okrem toho mali svetlejšie zrna, komponenty farby zrna (RGB) mali významne ( $P < 0,01$ ) vyššie hodnoty. Genotypy s *Pinb-D1a* mali tmavšie zrna, komponenty farby – červená (R) zelená (G) a modrá (B) mali významne ( $P < 0,01$ ) nižšie hodnoty.

*Práca vznikla za podpory Ministerstva pôdohospodárstva SR (projekt 2006 UO27/091 05 01/091 05 11 Biologické faktory podmieňujúce efektívnu a konkurencieschopnú rastlinnú výrobu) a APVV projektu VMSP-P-0047-09.*

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## AGING OF CELLULOSE – A SURVEY OF RECENT KNOWLEDGE

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Terms as recycling, secondary fibres, paper recovery, preservation and conservation of culture heritage on wood and paper basis etc. are connected with aging of ligno-cellulosic materials like paper and other cellulosic products. Especially, the cellulose as skeletal component of natural cell-walls is most important. The aging of paper is evoked by mechanical influence, physical influence (temperature, rel. humidity), chemical and photochemical influence, biochemical influence and also sometimes by radiochemical influence. By aging there are changed hypermolecular properties of paper (hornification), partly reversible process revitalised by beating and chemical composition of lignin and cellulose – fully irreversible deteriorative processes with fatal impact on cellulosic matter. Recently findings based on experimental observations by help of synchrotron X-ray microtomography, thermal techniques, chemi-luminescence and EPR techniques but predominantly UV-VIS spectroscopy of oxidised cellulose solution accompanied with appropriate chemical analysis afforded new information.

A specific role during aging plays the light-sensitivity of lignin causing the low photo-stability and material discolouration. However, due to structures of lignin compounds corresponding to the hindered phenols, lignin can act as effective antioxidants capable to scavenge reactive radical intermediates.

Cellulose aging is evoked by acid and enzymatic hydrolysis, by chemical and photochemical oxidation or by combination of both reactions – oxidative or photo-oxidative hydrolysis. As typical, due to these reactions cellulose and cellulosic materials are getting more fragile and yellow. The detailed knowledge of nitroxide-mediated oxidation of cellulose including its degradation and destruction has helped to better understanding of cellulose material aging because oxides of nitrogen pollute the air. The hypothetical mechanism of degradation and destruction of cellulose aging process during its acid oxidation process under the influence of air pollution is presented. This enables the process of cellulose aging followed by change of its appearance properties, fatal decreasing of fibre mechanical properties and finished by totally decay of cellulosic material to be explained. A key role in the oxidative hydrolysis of cellulose matter plays a transient intermediate PAGA-GA which is responsible for fully

following destruction of oxidized cellulose. Both – the oxidative and photo-oxidative hydrolyse of cellulose – have a destructive character on cellulosic materials accompanied by water elimination. Denaturising of polysaccharide materials is obviously evoked by presence of nitrogen oxides in atmosphere.

*The authors thank the Ministry of Industry and Ministry of Education of Czech Republic for financial support. This research was supported by grants IMPULS FT-TA4/051 and INGO LA 287.*

### PHYSICAL AND MECHANICAL PROPERTIES OF $\beta(1-3)$ , $(1-6)$ -D-GLUCAN FOILS

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$\beta(1-3)$ , $(1-6)$ -D-glucan (hereafter  $\beta$ -glucan), either itself or in combination with other proper substances, can be used in the form of foil as a bio-artificial wound dressing. The main effect of such a skin substitute, in addition to wound protection, is to promote wound healing by stimulating the host to produce various cytokines, whose stimulates the production of components in the basement membrane, preventing dehydration and increasing inflammation, and promotes the formation of granulation tissue. A good bio-artificial dressing, besides its wound-healing qualities, to the same degree necessitates certain physical and mechanical properties, e.g., strength, flexibility, porosity, etc. Thus, for complex understanding of mechanism of physical and mechanical effects is important to know macrostructure of prepared foils and their surface shape.

$\beta$ -Glucan foils were prepared by casting and drying of suspension of  $\beta$ -glucan, isolated from baker's yeast (*Saccharomyces cerevisiae*). Identity, chemical composition and structure of prepared foils from  $\beta$ -glucan were tested by FTIR spectroscopy, elemental analysis and X-ray diffraction. Appearance of foil surface was observed by microscopic methods and strength of foils was examined by tensile tests.

*This work was supported by the by the Czech Science Foundation (project 525/09/1133) and the Ministry of Education, Youth and Sports of the Czech Republic (project MSM 6046137305).*

### MODIFIED CHITOSAN HYDROGEL MEMBRANES FOR TECHNICAL AND PHARMACEUTICAL APPLICATIONS

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Chitosan is a cationic linear polysaccharide usually obtained by alkaline deacetylation of crustacean chitin from crab and shrimp shell wastes. Recently, chitosan and chemically and/or physically modified chitosan attracted interest as membrane materials for different kinds of pharmaceutical and technical applications. Chitosan membranes are modified by different methods, including blending, multilayer casting and crosslinking.

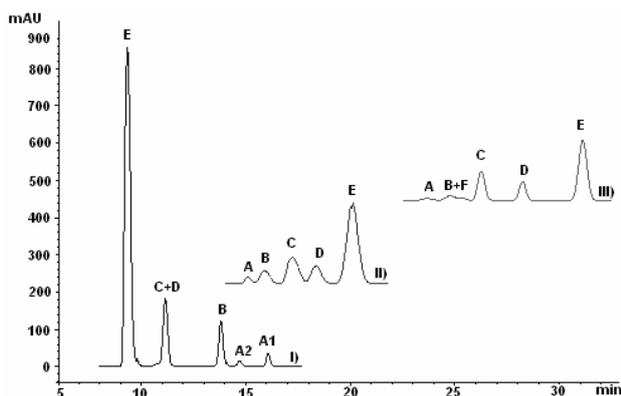
In the present work we have obtained three-component hydrogel membranes by crosslinking of chitosan (Ch) by low-molecular compounds. Glutaraldehyde (GA), sulfuric acid (H<sub>2</sub>SULF) and trisodium citrate (Na<sub>3</sub>CIT) were used as non-ionic and ionic crosslinking agents, respectively. Molecular and supermolecular structure as well as some physicochemical properties of synthesized three-component Ch/GA/SULF and Ch/GA/CIT membranes were studied using FTIR spectroscopy, X-ray diffraction method, SEM/EDX and AFM analysis. The results were compared to those obtained earlier for two-component Ch/GA, Ch/SULF, Ch/CIT ones and for unmodified Ch membrane. The results show that modification of chitosan membrane by adding low molecular crosslinking agents leads to the formation of covalently and ionically crosslinked chitosan membranes. The crosslinking process influences the supermolecular structure of chitosan membrane (its crystallinity) and its properties (swelling behaviour). SEM and AFM images indicate that the effect of modification on chitosan membrane morphology is rather small.

### VYUŽITÍ KAPALINOVÉ CHROMATOGRAFIE PŘI STANOVENÍ OLIGOSACHARIDŮ

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Pro stanovení cukrů se využívá řada technik, jako jsou kapalinová chromatografie s pulsní amperometrickou detekcí, iontově výměnná, kapalinová chromatografie s reverzní fází, ligand výměnná (založená na tvorbě komplexu mezi hydroxylovou skupinou cukru a vícemocného kovového prvku, jako je Pb<sup>2+</sup>), afinitní chromatografie,



Obr. 1. Chromatogramy stejného vzorku pro jednotlivé kolony; I)  $\text{NH}_2$  kolona, II) vápenatá kolona, III) olovnatá kolona; A: galakto-oligosacharidy (1 a 2 různé druhy), B: laktosa, C: glukosa, D: galaktosa, E: fruktosa-vnitřní standard, F: disacharidy

plynová chromatografie a také kapilární elektroforéza<sup>1</sup>. V potravinářství se nejvíce pro stanovení mono- a oligosacharidů využívá kapalinová chromatografie s refraktometrickou detekcí (RI). Používají se různé kolony např. iontově výměnná (vápenatá, olovnatá, ale i vodíková) či se skupinou  $\text{NH}_2$  vázanou na silikagel. Rozdíl mezi použitými kolonami je v pořadí dělení cukrů, citlivosti a také v různých mobilních fázích. Zatímco kolona s aminově vázaným silikagelem špatně dělí monosacharidy glukosu a galaktosu, tak vzniklé oligosacharidy je schopna rozdělit velmi dobře a identifikovat di- a trisacharidy, kdežto na iontově výměnné koloně je odhaleno daleko menší množství oligosacharidů<sup>2</sup>.

V mé práci jsem se zaměřila na stanovení směsi sacharidů vzniklých při transgalaktosylační reakci, jednalo se tedy o následující směs sacharidů: galakto-oligosacharidy, laktosa, glukosa, galaktosa a fruktosa používaná jako vnitřní standard. Tato směs byla analyzována na dvou iontově-výměnných a jedné koloně s navázanou  $\text{NH}_2$  skupinou. První iontově-výměnnou kolonou byla vápenatá, tato kolona výborně dělí monosacharidy a laktosu, nedělí ovšem oligosacharidy. Druhou kolonou byla také iontově-výměnná olovnatá, tato kolona dělí monosacharidy a laktosu, ale již částečně dělí oligosacharidy. Třetí byla kolona s vázanou  $\text{NH}_2$  skupinou, tato kolona dělí oligosacharidy, ale nedělí vznikající monosacharidy. Pro iontově-výměnné kolony byla použita voda jako mobilní fáze a v případě  $\text{NH}_2$  kolony byl mobilní fází acetonitril ve směsi s vodou. Detektor pro všechny tři kolony byl ELS.

Chromatogramy separované směsi sacharidů jsou znázorněny na obr. 1.

Tato práce byla podporována MŠMT, České republiky (Výzkumný záměr 140 MSM 6046137305).

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## FRUCTOOLIGOSACCHARIDES AS TEXTURE IMPROVING AGENT IN MILK DESSERTS

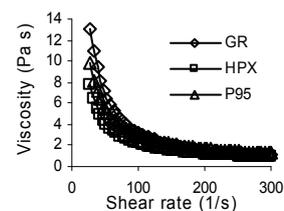
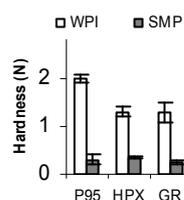
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Rheological properties of milk desserts are mainly affected by the type and amount of gelling agent<sup>1</sup>. Inulin is natural component of several fruits and vegetables and is considered, not as an additive, but as native and safe ingredient<sup>2</sup>. Inulin addition to fat free dairy dessert increased sweetness, thickness and creaminess<sup>3</sup>. No published data exists on influence of inulin on rheological properties of whey protein desserts.

**Materials and methods:** Inulins GR, HPX and oligofructose P95 (Beneo-Orafti, Belgium); WPI, WPC65 and WPC85 (Milei, Germany), SMP (Biomlek Poland), waxy maize starch (National Starch, Germany) and carrageenan (Sigma Aldrich, Poland) were used. Their chemical composition was evaluated using AOAC methods<sup>4</sup>. Desserts were prepared by mixing 4 % protein, inulin 4 or 5 %, starch 3 or 4 % and carrageenan (0.05, 0.1 or 0.2 %). Rheological properties of dairy desserts were analyzed using RS-300 ThermoHaake rheometer. The hardness and adhesiveness were analyzed using TA-XI2i texture analyzer.

**Results and discussion:** Dairy desserts with starch, carrageenan, inulin or oligofructose and skimmed milk powder (SMP) was compared with desserts obtained with whey proteins (WPI or WPC). All obtained dairy desserts showed shear-thinning flow behavior. This type of behavior is accordance with previous observations on dairy desserts obtained with inulin<sup>3</sup>. In comparison to whey proteins desserts, SMP produced desserts with lower apparent viscosity. The addition of inulins or P95 modified rheological properties of dairy desserts. caused decrease of dairy dessert hardness. The highest value of hardness



was observed for dessert obtained with 4% P95 ( about 2N). Dessert obtained with addition of inulin GR and HPX had similar values of hardness. The addition of carrageenan caused significantly increase in hardness and decrease in adhesiveness of dairy desserts. The effect 4% inulin or oligofructose addition on rheological properties of dairy dessert was clearly dependent on starch and carrageenan concentration. Obtained results are of interest in formulation of whey protein desserts particularly in terms of increased nutritional value products.

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#### MOLECULAR DIMENSION AND STRUCTURE OF WATER SOLUBLE POLYSACCHARIDES BY MEANS OF ADEQUATE CHROMATOGRAPHIC TECHNIQUES WITH DIFFERENT DETECTION SYSTEMS

*Invited lecture*

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Due to the fact that oligo- and polysaccharides from natural resources typically are broad distributed heterogeneous mix, preparative and analytical fractionation combined with controlled enzymatic and pure chemical fragmentation need to be applied to achieve information about sugar moieties, linkages types, branching characteristics and molecular dimension.

Additionally polysaccharides are made by nature in a rather complex sequence of synthesis-, transformation-, transportation- and disassembling-processes and prior to analysis pass a number of isolation- and purification- and dissolution-steps. Hence, history of polysaccharide material may become as essential for obtained analytical results as the general polymer-chemical background.

Because of the fact that polysaccharides are broad distributed materials with several superimposed heterogeneities any of these distributions must be considered with

respect to mass fractions profile as well as to molar fractions profile. Mean values on molecular characteristics may provide first order information; however, as even slight variations in any of the distributions may cause significant changes of surface / interface-qualities of polysaccharide materials, state of the art characterization regards actual distribution-data rather than mean values.

A chance to separate polysaccharide fractions due to differences in component mean-dimensions is entropy-controlled size-exclusion chromatography (SEC). Such SEC-elution profiles provide distributions of fractions with similar / identical excluded volumes with the need to consider the actual excluded volume for each of these fractions as a result from basically three groups of contributing influences: molecular dimension (1) scaled by molecule conformation (2) and milieu conditions (3). Interpretation of SEC separated polysaccharide characteristics based on on-line detected elution profiles of mass, scattering and viscosity provides absolute information about dimension and conformation distributions. However, due to the pronounced and permanently active tendency of polysaccharides to form supermolecular structures, such absolute information is rather 'apparently absolute' than 'truly absolute'.

Under this aspect a new approach for particular glucans being independent on supermolecular structures – quantitative labeling of the unique terminal hemiacetal groups on each glucan molecule combined with determination of mass and molar glucan concentrations – was developed and provides information on *de facto* molecular dimensions of individual glucans. In this case SEC-separation with mass detection (refractive index) and molar detection (fluorescence of labeled hemiacetals) is applied.

Furthermore comprehensive analysis of polysaccharides – such as long-chain branched (lcb)-glucans (native amylose), short-chain branched (scb) glucans (amylopectin), fructans and plant gums – will be presented. In this frame determination of molecular dimension (e.g. molar mass), molecular conformation (e.g. branching pattern) and interaction with solvent/environment (e.g. status of dissolution / aggregation) will be shown. Additionally Thin Layer Chromatography (TLC) combined with acidic and enzymatically catalyzed hydrolysis will be demonstrated as a useful tool for analysis of constituting sugar moieties. Information on structural details of identified moieties may be achieved by means of reductive methylation prior to gas chromatography (GC) and flame ionization detection (FID) or mass spectroscopy (MS).

## ROLE OF NON-STARCH COMPONENTS OF THE SURFACE OF WHEAT STARCH GRANULES ON PHYSICO-CHEMICAL PROPERTIES OF ENZYMATIC STARCH HYDROLYSATES

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Apart from starch its granules of different botanical origin contain various amounts of other components such as: lipids, proteins and pentosans. Friabilins (circa 15 kDa) rank among proteins contained in the surface of starch granules<sup>1</sup>. Most important members of this group of proteins are puroindoline A and puroindoline B, which are generally regarded as markers of hardness of cereal endosperm. Owing to the occurrence of tryptophan domain in their polypeptide chains both puroindoline A and B are capable of binding lipids. It gave rise to a hypothesis that lipids participated in binding of puroindolines with the surface of starch granules<sup>1,3,4</sup>.

Objectives of this work were: verification of the hypothesis postulating that puroindolines display various affinities for the surface of starch granules isolated under industrial conditions from starch samples produced from 3 different wheat varieties, and determination of their impact on physicochemical properties of enzymatic starch hydrolysates. Three different starch fractions: A, B and C were used in our experiments. These starch fractions differed in dimensions of starch granules and their chemical composition. Fractions of starch granule associated proteins (SGAPs), which were extracted by using different solvents and extraction conditions (dependent on composition of fractions of surface-bonded lipids), were subjected to qualitative and quantitative analyses and their effect on physicochemical characteristics of hydrolysates of fraction A of starch was determined.

These investigations were carried out by means of differential scanning calorimetry (DSC), X-ray crystallography and polyacrylamide gel electrophoresis under denaturing conditions (SDS-PAGE).

Our experiments revealed that the size of starch granules affected the quantity of substances associated with their surface such as proteins, lipids and pentosans. The greatest amounts of proteins and lipids were adsorbed on the smallest starch granules. We found that lipids interacted with members of puroindoline family of proteins exposed on the surface of starch granules. The presence of surface-bound proteins in wheat starch granules contributed to worse filtration performance and lower degree of saccharification of glucose syrups produced from starch. We found a correlation between the percentage content of puroindolines in total surface proteins and the color of starch hydrolysates.

The percentage content of friabilins (puroindolines) in total surface proteins was the highest for the largest starch granules (fraction A which was subjected to hydrolysis) as compared to the smaller starch granules (fractions B and C). This percentage content of puroindolines depends on the botanical source of starch. DSC analyses revealed different amounts of amylose-lipid complexes (AML) in wheat starch granules, related to their size and the type of solvent used for protein extraction from the surface of these granules. This in turn affected the susceptibility of starch to gelatinization and digestion by  $\alpha$ -amylase. When proteins were extracted with 2% aqueous solution of SDS the content of AML in starch was doubled and the starch was more resistant to hydrolysis catalyzed by  $\alpha$ -amylase although its gelatinization begun and was completed at relatively lower temperatures. When friabilins (puroindolines) were extracted from the surface of starch granules with 0.05N NaCl in 50% isopropanol (1:1) the changes in AML polymorph (from amorphous to crystalline) were observed. However, the total AML content in starch did not change. By contrast, protein extraction with 2% SDS solution resulted in a concomitant increase in AML concentration and its conversion from amorphous form to the crystalline one, which in turn decreased the susceptibility of wheat starch to hydrolysis by  $\alpha$ -amylase.

*This work is financially support by the Ministry of Science and High Education Project No. NN312 314337.*

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### SEED TYPE IDENTIFICATION BY USING IMAGE ANALYSIS – CORRELATION OF NUTRITIVE COMPOUNDS WITH SIZE, SHAPE AND COLOR CHARACTERISTICS

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Image analysis is the method in agriculture/biology suitable to analyse differences among varieties based on evaluation of qualitative and quantitative characteristics of seeds<sup>1</sup>. In the study differences in seed morphology were investigated by digitalized image system software Nis-



Fig. 1. MaxFerret- projection of object at  $\alpha = 0,10,\dots,180$

Elements v.2.3 (Lim, Prague, Czech Republic) based on scanning (size and shape). The color of detected images of seeds were captured by camera DUS-U1 with macrooptik lens Cosmical (color). Mathematical morphological operations extracted parameters such as Area, MaxFerret, Elongation, Circularity etc. (Fig. 1.) with a view on varietal differences in shape, size and color of seeds of model crops - pea (large seedy crop) and flax (small seedy crop) – Fig. 2. The generated data were statistically evaluated (Statsoft. Inc., USA). In addition of the other report<sup>2</sup> results of image analysis (determination of classes of highly contrasting seeds – visible clear differences) were taken in comparison/correlation with agricultural important compounds in seeds utilized in food/feed industry, in pea polysaccharides and in flax fatty acids. The compounds, which did not correspond directly with size and color of seeds, can be helpfull in granding system of seed technology. In pea content of polysaccharides in % of DW for the tested varieties Alan=53.81, Bohatýr=56.16, Herold=56.76, Janus=50.15, Romeo=53.27, Smaragd=51.75, Tyrkys=54.02 a Zekon=50.62 was determined. In flax fatty acids composition suggest about significant varietal differences.

The results of data analysis confirm positive correlation content of fat (%) and colour parameters for flax seeds. If the compounds effected the coloration of seeds (Fig. 3.), then we could detect the flax with low-linoleic (v. Lola 4.1%) and high-linoleic (v. Rina 60.1%) varieties of brown colorated seeds high distinct from yellow varieties (Amon and Jantar). Although the similar situation couldn't be found for pea, the obtained I.A. parameters were used for the identification of pea varieties. The seed characterization and classification method was developed for evaluation of genetic resourses similar to Canadian granding machine vision system for lens<sup>3</sup>.

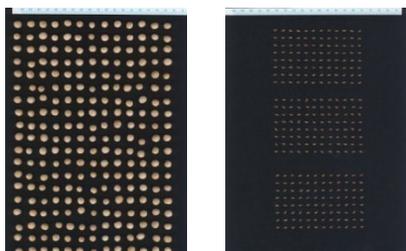


Fig. 2. Pea v. Alan (left) and flax v. Venica (right)

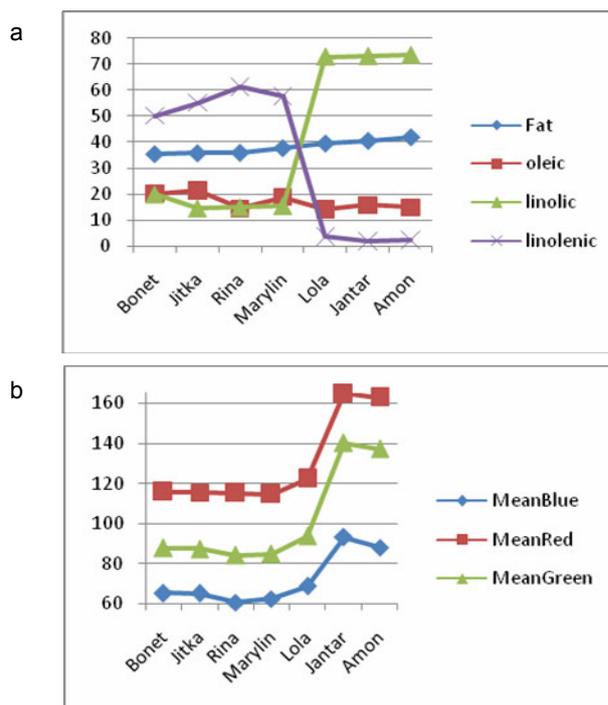


Fig. 3. Flax - fatty acid composition (a) and RGB values (b)

This project was financially supported by the Ministry of Education, Czech Republic (MSM No. 2678424601).

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#### STORAGE STABILITY OF THE QUAIL (*Coturnix coturnix*) EGG PASTA

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The objective of the study was to analyse storage stability of the quail (*Coturnix coturnix*) egg pasta obtained from common wheat flour. Thus, the Accelerated Shelf Life Test (ASLT) was employed with rising temperature and air humidity. Analysis of the sorption iso-

therm as well as microbial and sensory assays revealed that the shelf life of the product strongly depends on air humidity and can be stable for 12 months, when the product is stored at 20 °C under the conditions recommended by Polish Standard.

## BIODEGRADOVATELNÉ PLASTY PŘIPRAVENÉ Z ACETYLOVANÉHO B-ŠKROBU

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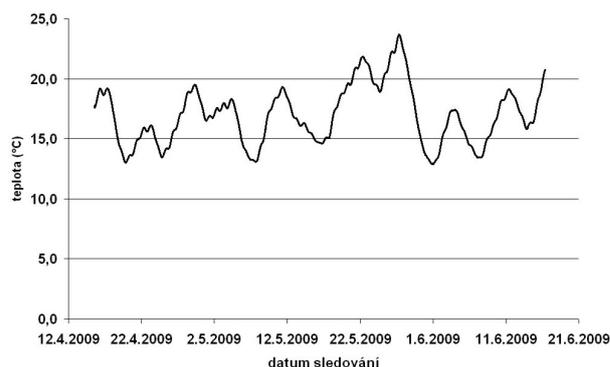
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Při zpracování pšeničné mouky na škrob se během rafinace dvě velikostní skupiny škrobových zrn oddělují, takže výsledným produktem je komerční A-škrob o velikosti zrn 10–40 μm a B-škrob s menšími škrobovými zrny. Chemické složení a struktura zrn B-škrobu ovlivňují jeho funkční a fyzikálně-chemické vlastnosti (měrný povrch, krystalinitu, charakteristiky mazovatění ad.)<sup>1</sup>. Jeho využitelnost je dosud omezená (vyšší energetická náročnost při sušení, nižší kvalita) a hledají se proto další aplikace.

Jednou z možností jeho dalšího použití je do biodegradabilních plastů. Podle Thakore a spol.<sup>2</sup> esterifikace škrobu umožňuje zvýšit termoplastické charakteristiky jako tepelnou odolnost, hydrofóbnost a krystalinitu těchto materiálů. Byla provedena proto nejprve acetylace průmyslového B-škrobu, která byla realizována v laboratorní aparatuře. Vzhledem k tomu, že menší zrna mají nižší reaktivitu s acetanhydridem než velká, bylo nutné syntézu acetylovaných škrobů optimalizovat z hlediska reakční doby, způsobu dávkování a přídavku činidel, které upravovaly charakter vzniklé suspenze. Šlo především o zamezení vzniku pevných agregátů v míchané směsi. K tomuto účelu byly zkoušeny následující látky: síran sodný, silikagel a povrchově aktivní látky. Různě měněné reakční podmínky ovlivňovaly i konečný stupeň acetylace.

Připravený acetát škrobu byl poté násobně promýván, za mokra desintegrován a usušen. Vzniklý materiál byl namlet na šrotovacím mlýnku a použit k přípravě kompozitů, ze kterých byly tvarovány zkušební plastové fólie o tloušťce 0,5 mm.

U zkušebních těles připravených plastů byly pomocí trhacího stroje Instron 5800 vyhodnoceny následující cha-



Obr. 1. Průběh vnitřní teploty kompostéru

rakteristiky: modul pružnosti, mez kluzu, poměrné prodloužení na mezi kluzu, mez pevnosti, poměrné prodloužení na mezi pevnosti a poměrné prodloužení při přetržení. Mechanické vlastnosti byly porovnávány s plastem z čistého PCL a PCL s A-škrobem v acetylované podobě.

Biodegradabilita vyrobených plastů byla testována ve směsném substrátu, vyrobeném a umístěném ve dvou kompostérech AL-KO K390 ve venkovním prostředí při průměrné teplotě  $17,0 \pm 2,4$  °C (viz obr. 1).

Substrát v kompostéru<sup>3</sup> byl připraven ze zeleného komunálního odpadu, bílé vrchovištní rašeliny a jílovité výkopové zeminy. U plastů byly určeny jejich mechanické charakteristiky. Kromě vlastností plastů před a po kompostování byla testována i odolnost plastů vůči vodě.

*Príspevek byl zpracován v rámci řešení grantového projektu GA ČR 525/09/0607 „Biodegradabilní kompozitní materiály na bázi B-škrobu s upotřebením v zemědělství“ a výzkumného záměru MSM 6046070901 „Setrvalé zemědělství, kvalita zemědělské produkce, přírodní a krajinné zdroje“.*

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## CHARAKTERIZACE ACETYLOVANÉHO B-ŠKROBU MĚŘENÍM VELIKOSTI ČÁSTIC POMOCÍ IMAGE ANALYSIS A LASEROVÉ DIFRAKCE A HODNOCENÍM SPEKTR NMR A FT-IR SPEKTROSKOPIE

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Připravený acetylovaný B-škrob byl usušen a mechanicky desintegrován. Následně byla proměřena velikost částic dvěma instrumentálními technikami – analýzou obrazu a metodou laserové difrakce. Stupeň acetylce byl stanoven pomocí <sup>1</sup>H NMR spekter. U jednotlivých vzorků byla proměřena rovněž FT-IR spektra, která byla statisticky vyhodnocena pomocí PCA. Při stupni acetylce DS > 1 byly významně odlišné vzorky A- a B-škrobu a vzorek B15, který obsahoval silikagel.

*Příspěvek byl zpracován v rámci řešení grantového projektu GA ČR 525/09/0607 „Biodegradabilní kompozitní materiály na bázi B-škrobu s upotřebením v zemědělství“.*

### IMAGE ANALYSIS AS A TOOL FOR SUGAR AND STARCH TECHNOLOGY

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The size of particles is a very important parameter for modelling of many engineering processes or designing food machines and devices.

The image analysis system (delivered by LABORATORY IMAGING Co., Prague, Czech Republic), involves a suitable measurement methodology (selection of the optimal magnification level, setting-up lighting, and creating a subroutine including contrast and threshold values).

Our department uses image analysis to measure particle size in these areas of sugar technology: growth of the precipitate in a prelimer<sup>1</sup>, 1<sup>st</sup> and 2<sup>nd</sup> carbonation slurry<sup>2</sup> or sugar slurry for crystallization.

We use this method in starch industry for surface and volume models of wheat, barley and legume seeds, identification of native or modified starches. E.g. a geometric model based on image analysis measurement, consisting of two cone frustums provided the best approximation of

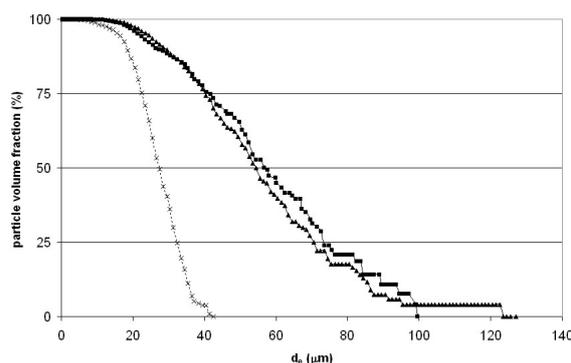


Fig. 1. **Cumulative distribution curves;** - -x- - wheat acetylated distarch adipate (ADA), --■-- potato ADA, --▲-- cationic starch

volume for a barley kernel<sup>3</sup>, and on the other hand geometry of wheat kernels<sup>4</sup> and most of bean varieties allowed to be well modelled as triaxial ellipsoid. Two sphere segments approximation was more suitable in the volume computation of both red and green lentils than oblate sphere approximation. The percentage difference between volumes estimated by the pycnometric method and that of optimized models was lower than 7.3 %. Besides this the method enables to determine specific area of seeds.

Identification of native or modified starch powders or suspensions is based on determined size distribution and comparison with known samples.<sup>5</sup> Iodine inking of starch granules enables identification in mixtures with other materials as well. Often the starch modification doesn't influence starch granule size significantly therefore the sample can be compared with other modified or native starches (see Fig. 1)

Digital image processing approach could potentially be a simple, rapid, and non-invasive alternative to the traditional measurement methods.

*This research was supported by the Research Intention "Theoretical Fundamentals of Food and Biochemical Technologies" of MSMT CR, No. MSM 6046137305.*

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## VARIATION IN THE CONTENT OF DIETARY FIBRE IN BREAD WHEAT VARIETIES

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Common wheat (*Triticum aestivum* L.) is one of the most widely cultivated crops, and thus it presents the main source of nutrients to the majority of the world's population. Numerous studies demonstrated the beneficial effects of fibre consumption in protection against heart disease and cancer, normalization of blood lipids, regulation of glucose absorption and insulin secretion and prevention of constipation and diverticular disease<sup>1,2</sup>. Products with a high content of dietary fibre are considered an essential part of a healthy diet.

In this study, we analyzed a set of 72 wheat cultivars (*Triticum aestivum* L.) kept in the collection of the Genebank Piešťany in order to find the variation in the content of dietary fibre and components thereof (namely  $\beta$ -glucans). Soluble fibre such as (1 $\rightarrow$ 3),(1 $\rightarrow$ 4)- $\beta$ -D-glucan (referred to as  $\beta$ -glucan), plays a role in the prevention and treatment of serious human health conditions, including high serum cholesterol and cardiovascular diseases, obesity and non-insulin-dependent diabetes<sup>3</sup>.  $\beta$ -Glucans were shown to have immunostimulating activity<sup>4</sup>. Wheat is not generally thought of as a  $\beta$ -glucan source; levels are usually less than 1 %, commonly about 0,6 %. However, specific histochemical techniques reveal a distinct localisation in the aleurone and adjacent sub-aleurone region. New friction/abrasion pre-processing techniques for wheat are able to access this region in a more precise fashion than has been achieved with conventional milling. Moreover, the  $\beta$ -glucan content of cereal grains is genotype-dependent and high level of variability was found among other cereal crop species such as oat and barley.

The results showed that the content of total dietary fibre in common wheat varieties varied between 10,3–15,7 %. The  $\beta$ -glucan levels varied from 0,19 to 1,68 %. We can conclude that the differences in composition between wheat varieties were genetically determined. The application of genome mapping allows revealing the associations between the variation in composition and specific genome regions, thus facilitating the development of molecular markers which are used by plant breeders to select for varieties with enhanced health benefits.

*This work was supported by the Slovak Grant Agency for Science VEGA (Grant No. 1/0845/08), AV (Grant No. 4/0013/07) and by the Slovak Research and Development Agency APVV (Grant No. VMSP-P-0022-07).*

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## OBRAZOVÁ ANALÝZA JAKO OBJEKTIVNÍ METODA HODNOCENÍ STŘÍDY PEČIVA

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Analýza obrazu je v současné době v cereálních laboratořích zavedena např. pro porovnání různých druhů a krajových typů pečiva nebo také pro hodnocení změn v receptuře. V této práci byla použita pro hodnocení vlivu ročníku sklizně na vzhled střídy pečiva připraveného ze čtyřiceti vzorků maloobchodních mouk vyrobených ve čtyřech ročnících. Dále byl testován vliv přísady mléčných složek a komerčních pekařských zlepšovadel na vzhled střídy pečiva připraveného z komerční pšeničné mouky. Pekařský pokus s těstem kompletní receptury byl proveden podle interní metodiky VŠCHT Praha. Byl hodnocen tvar a měrný objem pečiva, senzorický profil a penetrace střídy. Následně byla provedena analýza obrazu pomocí programu Lucia G 3.52. Zjištěné rozdíly ve vzhledu pečiva byly statisticky posouzeny korelační a variační analýzou a metodou hlavních komponent.

Výsledky pekařského pokusu a korelační analýzy potvrdily význam měrného objemu pro celkovou jakost a penetrace střídy pro spotřebitelskou kvalitu pečiva. Vzhled střídy pečiva z maloobchodních mouk vyrobených v roce 2003 byl průkazně odlišný v porovnání s ostatními ročníky – byla zjištěna nejmenší hodnota střední plochy póru (průměr souboru 0,84 mm<sup>2</sup>), nejvyšší počet pórů na cm<sup>2</sup> (43) a zároveň nejnižší objemy pečiva (273 ml/100 g). Naproti tomu v ročníku 2005 byla stanovena střední plocha póru největší s 33 póry na cm<sup>2</sup>, proto také průměr měrného objemu pečiva v souboru vzrostl o 25 % (341 ml/100 g). Analýza hlavních komponent prokázala rozdílný vliv mezi skupinami mléčných složek a zlepšujících přípravků. Přídavek mléčných surovin způsobil celkově mírný pokles měrných objemů pečiva a snížení střední plochy póru v průměru o 33 % (1,05 proti 1,51 mm<sup>2</sup>). Pekařské přípravky zvýšily měrný objem pečiva, ale nárůst střední plochy póru byl v průměru skupiny nevýznamný (1,56 vs. 1,51 mm<sup>2</sup>).

## DERIVATIVES OF OXIDIZED CELLULOSE

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The reactivity of Na<sup>+</sup> salt of oxidized cellulose and its oligosaccharides with chitosan will be presented. Hydrolysis of Na<sup>+</sup> salts of oxidized cellulose was carried out in homogenous system by means with microwave (MW) irradiation at constant conditions (100 °C, 950W). The reaction progress was monitored by capillary isotachopheresis and size exclusion chromatography. Reactivity of oxidized cellulose or its hydrolysates with NH<sub>2</sub> groups of chitosan was promoted by MW irradiation. Reaction was monitored by infrared spectroscopy.

This work was supported by the Ministry of Industry and Trade (project 2A-ITP1/041).

## CHARACTERIZATION OF CHITINOUS POLYAMINOGLYCOSIDES

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When degraded, the linear biopolymer chitosan forms polyaminoglycosides (chiPAGes) consisting of GlcNH<sub>2</sub> and GlcNHCOCH<sub>3</sub> units linked with β-glycosidic bonds. ChiPAGes show high biological activity (antimicrobial, anticancerogenic, anti-inflammatory, antidiabetic, and etc.). In this study, chiPAGes prepared by enzymatic, oxidative or microwave degradation were characterized by CP MAS <sup>13</sup>C NMR, MALDI TOF MS, FTIR and GPC.

## INFLUENCE OF DRYING ON RHEOLOGICAL PROPERTIES OF MARSHMALLOWS

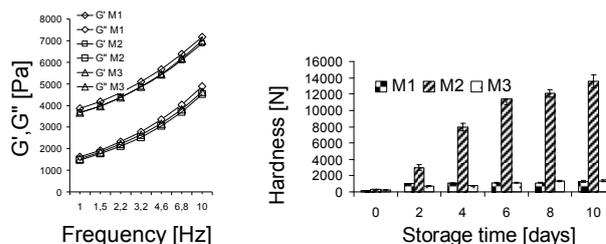
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Marshmallows are foamed polysaccharide confectionery products. They are prepared traditionally from a mixture of gelatin, sugar, and water, but carrageenan, starch, locust bean gum and other polysaccharides are also used. Marshmallows texture can range from very light, moist frappes, to firm, elastic marshmallows, and to dry crisp candies. Researchers have suggested that hardening of stored marshmallows can be caused by loss of moisture which influence their plasticity<sup>2</sup>. No published data exists on influence of storage of marshmallows on their rheological properties.

**Materials and methods:** Three different commercial marshmallows (M1, M2 and M3) were used. Their chemical composition was evaluated using AOAC methods<sup>3</sup>. Viscoelastic properties of marshmallows were analyzed using RS-300 ThermoHaake rheometer. Marshmallows were stored in humidity chamber for 10 days (25 °C, humidity 42 %). Every 2 days texture profile analysis by double compression (TA-XI2i texture analyzer) was performed.

**Results and discussion:** All analyzed marshmallows were elastic materials as storage modulus G' was several times higher than G'' loss modulus. M1 was characterized by the highest values of moduli and this product had the highest sucrose concentration (79.4 %) in comparison to M2 (76.1 %) and M3 (77.5 %). Storage decreased springiness, cohesiveness and resilience and increased hardness and gumminess and chewiness. For M2 much higher values of hardness were measured (chart). This product was characterized by the lowest fat content (0.09 %) in comparison to M1 (0.32 %) and M3 (0.24 %). High correlations were observed between hardness and gumminess, hardness and chewiness and between gumminess and chewiness (R<sup>2</sup> = 0.97–0.99). Tan et al.<sup>2</sup> concluded, that the main mechanism of hardening in marshmallows is because of moisture loss with sucrose crystallization possibly playing a role while for Gelatine B 2.2% formulation, gel networking seemed to be a factor. Our results show, that dif-



ferences in marshmallows fat content are probably responsible for different behavior of this product at the storage. Fat can inhibit water migration from inside of the product. Asama et al.<sup>4</sup> invented fat-and-oil compositions for inhibiting water migration from foods. Edible films could also prevent marshmallows water loss.

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#### PREPARATION OF SORBENTS BASED ON CHITOSAN DERIVATIVES

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Chitosan is a linear polysaccharide (polymer of 1,4 bound 2-amino-2-deoxy- $\beta$ -D-glucopyranose) obtained by *N*-deacetylation of chitin. Chitosan and its derivatives are important in many applications included pharmaceutical and biomedical ones. Some chitosan derivatives are also shown to have a cholesterol lowering effect. Quaternary salt of chitosan (*N*-trimethyl chitosan) and acylated chitosan (palmitoyl chitosan) were prepared and characterized. Quaternization of chitosan is carried out by methyl iodide/potassium carbonate in methanol, acylation was done by the reaction with palmitoyl chloride in DMF. Purity and substitution degree was controlled by FTIR spectroscopy and NMR.

*This work was supported by the Ministry of Education of the Czech Republic (project No. CEZ: MSM6046137305).*

#### VARIABILITY OF NON-STARCH POLYSACCHARIDES IN GRAIN OF VARIOUS BARLEY GENOTYPES

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Mixed linkage (1 $\rightarrow$ 3, 1 $\rightarrow$ 4) beta-glucans and pentosans (mainly arabinoxylans) are the major endosperm cell-

wall polysaccharides and the most important non-starch polysaccharides (NSP) of barley and wheat, respectively. These polysaccharides, although minor components of the whole grain, significantly affect the industrial and feeding utilization of these cereals. Their content varies depending on the genotype, climatic and cropping conditions<sup>1</sup>.

A set of 21 cultivars and 80 new lines of spring barley with hulled and hullless grain and a genetically different amylose/amylopectin ratio (presence of the recessive allele of the gene waxy encoding a decreased proportion of amylose was checked by molecular markers<sup>2</sup>) was used to study the content and variability in NSP and their relation to genotypic differences, *N*-substances content and kernel weight. The content of beta-glucans was determined using an FIA method (flow-injection analysis, according to EBC method 8.13.2), the content of pentosans using the spectrophotometric method (the measurement was made at 510 and 552 nm according to Douglas<sup>3</sup>), and the content of *N*-substances according to Dumas (ICC method No. 167).

The content of beta-glucans in grain ranged from 2.6 % to 10.9 % (KM2619.413.4.03 – a new line with hullless grain and waxy allele), pentosans from 3.68 % to 8.23 % (KM2691.386/5.10.03 – a new line with covered grain), while beta-glucans were higher in the group with hullless and pentosans in materials with covered grain. The significant negative correlation ( $r = -0.45^*$ ) was calculated between the two groups of NSP. Differences in grain hull content and the presence of an allele of the gene waxy affected both the level and direction of the interrelationship between NSP content and other characteristics examined. Whereas there was a significant positive correlation between kernel weight and beta-glucan content ( $r = 0.74^{**}$ ) and, on the contrary, negative correlation to pentosan content ( $r = -0.39^*$ ) in materials with hullless grain and standard starch composition, such trends were weak and insignificant in other sets.

In contrast with results reported by some foreign authors<sup>4</sup>, our findings document that materials with markedly different NSP content suitable for different non-malting use can be selected among hullless barley accessions.

Financial support from the Ministry of Agriculture and Ministry of Education, Youth and Sports, Czech Republic under projects QH91053 and MSM2532885901 is gratefully acknowledged.

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## SEED IDENTIFICATION BY MEANS OF IMAGE ANALYSIS AND LINEAR DISCRIMINANT ANALYSIS: CASE STUDIES

### Invited lecture

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Vision is the fundamental cognitive and exploration method. In research, as well as in industry, many analysis and evaluations are entrusted to vision. Electronics and computer science have created possibilities replacing visual assessment and this has spurred a wealth of research in this area.

Seed identification by specialized technicians is slow and somewhat subjective giving results which may be difficult to quantify both for business and technological implications. Therefore, it is important economically and technically to implement repeatable and quick automated methods to identify and classify seeds. Automatic systems can be based on seed images, from which the characteristics for the classification, such as size, shape, colour and texture, can be obtained quickly.

For many years at the Stazione Sperimentale di Granicoltura per la Sicilia laboratories, we have advantaged of image analysis technology, to develop applications or macros for routine analysis in various seed identification challenges. Some case studies, are here reported and discussed.

Seed colour and size determine the appearance of grain legumes such as lentils (*Lens culinaris Medik.*) for its quality colour grading. Seeds images were captured by a flatbed scanner, to measure seed size, shape and mean colour on individual seeds with a specifically developed tool based on image analysis library KS-400 V 3.0 (Carl Zeiss, Germany). Each seed imaging data were computed with a Linear Discriminant Analysis algorithm (Classifier) to identify five landraces and three varieties of lentil. This LDA algorithm was used also in the other case study to develop classifiers. The performance of the lentil classifier was 99.8 % for the training sets and 97.1 % for the independent test set. In addition to commercial international trade, lentil seed characterisation is very important to identify and catalogue in a biodiversity conservation program<sup>1</sup>.

Statistical classifiers to identify 15 landraces of bean (*Phaseolus vulgaris L.*), one landrace for two cultivation regions and two landraces for different harvest years were obtained. The macro, called Bean.mcr, works quickly and accurately. The performance of the four classifiers was as

follows: the first, for the identification of 15 landraces, 99 % training set and 98.20 % test set, respectively; the second, to identify two harvest years, 99 % and 100 %; the third, to identify three harvest years, 100 % and 98.82 %; the fourth, for the identification of the two different cultivation regions, 94.5 % and 82.40 %. The macro gives, to a certain extent, the possibility of tracing beans yield, in order to get a “market card” for landrace beans<sup>2</sup>.

Cultivar identification of *Vicia sativa L.* (common vetch) is done on distinctive traits relieved at variety registration following official protocols (UPOV). Seeds morpho-colorimetric features of nine cultivars of common vetch (*Vicia sativa L.*) and one of hairy vetch (*Vicia villosa Roth*) were measured on acquired images by flatbed scanner, using a specifically developed macro called Vetch.mcr. The performance of classifier was 99.2 % in the training set and 88.20 % in the test set respectively<sup>3</sup>.

Digital images acquired by a flatbed scanner of ex situ germplasm stored in a Germplasm Bank were used. The analysed accessions refer to 148 taxonomic units belonging to 102 genera and 47 families, typical of the Mediterranean flora. This method allowed carrying out a database for the characterization of autochthonous germplasm in entry to the bank and the realization of statistic classifiers for the discrimination of genera and species. Such classifiers showed a performance included between 74.3 % and 96.4 % (ref.<sup>4</sup>).

The proportion of vitreous kernels in a sample is an internationally recognized specification for determining the value of durum wheat (*Triticum durum Desf.*). Vitreous kernels are mostly related to quality, which affects the pasta performance during cooking. Vitreousness and the amount of shrunken kernels are visually assessed during the grading process.

A machine vision system was developed to determine the percentage of vitreous, starchy, piebald and shrunken kernels in approximately 100 grain samples, using a transilluminated image of one layer of non-singulated kernels (in bulk) acquired by a digital camera. Classification models were developed with stepwise LDA, as well as an online Bayesian classifier integrated with the image analysis system. The overall correct classification in Starchy classifier was high 98.58 % in the Training set, made up of 6679 grains, following the Linear Discriminant Analysis classification, of 30 Italian cultivars harvested in 2005 in three localities. An independent Test set was constituted by samples collected in 30 Sicilian Storage Centres in the 2007 harvest season, the overall classification was 96.03%. For the Shrunken classifier 95.27% of the Training set and 99.58 % of the Test set were correctly classified. The image analysis system was more reliable than the human inspectors who validated the system, both for the same samples measured many times and at different times<sup>5</sup>.

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## GLUCAN – MAGIC BULLET OR BIG CON?

### Invited lecture

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Polysaccharides have a long history as immunomodulators. The first investigations were published almost 60 years ago. When pharmacological actions of glucan are concerned, it all started with zymosan, which is basically a crude version of glucan. In 1956 it has been found that zymosan increased resistance to bacteria, later that it promotes rejection of sarcoma. Subsequent studies have shown that soluble glucans from mushrooms trigger rejection of cancer, in 1983 Japanese approved clinical use of Lentinan and Schizophyllan in patients with gastric carcinoma.

With commercialization of glucan came also a push to sell glucan as a newest magic bullet able to cure just about everything on Earth. How much are these claims accurate?

## EVALUATION OF STARCH CONTENT IN CANE SUGAR

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As a result of the 2006 reform of sugar market regime, Europe moved from the position of a significant exporter of white sugar to the position of the second in the world, after Russia, importer of sugar. The increasing entrance of cane sugar to the European market requires proper reaction of both sugar producers and industrial users of sugar. It is thus quite justified to undertake in Europe analysis of cane sugar concerning its quality as well as functional properties. The quality of cane sugar is strongly differentiated and it depends on the kind of sugar and on the country of its origin. Correct evaluation of the

quality of cane sugar requires proper analytical methods.

One of the criteria specific in the process of evaluation the quality of cane sugar is the content of starch. This polysaccharide is a natural component of sugar cane<sup>1</sup>. It is synthesized in the plant as a result of glucose condensation which takes place at night, that is, in the absence of light<sup>1</sup>. From cane, starch gets into all products of cane processing, including raw as well as refined sugar<sup>2,3</sup>. The presence of starch in raw sugar results in an increase of juice viscosity, which leads to lowering of the effectiveness of juice filtration and to poorer results of the processes of purification and decolorization<sup>4</sup>. Besides, the presence of starch is an obstacle in the process of crystallization<sup>1-3</sup>. We can thus see that the presence of starch finally leads to lower effectiveness of the refinery.

The aim of the present paper was to determine the content of starch in cane sugar of different origins by the ICUMSA method GS1-17. This method measures starch in sugar as a blue starch-iodine complex. The material for the analysis consisted of: raw and refined cane sugar samples and various commercial cane sugars.

The obtained results show that the content of starch in cane sugars was from 30 to about 400 mg kg<sup>-1</sup>, depending on the kind of cane sugar. Thus, the determination of the content of starch may be treated as a one of the indicators differentiating white cane sugar from beet sugar, which contains no starch. The content of starch in refined cane sugar should be an important criterion of the quality of sugar as raw material for various branches of food industry.

*The study was supported by the researcher grant No. NN312 165934 form the Polish Ministry of Science and Higher Education.*

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## SYNTHESIS AND SWELLING BEHAVIOR OF CHITOSAN/POLY(ACRYLIC ACID) HYDROGEL MEMBRANES

### KATARZYNA ZIELIŃSKA\*, ALEXANDER CHOSTENKO, and STANISŁAW TRUSZKOWSKI

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One of the way to partial reduction of water deficit

on light, can be application of additives causing the enlargement of water retention. To help plants and trees grow in extremely dry areas, the hydrogels are applied. They adsorb water and minerals and store it, releasing it back to the plant when needed, e.g. during the dry season. Hydrogels, for example chitosan membranes are three-dimensional networks which swell in water and biological fluids. Chitosan is a high-molecular-weight polysaccharide composed mainly of  $\beta$ -(1,4) linked D-glucosamine and partially of  $\beta$ -(1,4) linked N-acetyl-D-glucosamine. It is generally prepared by the partial deacetylation of chitin – the most abundant natural polymer next to cellulose<sup>1–3</sup>.

In this work, hydrogels based on chitosan membranes grafted acrylic acid were prepared by <sup>60</sup>Co  $\gamma$ -radiation. The aim of this work is to investigate the swelling characteristics of the chitosan/poly(acrylic acid) membranes under various pH condition.

*Scientific work funded by the European Social Fund and the State Budget as part of The Integrated Regional Operational Programme, Measure 2.6 "Regional Innovation Strategies and transfer of knowledge" under a project of the Regional Council of the Kujawsko-Pomorskie Province "Scholarships for PhD Students 2008/2009 – IROP".*

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#### RICE STARCH AS A PORE-FORMING AGENT IN CERAMIC TECHNOLOGY

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During the last decade starch has become one of the favorite pore-forming agents for the preparation of porous ceramics (the starch granules burn out during firing, leaving voids). Rice starch is interesting because it is the smallest commercially available starch type, but in ceramic processing it exhibits characteristic differences (compared to other starch types) in rheology, swelling behavior and the resulting pore space, which are investigated in this study.

*Support within the project „Porous ZrO<sub>2</sub> ceramics – preparation and characterization“ (internal grant VŠCHT) and the frame research program "Preparation and Research of Functional Materials and Material Technologies using Micro- and Nanoscopic Methods", (Grant MSM 6046137302, MŠMT) is gratefully acknowledged.*