

*SECOND INTERNATIONAL CONFERENCE  
DRUGA MEĐUNARODNA KONFERENCIJA*

**SUSTAINABLE POSTHARVEST AND  
FOOD TECHNOLOGIES - INOPTEP  
2011**

**ODRŽIVE POSLEUBIRAJUĆE I  
PREHRAMBENE TEHNOLOGIJE  
INOPTEP 2011**

*Velika Plana, Serbia, April 17<sup>nd</sup> – 22<sup>th</sup>,  
2011*

**BOOK OF ACCEPTED  
ABSTRACTS - PART I  
ZBORNİK PRIHVAĆENIH  
APSTRAKATA – I DEO**

(In alphabetical order - Po abecednom redu)

**Novi Sad, Serbia, Januray 16<sup>th</sup> 2011**

## EFFECT OF BENTOPEL ON QUALITY AND EFFICIENCY OF USAGE OF PELLETED FEED MIXTURES

Milan ADAMOVIĆ\*, Aleksandra BOČAROV-STANČIĆ\*\*, Mihailo RADIVOJEVIĆ\*\*\*

\* Institute for Technology of Nuclear and other Raw Materials, 11000 Beograd, Franše d'  
Eperea 86, Serbia

\*\*“BIO-ECOLOGICAL CENTER“ Ltd, 23000 Zrenjanin, P. Drapšina 15, Serbia

\*\*\*Institute PKB Agroekonomik, 11211 Pad. Skela, Zrenjaninski put bb, Serbia  
e-mail:m.adamovic@itnms.ac.rs

This paper presents the results of Bentopel impact on physical and chemical characteristics, microbiological and mycotoxicological safety of pelleted feed mixtures for laying hens. Furthermore, there is the overview of research results about impact of pelleted feed mixtures with added Bentopel on growth, consumption, use of food and pH in blood serum and rumen of calves. Bentopel (material for pelleting of feed mixtures) is a bentonite based product manufactured in the Institute for Technology of Nuclear and Other Raw Materials in Belgrade (No. 1/41/2010).

Assessment of physical and chemical characteristics, microbiological and mycotoxicological safety of mixture for laying hens was conducted by comparing the experimental (**O**) and control mixtures (**K**). Inclusion of Bentopel in mixture **O** in amount of 2% did not significantly impacted on its chemical composition. The exceptions were the contents of silicium (1.12% : 0.11%) and aluminum (0.210% : 0.025%) which are dominant components of Bentopel (**O** : **K**). Hardness of pellets in the mixture **O** was higher (6 Khal J/kg : 3.7 Khal J/kg), and the obliteration index was lower (10.7% : 14.1%). The total number of bacteria in the mixture **O** was several times lower than in the mixture **K** (5000/g : 39000/g). Pathogenic bacteria were not found in any of the tested mixtures. The total number of yeasts and molds in the mixture **O** was about three times lower (10/g : 30/g). The number of mold species identified was also smaller in mixture **O** (3) than in the mixture **K** (8). In analyzed mixtures for laying hens. mycotoxins were not detected.

Calves fed with mixtures supplemented with Bentopel (1.5%) have achieved a higher average daily growth (1.084 kg : 0.972 kg). Efficiency of the mixture utilization, expressed by consumption per kg gain was better in **O** group of calves (1.74 : 1.86 kg). PH values of the rumen content of calves at the age of 80<sup>th</sup> day were 6.54 and 6.28, while at the age of 120<sup>th</sup> day they were 6.39 and 6.14 respectively. PH values of blood serum at the age of 80<sup>th</sup> day were 7.45 and 7.40, while at the age of 120<sup>th</sup> day they were 7.49 and 7.40 respectively (**O** and **K** group). In group **O** these values were closer to the optimal physiological values.

In determining whether to use Bentopel in the production of pelleted fodder mixtures one should bear in mind the additional positive effects of its use.

**Key words:** bentonite, feed mixtures, pelleting.

## UTICAJ BENTOPEL-A NA KVALITET I EFIKASNOST KORIŠĆENJA PELETIRANIH KRMNIH SMEŠA

Milan ADAMOVIĆ\*, Aleksandra BOČAROV-STANČIĆ\*\*, Mihailo RADIVOJEVIĆ\*\*\*

\*Institut za tehnologiju nuklearnih i drugih mineralnih sirovina, 11000 Beograd, Franše d'  
Eperea 86, Srbija

\*\*Bio-ekološki centar” D.O.O., 23000 Zrenjanin, P. Drapšina 15, Srbija

\*\*\*Institut PKB Agroekonomik, 11211 Pad. Skela, Zrenjaninski put bb, Srbija  
e-mail:m.adamovic@itnms.ac.rs

U radu su prikazani rezultati istraživanja uticaja Bentopel-a na fizičko-hemijske osobine, mikrobiološku i mikotoksikološku ispravnost peletirane krmne smeše za koke nosilje. Dat je i prikaz rezultata istraživanja o uticaju peletirane krmne smeše sa dodatkom Bentopel-a na prirast, konzumiranje, korišćenje hrane i pH u krvnom serumu i buragu teladi. Bentopel (sredstvo za peletiranje krmnih smeša) je preparat na bazi bentonita proizveden u Institutu za tehnologiju nuklearnih i drugih mineralnih sirovina Beograd (br. 1/41/2010).

Ocena fizičko-hemijskih osobina, mikrobiološke i mikotoksikološke ispravnosti smeše za koke nosilje obavljena je poređenjem ogledne-**O** i kontrolne-**K** smeše. Dodatak 2% “Bentopel-a” smeši **O** nije znatnije uticao na njen hemijski sastav. Izuzetak je bio sadržaj silicijuma (1,12 : 0,11) i aluminijuma (0,210 : 0,025) koji su dominantni sastojci Bentopel-a (**O** : **K**). Tvrdoća peleta u smeši **O** bila je veća (6 Khal J/kg : 3,7 Khal J/kg), a indeks otiranja manji (10,7% : 14,1%). Ukupan broj bakterija u smeši **O** je bio višestruko manji nego u smeši **K** i iznosio je 5000/g : 39000/g uzorka. Patogene bakterije nisu utvrđene ni u jednoj od ispitanih smeša. Ukupan broj kvasaca i plesni u smeši **O** bio je tri puta manji (10/g : 30/g). Broj identifikovanih vrsta plesni je takođe bio manji u **O** smeši (3) nego u **K** smeši (8). U ispitivanim smešama za koke nosilje nije utvrđeno prisustvo mikotoksina.

Telad hranjena smešom sa dodatkom Bentopel-a (1,5%) ostvarila su veći prosečan dnevni prirast (1,084 : 0,972 kg). Efikasnost korišćenja smeše, izražena utroškom po kg prirasta, bila je povoljnija u **O** grupi teladi (1,74 : 1,86 kg). Vrednost pH sadržaja buraga teladi iznosila je 80. dana uzrasta 6,54 : 6,28, a 120. dana 6,39 : 6,14. Vrednost pH krvnog seruma 80. dana je iznosila 7,45 : 7,40, odnosno 120. dana 7,49 : 7,40 (**O** : **K**), i u **O** grupi je bila bliža optimalnim fiziološkim vrednostima.

Pri donošenju odluke o korišćenju Bentopel-a u proizvodnji peletiranih krmnih smeša treba imati u vidu i dodatne pozitivne efekte njegovog korišćenja..

**Ključne reči:** bentonit, krmne smeše, peletiranje.

## STUDY OF THE FRESH-CUT LEAVES VEGETABLES' SHELF LIFE

*Eva CSAJBOKNE CSOBOD, Maria GILINGERNE PANKOTAI*  
*Semmelweis University Budapest, Faculty of Health Sciences, Department of Dietetics and*  
*Nutritional Sciences, Hungary*  
*e-mail:gilingerne@se-etk.hu*

In our rushing world the customers increasingly prefer brushed and cut packed vegetables which can be used at home easily.

According to Codex Alimentarius Hungaricus date of packing, producer's or distributor's name and accessibility must be obligatory written onto the fresh packed vegetables. These products haven't got date of keeping quality, so these items can be stored until the shopkeepers or the customers at home judge them acceptable. Contrarily the cut or sliced vegetables, vegetable mixes are determined processed food. Date of keeping quality must be mentioned on the label in the form of date, which can be kept only if the advanced storage temperature is provided. Over this time limit the item mustn't be traded even if the quality is immaculate. The expiration- date doesn't necessary mean the deterioration of the product.

During storage experiments we analyzed several, in trade obtainable packed fresh-cut vegetables and vegetable mixes.

The aim of analysis is to demonstrate the relationship of expiration-date and the date of keeping quality in different storage temperature. In the course of analysis we evaluated the vegetables organoleptic and measured their peroxidase enzyme activity which alludes to respiratory activity.

Analyzed substances: one component fresh-cut vegetables: white cabbage, carrot, iceberg lettuce, rocket salad and cornsalad; vegetable mixes: mix1- white cabbage, red cabbage, carrot; mix2- endive escarole, frisée, red beet; mix3- iceberg lettuce, white cabbage, sweet corn, radicchio.

Storage trial: 6, 12, and 20 °C, 9 days, sampling four times: fresh and every third day

Organoleptic evaluation: observation the change of the habit, smell, taste, consistence.

Laboratory analysis: peroxidase enzyme activity by spectrophotometer.

After 3 day storage the vegetables kept their characteristic features, like fresh smell, colour, good taste, fresh habit. The time and the different temperatures induced different changes among others wizen, decay, and fermentation.

The initial peroxidase enzyme activity was substantially diverse among the examined vegetables. Where this value was low, the time and the temperature didn't induce large changes during the storage (iceberg lettuce, carrot). The high initial POD activity decreased slowly in process of ageing without any decay (endive, rocket salad). Quick growth of the POD activity eventuated when the microbiological deterioration appeared (cabbages).

The different vegetables and mixes behave unlike. The compounds of the mixes affect the storage life. At lower temperature the keeping quality is better, but the attractive appearance doesn't mean definitely edible quality, especially in case of products without expiration date.

**Key words:** expiration-date, storage trial, peroxidase enzyme activity, endive, iceberg lettuce, rocket salad, cabbage.

## FOOD SAFETY FROM THE STANDPOINT OF INTEGRATED PEST MANAGEMENT (IPM)

Suzana DJEDOVIC<sup>1</sup>, Marina VUKŠA<sup>1</sup>, Petar VUKŠA<sup>2</sup>, Bojan STOJNIC<sup>2</sup>, Goran JOKIĆ<sup>1</sup>

<sup>1</sup> Institute of Pesticides and Environmental Protection, Banatska 31b Zemun, Serbia

<sup>2</sup> Faculty of Agriculture, Institute of Phytomedicine, Nemanjina 6 Zemun, Serbia

e-mail: [Suzana.Djedovic@pestring.org.rs](mailto:Suzana.Djedovic@pestring.org.rs)

Integrated pest management (IPM) is an effective and sensitive approach that relies on natural active substances used to manage pests and eventually prevent damages. A thorough knowledge of population biology and ecology of some rodent pests (*Mus musculus* and *Rattus norvegicus*) is of major interest. The aim of our research was to prevent significant damages caused by rodents, reduce the overall threat from pest infestation to both animals and humans with the help of biological control methods and thus contribute to food quality and safety according to HACCP procedures.

The efficacy of the following products: EKOSEL-C granules (0.1% Na selenite); EKOSTOP-D<sub>3</sub> granules (0.075% cholecalciferol) and MAMAK-B (0.005% bromadiolone) against rodents was tested. The formulation of the product was paraffinized block (BB) used in storages and warehouses having a greater percentage of humidity.

Food chain safety depends primarily on the mode of action of active substances. Na selenite is known to influence the replacement of S-H group of functional protein cells with S-S groups causing cell lethality. The cholecalciferol-based product provokes the mobilization of calcium from bones and tissues and calcification in blood vessels and this eventually results in heart failure. Bromadiolone is an anticoagulant known to prevent blood coagulation and provoke blood loss.

Trials were conducted in buildings for cow milking, dairy plants, storage facilities and feed mills of the agricultural combine PIK Zemun, according to OEPP/EPP methods. Baits were laid in boxes for mice (10-30 g) and rats (50-100 g). They were monitored for 10 days and daily records were made of bait intake. These were replenished accordingly. Rodent abundance was estimated based on the highest and the lowest daily bait intake divided by their daily requirements. Their presence was monitored over the next 30 days. Abbott's formula was used to compute the efficacy of the products tested. The following results were obtained:

Product	<i>Mus musculus</i>	<i>Rattus norvegicus</i>
EKOSEL-C	87.5%	88.09%
EKOSTOP-D <sub>3</sub>	85.71%	83.33%
MAMAK-B	75%	86%

The conclusion which tends to emerge is that the efficacy of natural products (EKOSEL-C and EKOSTOP-D<sub>3</sub>) was substantially high and that *Mus musculus* (87.5 and 85.71%) was more susceptible in relation to *Rattus norvegicus* (88.09 and 83.33%). The efficacy of MAMAK-B was lower. This may be attributed to the often uncontrollable application of anticoagulants which provoked the resistance recorded. Thus, it is necessary to minimize the use of chemical preparations and if possible combine chemical preparations and natural products.

**Key words:** natural and chemical products, rodents, efficacy, food safety

## BEZBEDNOST POLJOPRIVREDNIH PROIZVODA KROZ ASPEKTE IZB

Suzana DJEDOVIC<sup>1</sup>, Marina VUKŠA<sup>1</sup>, Petar VUKŠA<sup>2</sup>, Bojan STOJNIC<sup>2</sup>, Goran JOKIĆ<sup>1</sup>

<sup>1</sup> Institut za pesticide i zaštitu životne sredine, Banatska 31b Zemun, Srbija

<sup>2</sup> Poljoprivredni fakultet, Institut za fitomedicinu, Nemanjina 6 Zemun, Srbija

e-mail: [Suzana.Djedovic@pestring.org.rs](mailto:Suzana.Djedovic@pestring.org.rs)

Kada kažemo integralna zaštita bilja, mislimo na sprečavanje nastanka štete preparatima na bazi prirodnih aktivnih materija, kao osnovni činilac zaštite životne sredine. Posebna pažnja posvećena je borbi protiv štetnih glodara kroz dobro poznavanje populacione biologije i ekologije pojedinih vrsta štetočina, kao što je *Mus musculus* i *Rattus norvegicus*. Cilj naših istraživanja je kako sprečiti ogromnu štetu koju čine glodari, a samim tim zarazu životinja i ljudi, kroz mere biološke borbe i očuvanje kvaliteta proizvoda i zdravstvene ispravnosti hrane u skladu HACCP koncepta.

Koristili smo preparate sa prirodnim aktivnim materijama EKOSSEL-C na bazi natrijum selenita (0,1 %), EKOSTOP-D<sub>3</sub> na bazi holekalciferola (0,075%) i MAMAK-B, na bazi hemijske aktivne materije bromadiolona (0,005 %). Formulacija preparata je parafinski blok (BB) i uglavnom se upotrebljava u objektima koji imaju veći procenat vlažnosti.

Bezbednost lanca ishrane u velikoj meri zavisi i od mehanizma delovanja aktivnih materija. Natrijum selenit utiče na zamenu S-H grupa funkcionalnih proteina ćelije S-S vezama i dovodi do smrti ćelija. Holekalciferol dovodi do mobilizacije kalcijuma iz kostiju i drugih tkiva i dovodi do kalcifikacije krvnih sudova srca i na kraju do zastoja rada srca. Bromadiolon je antikoagulant, sprečava koagulaciju krvi i dovodi do iskrvavljenja.

Istraživanja smo izveli u objektima izmuzilišta, mlekare, magacina i mešaona stočne hrane PIK Zemun, prema standardnoj OEPP/EPP0 metodi. Mamci su postavljeni u kutije, od 10-30 g za miševе i 50-100 g za pacove. Tokom deset dana posmatranja, svakodnevno je beležena količina pojedenog mamka i dodavana nova. Brojnost glodara je procenjena na osnovu najveće i najmanje dnevno pojedene količine mamka, podeljene sa njihovim dnevnim potrebama. Prisustvo glodara je praćeno i narednih mesec dana. Efikasnost testiranih preparata izračunata je po Abbott-u.

Dobili smo rezultate za:

Preparat	<i>Mus musculus</i>	<i>Rattus norvegicus</i>
EKOSSEL-C	87.5%	88.09%
EKOSTOP-D <sub>3</sub>	85.71%	83.33%
MAMAK-B	75%	86%

Utvdili smo da je efikasnost prirodnih preparata (EKOSSEL-C i EKOSTOP-D<sub>3</sub>) visoka i da je kućni miš osetljiviji (87,5 i 85,71 %), od pacova (88,09 i 83,33 %). MAMAK-B je pokazao manju efikasnost, mišljenja smo, da je čestom i ne kontrolisanom upotrebom antikoagulanata došlo do pojave određenog stepena rezistentnosti. Iz ovih razloga, moramo biti obazriviji pri upotrebi hemijskih preparata i njihovu upotrebu smanjiti, a tamo gde je neophodno kombinovati sa prirodnim preparatima..

**Ključne reči:** prirodni i hemijski preparati, glodari, efikasnost, bezbednost poljoprivrednih proizvoda.

## FINAL EVALUATION OF THE THEME: POSSIBILITY OF MAINTAINING RAPE SEED QUALITY AFTER PROCESSING

*Karlo ĐILVESI, Daliborka BUTAŠ, Jelena MRDA, Siniša PROLE, Goran JOKIĆ, Velimir  
LONČAREVIĆ*

*Institute of Field and Vegetable Crops, Novi Sad, Maksima Gorkog 30, Serbia*

*e-mail: [karlo.djilvesi@ifvcns.ns.ac.rs](mailto:karlo.djilvesi@ifvcns.ns.ac.rs)*

The basic prerequisite for high yields is a healthy plant that had developed from a healthy seed. Intensive agricultural production requires quality seed, capable of resisting primary infections and pests. Chemical treatment is counted among most effective and economically acceptable methods of seed protection. If treated seed is not sold and used in the year of production, it has to be kept in storage. Prolonged storage causes seed aging and loss of quality.

In this paper, we monitored the reaction to prolonged storage of the two main winter rapeseed cultivars of the Institute of Field and Vegetable Crops, **Banaćanka** and **Slavica**. The stored seed was at various processing stages. Ten-kilogram seed samples were kept in storage with partially controlled conditions in the following stages: untreated finally processed seed, fungicide-treated seed and fungicide- and insecticide-treated seed. In addition to laboratory tests of quality, which provide reliable data on seed aging rate, we also analyzed the loss of applied chemicals from seed surface. The established rates of change in germination energy and germinability were analyzed statistically to determine the effect of storage on seed aging rate. Significant differences in germination energy and germinability were registered between the results obtained in the official and control laboratories. These differences were concluded to arise due to the different methods used to determine the tested parameters. The amounts of dry matter removed from seed surface were expressed in grams and percents. In the case of the untreated control sample, the difference in weight before and after soaking was explained by the presence of dust on seed surface.

- Our results for germination energy and germinability confirmed the previously known facts.
- The tested samples showed that the applied doses of chemicals provided adequate seed protection, regardless of partial losses due to unforeseen factors.
- The obtained results confirmed that the rape seed retains its quality longer than other oilcrops.
- The length of rapeseed quality maintenance depended not only on the stage of seed processing and length of storage, but it was also a varietal characteristic. The cultivar Slavica lost its quality quicker than the cultivar Banaćanka, although the latter cultivar is older than the former.

**Key words:** chemicals for seed protection, seed treatment, storage, primary infection, quality, storage, aging, washing

## ZAVRŠNA OCENA REZULTATA TEME: MOGUĆNOSTI OČUVANJA KVALITETA SEMENA ULJANE REPICE POSLE DORADE

*Karlo ĐILVESI, Daliborka BUTAŠ, Jelena MRĐA, Siniša PROLE, Goran JOKIĆ, Velimir  
LONČAREVIĆ*

*Institut za ratarstvo i povrtarstvo, Novi Sad, Maksima Gorkog 30, Srbija  
e-mail: karlo.djilvesi@ifvcns.ns.ac.rs*

Osnovni preduslov za visoke prinose je zdrava biljka, koja će se razviti iz zdravog semena. Intenzivna poljoprivredna proizvodnja zahteva kvalitetno seme, koje će se moći odupreti primarnim zarazama i štetočinama. Jedan od najefikasnijih i ekonomski najprihvat-

ljivijih načina zaštite semena je hemijskim tretmanom. Ako se tretirano seme ne proda iste godine, čuva se u magacinu a čuvanjem u dužem vremenskom periodu seme stari i gubi u kvalitetu.

U ovom radu, dve osnovne sorte ozime uljane repice novosadskog Instituta za ratarstvo i povrtarstvo, u različitim oblicima stanja doradenosti, pratile su se proteklih godina u toku skladištenja. Određena količina semena (po 10 kg) sorti **Banaćanka** i **Slavica**, čuvali su se u magacinu sa delimično kontrolisanom atmosferom u stanjima: nezaprašeno doradeno finalno, zaprašeno samo fungicidom i zaprašeno fungicidom + insekticidom. Pored laborato-rijskog ispitivanja kvaliteta, na osnovu kojeg se može zaključiti brzina starenja semena, vršilo se ispitivanje analitičkom metodom i gubitak sredstava sa površine semena. U radu prikazani rezultati promene energije i klijavosti tokom perioda ispitivanja obrađeni su statistički da bi se utvrdio uticaj skladištenja na brzinu starenja semena. Iz rezultata se odmah uočava značajna razlika između energije i klijavosti dobijenih u zvaničnoj i dobijenih u međufaznoj laboratoriji.

To se objašnjava različitim metodama koje se koriste za određivanje navedenih parametara.

U daljem tekstu rada prikazani su rezultati oprane suve materije sa površine semena izraženi u gramima i procentima. Kod kontrolnog nezaprašenog uzorka se pojavljuje takođe razlika u masi pre i posle ovlaživanja što se objašnjava prisustvom prašine na ljusci semena.

- Svi dobijeni rezultati energije i klijavosti potvrđuju od ranije poznate činjenice.
- Ispitivani uzorci su pokazali da korišćene doze hemijskih zaštitnih sredstava pružaju zaštitu semenu bez obzira na delimični gubitak usled nepredviđenih uslova.
- Dobijeni rezultati potvrđuju da seme uljane repice zadržava kvalitet duže nego druge uljane kulture.
- Dužina očuvanja kvaliteta semena uljane repice ne zavisi samo od oblika doradenosti i dužine skladištenja već je to delimično i sortna karakteristika te sorta **Slavica** brže gubi kvalitet od sorte **Banaćanka**, bez obzira što je mlađa po vremenu selekcije.

**Gljučne reči:** hemijska zaštitna sredstva, zaprašivanje semena, skladištenje, primarna zaraza, kvalitet, skladištenje, starenje, spiranje



## ALFALFA SEED PROCESSING ON DIFFERENT EQUIPMENT

*Dragoslav ĐOKIĆ\**, *Rade STANISAVLJEVIĆ\**, *Dragan TERZIĆ\**, *Jordan MARKOVIĆ\**,  
*Ratibor ŠTRBANOVIĆ\**, *Zoran MILEUSNIĆ\*\**, *Aleksandra DIMITRIJEVIĆ\*\**

*\*Institut za krmno bilje, 37251 Globoder, Kruševac*

*\*\*Poljoprivredni fakultet 11080 Zemun, Nemanjina 6*

*e-mail: [dragoslav.djokic@ikbks.com](mailto:dragoslav.djokic@ikbks.com)*

For the establishment and exploitation of alfalfa, the seed must be of high purity, germination, and high genetic value. Most of these requirements is realized through processing or removal of foreign matter and seeds of lower quality. Alfalfa seed processing comprises a number of operations from which the most significant are: cleaning, packaging into ambalage, labeling, storage, disinfection and disinsection. In combine harvesting of alfalfa seeds, the obtained material is a mixture of seed of grown plant, seeds of other plants - cultivated and weed, and various impurities of organic and inorganic origin. The task is to remove all foreign matter and various impurities from the natural seed and extract pure grain of primary culture. The importance of processed seed is reflected in the fact that the seed must be prepared for sowing in the most favorable condition, quality and germination.

Losses of alfalfa seed in the processing are directly dependent on the type and quantity of weeds, other impurities, organic and inorganic components present in the natural seed. If the percentage of impurities in their natural seed is larger, the longer the processing is, which increases energy consumption, and therefore the cost of processed seed. It is particularly harmful to a large content of dodder (*Cuscuta* spp.) seeds, which is similar in size to alfalfa and makes cleaning and separation harder. For these reasons, seed processing requires expensive equipment and large consumption of labor for the removal of weed seeds.

In order to perform seed processing more efficiently, a better quality of processed seeds for the shortest possible time must be achieved by an appropriate combination of equipment, and by which the seed quality should correspond to the stipulated standards.

In this study natural alfalfa seed was processed on three different equipment. The aim of this research was to determine relevant parameters of all tested equipment for alfalfa seed processing. Relevant parameters that define the characteristics of equipment for seed processing were: pure seed (%), weed seeds and seeds of other crops (%), inert matter (%), the quantity of processed seed (kg), seed processing time (h), consumption of active energy (kWh) and reactive energy (kVArh), seed losses (%) and output (%).

Testing was conducted at the processing center of the Institute of Forage Crops in Globoder-Kruševac, with three replications. Natural alfalfa seed with purity of 78,0%, with an extremely high content of quarantine dodder weed (*Cuscuta* spp.), was processed. Based on these results it is possible to select an appropriate equipment and optimize and rationalize the alfalfa seed processing.

**Key words:** processing, seed, alfalfa, equipment

## DORADA SEMENA LUCERKE NA RAZLIČITIM SISTEMIMA MAŠINA

*Dragoslav ĐOKIĆ\**, *Rade STANISAVLJEVIĆ\**, *Dragan TERZIĆ\**, *Jordan MARKOVIĆ\**,  
*Ratibor ŠTRBANOVIĆ\**, *Zoran MILEUSNIĆ\*\**, *Aleksandra DIMITRIJEVIĆ\*\**

*\*Institut za krmno bilje, 37251 Globoder, Kruševac, Srbija*

*\*\*Poljoprivredni fakultet 11080 Zemun, Nemanjina 6, Srbija*

*e-mail: [dragoslav.djokic@ikbks.com](mailto:dragoslav.djokic@ikbks.com)*

Za zasnivanje i eksploataciju lucerke, seme mora biti visoke čistoće, klijavosti, kao i visoke genetske vrednosti. Veći deo ovih zahteva se ostvaruje kroz doradu, odnosno odstranjivanjem nečistoća i semena lošijeg kvaliteta. Dorada semena lucerke obuhvata veći broj operacija od kojih su najznačajnije: prečišćavanje, pakovanje u ambalažu, deklarisanje, skladištenje, dezinfekcija i dezinsekcija. Pri kombajniranju semenske lucerke materijal koji se dobija predstavlja mešavinu semena gajene biljke, semena drugih biljaka - kulturnih i korovskih, kao i razne nečistoće organskog i neorganskog porekla. Zadatak čišćenja je da se iz ovako dobijenog naturalnog semena sa primesama uklone sva zrna stranih primesa i razne nečistoće i izdvoji čisto zrno osnovne kulture. Značaj doradenog semena se ogleda u tome da se seme blagovremeno pripremi u što povoljnije stanje za sejalicu i kvalitetnu setvu, klijanje i nicanje.

Gubici semena lucerke pri doradi su u direktnoj zavisnosti od vrste i količine korova i ostalih nečistoća, organskog i neorganskog porekla prisutnih u naturalnom semenu. Ukoliko je procenat nečistoća u naturalnom semenu veći, utoliko je i sam tehnološki proces dorade duži, što povećava utrošak energije, a samim tim i cenu koštanja doradenog semena. Naročito je štetan veliki sadržaj semena viline kosice (*Cuscuta* spp.) koja je po veličini slična lucerki i otežava čišćenje i odvajanje kada se izmeša sa semenom lucerke. Iz tih razloga dorada semena zahteva skupu opremu i veliki utrošak rada za odstranjivanje semena korova.

Da bi se što efikasnije izvršila dorada semena potrebno je odgovarajućom kombinacijom mašina za doradu postići što bolji kvalitet doradenog semena za što kraće vreme, pri čemu kvalitet semena odgovara zakonski propisanim normama za semenski materijal.

U radu su prikazani rezultati ispitivanja naturalnog semena lucerke pri doradi na tri različita sistema mašina. Cilj ispitivanja bio je da se pri doradi semena lucerke odrede relevantni parametri za svaki sistem mašina. Relevantni parametri koji definišu karakteristike svakog sistema mašina za doradu semena bili su: čisto seme (%), seme korova i seme drugih kultura (%), inertne materije (%), količina doradenog semena (kg), vreme dorade semena (h), utrošak aktivne električne energije (kWh) i reaktivne električne energije (kVArh), gubici semena (%) i randman dorade (%).

Ispitivanje je obavljeno u doradnom centru Instituta za krmno bilje u Globoderu-Kruševcu, pri čemu je u tri ponavljanja doradivano naturalno seme obične lucerke čistoće 78,0% sa ekstremno visokim sadržajem karantinskog korova viline kosice (*Cuscuta* spp.). Na osnovu dobijenih rezultata moguće je izvršiti izbor odgovarajućeg sistema mašina za doradu semena lucerke, odnosno optimizaciju i racionalizaciju u procesu njene dorade.

**Ključne reči:** dorada, seme, lucerka, sistem mašina

## STATUS, DEVELOPMENT AND PROSPECTS OF USING BIOENERGY CROPS IN THE WORLD AND IN SERBIA

Željko DŽELETOVIĆ, Nevena MIHAILOVIĆ

INEP – Institute for the Application of Nuclear Energy, Banatska 31-b, Zemun, Serbia

e-mail: [zdzeletovic@inep.co.rs](mailto:zdzeletovic@inep.co.rs)

Bio-energy crops are grown with the specific purpose of utilizing their parts or the whole plant mass for the production of liquid or solid fuels, as an alternative to fossil fuels. Both developed and developing countries encourage utilization of the existing traditional or local bio-energy crops, as well as the investigation and development of new technologies and procedures of their utilization. Of the traditional bio-energy crops, crop straw and wood mass have a wide application. Utilization of agriculture crops for the production of bio-diesel and bio-ethanol is continually growing with the rate of 20-30% at the annual level, regardless of the global economic crisis. Also, utilization of various annual and perennial grasses is widely promoted. Among these, miscanthus (*Miscanthus x giganteus* Greef et Deu) is characterized with the biomass of exceptional quality. In the last few years, an intensive investigation is in progress of pyrolytic fluids obtained from various plant species and of their refinement, which should provide a significantly more efficient substitution of mineral fuels in small to large scale power generation systems.

By intensive utilization of the existing and new bio-energy crops, multi-functionality of agriculture is achieved and rural development is promoted. However, the plots under bio-energy crops are continually increasing and from marginal and infertile soils these crops are increasingly transferred to highly productive soils, primarily for the purpose of obtaining higher profit. Because of that, critics are pointing to potential social problems, ecologic consequences and increased food prices.

Utilization of bio-energy crops is connected with a number of limitations, the most important of which are: production costs, potential environmental impact and the efficiency of the conversion of the produced biomass into thermal energy. In EU countries, due to the linking to primary energy costs, an increase of profit from agriculture is expected, because energy cost increase will also increase the prices of agricultural products. At that, the food production will not be decreased significantly, and the energy production that will replace the primary agricultural production will not open new jobs.

Utilization of bio-energy crops in Serbia was initially promoted by the investigations supported by the Ministry of Science and Technological Development. The interest is evoked for the utilization of these crops in certain agricultural economies and individual households in rural regions. It is expected that the government, similarly to those in EU members, promote bio-energy crop cultivation in Serbia through certain subventions. Together with the profit, we estimate that the possibility of the realization of a high level energy independence of agricultural economies will be one of the main motives for the future utilization of these crops in Serbia.

**Key words:** straw of cereals, wood mass, bioethanol, biodiesel, miscanthus

## STATUS, RAZVOJ I PERSPEKTIVE KORIŠĆENJA BIOENERGETSKIH USEVA U SVETU I U SRBIJI

Željko DŽELETOVIĆ, Nevena MIHAILOVIĆ

INEP – Institut za primenu nuklearne energije, Banatska 31-b, Zemun, Srbija

e-mail: [zdzeletovic@inep.co.rs](mailto:zdzeletovic@inep.co.rs)

Bioenergetski usevi se specifično uzgajaju da bi se njihov deo ili celokupna biljna masa iskoristili za proizvodnju tečnih ili čvrstih energenata, kao alternativa fosilnim gorivima. I u razvijenim i u zemljama u razvoju se podstiče korišćenje postojećih tradicionalnih ili lokalnih bioenergetskih useva, kao i istraživanja i razvoj novih tehnologija i postupaka njihovog korišćenja. Od tradicionalnih bioenergetskih useva, široku primenu ima korišćenje slame žitarica i drvene mase. Upotreba ratarskih useva za proizvodnju biodizela i bioetanolu beleži neprekidni rast po stopi od 20-30% na godišnjem nivou, bez obzira na ekonomsku krizu u Svetu. Takođe, široko se promovise i korišćenje različitih vrsta jednogodišnjih i višegodišnjih trava, od kojih se, po kvalitetu biomase, posebno izdvaja miskantus (*Miscanthus × giganteus* Greef et Deu.). Poslednjih godina intenzivno se istražuju pirolizne tečnosti dobijene od različitih biljnih vrsta i njihova rafinacija, kojim bi trebalo da se obezbedi znatno efikasnija supstitucija mineralnih goriva u energetske sistemima male do velike snage.

Intenzivnim korišćenjem postojećih i novih bioenergetskih useva ostvaruje se multifunkcionalnost poljoprivrede, kao i relativna cenovna stabilnost poljoprivrede i može se podstaći ruralni razvoj. Međutim, površine pod bioenergetskim usevima su u neprekidnom porastu i sa marginalnih i zemljišta niske plodnosti sve češće se prelazi na njihovo gajenje na visoko-produktivnim zemljištima, pre svega zbog ostvarivanja većeg profita. Kritičari, zbog toga, ukazuju na potencijalne socijalne probleme, ekološke posledice i na povećanje cena hrane.

Korišćenje bioenergetskih useva je skopčano i sa nizom ograničenja, od kojih su najznačajnija: ekonomičnost proizvodnje, potencijalni uticaj na životnu sredinu i efikasnost konverzije proizvedene biomase u toplotnu energiju. U zemljama EU, zbog povezivanja sa cenama primarne energije, očekuje se povećanje prihoda od poljoprivrede u budućnosti, jer će povećanje cena energije povećati i cene poljoprivrednih proizvoda. Pri tom, neće se bitno smanjiti proizvodnja biljaka za hranu, a proizvodnja energije, kojom se zamenjuje primarna poljoprivredna proizvodnja, neće ostvariti nova radna mesta.

Korišćenje bioenergetskih useva u Srbiji inicijalno je podstaknuto istraživanjima finansiranim od strane Ministarstva za nauku i tehnološki razvoj. Prisutan je interes za korišćenje ovih useva za pojedina poljoprivredna gazdinstva i individualna domaćinstva u ruralnom području. Očekuje se da država, poput zemalja članica EU, kroz određene subvencije podstakne gajenje bioenergetskih useva u Srbiji. Pored ekonomske koristi, procenjujemo da će mogućnost ostvarivanja visokog nivoa energetske autonomije poljoprivrednih gazdinstava biti jedan od glavnih motiva za buduće korišćenje ovih useva u Srbiji.

**Ključne reči:** slama žitarica, drvena masa, bioetanol, biodizel, miskantus

## JERUSALEM ARTICHOKE (*HELIANTHUS TUBEROSUS* L.) AS A POSSIBLE SUPPLEMENT AND FODDER IN DOMESTIC ANIMALS FEEDING

Vladimir FILIPOVIĆ<sup>1</sup>, Stevan RADIVOJEVIĆ<sup>2</sup>, Goran JAĆIMOVIĆ<sup>3</sup>, Jonel SUBIĆ<sup>4</sup>

<sup>1</sup> Institute "Tamiš", Novoseljanski put 33, 26000 Pančevo, Serbia

<sup>2</sup> Institute for Food Technology Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia

<sup>3</sup> Faculty of Agriculture Dositeja Obradovića square 8 21000 Novi Sad, Serbia

<sup>4</sup> Institute of Agricultural Economics, Volgina 15, 11000 Belgrade, Serbia

e-mail: [vladf74@yahoo.com](mailto:vladf74@yahoo.com)

In winter period, when almost no fresh forage, in addition to concentrate nutrients is necessary to provide an additional source of fodder. As the arable land decreasing, it is necessary to introduce new plant species that are not particularly demanding to the soils which can not grow most of field, vegetable and forage crops. One of these plant species is a jerusalem artichoke (*Helianthus tuberosus* L.), representative of the *Asteraceae* family.

Use of jerusalem artichoke can be in the form of tubers or green mass, or both aspects simultaneously. Tubers are removed from the end of September to March, when the bitter taste disappears and turns into a sweet. Tuber yield, depending on growing conditions can be 10 to 30 t / ha. They contain 20 to 30% dry matter, where about 80% of carbohydrates in the form of inulin (*Chekroun et al.*, 1996), proteins from 1.5 to 5.0%, 0.2% oil and mineral material 1.1 to 1.4%. There is an adequate concentration of macro and micro nutrients for quality livestock nutrition. Macroelements Ca, Mg, P and K are present in appropriate quantities, and has more sodium than other plants with tubers (*Seiler*, 1990).

Overground part of the jerusalem artichoke harvests twice a year, during the opening of the first blossom. The average yield of overground mass can be 30 to 70 t / ha. Content of total sugar in dry matter is about 6.0%, total protein content from 6.0 to 10.0% and mineral nutrition content is similar to those from tubers. In addition to grazing, overground parts can be used as hay. Overground mass and tubers (fresh and cooked) can preserve by silage, which with the addition of preservatives significantly satisfy needs of ruminants (*Mihailovic et al.*, 2004).

**Key words:** Jerusalem artichoke, *Helianthus tuberosus* L., fodder, tuber, overground mass, silage

## ČIČOKA (HELIANTHUS TUBEROSUS L.) KAO MOGUĆI SUPLEMENT I STOČNA HRANA U ISHRANI DOMAĆIH ŽIVOTINJA

Vladimir FILIPOVIĆ<sup>1</sup>, Stevan RADIVOJEVIĆ<sup>2</sup>, Goran JACIMOVIĆ<sup>3</sup>, Jonel SUBIĆ<sup>4</sup>

<sup>1</sup>PDS Institut "Tamiš", Novoseljski put 33, 26000 Pančev, Srbija

<sup>2</sup>Institut za prehrambene tehnologije, Bulevar cara Lazara 1, 21000 Novi Sad, Srbija

<sup>3</sup>Poljoprivredni fakultet, Trg Dositeja Obradovića 8, 21000 Novi Sad, Srbija

<sup>4</sup>Institut za ekonomiku poljoprivrede, Volgina 15, 11000 Beograd, Srbija

e-mail: [vladf74@yahoo.com](mailto:vladf74@yahoo.com)

U zimskom periodu kada svežih hraniva gotovo i da nema, pored koncentrovanih hraniva, nužno je obezbediti dodatni izvor stočne hrane. Kako se oranične površine iz godine u godinu smanjuju, potrebno je uvoditi biljne vrste koje nisu naročito zahtevne prema zemljištima na kojima se ne može gajiti većina ratarskih, povrtarskih i krmnih biljnih vrsta. Jednu od takvih biljnih vrsta predstavlja čičoka (*Helianthus tuberosus* L.) predstavnica familije Asteraceae.

Iskorišćenje čičoke može biti preko krtola ili zelene mase, kao i oba vida istovremeno. Krtole se vade od kraja septembra do marta, kada gorak ukus nestaje i prelazi u sladak. Prinosi krtola u zavisnosti od uslova gajenja mogu biti od 10 do 30 t/ha. Krtole čičoke sadrže od 20 do 30% suve materije, gde je oko 80% ugljenih hidrata u vidu inulina (Chekroun et al., 1996), proteina 1,5 – 5,0%, ulja 0,2% i mineralnih materija 1,1 – 1,4%. Postoji adekvatna koncentracija makro i mikro elemenata za kvalitetnu ishranu stoke. Makroelementi Ca, Mg, P i K su prisutni u odgovarajućoj količini, dok natrijuma ima više nego kod drugih gajenih biljaka sa krtolama (Seiler, 1990).

Nadzemni deo čičoke se kosi dva puta godišnje i to u vreme otvaranja prvih cvasti. Prosečan prinos nadzemne mase može biti od 30 do 70 t/ha. U suvoj materiji sadržaj ukupnih šećera je oko 6,0%, ukupan sadržaj proteina od 6,0 do 10,0% i mineralne materije po sastavu slične onim iz krtola. Pored ispaše tj. neposredne ishrane nadzemni delovi se koriste i kao seno. Nadzemna masa i krtole (sveže i kuvane) se mogu konzervirati siliranjem, što uz dodatak konzervansa u značajnoj meri, zadovoljava potrebe ishrane preživara (Mihailović i sar., 2004).

**Ključne reči:** čičoka, *Helianthus tuberosus* L., stočna hrana, krtola, nadzemna masa, silaža.

## DESIGN AND CONSTRUCTION OF A MOBILE SOLAR DRYER

*Tale GERAMITCIOSKI, Vangelce MITREVSKI, Ilios VILOS*  
*University St.Kliment Ohridski, Technical Faculty Bitola, Macedonia*  
*e-mail: [tale.geramicioski@uklo.edu.mk](mailto:tale.geramicioski@uklo.edu.mk)*

Technical solutions to dry chambers for drying food products that use solar energy are quite diverse.

They can be purely solar, solar radiation, and combined with solar energy in addition, further use other energy source. In the nearby surroundings NTIM Belgrade Company Ltd. Has developed a mobile combined electrical and solar-type dryer Solaris 1, which is used for drying herbs, spices, fruits, vegetables and mushrooms. The concept of this dryer is developed in such a way to use the energy of the first sun to achieve optimum conditions of drying and when solar energy is used not enough another energy sources. The development of dryer on the Agricultural Faculty in Belgrade experimented with additional sources of energy in order to reduce energy requirements and increasing product quality. In this constructive version is used electricity selected as an additional source.

This paper will present the construction of mobile solar dryer that is used in more difficult access mountain areas in the Republic of Macedonia where the most common herbs and mushrooms, so you need to make a series of modifications to the design and selection of another source of extra energy.

The new constructive solution of a mobile solar dryer should meet the following conditions:

- smaller overall dimensions,
- lower weight of the empty dryer (existing structure with a weight of 960 kg, which is hampered her mobility)
- greater volume of the chamber,
- tried using butane gas instead of electricity as an extra source
- accessibility to difficult hilly and mountainous terrain access.

Expected results of a new constructive solution are:

- high degree of mobility and access to difficult mountainous terrain, through the combined use of renewable and additional source of energy management and automation of the process, reducing production costs, labor and transportation,
  - high quality drying material with retention of the natural color, taste and smell the product,
  - provided control and regulation of the process of drying,
  - possibility of setting up the moisture in the dried material according to market demands
- saves energy with minimal use of supplementary energy source,
- high degree of utilization of energy lodged - by 80%,
  - minimal maintenance costs,
  - fast and efficient service and removal of deficiencies,
  - high environmental protection of the environment

**Key words:** mobile solar dryer, design, construction

## DIZAJN I KONSTRUKCIJA MOBILNE SOLARNE SUSARE

*Tale GERAMITCIOSKI, Vangelce MITREVSKI, Ilios VILOS*  
*Univerzitet Sveti Kliment Ohridski, Tehnički fakultet, Bitola, Makedonija*  
*e-mail: [tale.geramitcioski@uklo.edu.mk](mailto:tale.geramitcioski@uklo.edu.mk)*

Tehnicka resenja susara za susenje prehrambenih produkata i koje koriste suncevu energiju su dosta raznovrsne. One mogu da budu cisto solarne, solarno radijacione i kombinovane gde se pored sunceve energije dopunski koristi I drugi energans.

U blizem okruzenju kompanija DOO NTIM Beograd ima razvijenu konstrukciju mobilne solarno-elektricne susare tip SOLARIS 1 koja se koristi za susebje ljekovitih biljka, zacina, voca, povrca i pecurke. Koncept ovog tipa susare je razvijen na nacin da najpre koristi energiju sunca za postiznanju optimalnih uslova susenja, a kada sunceva energija je nedovoljna za završavanje procesa, upotrebljava se drugi izvor energije. U razvijanju konstrukcijskog resenja susare na Poljoprivrednom fakultetu u Beogradu, eksperimentisalo se sa dopunskim izvorima energije u funkciji smanjivanja potrebnog intenziteta energije, a povećavanja kvaliteta produkata. U konstrukciji koja je izabrana, kao dopunski izvor se koristi elektricna energija.

U ovom radu je data konstrukcija mobilne susare koja bi se koristila u teze pristapnim planinskim predelima u republiku Makedoniju gde su najzastupljeni ljekovite biljke i pecurke, pa je potrebno da se izvedu niza modifikacije na konstrukciju i izbora drugog izvora dopunske energije.

Novo konstruktivno resenje mobilne susare treba da ispuni sledece uslove:

- Manje gabaritne dimenzije
- Manje tezine prazne susare (postojna konstrukcija je sa tezinom od 960kg sto otezava njenu mobilnost)
- Veci volumen komore za susenje
- Koriscenje propan-butan gasa namesto elektricnu energiju kao dopunski energans
- Pristupnost do tesko pristupnih regiona u planinama Makedonije

Ocekivani rezultati od novog konstruktivnog resenja su:

Visoki nivo mobilnosti i do tesko pristupnih ridsko-planinskih predela

- Preko kombinovanog koriscenja obnovljivog suncevog izvora energije i dopunskog gasnog izvora energije, automatizacije upravljanja procesa, smanjivanja troskova proizvodnje, radne sile i transporta
- Visoki kvalitet osusenih materijala sa zadržavanjem prirodnih boja, ukusa i mirisa osusenog produkta
- Obezbedjena kontrola i regulacija procesa susenja
- Proces susenja bice završen na zadatu krajnu vlagu bez razlike od vremena susenja i ulaznih parametra
- Mogucnost podessavanja vlage u osusenom materijalu u zavisnosti od pazarnih uslova
- Stedi energiju sa minimalnim koriscenjem dopunskog izvora energije
- Visok stupanj iskoristivosti u odnosu na ulozenu energiju (preko 80%)
- Minimalni troskovi održavanja susare
- Brzo i efikasno servisiranje i uklanjanje nedostataka, visoka ekoloska zastita zivotne sredine.

**Ključne reci:** mobilne solarne susare, dizajn, konstrukcija



## CHANGES IN QUALITY OF SWEET PEPPER TYPES DURING THE AFTER HARVEST RIPENING

*Maria GILINGERNE PANKOTAI<sup>1</sup>, Csaba ORBAN<sup>1</sup>, Zsuzsanna FUSTOS<sup>2</sup>*

*<sup>1</sup>Semmelweis University Budapest, Faculty of Health Sciences, Department of Dietetics and  
Nutritional Sciences, Hungary*

*<sup>2</sup>Central Agricultural Office, Budapest, Hungary*

*e-mail: [gilingerne@se-etk.hu](mailto:gilingerne@se-etk.hu)*

The pepper as climacteric fruit after harvest in the optimal condition continues the ripening. During ripening after harvest the fruit color changes, the quantity of orange and red carotinoides increases, and the ratio of red colored ingredients changes. The vitamin C content also increases in during the process of ripening, this process needs the intensive respiration. The ripening is more intensive in high and less in low temperature. Freshly harvested pepper must be stored between 7 to 10 °C and 95% relative humidity. In this condition the pepper can keep the optimal tone of fruit color and nutritive value for consumption. The shelf life of the pepper varieties means the keepability of quality of crops without cooling, on temperature 16-20 °C.

We studied the physiological process of the ripening after harvest in different experiments. In the presented experiments we evaluated the effect of storage for after harvest ripening of the pepper types: Cecei type, Kapia type, blocky type, long green type, apple shape, tomato shape) The origins of the pepper samples were greenhouses of CAO. We tested varieties of most important types marketed in Europe. The most favourable paprika type is “Cecei” in Hungary, as a light yellow, cone-shaped, thin-flesh, intensively tasty one, a real *Hungaricum*. Some well known foreign pepper types like Californian, blocky, Lamuyo are presented at Hungarian market. Moreover some conventional Hungarian types awaken in new varieties such as Pritamin (tomato shape) and Kapia.

We started the storage trial with samples on different ripening stages. The main question was how keep the different pepper types their vitamin C content and fresh-like during short time storage. We observed the following data: weight loss, the color of surface, vitamin C content and peroxidase enzyme activity. The storage trials and analyses in laboratory have managed by Semmelweis University, Department of Dietetics and Nutritional Sciences.

In the pepper fruits picked in half-matured level the vitamin C content have increased during the first period of storage. After that the processes of dissimilation and ageing became, and the vitamin C content has decreased. In the samples picked in full-matured level the vitamin C content has decreased at the 2<sup>nd</sup> week of storage. The changes in peroxidase-enzym activity were very similar than changes found in vitamin C content. The POD activity in samples picked in half-maturity level has increased in first period of storage, after than decreased. The POD activity in full-matured fruits was stabile low, has changed slightly. The results of our experiments gave new data about nutritive value and ripening process of different sweet pepper varieties, and help to choose most successful postharvest technics to keeping quality of pepper crops for different demand of consumers.

**Key words:** storage trial, vitamin C, peroxidase enzyme activity, ripening stage, cecei, kapia

## THE EFFECT OF NONSUCROSE COMPOUNDS ON SUCROSE SOLUBILITY AND RHEOLOGICAL PROPERTIES OF MOLLASSES

*Jasna GRBIĆ\**, *Rada JEVTIĆ-MUČIBABIĆ\**, *Stevan RADIVOJEVIĆ\**, *Tatjana  
KULJANIN\*\**, *Gordana KOPRIVICA\*\**, *Nevena MIŠLJENVIĆ\*\**

*\* Institute for Food Technology Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia*

*\*\* Faculty of technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia*

*e-mail: [jasna.grbic@fins.uns.ac.rs](mailto:jasna.grbic@fins.uns.ac.rs)*

The aim of the sucrose crystallization process is to achieve the highest sugar quality and yield with the lowest energy consumption together with most effective use of equipment and time. The deciding control parameters during the crystallisation process are the supersaturation of the mother liquor and the crystal content of the massecuite. The effect of the quality and amount of nonsucrose substances on the sucrose solubility and crystallization kinetic become particularly important in the lower purity of syrups and molasses. The main by product molasses are responsible for the largest sugar losses in a sugar factory.

Exhaustion of molasses affect: non-sucrose concentration, temperature during afterproduct cooling crystallization, viscosity, dry solids content and purity. Supersaturation is the driving force of the crystallization process. For pure sucrose solution the crystallization metastable zone lies between 1.0 and 1.2 of supersaturation coefficient, but in industrial sugar solutions the nonsucrose substances affect the sucrose solubility. Change in sucrose solubility for impure solutions changes the boundaries of the crystallization zones. Molasses contains nonsucrose compounds such as reducing sugars, raffinose, mineral and trace elements, nitrogenous compounds, colorants, non-nitrogenous organic acids, , inorganic anions, vitamins. In theory, every nonsucrose compound has an effect on the solubility of sucrose. The viscosity of molasses varies with the nature and amount of nonsucrose compounds present in it. The rheological behavior is an important factor affecting the efficiency of the processes such as crystallization, centrifugal separation and pumping.

In this paper the investigations were carried out with sugarbeet molasses of widely differing quality. The aim of this study was determination a) the effect of different methods application to the estimation of molasses saturation coefficients, b) the nonsucrose compounds impact on the sucrose solubility and rheological properties of sugarbeet molasses as micro-kinetic elements of after-product massecuite cooling crystallisation.

**Key words:** sugarbeet molasses, nonsucrose compounds, sucrose solubility, viscosity

## UTICAJ NESAHAROZNIH JEDINJENJA NA RASTVORLJIVOST SAHAROZE I REOLOŠKE OSOBINE MELASE

*Jasna GRBIĆ\*, Rada JEVTIĆ-MUČIBABIĆ\*, Stevan RADIVOJEVIĆ\*, Tatjana  
KULJANIN\*\*, Gordana KOPRIVICA\*\*, Nevena MIŠLJENVIĆ\*\**

*\* Univerzitet u Novom Sadu, Institut za prehrambene tehnologije u Novom Sadu, Bulevar cara  
Lazara 1, 21000 Novi Sad, Republika Srbija*

*\*\* Univerzitet u Novom Sadu, Tehnološki fakultet, Bulevar cara Lazara 1, 21000 Novi Sad,  
Republika Srbija*

*e-mail: [jasna.grbic@fins.uns.ac.rs](mailto:jasna.grbic@fins.uns.ac.rs)*

Zadatak procesa kristalizacije saharoze je proizvodnja maksimalne količine konzumnog proizvoda – belog šećera, dobrog kvaliteta, uz minimalnu potrošnju energije i efikasno korišćenje opreme i vremena. Prezasićenost matičnog sirupa i sadržaj kristala u šećerovini predstavljaju glavne parametre kontrole procesa kristalizacije. Uticaj vrste i količine nesaharoznih jedinjenja na rastvorljivost saharoze i kinetiku kristalizacije ima posebno velik značaj u sirupima nižeg kvocijenta čistoće i melasi. U fabrici šećera, glavni nus proizvod melasa nosilac je najvećih gubitaka šećera.

Iscrpljenje melase zavisi od: koncentracije nesaharoznih jedinjenja, temperature tokom kristalizacije hlađenja na poslednjem kristalizacionom stepenu, sadržaja suve materije i kvocijenta čistoće. Prezasićenost je motorna sila procesa kristalizacije. U čistim rastvorima saharoze metastabilna zona kristalizacije je između 1.0 i 1.2 koeficijenta prezasićenosti, ali u industrijskim rastvorima saharoze nesaharozne supstance utiču na rastvorljivost saharoze. Promene rastvorljivosti saharoze u nečistim rastvorima menjaju granice zona kristalizacije. Melasa sadrži nesaharozna jedinjenja kao što su redukujući šećeri, rafinoza, mineralne elemente i elemente u tragovima, azotna jedinjenja, bojene materije, organske kiseline bez azota, neorganske anjone, vitamine. Teoretski, svako nesaharozno jedinjenje ima uticaj na rastvorljivost saharoze. Viskozitet melase varira u zavisnosti od prirode i količine nesaharoznih jedinjenja prutnih u njoj. Reološke osobine predstavljaju važan faktor uticaja na efikasnost procesa kao što su kristalizacija, centrifugiranje i transport.

U ovom radu ispitivanja su izvedena na melasi šećerne repe veoma različitog kvaliteta. Cilj ovih ispitivanja bio je određivanje a) uticaja primene različitih metoda na određivanje koeficijenta zasićenosti melase, b) uticaja nesaharoznih jedinjenja na rastvorljivost saharoze i reološke osobine melase šećerne repe kao mikro-kinetičkih elemenata kristalizacije hlađenja na poslednjem kristalizacionom stepenu.

**Ključne reči:** melasa šećerne repe, nesaharozna jedinjenja, rastvorljivost saharoze, viskozitet

## THE INFLUENCE OF METHOD OF EXTRACTION AND DRYING OF PEA PROTEINS ON THEIR SOLUBILITY

*Raul IANCHICI, Simona Perta CRISAN, Rodica SEGAL*  
*“Aurel Vlaicu” University Arad, Romania*  
*e-mail: Ianchici@yahoo.com*

Pea proteins contain all essential amino acids necessary for human nutrition, and they are relatively well tolerated by the human body. Therefore they can be used for fortification of different foods in order to increase the proteins content and improve the amino acids balance, but first must to be extracted, separated and dried in the form of protein isolates.

In this study, we performed pea proteins extraction using two methods. First is ultrasound assisted extraction, an unconventional extraction method which increases the extraction efficiency and second is conventional method by mechanical stirring. For separation of proteins from the solution we used in all cases precipitation from solution at the isoelectric point. Drying of proteins was done by dehydration with organic solvents and freeze drying. The different extraction and drying methods can have an impact on the quality of extracted proteins, respectively on their functional properties. Solubility of proteins is very important in order to use the protein isolates for fortification of different foods.

We have studied the comparative solubility of proteins, extracted and dried by different methods described above. Also for comparison we used a commercial protein isolate supplied by MyProtein Company from UK. Protein solubility was studied in the pH range between 3 and 10 for each sample. In order to determine the quantity of dissolved proteins the Lowry assay was used.

The proteins extracted by ultrasounds, and freeze dried had the highest solubility, followed by the proteins extracted by mechanical stirring and freeze dried. The proteins extracted by mechanical stirring and dehydrated with organic solvents had the lowest solubility. The commercial product had a intermediate solubility. Among the extraction methods the ultrasound extraction gives the most soluble proteins, and regarding drying techniques, the freeze drying gives more soluble proteins than dehydration with organic solvents. In all cases the solubility of pea proteins was higher in alkaline medium than in acid medium.

**Key words:** pea proteins, ultrasound protein extraction, proteins solubility

## EXPERIENCES OF SMALL-SCALE, BATCH BIODIESEL PRODUCERS IN SOUTH AFRICA: CHALLENGES AND SUCCESS FACTORS

*Ipeleng Maroo KEAMOGETSOE*

*Agricultural Research Council-Institute for Agricultural Engineering, South Africa*

*e-mail: [marooki@arc.agric.za](mailto:marooki@arc.agric.za)*

The depleting fossil fuel reserves, increase in energy demand and environmental concerns especially relating to global warming have resulted in a global trend towards clean, renewable and sustainable energy resources. Biodiesel is a biofuels technology that has gained renewed worldwide interest as the potentially cleaner and environmentally friendly alternative liquid fuel, especially for use in the agricultural sector. South Africa is among the world's top 20 most carbon intensive countries and in line with global trends, South Africa has put measures in place to promote the development of a biodiesel industry as documented in the National Biofuels Industrial Strategy of 2007. Another initiative by the government is to attract farmers to produce biodiesel that will be incorporated into the national liquid fuel resources. However, the biodiesel industry in South Africa is still on the developmental phase thus this study gives a general outlook on the current position of small scale biodiesel producers. This study reports on the experiences of various small-scale batch biodiesel producers in South Africa and provides a reference framework for new entrants into the industry. Snowball sampling was used to identify and illustrate the current scenario of South African small-scale batch processing biodiesel producers who were voluntarily interviewed on issues relating to technology systems employed, capital investment, production costs, management and operation of the plant and biodiesel quality testing methods. This paper further reports on the challenges in small-scale biodiesel production. It was found that the present economical as well as the legislative environment is not conducive to the profitable production of biodiesel. Using literature and the interviews, deductions and recommendations were made for elevating the South African scenario. The future outlook of this investigation is that once the recommended critical success factors are implemented, this would assist to further develop the biodiesel industry and spur the market for biodiesel uptake.

**Key words:** biodiesel, renewable energy, small-scale production, south africa

## POSSIBILITIES OF APPLICATION OF NATURAL ZEOLITES IN STORED WHEAT GRAIN PROTECTION AGAINST PEST INSECTS

Petar KLJAJIĆ<sup>1</sup>, Goran ANDRIĆ<sup>1</sup>, Milan ADAMOVIĆ<sup>2</sup>, Marijana PRAŽIĆ GOLIĆ<sup>1</sup>

<sup>1</sup>Pesticide and Environment Research Institute, Belgrade, Serbia,

<sup>2</sup>Institute of Technology of Nuclear and Other Mineral Raw Materials, Belgrade, Serbia  
e-mail: petar.kljajic@peping.org.rs

In recent years, due to the presence of pesticide residues in food and resistance of storage insects, the application of contact insecticides and fumigants is under increasing restriction. Therefore, further activities aim at introduction of alternative protection measures, among which inert dusts stand for their effectiveness and safety. Of all the inert dusts, diatomaceous earth (DE) is the best known and many products are on the market in the world. The effectiveness of DE and other inert dusts, besides species of storage insects, is significantly affected by environmental conditions, primarily by air and substrate humidity and temperature, then by the content of silicon dioxide, as well as by shape and size of the particles in the products.

Natural zeolites (alkaline aluminum silicates) are widely used in agriculture, especially for the improvement of soil properties and increase of the crop yield, but also as a food additive for farm animals because they reduce the presence of mycotoxins. However, recent studies show that they also possess a significant insecticidal potential in control of storage insects such as *Sitophilus oryzae*, *Rhyzopertha dominica* and *Tribolium castaneum*, with an emphasis on high dependance of demonstrated efficacy on relative air humidity (45-65%), exposure duration (7, 14 i 21 day) and their properties (Natural zeolite–NZ, Modified natural zeolite–MNZ or Fine granulated natural zeolite–FGNZ).

Dusts NZ and MNZ applied at the rate of 0.25, 0.50 and 0.75 g/kg of wheat, at a temperature of 24°C and lower relative air humidity 45±5%, for *S. oryzae* and *T. castaneum* after 21 days of exposure are >90% efficient, and for *R. dominica* 23-73%. Dusts demonstrated the highest impact on the progeny production of insects after 21 days of parents exposure, having on mind that NZ achieves high reduction of offspring (90%) only at the application rate of 0.75 g/kg. In general, under higher relative air humidity against parents (50-55%) and offspring (60±5%), all dusts show significantly lower efficacy, especially MNZ. Maximum efficacy >95% and 79% was achieved by dusts NZ and FGNZ after 21 days of contact with *S. oryzae* and *T. castaneum*, and *R. dominica* at 1 g/kg, while the highest progeny reduction generated after 21 days of parents exposure, for *T. castaneum* and *R. dominica* >90%, and for *S. oryzae* 85 and 82%, respectively.

The results show that dusts based on natural zeolite, particularly NZ, applied in the same amounts as DEs products, can successfully protect stored wheat grain from the most important pest insects.

**Key words:** wheat grain, storage insects, control, natural zeolite.

## MOGUĆNOSTI PRIMENE PRIRODNOG ZEOLITA U ZAŠTITI USKLADIŠTENE PŠENICE OD ŠTETNIH INSEKATA

Petar KLJAJIĆ<sup>1</sup>, Goran ANDRIĆ<sup>1</sup>, Milan ADAMOVIĆ<sup>2</sup>, Marijana PRAŽIĆ GOLIĆ<sup>1</sup>

<sup>1</sup> Institut za pesticide i zaštitu životne sredine, Beograd, Srbija

<sup>2</sup> Institut za tehnologiju nuklearnih i drugih mineralnih sirovina, Beograd, Srbija

e-mail: petar.kljajic@peping.org.rs

Primena kontaktnih insekticida i fumiganata je zbog prisustva rezidua u hrani i rezistentnosti skladišnih insekata u poslednje vreme pod sve većom restrikcijom, zbog čega se uvode alternative mere zaštite, među kojima se po efektivnosti i bezbednosti izdvajaju inertna prašiva. Od svih inertnih prašiva najpoznatija je diatomejska zemlja, čiji se preparati u svetu široko primenjuju. Na efektivnost diatomejske zemlje i drugih inertnih prašiva pored vrste skladišnih insekata značajno utiču uslovi sredine, pre svih vlažnost vazduha i supstrata i temperatura, zatim sadržaj silicijum dioksida, kao i oblik i zastupljenost veličina čestica u preparatima.

Prirodni zeoliti (alkalni aluminijum silikati) se široko primenjuju u poljoprivredi, naročito za poboljšanje osobina zemljišta i povećanje prinosa gajenih biljaka, ali i kao dodatak hrani za domaće životinje jer smanjuju prisustvo mikotoksina. Međutim, noviji rezultati istraživanja pokazuju da poseduju i značajan insekticidni potencijal u suzbijanju štetnih vrsta skladišnih insekata, na primer: *Sitophilus oryzae*, *Rhizopertha dominica* i *Tribolium castaneum*, uz isticanje visoke zavisnosti ispoljene efikasnosti od relativne vlažnosti vazduha (45-65%), dužine izlaganja (7, 14 i 21 dan) i osobina prašiva (Prirodni zeolit, Modifikovani prirodni zeolit i Prirodni zeolit finije granulacije).

Prašiva Prirodni zeolit i Modifikovani prirodni zeolit primenjena u količini 0,25 0,50 i 0,75 g/kg pšenice, pri temperaturi 24°C i nižoj relativnoj vlažnosti vazduha 45±5%, su za *S. oryzae* i *T. castaneum* posle 21 dan izlaganja efikasni >90%, a za *R. dominica* u rasponu 23-73%. Najveći uticaj ovih prašiva na produkciju potomstva insekata je zabeležen posle 21 dan izlaganja roditelja, s tim da prašivo Prirodni zeolit visoku redukciju potomstva (90%) ostvaruje samo sa količinom 0,75 g/kg. Generalno, u uslovima povišene vlažnosti vazduha za roditelje (50-55%) i za potomstvo (60±5%), sva prašiva ispoljavaju značajno nižu efikasnost, a naročito Modifikovani prirodni zeolit. Najvišu efikasnost, >95% i 79% su ostvarila prašiva Prirodni zeolit i Prirodni zeolit finije granulacije posle 21 dan kontakta *S. oryzae* i *T. castaneum*, odnosno *R. dominica* sa pšenicom tretiranom sa 1 g/kg, dok je najviša redukcija potomstva ostvarena posle 21 dan ekspozicije roditelja, kod *T. castaneum* i *R. dominica* >90%, a kod *S. oryzae* 85 i 82%.

Rezultati istraživanja pokazuju da prašiva na bazi prirodnog zeolita, kada se primene u količinama kao i preparati na bazi diatomejske zemlje, mogu uspešno da zaštite uskladištenu pšenicu od napada najvažnijih vrsta štetnih insekata.

**Ključne reči:** pšenica u zrnju, skladišni insekti, suzbijanje, prirodni zeolit.

## THE ANALYSIS OF PROFICIENCY TESTS RESULTS ON PURITY AND OTHER SEED DETERMINATION FOR THE TEN YEAR PERIOD

Jasna KOJIĆ, Marija MILIVOJEVIĆ, Jasmina STOJADINOVIĆ, Maja MARINKOVIĆ,  
Dragica IVANOVIĆ  
Maize Research Institute "Zemun Polje", Belgrade, Serbia  
e-mail: [jvujinovic@mrizp.rs](mailto:jvujinovic@mrizp.rs)

Since the first Handbook on Seed Testing was published by Nobbe (Lower Saxony) in 1876 in which the seed testing methods were presented, the motto "Uniformity in Seed Testing" was unanimously coined. In order to achieve uniformity in the application of recommended methods and to have generally accepted results, accredited seed testing laboratories must participate in the *Proficiency* tests, which are organised by ISTA (International Seed Testing Association) three times a year. The essence of these tests is not to select the most successful laboratory in the world, but to identify laboratories that do not meet minimum competence that is expected from the ISTA accredited laboratories, as well as, the employment of corrective measures in order to achieve required minimum.

The aim of the present study was to analyse ten-year results for purity and other seed determination on *Proficiency* tests of the Maize Research Institute Seed Testing Laboratory. In the 2001-2010 period the Laboratory participated (compulsory participations) in 19 rings, while it participated in three rings voluntarily (*Lolium multiflorum*, *Festuca arundinaceae* and *Portulaca grandiflora*, as these three species were not encompassed by the accreditation). Results of *Proficiency* tests for all ISTA accredited laboratories were statistically processed, and based on the standard deviation and the Z values the following estimations were made: A, B, C or BMP (Below Minimum Performance). The evaluations A and B are acceptable, but in a case of C or BMP the laboratory has to apply corrective measures, i.e. it has to find out the reason for obtaining such poor results and tests have to be repeated.

Results of *Proficiency* tests for the species the laboratory was accredited, were evaluated with A. C was given for the seed purity analysis in *Portulaca grandiflora* and the laboratory had to apply the corrective measure. The aim of participation in the *Proficiency* test with *P. grandiflora* was to broaden the accreditation to flower seeds as it was achieved in 2009. There were problems related to the determination of other seed in several last rings of the *Proficiency* tests. ISTA increases its requirements from the accredited laboratories, hence it demands the determination of the species not typical for the regions in which laboratories perform their tests, as well as, the determination of seed all the way to the species (earlier only to the genus).

Based on the analysis of the ten-year results of the *Proficiency* tests, it is observable that the trend of competence of the laboratory's staff has been increasing. Moreover, awareness of necessary permanent learning and advance training, supervision over the whole process of testing with the aim of achieving reliable results, is greater. Furthermore, by the participating in the *Proficiency* tests, the laboratory obtains valuable seeds of very rare plant species and due to it, it completes its own seed collection, which is the richest reference collection within the region.

**Key words:** Proficiency test, seed purity, other seed determination



## ANALIZA REZULTATA ČISTOĆE I DETERMINACIJE DRUGOG SEMENA U PROFICIENCY TESTOVIMA ZA PERIOD OD DESET GODINA

Jasna KOJIĆ, Marija MILIVOJEVIĆ, Jasmina STOJADINOVIĆ, Maja MARINKOVIĆ,  
Dragica IVANOVIĆ  
Institut za kukuruz „Zemun Polje”, Beograd, Srbija  
e-mail: [jvujinovic@mrizp.rs](mailto:jvujinovic@mrizp.rs)

Od izdavanja prvog Priručnika za ispitivanje semena, 1876. godine od strane Nobeia (Donja Saksonija), u kome su prvi put preporučene metode za ispitivanje, jednoglasno je prihvaćen moto "*uniformnost u ispitivanju semena*". Da bi se postigla uniformnost u primeni preporučenih metoda i da bi rezultati bili opšte prihvaćeni, akreditovane laboratorije za ispitivanje semena su obavezne da učestvuju u *Proficiency* testovima, koje ISTA (International Seed Testing Association) organizuje tri puta godišnje. Suština *Proficiency* testova (testovi stručnosti) nije izabrati najbolju laboratoriju u svetu, već identifikovati laboratorije koje ne zadovoljavaju minimum stručnosti koji se očekuje od ISTA akreditovanih laboratorija, kao i preduzimanje potrebnih korektivnih mera da bi se postigao traženi minimum.

Cilj ovog rada je analiza desetogodišnjih rezultata čistoće i determinacije drugog semena u *Proficiency* testovima laboratorije za ispitivanje semena Instituta za kukuruz "Zemun Polje". Od 2001. do 2010. godine Laboratorija je učestvovala (obavezno učešće) u 19 krugova, a u tri kruga je učestvovala dobrovoljno (*Lolium multiflorum*, *Festuca arundinaceae* i *Portulaca grandiflora*) obzirom da ove tri vrste nisu bile pod akreditacijom. Rezultati *Proficiency* testova, za sve ISTA akreditovane laboratorije su statistički obrađeni, i na osnovu standardne devijacije i Z vrednosti date su ocene A, B, C ili BMP (stručnost ispod minimuma). Prihvatljiva ocena je A i B, a u slučaju da laboratorija dobije ocenu C ili BMP ista mora uraditi korektivne mere, odnosno mora pronaći uzrok dobijanja loših rezultata i ponoviti ispitivanja.

Rezultati u *Proficiency* testovima, za one vrste za koje je laboratorija akreditovana, su ocenjeni ocenom A, dok je rezultat za *Portulaca grandiflora* ocenjen sa C, i laboratorija je morala uraditi korektivnu meru. Cilj učestvovanja u *Proficiency* testu sa *P. grandiflora* bio je da laboratorija proširi akreditaciju na seme cveća što je i ostvareno u 2009. godini. U nekoliko zadnjih krugova *Proficiency* testova problem se javljao kod determinacije drugog semena. ISTA postavlja sve veće zahteve prema akreditovanim laboratorijama, tako da se od njih traži determinacija vrsta koje nisu tipične za podneblja u kojima laboratorije rade, kao i determinacija semena do vrste (ranije do roda).

Na osnovu analize desetogodišnjih rezultata *Proficiency* testova, uočava se trend povećanja stručnosti i kompetentnosti osoblja Laboratorije, kao i podizanja svesti o potrebi stalnog učenja i usavršavanja, nadzora nad celokupnim procesom ispitivanja, u cilju postizanja pouzdanih rezultata. Takođe, učestvovanjem u *Proficiency* testovima laboratorija dolazi do dragocenog semena vrlo retkih biljnih vrsta i time upotpunjuje sopstvenu kolekciju semena, koja je najbogatija referentna kolekcija u regionu.

**Ključne reči:** profiency test, čistoća semena, determinacija drugog semena

## COUNTER-CURRENT OSMOTIC DEHYDRATION OF CARROT AND APPLE IN SUCROSE SOLUTIONS AND SUGAR BEET MOLASSES

*Ljubinko LEVIĆ, Nevena MIŠLJENVIĆ, Gordana KOPRIVICA*  
*Faculty of Technology, Bulevar Cara Lazara 1, Novi Sad, Serbia*  
*e-mail: [nevenam@uns.ac.rs](mailto:nevenam@uns.ac.rs)*

Osmotic dehydration is a process of the partial removal of water by direct contact of plant or animal tissue with a suitable hypertonic solution, i.e., highly concentrated sugar, salt, sugar/salt mixtures, etc. Driving force for water removal is the concentration gradient between the surrounding solution and the intracellular fluid. Diffusion of water is followed by simultaneous diffusion of the solutes from the osmotic solution into the plant tissue. During the process, third transfer process takes place, leaching of product solutes (sugars, acids, minerals, vitamins) from plant tissue into the surrounding solution, which is quantitatively negligible but affects the sensorial, nutritional, and functional characteristics of the final product. By the osmotic dehydration process, initial moisture content can be halved, while the dried product retains its nutritive value (especially vitamins), color, and flavor. In the area of osmotic dehydration of fruits is still a lot of research work ahead, but it is considered that this way of preservation has a possibility for wider industrial scale application.

Silin's theory of the extraction of sucrose from sugar beet served as a model for of counter-current extraction of water from plant tissue. The aim of this study was to investigate the possibility of counter-current osmotic dehydration of apple and carrot in sucrose solutions (40, 50, 60 and 70%) and sugar beet molasses (50, 60, 70 and 80%). Weight ratio of solution to apple and carrot samples was 1:5. After dehydration in the solution of lower concentration, sample was re-entered in the higher concentrated solution. Each phase lasted for 15 min and the whole process of counter-current osmotic dehydration lasted 1 hour. Counter-current osmotic dehydration was carried out at atmospheric pressure and temperature of 65<sup>o</sup>C.

By counter-current osmotic dehydration, dry matter content in apples and carrots was increased several times. After 60 minutes of counter-current osmotic dehydration of apple dry matter content was changed from the initial 13.43 to 42.3% in sugar beet molasses, while in the sucrose solution dry matter content was increased from 15.05 to 43.89%. In case of counter-current dehydration of carrots, dry matter content was varied from 11.19 to 42.11% when sugar beet molasses was used as an osmotic solution, while in the case of sucrose solution dry matter content was changed from 11.43 to 43.21%. Counter-current process has advantage in comparison with usual procedure of osmotic dehydration, because dry matter content in apples and carrots, reached after 1 hour of counter-current osmotic dehydration, by usual method is reached after 3 hours.

**Key words:** osmotic dehydration, sugar beet molasses, sucrose, carrots, apples

## PROTIVSTRUJNA OSMOTSKA DEHIDRATACIJA JABUKE I MRKVE U RASTVORIMA SAHAROZE I MELASI ŠEĆERNE REPE

*Ljubinko LEVIĆ, Nevena MIŠLJENović, Gordana KOPRIVICA*  
*Tehnološki fakultet, Bulevar Cara Lazara 1, Novi Sad, Srbija*  
*e-mail: [nevenam@uns.ac.rs](mailto:nevenam@uns.ac.rs)*

Osmotska dehidracija predstavlja postupak delimičnog uklanjanja vode, direktnim kontaktom biljnog ili životinjskog tkiva sa adekvatnim hipertoničnim rastvorom tj. visokokoncentrovanim rastvorima šećera, soli, smeše soli i šećere, itd. Pogonska sila za uklanjanje vode je koncentracioni gradijent između okolnog rastvora i unutarćelijske tečnosti. Difuzija vode praćena je istovremenom difuzijom rastvorka iz osmotskog rastvora u tkivo. Tokom procesa se odvija i treći tok prenosa mase koji podrazumeva difuziju materija (šećera, kiselina, minerala, vitamina) iz biljnog tkiva u okolni rastvor koji, iako kvantitativno zanemarljiv, utiče na senzorske, nutritivne i funkcionalne karakteristike finalnog proizvoda. Osmotskim putem se početna vlažnost materijala može prepoloviti, a osušeni proizvod zadržava hranljive vrednosti (naročito vitamine), boju i aromu. Na planu osmotskog sušenja voća predstoji još dosta naučnoistraživačkog rada, te se smatra da je ovo jedan od načina konzerviranja pred kojim se tek otvaraju šire mogućnosti industrijske primene.

Silinova teorija o ekstrakciji šećera iz šećerne repe poslužila je kao model za razvijanje teorije o protivstrujnoj ekstrakciji vode iz biljnog tkiva. Cilj ovog rada je da se ispita mogućnost izvođenja protivstrujne osmotske dehidracije jabuke i mrkve u rastvorima saharoze (40, 50, 60 i 70%) i melase šećerne repe (50, 60, 70 i 80%) različitih koncentracija. Odnos mase uzoraka jabuke i mrkve prema masi rastvora bio je 1:5. Uzorak se nakon dehidracije u rastvoru manje koncentracije ponovo unosi u rastvor veće koncentracije. Svaka faza traje po 15 min a sam proces protivstrujne osmotske dehidracije sat vremena. Protivstrujna osmotska dehidracija je izvedena na atmosferskom pritisku i temperaturi od 65°C.

Primenom postupka protivstrujne osmotske dehidracije višestruko je povećan sadržaj suve materije u jabuci i mrkvi. Nakon 60 min protivstrujne osmotske dehidracije jabuke sadržaj suve materije se povećava sa početnih 13.43 na 42.3% u melasi šećerne repe, dok se u rastvoru saharoze sadržaj suve materije povećava sa 15.05 do 43.89%. Kada je u pitanju mrkva, sadržaj suve materije se menjao od 11.19 do 42,11% kada je kao osmotski rastvor korišćena melasa šećerne repe, dok se u slučaju saharoze sadržaj suve materije kretao od početnih 11.43 do 43.21%. Sadržaj suve materije u jabuci i mrkvi, postignut nakon 1 sata protivstrujne osmotske dehidracije, se uobičajenim postupkom osmotske dehidracije dostiže tek nakon 3 sata što ukazuje na bitnu prednost protivstrujnog postupka.

**Ključne reči:** osmotska dehidracija, melasa šećerne repe, rastvor saharoze, mrkva, jabuka

## CHANGES OF CHEMICAL PARAMETERS IN MALTING BARLEY AND MALT INFLUENCED BY POST-HARVEST RIPENING

*Miriam LIŠKOVÁ, Helena FRANČÁKOVÁ, Ján MAREČEK*

*The Slovak University of Agriculture, Department of Storing and Processing of Plant  
Products, Nitra*

*e-mail: miriam.liskova@uniag.sk*

Effect of post-harvest ripening on the quality of barley and malt is of considerable importance to the barley, malting and brewing industry. Barley used for malt should have low protein content and malt with a high extract level to increase brewing yield and efficiency. To meet these requirements barley must be post-harvest ripped and be able to germinate vigorously. Aim of this study was to determine to what extent post-harvest ripening influenced selected chemical parameters of malting barley as are starch and crude protein and further more parameters of malt as are extract and apparent final attenuation. Barley post-harvest ripening was monitored in the second, sixth and in the twenty-fifth week after harvest using Slovakian newly selected varieties. Results revealed that already in the sixth week after harvest, amount of starch and crude protein decreased and amount of extract and apparent final attenuation increased, due to post-harvest ripening. The results indicated a considerable effect of post-harvest ripening on chemical parameters of barley and malt ( $P < 0.001$ ) as well. During the time of storage in the twenty-fifth week after harvest the amount of starch and crude protein had decreasing tendency and the amount of extract and apparent final attenuation had increasing tendency. Moreover the results confirmed that the choice of growing locality is also important. Growing locality significantly influenced the amount of crude protein and starch content. The lowest amount of crude protein was measured in barley from locality Jakubovany which is situated in colder growing area in comparison with localities Sládkovičovo and Veľké Ripňany which are situated in arid growing areas. On the other hand, the highest amount of starch was measured in barley from localities Jakubovany and Veľké Ripňany.

**Key words:** barley, starch, crude protein, post-harvest ripening, malt, extract

## QUALITATIVE PARAMETERS EVALUATION OF THE SLOVAK AND SERBIAN VARIETIES *TRITICUM AESTIVUM*, L. AND *TRITICUM DURUM*, L.

Ján MAREČEK, Helena FRANČÁKOVÁ, Moko KAROLINA, Miriam LÍŠKOVÁ  
The Slovak University of Agriculture, Department of Storing and Processing of Plant  
Products, Nitra  
e-mail: [Jan.Marecek@uniag.sk](mailto:Jan.Marecek@uniag.sk)

This work focuses on evaluation of the trade parameters (dry matter content), milling parameters (amount of the 1. class, volume weight, thousand grain weight, mineral substances, water activity), baking parameters (amount of wet gluten, gluten tensibility and swelling ability, falling number, Zeleny sedimentation index, crude protein and starch content) using samples from the harvest years 2009 and 2010.

Evaluated were Serbian varieties *Triticum aestivum*, L.: Etida, Vojvodina, Pobeda, Renesansa, Rusija and *Triticum durum*, L.: NS Dur and Durumko, grown at Institute of Field and vegetable Crops from Novi Sad, Serbia. Slovak varieties Karpatia (*Triticum aestivum*, L.) and Pentadur (*Triticum durum*, L.) were grown in Control and Testing Institute of Agriculture, Solary, Slovakia. The highest amount of first class in the year 2009 was found out in variety Rusija (92,4%) and in the year 2010 in variety Pentadur (93,7%). Volume weight was highest in variety Karpatia (2010- 824 g.l<sup>-1</sup>). The amount of mineral substances in grain was in the range from 1,35 to 1,69% in both years. The highest thousand grain weight from the harvest year 2010 was found out in variety Pentadur (54,4g). Values of water activity (aw-25°C) were in the year 2009 lower (0,440-0,518), in comparison with the harvest year 2010 (0,488-0,564).

In the years 2009 and 2010 the highest activity of alfa-amylases (falling number) was measured in varieties NS Dur (62/86s), Durumko (103/66s). On the other hand the lowest activity was measured in variety Pentadur (418/335s). The other varieties had values in optimal range 200-300s. The highest sedimentation index according to Zeleny was found out in variety Rusija and Karpatia (2010-62 cm<sup>3</sup>). Wet gluten content was highest in variety Rusija (35,54/37,07%) and Karpatia 42,57%. The highest gluten swelling ability by 32 °C in the year 2009 was measured in variety Etida (16 cm<sup>3</sup>) and in the year 2010 in varieties Renesansa, Karpatia (17 cm<sup>3</sup>). The highest gluten tensibility 15 cm was found out in variety (NS Dur 2009) and 12 cm (Pobeda, Pentadur, 2010).

According to gained results we can conclude that varieties Rusija, Pobeda and Karpatia cloud be considered as varieties with higher proportion of insoluble protein. Positive state of protein complex was found out also by evaluation of Zeleny index. In measurements of alfa-amylase activity higher difference in values among varieties was found out, especially in varieties *Triticum durum*, L.

**Key words:** cereals, *Triticum aestivum*, L., *Triticum durum*, L., quality of wheat

## PRELIMINARY SURVEY ON THE EFFECTS OF IONIZING RADIATIONS ON *ASPERGILLUS* SPP. AND ON AFLATOXIN B<sub>1</sub> CONTAMINATING MAIZE GRAINS

*Andrea MARIOTTI, Roberta GALUPPI, Alberto ALTAFINI, Andrea SERRAINO, Anna  
ZAGHINI*

*Alma Mater Studiorum - University of Bologna, Italy*

*e-mail: [a.mariotti@unibo.it](mailto:a.mariotti@unibo.it)*

All the aflatoxins (AFB<sub>1</sub>, AFB<sub>2</sub>, AFG<sub>1</sub>, AFG<sub>2</sub> and AFM<sub>1</sub>) are classified as group 1 carcinogens (IARC, 2002). There has been increasing interest in the use of ionizing radiation for killing endogenous microorganisms in stored grains (Erhart, 1990). The aim of this study was to evaluate the effects of different doses of  $\gamma$  radiations (3, 5, 7, 10 kGy) on *Aspergillus* spp., naturally affecting maize, and examine the aflatoxin B<sub>1</sub> (AFB<sub>1</sub>) contamination at 10 kGy, the maximum permitted dose by the European rules.

8 samples (each 20 kg) of maize grains before drying up treatment were collected and kept at room temperature for 2 months. 5 subsamples (240 g) were obtained from each sample, packaged in polyethylene bags and stored at 5±3°C before irradiation. One of these was used as control sample, while the others were irradiated. Subsamples were exposed to a <sup>60</sup>Co  $\gamma$  source with the dose rate of 5143 Gy/h at room temperature. After treatment with ionizing radiations, every irradiated subsample and the unirradiated control one were divided in 2 aliquots assigned to two different analysis: 40 g to detect the total viable mycetes and 200 g to assess the AFB<sub>1</sub> contamination by HPLC and fluorimetric detection. The subsamples were re-stored at 5±3°C until the analysis.

The mean contamination level disclosed from total moulds count in unirradiated samples was 10<sup>6</sup> CFU/g. The irradiated samples showed a significant dose-dependent CFU/g decrease. At 3 kGy a mean fall of 98,3% was observed; at 5 kGy only the 0,003% of colonies was born. Finally at 7 kGy and 10 kGy doses, the CFU/g decrease was nearby 100%. Several modified conidiophores in colonies irradiated at 5 kGy indicated the presence of some mutants. In fact, were observed some hyphae projected from these conidiophores, instead of conidia, that subsequently become as many conidiophores producing conidia.

The mean levels of AFB<sub>1</sub> contamination, detected with HPLC-FL in control and in 10 kGy irradiated samples, were respectively 1212,8 median 1319 ppb and 1975,8 median 1924,5 ppb.

According to literature, total count of viable mycetes showed a dose-dependent decrease of *Aspergillus* spp. and underlines the sensitivity of fungi to  $\gamma$  radiation. On the contrary, after  $\gamma$  exposition AFB<sub>1</sub> increased the contamination degree, probably due to a structural modification of the AFB<sub>1</sub> molecule with a consequent change of fluorimetric response of compound. It is possible that the molecular modification could lead to a degradation product more fluorescent than the unirradiated AFB<sub>1</sub> and makes it appear as increased.

Therefore, more studies are required in order to assess the AFB<sub>1</sub> radio-sensitivity and its molecular changing after irradiation that maybe has created a new product not distinguishable with HPLC-FL.

**Key words:** HPLC, *Aspergillus* spp., AFB<sub>1</sub>,  $\gamma$  rays, maize

## POSSIBILITIES OF IMPROVING FRUIT PRODUCTION IN SERBIA

*Dušan MILIĆ*

*Faculty of Agriculture, 21000 Novi Sad, Trg Dositeja Obradovića 8, Serbia*

*e-mail: [milic@polj.uns.ac.rs](mailto:milic@polj.uns.ac.rs)*

The favorable natural conditions for fruit production (climate, soil, location, etc.) in the regions of fruit production, have had positive impact on personal and common standard of fruit producers in Serbia. In the beginning, through the assortments, and later by other measures (nutrition, care, pruning, etc.) science is located in this production the largest application. In the foreground is the intensification and mechanization in fruit growing, then assortments of changes and the introduction of the production new and the qualities cultivars with higher biological potential, finding new and cost-effective production system and the formation of the corresponding crown adapted species, varieties and ecological environment, and applied agrotechnics (pruning, processing, fertilization, irrigation and protection of fruit trees from pests and diseases).

Fruit production has traditionally been one of the most important agricultural branches in the Republic of Srbija. The orchards in this region rely upon to meet their own needs in fresh fruits and processed, and sold on the domestic and international markets. As the fruit a very complex area of production, the main aim is to determine the basic trends of fruit production with simultaneous consideration of measures to enhance and improve fruit production in the Republic Srbiji. The tradition of growing fruits and draws great interest of farmers for fruit, as well as incentive measures Serbian government, which should enable faster development of rural areas.

In the investigated period (2000-2009) in fruit production of Serbia are the most important fruits of plums, apples and cherries, as the number of trees, and the realized production. With an average production of 482,000 t. plum participate for 44.9% of total fruit production. According to the representation of the total fruit production followed by apples (19.20%), sour cherry and raspberry with an average share of 7.55%. Fruit species analyzed in the reference period show tendencies to increase. Trend increase was especially pronounced in plum production (rate of change 9.81%), apple production (rate of change 7.42%), apricot (7.31%), peaches (6.83%) and cherry production (rate of change 6.64%).

Ministry of Agriculture, Forestry and Water Management of Republic of Serbia in the National Program of Agriculture from 2010. to 2013. the adopted measures for the development of fruit growing and viticulture, which primarily relate to the production and distribution of planting material, cultivation technology, with special emphasis on organic production, quality and standardization of packaging and logistics.

At this point the chances that the application of quality production of planting materials through proper selection of varieties, make real small revolution in these agricultural branches. Advantage our fruit is in the physical and biological diversity, favorable climate, tradition in the production of fruit. There are significant interest farmers for fruit production, which, along with state incentives and establishment of cooperatives (associations) can bear fruit.

**Key words:** fruit production, trends in development, measures to improvement, Republic of Serbia

## MOGUĆNOSTI UNAPREĐENJA VOĆARSKE PROIZVODNJE U SRBIJI

Dušan MILIĆ

Poljoprivredni fakultet, 21000 Novi Sad, Trg Dositeja Obradovića 8, Srbija

e-mail: [milic@polj.uns.ac.rs](mailto:milic@polj.uns.ac.rs)

Povoljni prirodni uslovi za voćarsku proizvodnju (klima, zemljište, položaj i sl.) u rejonima proizvodnje voća, pozitivno su uticali na lični i zajednički standard proizvođača voća u Srbiji. U početku preko sortimenta, a kasnije i preko ostalih mera (ishrana, zaštita, rezidba i dr.) nauka je u ovoj proizvodnji nalazila sve veću primenu. U prvom planu su intenzifikacija i mehanizacija u voćarstvu, zatim promena sortimenta i uvođenje u proizvodnju novih i kvalitetnijih sorti sa većim biološkim potencijalom, iznalaženje novih i ekonomičnih sistema gajenja i formiranje odgovarajuće krune prilagođene vrsti, sorti i ekološkoj sredini, kao i primenjena tehnologija (rezidba, obrada, đubrenje, navodnjavanje i zaštita voćaka od bolesti i štetočina).

Voćarska proizvodnja je tradicionalno jedna od značajnih poljoprivrednih grana u Republici Srbiji. Voćnjaci su na ovim prostorima zasnovani radi zadovoljenja sopstvenih potreba u svežim plodovima i u prerađenom stanju, kao i prodaje na domaćem i inostranom tržištu. S obzirom da je voćarstvo jedna veoma kompleksna oblast proizvodnje, osnovni cilj istraživanja je utvrđivanje osnovnih trendova voćarske proizvodnje uz istovremeno sagledavanje mera za poboljšanje i unapređenje proizvodnje voća u Republici Srbiji. Duga tradicija gajenja voća povlači i veliko interesovanje poljoprivrednika za voćarstvo, kao i stimulativne mere Vlade Republike Srbije koje treba da omoguće brži razvoj ruralnih sredina.

U ispitivanom periodu (2000-2009) u voćarskoj proizvodnji Srbije najznačajnije voćne vrste su šljiva, jabuka i višnja, kako po broju rodni stabala, tako i po ostvarenoj proizvodnji. Sa prosečnom proizvodnjom od 482.000 t. šljiva učestvuje sa 44,9 % u ukupnoj proizvodnji voća. Prema zastupljenosti u ukupnoj proizvodnji voća zatim slede jabuka (19,20 %), višnja i malina sa prosečnim učešćem od 7,55 % . Analizirane voćne vrste pokazuju tendenciju povećanja. Trend povećanja je naročito izražen u proizvodnji šljive (stopa promene 9,81%), proizvodnji jabuke (stopa promene 7,42 %), kajsije (7,31%), breskve (6,83 %) i proizvodnji višnje (stopa promene 6,64 %).

Ministarstvo poljoprivrede, šumarstva i vodoprivrede Republike Srbije je u okviru Nacionalnog programa poljoprivrede od 2010. do 2013. godine donelo mere za razvoj voćarsko-vinogradarske proizvodnje, a koje se prvenstveno odnose na proizvodnju i promet sadnog materijala, tehnologiju gajenja, sa posebnim naglaskom na organsku proizvodnju, kvalitet i standardizaciju i pakovanje i logistiku.

U ovom trenutku velika je šansa, da primenom kvalitetne proizvodnje od materijala za sadnju preko odabira pravog sortimenta, ostvarimo pravu malu revoluciju u ovoj grani poljoprivrede. Prednost našeg voćarstva je u prostornoj i biološkoj raznovrsnosti, povoljnoj klimi, tradiciji u proizvodnji voća. Postoji značajna zainteresovanost poljoprivrednika za voćarstvo, koje uz državne podsticajne mere i osnivanje zadruga (asocijacija) mogu uroditi plodom.

**Ključne reči:** voćarska proizvodnja, tendencije razvoja, mere za unapređenje, Republika Srbija



## DENSITY OF SOME VEGETABLES DURING CONVECTIVE DRYING

V. MITREVSKI<sup>1</sup>, F. POPOVSKI<sup>2</sup>, D. POPOVSKI<sup>1</sup>

University "St Clement Ohridski" – Bitola, Faculty of Technical Sciences, Bitola, Macedonia<sup>1</sup>

International Balkan University – Skopje, Macedonia<sup>2</sup>

e-mail: [vangelce.mitrevski@uklo.edu.mk](mailto:vangelce.mitrevski@uklo.edu.mk)

The density is important physical properties characterizing the texture and the quality of dry materials. Fresh potatoes and carrots were used in this study. To prepare samples, carrots and bananas were sliced using electric slicing machine to give a uniform sample thickness of 3 mm before being reduced to a cylinder form with diameter of  $40 \pm 0.1$  mm.

The study of particle density of potato and carrot slices was conducted in a laboratory air-dryer (figure 1). The shelf holding with three carrot or banana slices was inserted into the rectangular experimental channel. The slices were dried until the equilibrium moisture content was reached. The dimensions and the mass of the slices were measured every 10 min. The initial moisture content and the initial slices dimensions were measured as well. A lot of experiments were made. The experiment was repeated at different air temperatures and velocities. The drying air temperature was 40, 50, 60 and 70 °C and the drying air velocity 1, 2 and 3 m/s.

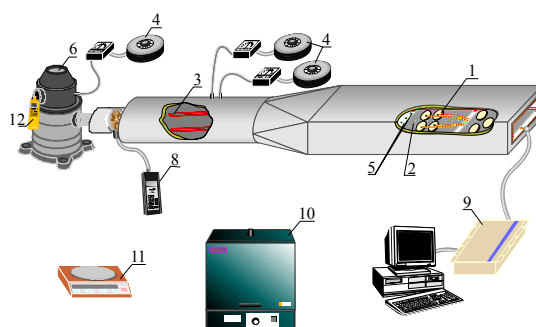


Figure 1. Experimental apparatus

1-material, 2-shelf, 3-electrical heaters, 4-transformers, 5-thermocouples, 6-centrifugal fan, 7-anemometer, 8-panel meter, 9-data acquisition system, 10-stove, 11-balance, 12-hygrometer

Some new mathematical models for correlating the dimensionless particle density  $\rho_0/\rho$  with the dimensionless material moisture content  $U = u_0 - u/u_0$  are proposed (Table 1).

Table 1. Mathematical models

Model	$\rho_0/\rho$
1	EXP(-A*U)
2	1-LOG(A*U+1)
3	1/(A*U+1)
4	U**A-1
5	A*U+1

Regression analysis on the experimental data is made. High values of the correlation coefficients show that the differences between predicted and observed data are very small.

**Keywords:** density, drying, potato, carrot.

## GUSTINA NEKIH POVRĆA ZAVREME KONVEKTIVNOG SUŠENJA

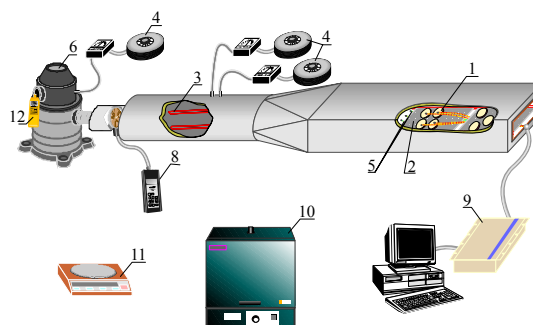
V. MITREVSKI<sup>1</sup>, F. POPOVSKI<sup>2</sup>, D. POPOVSKI<sup>1</sup>

Univerzitet "Sveti Klement Ohridski" – Bitola, Fakultet tehničkih nauka<sup>1</sup>, Bitola, Makedonija  
Međunarodni Balkanski Univerzitet - Skoplje, Makedonija<sup>2</sup>

e-mail: [vangelce.mitreovski@uklo.edu.mk](mailto:vangelce.mitreovski@uklo.edu.mk)

Gustina je važna fizička osobina koja karakteriše teksturu i kvalitet osušenog materijala. Svež krompir i šargarepa nakon ljuštenja se seku na komade (listiće) debljine 3 mm i prečnika  $40 \pm 0.1$  mm.

Pri određivanju gustine sušenih uzoraka jedan deo listića postavlja se na lesu u kanal eksperimentalne konvektivne sušare (sl.1), a drugi deo se suši u laboratorijskoj peći do potpuno suvog stanja kako bi se odredio početni sadržaj vlage. Na eksperimentalnoj aparaturi je realizovana serija eksperimenata. Za svaki eksperiment unapred su zadate vrednosti temperature i brzine vazduha koji su održavani konstantnim tokom jednog režima sušenja. Listići krompira i šargarepe sušeni su na različitim temperaturama (40, 50, 60 i 70 °C) i različitim brzinama vazduha (1, 2 i 3 m/s). Promene dimenzija i mase sušenih uzoraka merene su svakih deset minuta.



Sl. 1. Eksperimentalna aparatura

1 - materijal, 2 - lesa, 3 - grejači, 4 - transformatori, 5 - termoparovi, 6 - centrifugalni ventilator, 7 - anemometar, 8 - panelmetar, 9 - sistem za akviziciju, 10 - peć, 11 - vaga, 12 - higrometar

Predloženi su novi matematički modeli za aproksimaciju zavisnosti bezdimenzionone gustine materijala  $\rho_0/\rho$  od bezdimenzionog sadržaja vlage  $U = u_0 - u/u_0$  (Tabla 1).

Tabela 1. Matematički modeli

Model	$\rho_0/\rho$
1	$\text{EXP}(-A*U)$
2	$1-\text{LOG}(A*U+1)$
3	$1/(A*U+1)$
4	$U**A-1$
5	$A*U+1$

Visoke vrednosti koeficijenta korelacije pokazuju da su razlike između proračunatih i izmerenih vrednosti veoma male.

**Ključne reči:** gustina, sušenje, krompir, šargarepa

## NITROGEN COMPOUNDS IN THE MOLASSES

*Rada JEVTIĆ-MUČIBABIĆ<sup>1</sup>, Jasna GRBIĆ<sup>1</sup>, Nevena MIŠLJENović<sup>2</sup>, Gordana  
KOPRIVICA<sup>2</sup>, Tatjana KULJANIN<sup>2</sup>, Stevan RADIVOJEVIĆ<sup>1</sup>*

<sup>1</sup> *Institute for Food Technology Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia*

<sup>2</sup> *Faculty of technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia*

*e-mail: [rada.jevtic@fins.uns.ac.rs](mailto:rada.jevtic@fins.uns.ac.rs)*

Molasses, byproduct of sugar beet processing, is polycomponent system that is a very valuable raw material for various technologies. The reason for this lies in the fact that molasses contains over two hundred organic and inorganic compounds, which are necessary for its use in the processing and fermentative technologies.

Composition of the molasses depends on the sugar beet composition and applied processing technology. Molasses, obtained under adequate conditions of sugar beet processing, has about 80% of dry matter content (about 50% is saccharose and about 30% non-saccharose matter). The molasses contains concentrated non-sugar components that have not been removed in the purification process, non-sugar components that are formed during the evaporation and crystallization, as well as the remains of the auxiliary materials used in the sugar beet processing. The non-sugar components of the molasses are divided into three major groups: inorganic (mineral) compounds, organic compounds with nitrogen and organic compounds without nitrogen.

Inorganic, mineral part of non – sugar components in the molasses is composed of carbonate salts, sulfates, chlorides, potassium nitrate (in small amounts of potassium phosphate), sodium, calcium, magnesium, aluminum, iron and ammonium.

Non-sugar organic matter without nitrogen consists: hemicellulose degradation products, products of thermal decomposition of sucrose, non-volatile and volatile organic acids, pectins and products of their degradation, as well as a number of other compounds.

The content of nitrogen compounds in molasses depends on its content in sugar beet and the transformation of some compounds during the sugar beet processing. About one-third of the nitrogen compounds in molasses is betaine and the rest are amino acids, proteins, amides, melanoidines and a negligible amount of ammonium salts. For fermentation technology, especially for the production of baker's yeast, molasses, which does not contain sufficient amounts of nitrogen compounds is incomplete raw material. A criteria for evaluation of the quality of the molasses in fermentative technologies is not the content of total nitrogen, than content of nitrogen which can be easily assimilated by microorganisms.

This paper examined the composition of organic nitrogen compounds in the molasses and the impact of sugar beet processing on the content of mentioned compounds. The research was comprehended within six local sugar factories by use of average campaign samples of molasses.

**Key words:** molasses, nitrogen compounds, sugar beet

## AZOTNE MATERIJE U MELASI

*Rada JEVTIĆ-MUČIBABIĆ<sup>1</sup>, Jasna GRBIĆ<sup>1</sup>, Nevena MIŠLJENović<sup>2</sup>, Gordana  
KOPRIVICA<sup>2</sup>, Tatjana KULJANIN<sup>2</sup>, Stevan RADIVOJEVIĆ<sup>1</sup>*

<sup>1</sup>*Univerzitet u Novom Sadu, Institut za prehrambene tehnologije, Bul. cara Lazara 1, 21000  
Novi Sad, Srbija*

<sup>2</sup>*Univerzitet u Novom Sadu, Tehnološki fakultet, Bul. cara Lazara 1, 21000 Novi Sad, Srbija  
e-mail: [rada.jevtic@fins.uns.ac.rs](mailto:rada.jevtic@fins.uns.ac.rs)*

Melasa, nusproizvod prerade šećerne repe, je polikomponentni sistem koji predstavlja vrlo vrednu sirovinu za čitav niz tehnologija. Razlog za to leži u činjenici da melasa sadrži preko dvesta organskih i neorganskih jedinjenja, neophodnih za njenu primenu u prerađivačkim i fermentativnim tehnologijama.

Sastav melase zavisi od šećerne repe i primenjene tehnologije prerade. Pod adekvatnim uslovima prerade šećerne repe dobija se melasa sa oko 80% suve materije, od čega oko 50% čini saharoza i oko 30% nesaharozne materije. U melasi se koncentrišu nešećeri koji nisu uklonjeni postupkom čišćenja, nešećeri koji se formiraju tokom uparavanja i kristalizacije kao i ostaci pomoćnih materijala koji se koriste u peradi repe. Nesaharozne komponente melase podeljene su u tri velike grupe: neorganske (mineralne), organske sa azotom i organske bez azota.

Neorganski, mineralni deo nešećera melase sastoji se iz soli karbonata, sulfata, hlorida, nitrata (u malim količinama fosfata) kalijuma, natrijuma, kalcijuma, magnezijuma, aluminijuma, gvožđa i amonijuma.

Organske nešećerne materije bez azota se sastoje od produkata razlaganja hemiceluloze, produkata toplotnog razlaganja saharoze, neisparljivih i isparljivih organskih kiselina, pektinskih materija i produkata njihovog razlaganja, kao i čitavog niza drugih jedinjenja.

Sadržaj azotnih jedinjenja u melasi zavisi od istih u šećernoj repi i transformaciji nekih jedinjenja u procesu prerade repe. Oko jedne trećine azotnih materija melase čini betain, a ostalo amino-kiseline, belančevine, amidi, melanoidini i u neznatnoj količini soli amonijaka. Za fermentativne tehnologije, a naročito za proizvodnju pekarskog kvasca, melasa koja ne sadrži dovoljnu količinu azotnih jedinjenja je nekompletna sirovina. Kriterijum za ocenu melase u fermentativnim tehnologijama nije sadržaj ukupnog azota, nego sadržaj azota koji proizvodni mikroorganizam može lako da asimiluje.

U radu je ispitan sastav organskih jedinjenja azota u melasi kao i uticaj uslova prerade šećerne repe na sadržaj istih. Istraživanja su obuhvatila prosečne, kampanjske uzorke melase iz šest domaćih fabrika šećera.

**Ključne reči:** azotne materije, melasa, šećerna repa

## THE EXPERIENCE OF THE FUNCTIONING OF FOOD ALLERGY DATABANK IN HUNGARY

*Erzsébet PÁLFI, Zoltánné HORVÁTH, Jánosné GAÁL, Maria BARNA*  
*Semmelweis University Faculty of Health Sciences Department of Dietetics and Nutrition*  
*Sciences, Budapest, Hungary*  
*e-mail: [palfie@se-etk.hu](mailto:palfie@se-etk.hu)*

The prevalence of food allergy has been estimated to be approximately 1-3 % in adults and 2-9 % in children in Europe. The treatment of the food allergy is the lifelong allergen elimination diet that should be feasible only with adequate information about allergen content of foods and dietetic management. In Hungary, there are different informational and educational techniques for food sensitive consumers. There are the current food labelling laws (EU and national), numerous medical centers and the Hungarian Food Allergy and Food Intolerance Databank. The Databank is functioning in our department, Semmelweis University Faculty of Health Sciences Department of Dietetics and Nutrition Sciences. The Databank is collecting the information about 'free from' products and we are taking continuous and regular dietetic counselling.

The aim of presentation is to show our experience of functioning of Hungarian Food Allergy Databank. We applied descriptive statistics and analyzed data from the registered food companies, products and the patients in the Hungarian Databank.

The Databank works side by side the EU and national food labelling laws. It is another way for consumers suffering from food allergy to know the information about "free from" product. We developed an electronic data basis containing 9 'free from' categories (gluten, milk, lactose, egg, soy, peanut and nuts, azocolour, benzoic-acid and sulphites) in the year 2000. The Databank has published the 'free from' products list since 2001. The databank is requesting most of the patients suffering coeliac disease, milk allergy and lactose intolerance. We found that the number of registered products as well as the number of registered companies increased between 2001-2006, but decreased these parameters between 2006-2010. In addition, in 2010 we sent over 5000 pieces to the patients who suffered from food allergy. Since 2004 a website has been worked that contains the 'free from' lists and educational materials for patients about allergy and allergen information. The total visit of this website is 5086±650.

**Key words:** food allergy, Food Allergy Databank, allergen labeling

## ALLERGEN LABELLING PRACTICE OF HUNGARIAN MEAT PRODUCTS

*Erzsebet PÁLFI, Cecília GÁL, Judit KECSKEMÉTI, István SZABOLCS, József SURÁNYI*  
*Semmelweis University Faculty of Health Sciences Department of Dietetics and Nutrition*  
*Sciences, Budapest, Hungary*  
*e-mail: [palfie@se-etk.hu](mailto:palfie@se-etk.hu)*

Food allergy is an adverse immune reaction to food proteins that affects the quality of life of patients. There has been recent increase in the prevalence of allergic reactions in westernized countries. The major food allergens are egg, milk and soy in childhood. Vegetables, such as celery, are more common in adulthood and peanut allergy is common among children as well as adults. The treatment is the allergen avoidance diet. One side, the diet is difficult, because the information of allergen content might be confusing. For example, consumer suffering from milk allergy might not recognize that casein is milk ingredient. Other side, the gluten, milk, soy content food, such as meat products essential part of Hungarian cuisine. Meat products consumption of Hungarian population is approximately 16,2 kg/year. The European Union regulates the allergen labelling in Directive of 2000/13/EC (2003/89/EC modification), that recites 14 major allergens. These are the cereals containing gluten, crustaceans, eggs, fish, peanuts, soybeans, cow's milk and dairy products including lactose, nuts, sesame seeds, celery, mustard, molluscs and sulphite at concentration of 10 mg/kg and lupin. The meat products contain gluten, milk, lactose, soy and celery from major, labelling required 14 allergens. The aim of this study is to estimate the practice of allergen labelling. We took into the study 74 meat products (Horeca Select and Aro brands) from Metro Cash & Carry. We measured the format, the phrasing and distinctness of allergen labelling. There are allergen information on the label of the most of the measured meat product; 6/14 from Horeca Select products and 46/60 from Aro products. The allergen information is located among ingredients list, 'may contain', 'may contain traces of' and 'free from milk or soy' labelling on the back of meat products. The labelling is unambiguous on every product.

**Key words:** food legislation, allergen labelling, meat products

## PROCESSING METHODS FOR THE JUICE OF BITTER MELON FRUITS

*Simona PERTA-CRISAN, Raul IANCHICI*  
*Aurel Vlaicu University, Arad, Romania*  
*e-mail: [simo\\_crisan@yahoo.com](mailto:simo_crisan@yahoo.com)*

*Momordica charantia* L. belongs to *Cucurbitaceae* family and is commonly named bitter gourd or bitter melon. Native to Asia, this plant is cultivated especially throughout the tropics, but can accommodate itself to other countries' warm climate. All parts of plant have been used since ancient times in traditional medicine for treating various diseases like tumours, hypertension and infections of the skin, but most of all it represents an important source of active principles with antidiabetic action. Various parts of plant, especially the fruit, have been widely used for preparation of hypoglycemic pharmaceutical compositions. The juice of the fruit is known to exhibit hypoglycemic properties and it is often recommended to reduce the blood sugar levels in patients suffering of diabetes mellitus. Among chemical compounds with demonstrated hypoglycemic activity can be noticed: charantin, vicine, lectins, polypeptide-p/p-insulin/v-insulin, peptide MC6. The action mechanism of these compounds is not clarified, not existing till present any conclusions if any of these active compounds acts alone or their action is synergic. Our researches focused on studying two protein fractions from the juice of bitter melon fruits, compounds with proved hypoglycemic activity: polypeptide-p and peptide MC6. In order to preserve these biological active compounds and also hypoglycemic properties we have proceeded to drying fresh cellular juice from fruits through three different methods: pulverization drying, under-pressure drying and lyophilization. For further qualitative analysis we have reconstructed the juice by rehydration, demonstrating that studied compounds have not been damaged by thermal treatments, which constitute good processing and preserving methods. The separation of all protein fractions and identification of compounds of interest from juices were realized by SDS-PAGE electrophoresis.

**Key words:** bitter melon, polypeptide-p, peptide MC6, pulverization drying, under-pressure drying, lyophilization, SDS PAGE

## REFURBISHMENT OF A SEED PROCESSING PLANT AT INSTITUTE OF FIELD AND VEGETABLE CROPS AND QUALITY ANALYSIS OF PROCESSED SEED

*Siniša PROLE, Jelena MRĐA, Goran JOKIĆ, Daliborka BUTAŠ, Velimir RADIĆ, Karlo  
DILVESI, Vladimir MIKLIĆ*

*Institute of Field and Vegetable Crops, Oilcrops Department, Novi Sad, Maxim Gorki St. 30,  
Serbia*

*e-mail: [sinisa.prole@ifvcns.ns.ac.rs](mailto:sinisa.prole@ifvcns.ns.ac.rs)*

In the conditions of market economy and fierce market competition, a priority for oilcrops seed producers and processors is meeting the high requirements of seed quality. Oilcrops seed processing is done in the processing plant of Oilcrops Department of Institute of Field and Vegetable Crops. The plant was constructed and put in operation in 1997. The employed technology was able to meet the contemporaneous production and technical requirements.

Production of sunflower seed, of the required quality, has to be completed in a short period of time, in order to leave sufficient time for a country-wide advertizing campaign and shipment of the entire seed production to end customers. In addition to these time constraints, seed processing has been simultaneously required to keep improving the quality of processed seed. As the quality of seed processing and quantity of processed seed are directly proportional parameters, plant refurbishment activities have been bound to proceed in a previously determined direction.

To achieve the planned objectives, it was necessary to increase the production capacity of the processing plant. Due to limited space and financial resources, the problem has been solved by re-connecting the machines and equipment to work as two parallel processing lines. Continuity of the process as well as its semi-automatic operation have been achieved by putting in practice an original design. The way of synchronizing the operation of the new machines, as well as the synchronization of their operation with that of the existing machinery and equipment, involve original and innovative technical solutions.

The paper discusses the tests of several seed quality parameters, for two sunflower hybrids. The policy of the plant is to process hybrid sunflower seed in lots (a maximum weight of 20,000 kg), each lot originating from a single location. The studied period involved ten production years. Quality parameters were observed per lot and production year.

The analysis of the 10-year results showed that, in consequence to the introduction of the technical and technological solutions mentioned above, the refurbished plant supplies the hybrid sunflower seed whose quality parameters significantly exceed the standards prescribed by law.

**Key words:** processing, processing capacity, plant refurbishment, sunflower seed purity, location, production year.



## REKONSTRUKCIJA CENTRA ZA DORADU I ANALIZA KVALITETA DORAĐENOG SEMENA U INSTITUTU ZA RATARSTVO I POVRTARSTVO

*Siniša PROLE, Jelena MRĐA, Goran JOKIĆ, Daliborka BUTAŠ, Velimir RADIĆ, Karlo  
ĐILVESI, Vladimir MIKLJIĆ*

*Institut za ratarstvo i povrtarstvo, Odeljenje za uljane kulture, Novi Sad, Maksima Gorkog 30,  
Srbija*

*e-mail: [sinisa.prole@ifvns.ns.ac.rs](mailto:sinisa.prole@ifvns.ns.ac.rs)*

U tržišnim uslovima privređivanja i ambijentu oštre konkurencije, prioritetan zadatak proizvođača semena uljanih kultura je proizvodnja semenskog materijala koja zadovoljava visoke zahteve kvaliteta proizvoda. Dorada semena uljanih kultura se realizuje u Centru za doradu semena, Odeljenja za uljane kulture Instituta za ratarstvo i povrtarstvo iz Novog Sada. Tehnološka postavka sistema dorade je prethodno montirana 1997 godine, što je u tom periodu zadovoljavalo postavljene proizvodne i tehničko-tehnološke zahteve.

Proizvodnju kvalitetnog semena suncokreta je potrebno realizovati u veoma kratkom vremenskom periodu, kako bi se na vreme marketinški pokrilo tržište i kompletna proizvodnja semena plasirala do krajnjeg kupca. Pored vremenskog ograničenja dorade, postavljeni su paralelno i zahtevi poboljšanja kvaliteta dorađenog semena. Kvalitet i kvantitet dorade su direktno proporcionalne veličine, te su pravci rekonstrukcije determinisani u tom smeru.

Za pomenute aktivnosti bilo je neophodno povećati kapacitet dorade semena uljanih kultura. Zbog ograničenog prostora i finansijskih sredstava, problem je rešen specifičnim povezivanjem mašina i opreme u paralelnu vezu. Kontinuitet procesa, kao i poluautomatski rad je originalno projektovan i realizovan. Međusobna sinhronizacija rada novih mašina, kao i sinhronizacija rada sa postojećim mašinama i opremom, predstavljaju originalno i inovativno tehničko rešenje.

Radom su obuhvaćena ispitivanja više parametara kvaliteta, za dva hibrida semena suncokreta. Seme hibridnog suncokreta je dorađivano po partijama (max. 20.000 kg) i lokalitetima (mestima proizvodnje). Istraživanje se odnosilo na period od deset godina proizvodnje, za izabrane hibride. Parametri kvaliteta su posmatrani po partijama i godinama proizvodnje.

Rezultat navedenih tehničko-tehnoloških rešenja i desetogodišnjih ispitivanja, je dorada hibridnog semena suncokreta, sa parametrima kvaliteta koje značajno prevazilaze zakonom predviđene norme.

**Ključne reči:** dorada, kapacitet dorade, rekonstrukcija dorade, seme suncokreta, čistoća semena, lokalitet, godina proizvodnje.

## TECHNOLOGY HIGH QUALITY CULTIVARS TOLERANT SUGAR BEET IN THE AP VOJVODINA

*Stevan RADIVOJEVIĆ, Jasna GRBIĆ, Rada JEVTIĆ-MUČIBABIĆ, Vlada FILIPOVIĆ*  
*Institute for Food Technology Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia*  
*e-mail: [stevanradivojevic@sbb.rs](mailto:stevanradivojevic@sbb.rs)*

Varietal microtrials with fifteen sugar beet cultivars characterized with different tolerance to *Cercospora beticola*, rhizomania and *Rhizoctonia solani* were set according to standard methods at two localities (Sombor and Stara Pazova) in four replicates. Both trials were sown at optimal period in 2009 and harvested in the first half of October. Chemical and data analyses were done according to standard methods.

The obtained results showed that root yield varied from 77,08 t/ha for cultivar No. 14 (Sombor site) to 114,49 t/ha for cultivar No. 7 (Stara Pazova site). High variability in the root sugar content was observed that ranged from 14,32 % for cultivar No. 8 (Stara Pazova) to 20,10 % for cultivar No. 3 (Sombor). There was also high difference regarding sugar utilization within the tested cultivars and it amounted to 6,21 % absolute. Marked differences in thick juice purity and molasses content were also registered.

There were high variations in the content of non-sugar compounds in beet (K, Na,  $\alpha$ -N) especially in the sodium content. Depending on the level of disease tolerance of cultivar, sodium content ranged from 0,88 mmol/100°S to 16,20 mmol/100°S, which is a 18,41-fold difference. Granulated sugar content, as the most important quality parameter, reached the best figure in the cultivar with the highest tolerance (17,096 t/ha) whereas it was the lowest in the case of the least tolerant cultivar (10,465 t/ha). The difference in this parameter can be considered as very high (6,631 t/ha) in favour of highly tolerant cultivar. If this difference is multiplied with the average area cultivated with sugar beet (around 75000 ha), economic benefit is more than obvious.

**Key words:** sugar beet, variety, yield, processing quality

## TEHNOLOŠKI KVALITET VISOKO TOLERANTNIH SORTI ŠEĆERNE REPE U AP VOJVODINI

*Stevan RADIVOJEVIĆ, Jasna GRBIĆ, Rada JEVTIĆ-MUČIBABIĆ, Vlada FILIPOVIĆ*  
*Univerzitet u Novom Sadu, Institut za prehrambene tehnologije, Bul. cara Lazara 1, 21000*  
*Novi Sad, Srbija*  
*e-mail: [stevanradivojevic@sbb.rs](mailto:stevanradivojevic@sbb.rs)*

Sortni mikroogledi sa petnaest sorata šećerne repe, različite tolerantnosti na cercosporu beticola, rizomaniju i rizoctoniju solani, bili su postavljeni po standardnim metodama, na dva lokaliteta (Sombor i Stara Pazova) u četiri ponavljanja. Oba mikroogleda zasejana su u optimalnom roku u toku 2009. godine, a vađenje šećerne repe izvršeno je u prvoj polovini oktobra. Hemiske analize uzoraka, urađene su po jednoobraznim metodama rada, u Institutu za prehrambene tehnologije, a takođe su izvršeni neophodni obračuni za važne pokazatelje tehnološkog kvaliteta.

Na osnovu utvrđenih rezultata vidljivo je da se prinos korena šećerne repe kretao od 77,08 t/ha, kod sorte broj četrnaest u Somboru do 114,49 t/ha kod sorte broj sedam u Staroj Pazovi. U pogledu sadržaja šećera u repu ustanovljena su takođe visoka odstupanja, i to: od 14,32 % kod sorte broj osam u Staroj Pazovi, do 20,10 % kod sorte broj tri u Somboru. Visoka razilka utvrđena je kod iskorišćenja šećera na repu, kod napred navedenih sorata, i ona je iznosila 6,21 % apsolutnih. Značajna ekstremna razilka bila je i u vrednostima kvocijenta gustog soka i sadržaja šećera u melasi u procentima na repu.

Izuzetno visoka variranja bila su i kod sadržaja nešećernih materija u repu (K, Na,  $\alpha$ -N), a naročito kod sadržaja natrijuma. U zavisnosti od tolerantnosti sorti na pomenuta obolenja, sadržaj natrijuma kretao se od 0,88 mmol/100°S do 16,20 mmol/100°S, što iznosi 18,41 puta. Prinos kristalnog šećera, kao najvažniji pokazatelj u proizvodnji šećerne repe, najbolji je bio kod visoko tolerantne sorte (17,096 t/ha), a najslabiji bio je kod sorte sa manjom tolerantnošću (10,465 t/ha). Navedena razlika je veoma visoka i iznosi 6,631 t/ha, u korist sorte sa visokom tolerantnošću. Pomenuta razlika ako se pomnoži sa prosečno zasejanim površinama pod šećernom repom (oko 75000 ha) predstavlja veoma visoku ekonomsku korist za Republiku Srbiju.

**Ključne reči:** šećerna repa, sorta, prinos, tehnološki kvalitet

## VARIABILITY OF YIELD AND KERNEL QUALITY PARAMETERS FOR POPCORN HYBRIDS (*Zea mays L. everta*)

Jelena SRDIĆ, Zorica PAJIĆ  
Maize Research Institute "Zemun Polje", Belgrade, Serbia  
e-mail: [jsrdic@mrizp.rs](mailto:jsrdic@mrizp.rs)

Popcorn is the special flint type of maize, which is distinctive by its ability to form large "flake", as a response to heating of kernel. Therefore beside the yield itself as the major trait, quality of the popped kernel i.e. popping volume is important as much for this type of maize.

The experiment with 12 popcorn hybrids was set up according to the complete randomized block design with three replicates. Examined traits were: grain yield (with 14% moisture), popping volume and number of kernels per 10g. ANOVA showed statistical differences among examined genotypes according to all three traits.

Defining the term of high quality of popcorn depends on the view of the producer, processor and the consumer of popcorn. That is why during breeding process, special attention is paid equally to the increase of the yield and maintaining and increasing of quality of the popped and unpopped kernel. Grain yield of the hybrids in this research varied from 3.36 t/ha (ZPkok 8) up to 6.07 t/ha (ZPkok 1). Popping volume is the ratio between volume of the popped and unpopped kernel and beside the taste and appearance of the flake, is the major quality parameter for consumers. The lowest popping volume had hybrid ZPkok 3 (27.33 cm<sup>3</sup>/g), which is considered unsatisfactory, while five hybrids had good popping volume over 38.00 cm<sup>3</sup>/g. The highest popping volume had hybrid ZPkok 12 with 39.50 cm<sup>3</sup>/g. The size of the kernel is measured by the number of kernels per 10g, and the classification is: large kernels (52-67); middle sized (68-75); small (76-105) and very small (>105 kernels in 10g). Six hybrids had large sized kernels, five were middle sized, while ZPkok 3 (83 kernels in 10g) had small sized kernels.

Correlation between examined traits was performed by *Spearman's* rank correlation coefficient. Negative correlation was determined between grain yield and popping volume (-0.52), which although wasn't significant pointed to the fact that higher yielding hybrids often have lower popping volumes. Significant correlation was between grain yield and number of kernels per 10 g (-0.70\*), i.e. hybrids with higher yield had larger sized kernels. Positive significant correlation was between number of kernels per 10g and popping volume (0.66\*), or smaller sized genotypes performed higher popping volumes. These results point out to the fact that breeding of popcorn is very complex process, for there is necessity of producing high yielding and good popping quality hybrids, what is mostly contradictory.

**Key words:** popcorn, grain yield, popping volume, number of kernels in 10g

## VARIJABILNOST PRINOSA I PARAMETARA KVALITETA ZRNA HIBRIDA KUKURUZA KOKIČARA (*Zea mays L. everta*)

Jelena SRDIĆ, Zorica PAJIĆ  
Institut za kukuruz „Zemun Polje”, Beograd, Srbija  
e-mail: [jsrdic@mrizp.rs](mailto:jsrdic@mrizp.rs)

Kukuruz kokičar je specijalna vrsta kukuruza tvrduca, koji se odlikuje mogućnošću da formira krupnu „pahuljicu“ ili „kokicu“ kao odgovor na zagrevanje zrna. Zbog toga je za ovaj tip kukuruza pored prinosa kao glavne osobine bitan i kvalitet iskokanog zrna, naročito njegova zapremina.

Ogled sa 12 hibrida kukuruza kokičara postavljen je po principu slučajnog bloka u 3 ponavljanja. Ispitivane su osobine prinosa zrna kukuruza (sa 14% vlage), zapremina kokičavosti i broj zrna u 10g. Analiza varijanse pokazala je da postoje statistički značajne razlike između posmatranih genotipova u pogledu sve tri ispitivane osobine.

Definisanje visokog kvaliteta kukuruza kokičara zavisi od aspekta kako proizvođača, dorađivača tako i potrošača. Zbog toga se posebna pažnja u oplemenjivanju posvećuje povećanju prinosa, ali sa zadržavanjem i povećanjem kvaliteta iskokanog i neiskokanog zrna. Prinos zrna hibrida u ovom istraživanju, kretao se od 3,36 t/ha (ZPkok 8) do 6,07 t/ha (ZPkok 1). Zapremina kokičavosti predstavlja odnos zapremine iskokanog i neiskokanog zrna i pored ukusa i izgleda kokice glavna je osobina koju potrošači cene. Najmanju zapreminu ostvario je hibrid ZPkok 3 (27,33 cm<sup>3</sup>/g), što se smatra izuzetno niskom zapreminom, dok je 5 hibrida imalo dobru zapreminu kokičavosti od preko 38,00 cm<sup>3</sup>/g. Najvišu zapreminu kokičavosti ostvario je ZPkok 12 sa 39,50 cm<sup>3</sup>/g. Veličina zrna kokičara meri se brojem zrna u 10g, pa se na ovaj način mogu klasifikovati zrna u krupna (52-67); srednja (68-75); sitna (76-105) i vrlo sitna (>105 zrna u 10g). Šest hibrida iz ovog istraživanja imalo je krupno zrno, pet hibrida je bilo srednje krupnoće zrna, dok je hibrid ZPkok 3 (83 zrna u 10g) bio sitnog zrna.

Utvrđena je korelacija između posmatranih osobina, pomoću *Spearman*-ovog koeficijenta korelacije ranga. Negativna korelacija utvrđena je između prinosa i zapremine kokičavosti (-0,52), koja iako nije bila značajna ukazuje na srednju jačinu zavisnosti između parametara i na to da prinostniji hibridi uglavnom imaju manju zapreminu kokičavosti. Značajna negativna korelacija utvrđena je između prinosa i broja zrna u 10g (-0,70\*), odnosno prinostniji genotipovi imaju i krupnije zrno. Značajna pozitivna korelacija bila je između broja zrna u 10g i zapremine kokičavosti (0,66\*), odnosno genotipovi sitnijeg zrna imali su veću zapreminu kokičavosti. Ovakvi rezultati govore u prilog kompleksnosti procesa oplemenjivanja kukuruza kokičara.

**Ključne reči:** kukuruz kokičar, prinos, zapremina kokičavosti, broj zrna u 10g

## THE INFLUENCE OF SEED STORAGE ON GERMINATION OF TALL FESCUE DURING AFTER-RIPENING PERIOD

*Rade STANISAVLJEVIĆ\**, *Dragoslav ĐOKIĆ\**, *Jasmina MILENKOVIĆ\**, *Dragan TERZIĆ\**,  
*Dragi LAZAREVIĆ\**, *Lana ĐUKANOVIĆ\*\**, *Vesna VUGA-JANJATOVIĆ\*\**

*\*Institute for Forage Crops, Trg Kosturnice 50, 37000 Kruševac, Serbia*

*\*\*Agricultural Extension Service Sremska Mitrovica, Svetog Dimitrija 22, 22000 Sremska  
Mitrovica, Serbia*

*e-mail: rade.stanisavljevic@ikbks.com*

Tall fescue is one of the most important forage grasses, which often became part of the grass-legume mixtures. This type is characterized by good adaptation to environmental conditions, high yield of seed and forage.

After the harvest of tall fescue seed dormancy is present, indicating the reduction of germination. During the after-ripening period, a reduction in the amount of dormant seeds and increases seed germination, which allows planting in the fall of that year.

In the presence of natural meadow communities dormant seed can affect the germination delay or lack of germination in late autumn, resulting in germination in the spring when ecological conditions were favorable. This can affect the loss of grass species of meadow communities.

After drying and reducing the humidity below 13%, seeds can be stored in bulk or in containers. In practice, the seed of tall fescue is usually kept in large PVC bags.

In conventional storage conditions for seed storage, we investigated the influence of three different packaging (paper bags, canvas bags and plastic bags) to change the germination of seeds immediately after harvest, after 30, 60 and 90 days. At the three tested seed lot of meadow fescue, immediately after harvest showed 35-42% dormant seed, which caused the initial germination of 56 to 64%

After 30 days seed dormancy is reduced by 1 to 3% and germination was increased by 2-3%, while the impact of packaging had no significant effect.

The decreasing trend in seed dormancy and increased germination even after 60 days continued in the same percentages. Impact of packaging in this period also had no statistical significance ( $P \leq 0,05$ ).

After 90 days of storage of seeds observed a decrease dormant seed to 22-35% and increase the germination rate of 65-72%.

In the period of 90 days, the impact of packaging exhibited statistical significance. Also, some seed lots of the seeds have passed legislation to put the seeds on the market which is certainly influenced by the packaging for storage.

**Key words:** Tall Fescue, seed, storage

## UTICAJ ČUVANJA SEMENA VISOKOG VIJUKA NA KLJAVOST TOKOM POSŽETVENOG DOZREVANJA

*Rade STANISAVLJEVIĆ\**, *Dragoslav ĐOKIĆ\**, *Jasmina MILENKOVIĆ\**, *Dragan TERZIĆ\**,  
*Dragi LAZAREVIĆ\** *Lana ĐUKANOVIĆ\*\**, *Vesna VUGA-JANJATOVIĆ\*\**

*\*Institut za krmno bilje, 37000 Kruševac, Trg Kosturnice 50, 37000 Kruševac, Srbija*

*\*\*Poljoprivredna stručna služba Sremska Mitrovica, Svetog Dimitrija 22, 22000 Sremska Mitrovica, Srbija*

*e-mail: [rade.stanisavljevic@ikbks.com](mailto:rade.stanisavljevic@ikbks.com)*

Visoki vijuk je jedna od važnijih krmnih trava, koja vrlo često ulazi u sastav travno-leguminoznih smeša, dok je gajenje u čistom usevu ređi slučaj. Ova vrsta se odlikuje dobrom prilagođavanju prema uslovima spoljne sredine, visokim prinosom krme i semena.

Posle žetve visokog vijuka je prisutno dormantno seme, što uslovljava smanjenje kljavosti. Tokom perioda dozrevanja, dolazi do smanjenja količine dormantnog semena i povećanja kljavosti, što omogućava setvu u jesen iste godine. U prirodnim livadskim zajednicama prisutnost dormantnog semena može uticati na odlaganje kljavosti ili, izostanak klijanja u kasnom jesenjem periodu, što ima za posledicu klijanje u proleće kada su povoljni uslovi spoljne sredine, a što dalje utiče na gubljenje ove travne vrste iz livadskih zajednica.

Nakon dosušivanja semena i smanjenja vlažnosti ispod 13 %, seme je moguće čuvati u rinfuzu, ili u ambalaži. U praksi, seme visokog vijuka se najčešće čuva u većim PVC vrećama.

U klasičnim skladišnim uslovima za čuvanje semena, ispitivan je uticaj tri različite ambalaže (papirne kese, platnene kese i PVC kese) na promenu kljavosti, odmah nakon ubiranja semena, nakon 30, 60 i 90 dana.

Na tri ispitivane partije semena livadskog vijuka, odmah nakon žetve je utvrđeno 35 – 42 % dormantnog semena, što je uslovalo početnu kljavost od 56 do 64%. Nakon 30 dana dormantnost semena se smanjila za 1 do 3 % a kljavost se povećala za 2-3 %, dok uticaj ambalaže nije imao značajan uticaj. Trend smanjenja dormantnosti semena i povećanja kljavosti se i nakon 60 dana nastavio u istim procentima. Uticaj ambalaže u ovom periodu, takođe, nije imao statističku značajnost ( $P \leq 0,05$ ).

Nakon 90 dana čuvanja semena zapaženo je smanjenje dormantnog semena na 22-35 % i povećanje kljavosti na 65-72 %. U periodu od 90 dana, uticaj ambalaže na kljavost je ispoljio statističku značajnost. Takođe, neke partije ovog semena su zadovoljile zakonsku regulativu za stavljanje semena u promet na šta je, svakako, uticala i ambalaža za čuvanje.

**Ključne reči:** visoki vijuk, seme, čuvanje

## EFFECT OF SOWING DATE ON MAIZE YIELD

*Živorad VIDENović, Milena SIMIĆ, Jelena SRDIĆ, Zoran DUMANović, Milovan PAVLOV*

*Maize Research Institute "Zemun Polje", Belgrade, Serbia*

*e-mail: [zvidenovic@mrizp.rs](mailto:zvidenovic@mrizp.rs)*

The date of maize sowing is the factor that has significant impact on the level of maize production. The beginning of the vegetative season depends on the favorable temperatures and sufficient amounts of precipitations. Optimal sowing date could be defined as the sowing date that provides, that maize seedling emergence occurs in the most favorable moment, and that conditions of the vegetative period are maximally exploited in terms of the maximizing the yield.

These experiments were conducted in the period from the year 2003 until 2008. in Zemun Polje on the chernozem soil type. Six sowing dates were examined: three in April: 5<sup>th</sup> (T<sub>1</sub>), 15<sup>th</sup> (T<sub>2</sub>) and 25<sup>th</sup> (T<sub>3</sub>), and three in May 5<sup>th</sup> (T<sub>4</sub>), 15<sup>th</sup> (T<sub>5</sub>) and 25<sup>th</sup> (T<sub>6</sub>). Five hybrids were included in this research: ZP 434, ZP 578, ZP 580, ZP 680 and ZP 684.

Soil cultivation was performed in the conventional fashion. After winter wheat harvest shallow stubble ploughing was performed at the depth of 15 cm. Autumn ploughing was performed to the depth of 25cm. Soil preparation was done by seed bed tiller, 7-10 days prior to sowing. Sowing density was 62.112 plants/ha. All amounts of fertilizers: 150kg/ha N; 100kg/ha P<sub>2</sub>O<sub>5</sub> and 80kg/ha K<sub>2</sub>O, were applied in the autumn by spreading on the soil surface. After sowing following herbicides were applied: Atrazin in amounts of 1 l/ha = 500g a.i., and Acetohlor – 2 l/ha = 1800g. a.i. During vegetation one interrow cultivation was performed.

In the examined period three unfavorable years for the maize production were distinguished: 2003 with 210,0mm; 2007 with 290,1mm, and 2008 with 224,6mm of precipitation; 2005 had moderately favorable conditions with 387,4mm of precipitation during vegetative period and two years were favorable for the maize production both in terms of amounts and distribution of precipitation during vegetative period: 2004 with 427,6mm and 2006 with 417,1mm.

The highest average yield was achieved for the T<sub>2</sub> sowing date - 15<sup>th</sup> April (11,13 t/ha – 100%). In the other April sowing dates average yield was lower T<sub>1</sub> 11,02t/ha (99,05%); T<sub>3</sub> 10,97 (98,55%). The effects of the May sowing dates were significantly lower comparing with the T<sub>1</sub>: T<sub>4</sub> 10,54 t/ha (94,69%); T<sub>5</sub> 10,43 t/ha (93,75%) and T<sub>6</sub> 9,71 t/ha (87,27%). The highest yielding hybrid was ZP 684 (11.16 t/ha), while the others achieved lower yields than it for 2,26% - ZP 680, 4,57% - ZP 580, 3,58% - ZP 578 and 8,15% - ZP 434.

We started measuring kernel moisture content when it was about 30%. Kernel moisture content varied depending on the hybrid, sowing date and the year. Hybrid ZP 434 had the lowest moisture content of all the hybrids (22,20%). Sowing date T<sub>1</sub> had the lowest moisture content (20,91%), while the T<sub>6</sub> had the highest moisture content (26,91%). The moisture content was significantly higher in the two latest sowing dates. This is the consequence of the higher temperatures in the period of seed maturation of the earlier sowing dates, comparing to the later sowing dates. Nevertheless there were some years that moisture content in the kernel was up to 40% in the last two sowing dates.

These results doubtlessly point to the fact that sowing date in the mid of April is the optimum sowing date for the most important maize production areas in Serbia. In regard to that, moisture content is lower and there is no need for extra expenses for kernel drying. In the case that the sowing must be done in May it is better to use maize hybrids of shorter vegetation such as FAO 400 or less.

**Key words:** maize hybrids, sowing date, amounts of precipitations, kernel moisture



## EFEKAT VREMENA SETVE NA PRINOS KUKURUZA

*Živorad VIDENOVIC, Milena SIMIC, Jelena SRDIC, Zoran DUMANOVIC, Milovan  
PAVLOV*

*Institut za kukuruz „Zemun Polje”, Beograd, Srbija*

*e-mail: [zvidenovic@mrizp.rs](mailto:zvidenovic@mrizp.rs)*

Vreme setve spada u faktore koji imaju značajan uticaj na nivo prinosa kukuruza. Početak vegetacione sezone zavisi od povoljne temperature i dovoljnih količina padavina. Optimalni rok setve bi se mogao definisati kao vreme setve kojim se obezbeđuje da kukuruz nikne u najpovoljnijem trenutku, kako bi maksimalno iskoristio uslove vegetacionog perioda i formirao što veći prinos.

Ova ispitivanja obavljena su u periodu od 2003. do 2008. godine u Zemun Polju na zemljištu tipa černozem. Ispitivana su šest rokova setve: tri u aprili mesecu 5. (T<sub>1</sub>), 15. (T<sub>2</sub>) i 25. (T<sub>3</sub>) aprili i tri u maju mesecu 5. (T<sub>4</sub>), 15. (T<sub>5</sub>) i 25. maj (T<sub>6</sub>). U ispitivanje su bila uključena 5 hibrida: ZP 434, ZP 578, ZP 580, ZP 680 i ZP 684.

Obrada zemljišta obavljena je na klasičan način. Posle žetve pšenice izvršeno je plitko zaoravanje strništa na dubini od 15cm. U jesen je obavljeno oranje na dubini od 25cm. Priprema zemljišta za setvu izvršena je setvospremačem, 7-10 dana pre setve. Gustina setve bila je 62.112 biljke/ha. Ukupna količina đubriva primenjena je u jesen rasturanjem po površini zemljišta: 150kg/ha N; 100kg/ha P<sub>2</sub>O<sub>5</sub> i 80kg/ha K<sub>2</sub>O. Posle setve primenjen je herbicid Atrazin u količini od 1/l = 500g a.i., i Acetohlor u količini od 2l/ha = 1800g. a.i. U toku vegetacije izvršeno je jedno međuredno kultiviranje.

U toku ispitivanja bile su tri nepovoljne godine za proizvodnju kukuruza: 2003.g sa 210,0mm; 2007.g. sa 290,1mm i 2008.g. sa 224,6mm; jedna godina sa umereno povoljnim uslovima: 2005.g. sa 387,4mm i dve povoljne godine: 2004.g sa 427,6mm i 2006.g sa 417,1mm, koje su imale i dobar rasporeda padavina u toku vegetacije.

Najveći prosečan prinos ostvaren je pri setvi 15. aprila (11,13 t/ha), koji je uzet kao 100,00%. U ostalim rokovima setve u aprilu mesecu prinos je bio manji: T<sub>1</sub> 11,02t/ha (99,05%); T<sub>3</sub> 10,97 (98,55%). Varijante setve u maju mesecu, bile su statistički veoma značajno manje u odnosu na onu koja je imala najveći prinos: T<sub>4</sub> 10,54 t/ha (94,69%); T<sub>5</sub> 10,43 t/ha (93,75%) i T<sub>6</sub> 9,71 t/ha (87,27%). Hibrid ZP 684 imao je najveći prosečan prinos od 11,16 t/ha a svi ostali dali su manji prinos: ZP 680 za 2,26%; ZP 580 za 4,57%; ZP 578 za 3,58% i ZP 434 za 8,15%.

Početak praćenja sadržaja vlage zrna bio je kada je ona iznosila oko 30%. Sadržaj vlage zrna bio je različit kod ispitivanih hibrida i vremena setve i po godinama ispitivanja. Hibrid ZP 434 je u proseku imao najmanju vlagu zrna 22,20%. Za rok setve T<sub>1</sub> prosečan sadržaj vlage je bio 20,91% a zatim se povećavala i u poslednjem roku setve bila je 26,91%. Ovo je logična posledica većih temperatura u vreme dozrevanja ranijih rokova setve u odnosu na one koji su obavljani kasnije. Međutim, bilo je i godina kada je u poslednja dva roka setve vlaga zrna bila i do 40%.

Navedene činjenice nedvosmisleno ukazuju da je setva polovinom aprila meseca, najpovoljniji rok setve za najznačajnija proizvodna područja kukuruza Srbije. Naime, sadržaj vlage zrna je niži i nisu potrebni dodatni troškovi za sušenje zrna. U slučaju da setva mora da se obavi u maju mesecu treba koristiti hibride kukuruza FAO 400 i kraće vegetacije.

**Ključne reči:** hibridni kukuruz, datum setve, količina padavina, vlažnost zrna