XXVI MEĐUNARODNO SAVJETOVANJE
26th INTERNATIONAL CONFERENCE

KRMIVA 2019

ZBORNIK SAŽETAKA ❖ BOOK OF ABSTRACTS

Opatija HRVATSKA ❖ CROATIA

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ZBORNIK SAŽETAKA
26. MEĐUNARODNOG SAVJETOVANJA KRMIVA
2019

BOOK OF ABSTRACTS
OF THE 26th INTERNATIONAL CONFERENCE
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Teme savjetovanja	***Conference topics:***
Aditivi, mikro i makro elementi u hranidbi životinja	*Additives, micro and macroelements in animal nutrition*
Alternativni izvori hranjivih tvari u hranidbi životinja	*Alternative sources of nutrients in animal nutrition*
Utjecaj hranidbe na proizvodnost i zdravlje životinja te kvalitetu animalnih proizvoda	*Impact of nutrition on production and health of animal and the quality of animal products*
Legislativa u hranidbi životinja	*Legislation in animal nutrition*
Tehnologija izrade i analiza krmiva i krmnih smjesa	*Technology for the production and analysis of feed and feed mixtures*
Suvremene tehnologije u stočarskoj proizvodnji	*Modern technologies in livestock production*
Slobodne teme	*Open topics*

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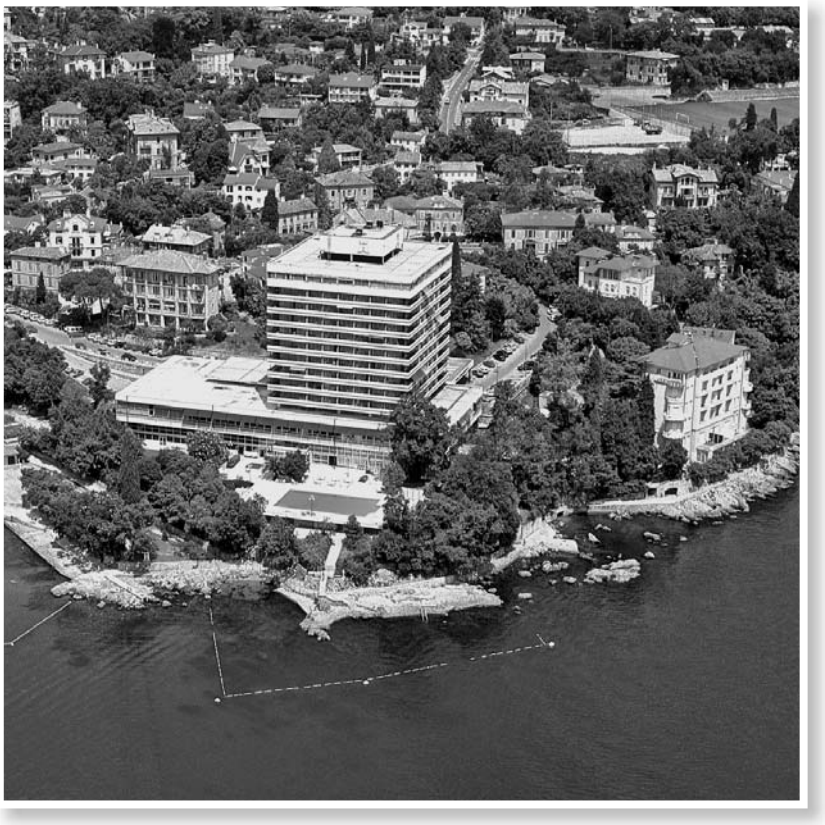
26th INTERNATIONAL CONFERENCE



Pod visokim pokroviteljstvom
predsjednice Republike Hrvatske Kolinde Grabar-Kitarović
Under the high patronage
of the President of the Republic of Croatia Kolinda Grabar-Kitarović

Ministarstvo poljoprivrede
Ministry of Agriculture

Ministarstvo znanosti i obrazovanja
Ministry of Science and Education

5. – 7. lipnja 2019. / June 5 – 7, 2019

Hotel Ambasador, Opatija
Hrvatska / Croatia

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GOLDEN SPONSOR

26. Međunarodnog savjetovanja KRMIVA 2019
of the 26th International conference KRMIVA 2019

Primila sam Vaše pismo i zamolbu za pokroviteljstvom nad 26. Međunarodnim savjetovanjem KRMIVA 2019 koje će biti održano od 5. do 7. lipnja 2019. u Opatiji.

Zahvaljujem na pismu te Vas izvješćujem kako, i ove godine, s velikim zadovoljstvom prihvaćam pokroviteljstvo nad savjetovanjem KRMIVA, uz uvjerenje kako će navedena manifestacija privući veliki broj domaćih i inozemnih znanstvenika i stručnjaka, kojima će omogućiti plodonosnu razmjenu znanja i iskustava.

Srdačno Vas pozdravljam i želim puno uspjeha u pripremi i održavanju najavljenog savjetovanja.

S poštovanjem,

PREDSJEDNICA REPUBLIKE HRVATSKE

Kolinda Grabar-Kitarović

*iz pisma Predsjednice Republike Hrvatske Kolinde Grabar-Kitarović

I received your letter and the request for the patronage of the 26th International Conference KRMIVA 2019 which will be held 5 to 7 June 2019 in Opatija.

I thank you for the letter and I report to you that this year, with great pleasure I accept the patronage of KRMIVA conference, with the conviction that this event will attract a large number of domestic and foreign scientists and experts to enable fruitful exchange of knowledge and experience.

I cordially welcome you and wish you a lot of success in preparing and maintenance of the announced conference.

With respect,

PRESIDENT OF THE REPUBLIC OF CROATIA

Kolinda Grabar-Kitarović

**from the letter of the President of the Republic of Croatia Kolinda Grabar-Kitarović*

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PROGRAM MEĐUNARODNOG SAVJETOVANJA | *PROGRAM OF INTERNATIONAL CONFERENCE*

SRIJEDA, 5. lipnja 2019. | *Wednesday, June 5, 2019*

14:00 Registracija sudionika u hotelu Ambasador | *Registration*

15:00 Svečano otvaranje Međunarodnog savjetovanja KRMIVA 2019 | *Opening*

"Lijepa naša domovino" | *"Lijepa naša domovino" - Croatian anthem*

In memoriam – prof. dr. sc. Marijan Sviben | *In memoriam – prof. dr. sc. Marijan Sviben*

Pozdravi | *Addresses*

Voditelji | *Co-chairpersons:*

Matija Domaćinović, Nora Mas, Krzysztof Kwiatek

15:30 **Goran Kiš** (Agronomski fakultet, Zagreb – Hrvatska)
Precizna hranidba domaćih životinja
Precise feeding of domestic animals

15:50 **Miroslav Florian, Jiri Fiala, Jana Kalinova** (CISTA, Brno – Češka)
Krivotvorenje hrane za životinje – problem u nastajanju
Feed adulteration – an emerging issue

16:00 **Jasna Stevanović** (Privredna komora Srbije, Beograd - Srbija)**, Slađana Rakita, Dušica Čolović, Jovanka Lević** (Naučni institut za prehrambene tehnologije, Novi Sad - Srbija)
Značaj unapređenja regulatornog okvira u oblasti hrane za životinje
Importance of improving the regulatory framework in the field of animal feed

16:10 **Alfred Hera** (Veterinarsko i farmaceutsko sveučilište, Brno - Češka)**, Vera Billova, Eva Vernerova** (Institut državne kontrole za veterinarske i biološke lijekove, Brno – Češka)
Farmakovigilancijo istraživanje ljekovite hrane za divljači
Pharmacovigilance study of medicinal feed for game animals

16:20 **Waldemar Korol, Grazyna Bielecka, Jolanta Rubaj**
(Državni laboratorij za krmiva, Lublin – Poljska)
Sadržaj hranjivih i nepoželjnih supstanci u sjemenu soje koja nije genetski modificirana i dorađenih proizvoda za potrebe hranidbe
Nutrient and undesirable substance contents in non-GM native soybean seed and processed products for feeding purpose

16:30 **Ewelina Patyra** (Državni veterinarski istraživački institut, Pulawy - Poljska)**, Carolina Nebot, Rosa Elvira Gavilan** (Veterinarski fakultet, Lugo - Španjolska)**, Krzysztof Kwiatek, Monika Przenioslo-Siwczynska** (Državni veterinarski istraživački institut, Pulawy - Poljska)**, Alberto Cepeda** (Veterinarski fakultet, Lugo - Španjolska)
Analiza životinjskih fekalija kao alat za praćenje korištenja antibiotika
The analysis of animal faeces as a tool to monitor antibiotic usage

16:40 **Petr Vaculik** (CISTA, Brno – Češka)
Novi propisi EU o veterinarskim lijekovima i hrani koja sadrži lijekove
New EU regulation on veterinary medicines and medicated feeds

16:50 **Jana Tkačikova** (Pravni fakultet, Brno - Češka)
Trenutna zakonska regulativa EU na području zloupotrebe hrane i hrane za životinje
Current EU legal regulation the area of fraud food and feed

17:00 - 17:10 Rasprava | *Discussion*

17:10 - 17:30 Odmor | *Short break*

Voditelji | *Co-chairpersons*:

Darko Grbeša, Goran Kiš

OGRUGLI STOL | *ROUND TABLE DISCUSSION*

u suradnji sa Akademijom poljoprivrednih znanosti Zagreb
in cooperation with the Academy of Agricultural Sciences of Zagreb

17:30	**Željka Zgorelec, Ivana Šestak, Milan Mesić** (Agronomski fakultet, Zagreb – Hrvatska) Međuodnos poljoprivrede i okoliša *Interrelation between agriculture & the environment*
17:45	**Zlatko Svečnjak** (Agronomski fakultet, Zagreb – Hrvatska) Ekološki otisak proizvodnje hrane za životinje *Ecological brand of feed production*
18:00	**Darko Grbeša** (Agronomski fakultet, Zagreb – Hrvatska) Globalni ekološki otisak animalne proizvodnje *Ecological brand of animal production*
18:15	**Goran Kiš** (Agronomski fakultet, Zagreb – Hrvatska) Emisija stakleničkih plinova animalne proizvodnje RH – enterička fermentacija *Animal production of greenhouse gasses emission in the Republic of Croatia – enteric fermentation*
18:30	**Krešimir Salajpal** (Agronomski fakultet, Zagreb – Hrvatska) Emisija stakleničkih plinova animalne proizvodnje RH – gospodarenja stajskim gnojem *Animal production of greenhouse gasses emissions in the Republic of Croatia - manure management*
18:45	**Galyna Dukhta** (Sveučilište Kaposvar, Kaposvar - Mađarska)**, Jaap van Milgen** (PEGASE, Saint-Gilles- Francuska)**, György Köver, Veronika Halas** (Sveučilište Kaposvar, Kaposvar - Mađarska) Korištenje modela dinamičkog mehanizma brojlera kako bi se smanjio utjecaj na okoliš *Use of a dynamic mechanistic broiler model to reduce environmental footprint*
19:00 – 19:10	Rasprava | *Discussion*
19:30 – 20:00	100 godina AFZ – Zavoda za poljoprivrednu tehnologiju, skladištenje i transport te Zavoda za hranidbu životinja *100 years of AFZ - Department of Animal Nutrition and Department of Agricultural Technology, Storage and Transport*
20:00	Domjenak za učesnike Savjetovanja priređuje u hotelu Ambasador Krmiva d.o.o. Zagreb *Welcome party for participants of the Conference has been prepared by Krmiva d.o.o. Zagreb* Sponzori domjenka: | *Welcome party is sponsored by:* - Krmiva d.o.o., Zagreb - Žito d.o.o., Osijek

ČETVRTAK, 6. lipnja 2019. | *Thursday, June 6, 2019*

Voditelji | *Co-chairpersons*:

Zvonko Antunović, Zlatko Janječić, Robert Tothi

08:30 **Ivana Čabarkapa, Olivera Đuragić, Zorica Tomičić, Jovanka Lević**
(Naučni institut za prehrambene tehnologije, Novi Sad – Srbija)
Alge kao alternativni izvori proteina
Algae as alternative protein sources

08:40 **Tugomir Majdak** (Ministarstvo poljoprivrede RH, Zagreb - Hrvatska)**, Ana Matin, Zlatko Janječić, Mateja Grubor** (Agronomski fakultet, Zagreb – Hrvatska)
Mogućnost korištenja alternativnih izvora bjelančevina u hranidbi životinja
The possibility of alternative protein sources use in animal feeding

08:50 **Anna Weiner, Ilona Paprocka, Krzysztof Kwiatek**
(Državni veterinarski istraživački institut, Pulawy - Poljska)
Insekti- alternativni izvor proteina u hranidbi životinja
Insects - an alternative source of protein in animal nutrition

09:00 **Tomislav Mašek, Liča Lozica, Aleksandar Gavrilović, Kristina Starčević**
(Veterinarski fakultet, Zagreb - Hrvatska)
Varijabilnost u sastavu masnih kiselina u uzgoju komercijalno značajnih vrsta insekata - crne vojničke muhe (*Hermetia illucens*) i jamajčanskog poljskog šturka (*Gryllus assimilis*)
Variability in the fatty acid profile of important insect species in commercial production – Black soldier fly (Hermetia illucens) and Jamaican field cricket (Gryllus assimilis)

09:10 **Worku Alemayehu, Robert Tothi** (Fakultet poljoprivrednih i prirodnih znanosti, Kaposvar – Mađarska)**, Szilvia Orosz** (Animal Breeding Performance Testing Ltd, Gödöllo - Mađarska)**, Hedvig Febel** (Istraživački institut za uzgoj životinja, Herceghalom - Mađarska)**, Laszlo Kacsala, György Bazar, Tamas Toth** (Fakultet poljoprivrednih i prirodnih znanosti, Kaposvar – Mađarska)
Karakteristike hranidbenog sastava i aerobna stabilnost silaže talijanskog ljulja te mješavine ozimih žitarica u hranidbi mliječnih krava
Nutrient content and fermentation characteristics of ensiled italian ryegrass and winter cereal mixtures for dairy cows

09:20 **Josip Novoselec, Željka Klir, Vinko Sičaja, Zvonimir Steiner, Zvonko Antunović**
(Fakultet agrobiotehničkih znanosti, Osijek - Hrvatska)
Proizvodno - hematološki učinci primjene pira (*Triticum aestivum* spp. *spelta* L.) u tovu janjadi
Production - hematological effects of spelt (Triticum aestivum spp. spelta L.) in the fattening of lambs

09:30 **Hrvoje Milošević** (S.O.L.I.D., Graz - Austrija)
Korištenje obnovljivih izvora energije – potencijal primjene sunčeve energije za grijanje i hlađenje farmi - ušteda u potrošnji fosilnog goriva
Use of renewable energy sources – use of solar energy potential for farm heating and cooling - savings in fossil fuel consumption

09:50 – 10:00 Rasprava | *Discussion*

10:00 – 10:30 Odmor | *Short break*

Voditelji | *Co-chairpersons*:

Zlata Kralik, Dalibor Bedeković, Slađana Rakita

10:30 **Chongxiao Chen** (Sveučilište u Georgiji, Athens – SAD), **Byoungyun Jung** (Pathway Intermediates, Seoul - Južna Koreja), **Woo K. Kim** (Sveučilište u Georgiji, Athens - SAD))
Poboljšavanje performansa rasta i razvoj crijeva tovnih pilića lizofosfolipidom
Lysophospholipid improves growth performance and intestinal development in broilers

10:50 **Slađana Rakita, Radmilo Čolović, Vojislav Banjac** (Naučni institut za prehrambene tehnologije, Novi Sad – Srbija), **Farshad Goodarzi Boorojeni, Jürgen Zentek** (Institut za hranidbu životinja, Berlin - Njemačka)
Utjecaj dodatka sporednih proizvoda prerade uljarica na fizičke i nutritivne karakteristike ekstrudirane hrane za brojlere
Effect of oilseed by-products addition on physical and nutritional quality of extruded feed for broilers

11:00 **Ruud Kock** (Koudijs Animal Nutrition B.V., Ede-Wegeningen, Nizozemska)
Proizvodnja hrane za životinje: Kako proizvesti hranu sa najvišim ekonomskim učincima?
Feed production: How to produce feed for the highest economical performances?

11:20 **Jolanta Rubaj, Waldemar Korol, Grazyna Bielecka**
(Državni laboratorij za krmiva, Lublin – Poljska)
Utjecaj prirodnog sojinog obroka bez GM-a i proteaze na djelovanje brojlera
The influence of non-GM native soybean meal and protease on performance of broiler chickens

11:30 **Gordana Kralik** (Znanstveni centar izvrsnosti za personaliziranu brigu o zdravlju, Osijek - Hrvatska)**, Manuela Grčević, Danica Hanžek, Polonca Margeta, Zlata Kralik** (Fakultet agrobiotehničkih znanosti, Osijek - Hrvatska)
Obogaćivanje konzumnih jaja s n-3 masnim kiselinama
The enrichment of table eggs with n-3 fatty acids

11:40 **Hrvoje Valpotić, Dijana Brozić, Danijela Horvatek, Željko Gottstein, Liča Lozica, Silvijo Vince, Dražen Đuričić** (Veterinarska stanica, Đurđevac - Hrvatska)**, Ivona Žura Žaja** (Veterinarski fakultet, Zagreb - Hrvatska)**, Martina Đurić Jarić** (Ewopharma d.o.o., Zagreb - Hrvatska)**, Marko Samardžija, Željko Mikulec** (Veterinarski fakultet, Zagreb - Hrvatska)
Utjecaj nanočestica klinoptilolita na proizvodnost i oksidativni status tovnih pilića
Effect of clinoptilolite nanoparticles on performance and oxidative status of broiler chickens

11:50 **Saksit Srinongkote, Barbara Auer, Ana Gavrau** (Agrana Stärke, Beč - Austrija)
Usporedba učinaka različitih metilnih skupina na kvalitetu trupova brojlera u izazvanim uvjetima i utjecaj na kvalitetu legla
Comparing the effects of different methyl group donors on the carcass quality of broilers in challenged conditions and the effect on the litter quality

12:10 – 12:20 Rasprava | *Discussion*

12:20 – 12:30 Odmor | *Short break*

Voditelji | *Co-chairpersons*:

Hrvoje Valpotić, Dragan Šefer, Veronika Halas

12:30 **Vlado Vuković, Sreten Andonov** (Fakultet agronomskih znanosti i hrane, Skopje - Sjeverna Makedonija)**, Simo Stojkovski (**Eurogen DOOEL, Sjeverna Makedonija)**, Aleksandar Stojkovski, Trajče Filipovski** (Fakultet agronomskih znanosti i hrane, Skopje - Sjeverna Makedonija)**, Gyula Simon** (Topigs Norsvin Central Europe Ltd., Budimpešta - Mađarska)
Utjecaj kakvoće sjemena na reproduktivne rezultate na dvije Topigs Norsvin InGene farme
The Influence of semen quality on the reproductive results in two Topigs Norsvin InGene farms

12:50 **Veronika Halas** (Sveučilište Kaposvar, Kaposvar - Mađarska)**, Jaap van Milgen** (PEGASE, Saint-Gilles- Francuska)**, Galyna Dukhta, György Köver** (Sveučilište Kaposvar, Kaposvar - Mađarska)
Odluka o poticanju održive prehrane svinja
A decision support tool for sustainable swine nutrition

13:00 **Dragan Šefer, Radmila Marković, Stamen Radulović**
(Fakultet veterinarske medicine, Beograd – Srbija)
Uporaba butirata u prehrani svinja
Use of butyrate in pig nutrition

13:10 **Gergo Sudar, Jackline Mwikali, Janos Tossenberger**
(Fakultet poljoprivrednih i prirodnih znanosti, Kaposvar – Mađarska)
Probavljivost hranjivih tvari utjecajem dodavanja ksilanaze u svinjama koje rastu
Effect of xylanase supplementation on the digestability of nutrients in growing pigs

13:20 **Zoltan Csillik** (BASF Hungaria, Budimpešta - Mađarska)
BASF-ov enzim istraživanje i razvoj. Najveće prekretnice u tijeku
BASF enzyme research and development. Largest milestones in progress

13:40 **Zvonimir Steiner** (Fakultet agrobiotehničkih znanosti, Osijek – Hrvatska)**, Ivana Čeh** (Ministarstvo poljoprivrede RH, Zagreb - Hrvatska)**, Ivana Prakatur, Josip Novoselec, Željka Klir, Mario Ronta, Ivana Mirković, Davor Kralik, Robert Spajić** (Fakultet agrobiotehničkih znanosti, Osijek – Hrvatska), **Sabina Begić** (Tehnološki fakultet, Tuzla – Bosna i Hercegovina)
Primjena različitih koncentracija arome u krmnim smjesama na proizvodne karakteristike odlučene prasadi
The application of different concentrations of flavor in feed mixtures to the production characteristics weaning piglets

13:50 – 14:00 Rasprava | *Discussion*

Vrijeme za ručak | *Lunch*

Voditelji | *Co-chairpersons*:

Jasna Pintar, Kristina Kljak, Željka Klir

16:00 **Kristina Kljak, Marija Duvnjak, Darko Grbeša** (Agronomski fakultet, Zagreb – Hrvatska)
Sadržaj blagotvornih tvari u siliranom rehidriranom zrnu kukuruza
Content of beneficial compounds in ensiled rehydrated maize

16:10 **Darko Grbeša, Klara Novaković, Kristina Kljak** (Agronomski fakultet, Zagreb – Hrvatska)
Hibrid i duljina skladištenja silaže rehidriranog zrna kukuruza djeluju na *in vitro* kinetiku probavljivosti škroba
Hybrid and prolonged storage of rehydrated maize grain silage affects in vitro digestibility kinetics of starch

16:20 **Santina Pamić, Kristina Kljak** (Agronomski fakultet, Zagreb – Hrvatska)**, Vedran Bogdanović** (Farma muznih krava Kapelna, Žitar d.o.o., Donji Miholjac - Hrvatska)**, Darko Grbeša** (Agronomski fakultet, Zagreb – Hrvatska)
Koncentracija retinola i β-karotena u plazmi sisajuće teladi
Concentration of retinol and β-carotene in plasma of suckling calves

16:30 **Marina Horčička, Kristina Kljak, Darko Grbeša** (Agronomski fakultet, Zagreb – Hrvatska)
In vivo probavljivost vlakana u tovu junadi hranjene siliranim rehidriranim zrnom kukuruza
In vivo digestibility of fibers in fattening beef cattle fed ensiled rehydrated maize grain

16:40 **Kristina Sabo, Kristina Kljak, Darko Grbeša** (Agronomski fakultet, Zagreb – Hrvatska)
Utjecaj stajanja silaže visokovlažnog zrna kukuruza na koncentraciju karotenoida, tokola i retinola u plazmi junica
Effect of prolonged storage of high-moisture maize grain silage on concentration of carotenoids, tocols and retinol in plasma of heifers

16:50 – 17:00 Rasprava | *Discussion*

17:00 **POSTER SEKCIJA | *POSTER SESSION***

Voditelj | *Chairperson*:

Zvonimir Steiner

PETAK, 7. lipnja 2019. | *Friday, June 7, 2019*

Voditelji | *Co-chairpersons*:

Ana Matin, Davor Kralik, Radmila Čolović

08:30 **Ivana Vitasović – Kosić** (Agronomski fakultet, Zagreb – Hrvatska)
Tradicionalna hrana za životinje - etnobotanički aspekt korištenja bilja u Mediteranskom dijelu Hrvatske
Traditional feed for animals - the ethnobotanical aspects of using plants in the Mediterranean part of Croatia

08:40 **Ana Matin, Tajana Krička, Franko Jukić, Mateja Grubor**
(Agronomski fakultet, Zagreb – Hrvatska)
Kvalitativna i kvantitativna svojstva eteričnog ulja samoniklog i uzgojenog smilja u ekološkoj proizvodnji
Qualitative and quantitative properities of wild and organic grown helichrysum italicum immortelle essential oil

08:50 **Zlatko Janječić, Manuela Vukić, Ivica Kos, Klaudija Carović Stanko, Dalibor Bedeković** (Agronomski fakultet, Zagreb – Hrvatska)
Učinci dodavanja eteričnih ulja u hranu na proizvodne rezultate i kvalitetu mesa i jaja peradi
Effects of adding essential oils in feed to the production results and the quality of meat and poultry eggs

09:00 **Mateja Grubor, Tajana Krička, Ana Matin** (Agronomski fakultet, Zagreb – Hrvatska)
Brzina otpuštanja vode prilikom sušenja i fizikalna svojstva zrna soje
Water release speed during drying and physical properties of soya seed

09:20 **Josip Rukavina, Davor Kralik, Robert Spajić, Đurđica Kovačić, Daria Jovičić** (Fakultet agrobiotehničkih znanosti, Osijek – Hrvatska)
Mogućnost proizvodnje bioplina iz Miskantusa (*Miscanthus x Gigantheus*)
Possibility of bioplin production from Miscants (Miscanthus x Gigantheus)

09:30 – 09:50 Rasprava | *Discussion*

10:00 – 10:30 Odmor | *Short break*

Voditelji | *Co-chairpersons*:

Bojana Kokić, Emir Džomba, Robert Gasior

10:30 **Robert Gasior, Wojciech Wroblewski**
(Državni istraživački institut za animalnu proizvodnju, Balice n. Krakow - Poljska)
Procjena ne-proteinskog dušika metodom infracrvene spektroskopije
Estimation of non-protein nitrogen by near infrared reflectance spectroscopy

10:40 **Bojana Kokić** (Naučni institut za prehrambene tehnologije, Novi Sad – Srbija)**, Ljubica Dokić** (Tehnološki fakultet, Novi Sad - Srbija)**, Radmilo Čolović, Vojislav Banjac, Sanja Popović, Nedeljka Spasevski** (Naučni institut za prehrambene tehnologije, Novi Sad – Srbija)**, Lato Pezo** (Institut za opću i fizičku kemiju, Beograd – Srbija)
Utjecaj termičkih tretmana na razgradnju škroba u buragu
The influence of thermal treatments on starch rumen degradability

10:50 **Krzysztof Wojtycza, Robert Gasior** (Državni istraživački institut za animalnu proizvodnju, Balice n. Krakow - Poljska)**, Halina Bielinska** (Eksperimentalna stanica Državnog istraživačkog instituta za animalnu proizvodnju, Balice n. Krakow - Poljska)**, Angelika Odrzywolska** (Državni istraživački institut za animalnu proizvodnju, Balice n. Krakow - Poljska)
Otkrivanje hlapivih spojeva u mesu White Koluda® gusaka
Detection of volatile compounds in meat of White Koluda geese®

11:00 **Robert Gasior, Ewa Sosin-Bzducha, Krzysztof Wojtycza**
(Državni istraživački institut za animalnu proizvodnju, Balice n. Krakow - Poljska)
Otkrivanje hlapivih spojeva u mesu Polish Red-White i Simentalskog goveda
Detection of volatile compounds in meat of Polish Red-White and Simmental beef cattle

11:10 **Wladyslaw Migdal** (Poljoprivredno Sveučilište, Krakow - Poljska)**, Čedomir Radović, Vladimir Živković** (Institut za stočarstvo, Beograd-Zemun - Srbija)**, Maria Walczycka, Marzena Zajac, Joanna Tkaczewska, Piotr Kulawik, Ewelina Wesierska** (Poljoprivredno Sveučilište, Krakow - Poljska)**, Lukasz Migdal** (Zavod za genetiku i uzgoj životinja, Krakow - Poljska)**, Anna Migdal** (Institut za veterinarstvo, Krakow - Poljska)
Kemijske karakteristike tradicionalnih europskih kobasica
The chemical composition of traditional European sausages

11:20 – 11:30 Rasprava | *Discussion*

Zaključci i svečano zatvaranje Savjetovanja
Conclusions and official closing of Conference

Zlatko Janječić, Zvonko Antunović i Mario Modrić

"Bože čuvaj Hrvatsku" | *"God save Croatia"*

Cocktail za sve sudionike Savjetovanja priređuju KRMIVA d.o.o., Zagreb

Cocktail for all Conference participants hosted by KRMIVA d.o.o., Zagreb

POSTER SEKCIJA | *POSTER SESSION*

1. **Željka Klir, Josip Novoselec, Zvonko Antunović** (Fakultet agrobiotehničkih znanosti, Osijek – Hrvatska)
   Upotreba konoplje (*Cannabis sativa* L.) u hranidbi domaćih životinja
   The use of hemp (Cannabis sativa L.) in animal nutrition

2. **Emir Džomba, Senada Čengić-Džomba, Salko Muratović, Dženan Hadžić**
   (Poljoprivredno-prehrambeni fakultet, Sarajevo - Bosna i Hercegovina)
   Utjecaj dodavanja silaže lucerne košene u različitim periodima dana na proizvodna svojstva koza u porastu
   Feed intake and growth performance in goats fed alfalfa silages cut in various periods of day

3. **Nikola Puvača, Dragan Soleša** (Fakultet za ekonomiju i inženjerski menadžment, Novi Sad - Srbija)**, Dejan Obućinski** (Beogradska poslovna škola, Beograd - Srbija)**, Dragana Ljubojević Pelić** (Naučni institut za veterinarstvo, Novi Sad - Srbija)**, Radivoj Prodanović, Jelena Bošković** (Fakultet za ekonomiju i inženjerski menadžment, Novi Sad - Srbija)**, Denis Kučević** (Poljoprivredni fakultet, Novi Sad - Srbija)
   Utjecaj mineralne gnojidbe tla na sastav kukuruzne silaže, prinos mlijeka i zdravlje krava
   Maize silage proximate composition, milk yield and cows health influenced by soil mineral fertilization

4. **Mariola Pabianczyk, Jacek Nowicki, Tomasz Schwarz** (Poljoprivredno sveučilište, Krakow - Poljska)**, Martyna Malopolska** (Državni istraživački institut za animalnu proizvodnju, Balice n. Krakow - Poljska)**, Ryszard Tuz** (Poljoprivredno sveučilište, Krakow - Poljska)
   Preferencije hranjivih spojeva kojima su glavni sastojci žitarice od 40 ili 60% na rast svinja
   Preferences of growing pigs to feed compounds containing 40 or 60% of main cereal constituents

5. **Piotr Dobrowolski** (Fakultet biologije i biotehnologije, Lublin - Poljska)**, Ewa Tomaszewska** (Fakultet veterinarske medicine, Lublin – Poljska)**, Siemowit Muszynski** (Sveučilište prirodoslovnih znanosti, Lublin - Poljska)**, Katarzyna Wozniak, Katarzyna Kras** (Fakultet biologije i biotehnologije, Lublin - Poljska)**, Jose Luis Valverde Piedra, Marcin B. Arciszewski, Anna Zacharko-Siembida, Sylwia Szymanczyk, Sylwester Kowalik, Agnieszka Chalabis-Mazurek** (Fakultet veterinarske medicine, Lublin – Poljska)**, Tomasz Schwarz** (Poljoprivredno sveučilište, Krakow - Poljska)
   Utjecaj suvremenih sorta raži na histološku strukturu i crijevnu barijeru gastrointestinalnog trakta svinja
   The effect modern varieties of rye on the histological structure and intestinal barrier of the gastrointestinal tract of pigs

6. **Wladyslaw Migdal, Regina Kulig, Maria Walczycka, Ewelina Wesierska, Marzena Zajac, Joanna Tkaczewska, Piotr Kulawik** (Poljoprivredno Sveučilište, Krakow - Poljska)**, Lukasz Migdal** (Zavod za genetiku i uzgoj životinja, Krakow - Poljska)**, Anna Migdal** (Institut za veterinarstvo, Krakow - Poljska)**, Katarzyna Krepa – Stefanik** (Poljoprivredno Sveučilište, Krakow - Poljska)
   Kemijski sastav i kvaliteta mesa poljskih izvornih pasmina svinja
   The chemical composition and quality of meat polish native pig breeds

7. **Krzysztof Wojtycza, Robert Gasior** (Državni istraživački institut za animalnu proizvodnju, Balice n. Krakow - Poljska)**, Halina Bielinska** (Eksperimentalna stanica Državnog istraživačkog instituta za animalnu proizvodnju, Balice n. Krakow - Poljska)
   Određivanje hlapivih organskih spojeva u mesu noge dvije skupine gusaka pomoću mikroekstrakcije - plinske kromatografije - masene spektrometrije
   Determination of volatile organic compounds in leg meat of two groups of geese by Headspace Solid-Phase Microextraction–Gas Chromatography–Mass Spectrometry coupled with Chemometrics

8. **Robert Gasior, Krzysztof Wojtycza, Aldona Kawecka, Ewa Sosin-Bzducha, Jacek Sikora**
   (Državni istraživački institut za animalnu proizvodnju, Balice n. Krakow - Poljska)
   Određivanje hlapivih organskih spojeva u mesu ovaca, koza i goveda pomoću mikroekstrakcije - plinske kromatografije - masene spektrometrije
   Determination of volatile organic compounds in sheep, goat, and beef meat by Headspace Solid-Phase Microextraction–Gas Chromatography–Mass Spectrometry coupled with Chemometrics

9. **Krzysztof Wojtycza, Robert Gasior, Angelika Odrzywolska** (Državni istraživački institut za animalnu proizvodnju, Balice n. Krakow - Poljska)**, Halina Bielinska** (Eksperimentalna stanica Državnog istraživačkog instituta za animalnu proizvodnju, Balice n. Krakow - Poljska)
   Olfaktometrijska analiza spojeva aroma u mesu White Koluda® guske pomoću plinske kromatografije
   Gas chromatography-olfactometry analysis of aroma compounds in meat of White Koluda geese®

10. **Grazyna Bielecka, Jolanta Rubaj, Waldemar Korol**
(Državni laboratorij za krmiva, Lublin – Poljska)
Utjecaj prirodne ekstrudirane soje bez GM-a s visokom aktivnošću antitripsina na performanse pilića brojlera
The influence of non-GM native soybean extruderate with relatively high antitrypsin activity on performance of broiler chickens

11. **Jose Luis Valverde Piedra, Agnieszka Chalabis-Mazurek, Paulina Lesniak, Ewa Tomaszewska, Sylwia Szymanczyk, Marcin Arciszewski, Anna Zacharko** (Fakultet veterinarske medicine, Lublin – Poljska)**, Siemowit Muszynski** (Sveučilište prirodoslovnih znanosti, Lublin - Poljska)**, Piotr Dobrowolski** (Fakultet biologije i biotehnologije, Lublin - Poljska)**, Sylwester Swiatkiewicz, Ania Arczewska** (Državni istraživački institut za animalnu proizvodnju, Balice n. Krakow - Poljska)**, Tomasz Schwarz** (Poljoprivredno sveučilište, Krakow - Poljska)
Utjecaj raži kao komponente u krmnoj smjesi na razinu kadmija i olova te na odabrana tkiva pilića brojlera
The impact of rye on the level of cadmium and lead in the feed mixture and in selected tissues of broiler chicken

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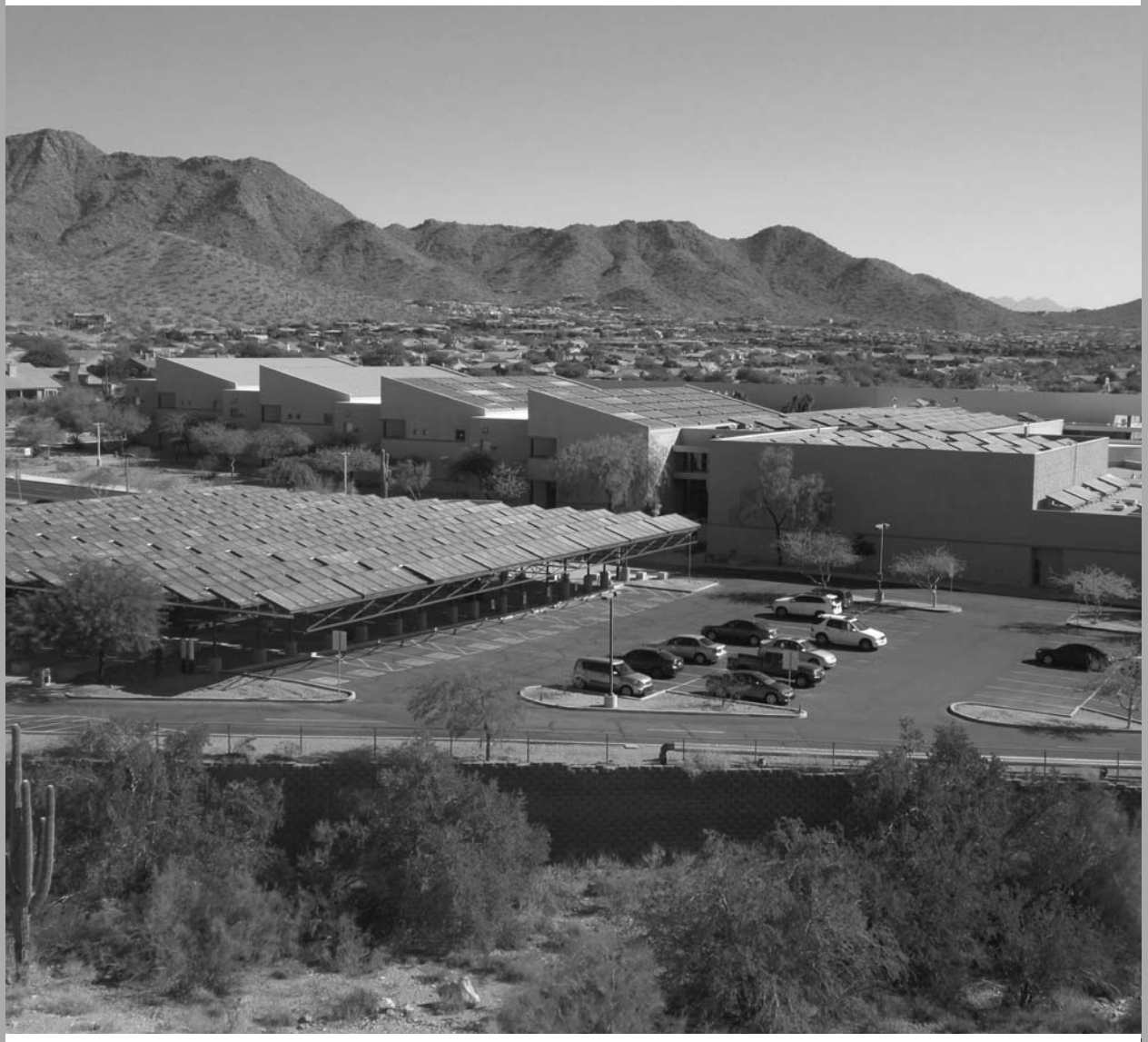

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PRECIZNA HRANIDBA DOMAĆIH ŽIVOTINJA
PRECISION ANIMAL NUTRITION

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SAŽETAK

Precizna hranidba ili precizno hranjenje životinja integralni je dio koncepta precizne poljoprivrede (PA), odnosno, precizne animalne proizvodnje (PLF). Uključena je u integrirani informacijski sustav kojim se optimizira, što je moguće točnije, zadovoljenje hranidbenih potreba životinja u interesu sigurne, profitabilne, visokokvalitetne i učinkovite proizvodnje uz istodobno osiguranje najnižeg mogućeg utjecaja na okoliša. Stoga, precizna hranidba životinja podrazumijeva primjenu načela, tehnika i tehnologija koje automatski integriraju biološke i fizikalne procese vezane uz hranidbu životinja. Koriste se sofisticirani alati za daljinsko praćenje, modeliranje i kontrolu, odnosno, kojim se omogućuje donošenje preciznih, točnih i pravovremenih odluka na farmi. Cilj precizne hranidbe je poboljšati preciznost odluka vezanih uz hranidbu kako bi se bolje reagiralo na promjene nutritivnog statusa životinja, tijekom vremena, te da bi se dostigla optimalna hranidba, čime se neizravno može poboljšati zdravlje i dobrobit životinja. Precizna hranidba koristi najnovija znanstvena otkrića za formulaciju krmnih smjesa i obroka za točno zadovoljenje jedinstvenih, hranidbenih potreba životinja, držanih u njihovim jedinstvenim okolišnim uvjetima. Primjenjuje rezultate istraživanja svih područja hranidbe, a sljedeći principi moraju se uzeti u obzir: upotreba preciznih podataka o potrebama za hranjivim tvarima životinja i sadržaja hranjivih tvari hrane; pravilno korištenje dodataka kao što su enzimi, prebiotici, probiotici, antioksidanti, inhibitori plijesni i drugi dodaci hrani; iskorištavanje genetskih poboljšanja životinja i stočne hrane; smanjenje toksičnih i antinutritivnih čimbenika hrane; te korištenje poboljšanih tehnika prerade koje će dovesti do njezinog boljeg iskorištenja. Proizvodnja ekološki prihvatljivih animalnih proizvoda sve više postaje društveni imperativ. Hranidba životinja još uvijek ima ogromni neiskorišteni potencijal na tom području, primjerice, u razvoju novih sustava i tehnologija hranjenja životinja. Praktična primjena koncepta precizne hranidbe može biti od velike pomoći u postizanju tih ciljeva, te pridonijeti povećanju učinkovitosti inovacijskih aktivnosti cjelokupne animalne/poljoprivredne proizvodnje.

Ključne riječi: *precizna hranidba, životinje, proizvodnja, okoliš*

ABSTRACT

Precision animal nutrition or precise feeding is an integral part of the Precise Agriculture (PA) i.e. Precise Livestock Farming (PLF). It is involved in an integrated information system optimizing, as accurately as possible, meeting the animal nutrition requirements in the interest of safe, profitable, high quality and efficient production while ensuring the lowest possible environmental impact. Therefore, precise nutrition implies the application of principles, techniques and technologies that automatically integrate biological and physical processes related to animal nutrition. Sophisticated remote monitoring, modeling and control tools are used enabling accurate, accurate and timely decision-making on the farm. The goal of precise nutrition is to improve the precision of nutrition decisions, in order to react better to changes in nutritional status of animals over time, and to achieve optimal nutrition, thereby indirectly improving the health and welfare of animals. Precise nutrition uses the latest scientific discoveries for compound feed formulas and rations to meet precisely the unique, nutritional needs of each animal kept in their unique environmental conditions. Appling results of research in all areas of nutrition and the following principles must be taken into account: the use of precise data on nutrient requirements and the nutrient content of feedingstuffs; proper use of supplements such as enzymes, prebiotics, probiotics, antioxidants, mold inhibitors and other food additives; exploitation of genetic improvement of animals and feeds; reduction of toxic and antinutritive feed factors; and the use of improved processing techniques that will lead to its better utilization. The production of environmentally friendly animal products is increasingly becoming a social imperative. Animal nutrition still has huge untapped potential in this area, for example, in developing new animal feeding systems and technologies. Practical application of the concept of precision animal nutrition can be of great help in achieving these goals and contribute to increasing the efficiency of innovation activities of the overall animal/agricultural production.

Keywords: *precision nutrition, animals, production, environment*

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KRIVOTVORENJE HRANE ZA ŽIVOTINJE – PROBLEM U NASTAJANJU

FEED ADULTERATION – AN EMERGING ISSUE

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ABSTRACT

Feed market is quite competitive in general. In the past there used to be some issues concerning safety and quality, nevertheless, not much concerning adulteration issues. However, this seems to be changing now. As some feed materials are rather expensive it might be attractive to manipulate the quality on purpose. A general provision from the European law (Regulation 767/2009) says that feed has to be sound, genuine, unadulterated, etc… The parameters and methods for chemical analyses are well known to the operators so the unfair ones may try to adulterate some types of feed/feed materials that way that it is hard to be disclosed by control authorities.

The most interesting cases we can report concerns feed yeast, fish meal and PET food.

Feed yeast - During the official control a sample of dried feed yeast was delivered to our commodity expert. Due to suspicious colour (different to "normal" one) an analysis on crude protein was requested. The result of that analysis was compliant yet. Subsequently the expert carried out a detailed microscopical examination that revealed some unusual mineral crystals. After that detailed analyses on amino acids (lysin, threonine) and ammoniacal nitrogen was performed. The poor results on amino acids and high content on nitrogen proved the suspicion that those yeast were adulterated using plant material and the "crude protein" content was "improved" using ammonium sulphate.

Fish meal - A sample of fish meal was analysed on pesticide residues (multiresidual method). The results uncovered content of chlormequat (plant growth regulator) which was very strange. After microscopic investigation we detected high content of fine milled rape oil cake (around one third of content) and ammonium sulphate crystals.

In another fish meal sample, declared as "Salmon meal" a significant amount of poultry meal was confirmed (microscopy + PCR analysis).

PET food – the real composition differs from the declaration in some cases. Some feed materials are declared yet missing (rice, specific meats), some present although not declared (soy). In feed labelled as not GMO we detect significant shares of GMO ingredients.

As the illegal practices mentioned above deliver not negligible profits it can be expected that more operators can give in to temptation of doing so. It means that control authorities must be alert and capable of disclosing and suppressing such practises.

Our results also proved that we cannot abandon "old" methods such as microscopy as those can be increasingly important in some specific cases.

ZNAČAJ UNAPREĐENJA REGULATORNOG OKVIRA U OBLASTI HRANE ZA ŽIVOTINJE

IMPORTANCE OF IMPROVING THE REGULATORY FRAMEWORK IN THE FIELD OF ANIMAL FEED

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SAŽETAK

U opisu zakonodavstva u okviru ishrane životinja, širok obuhvat kontrolnih aktivnosti imaju za cilj garantovanje visokog standarda zdravlja ljudi i životinja. U okviru Evropske unije različiti regulatorni okviri država članica vremenom su morali biti prilagođeni jedinstvenom harmonizovanom sistemu Unije. Kontinuirana procena rizika od strane naučne infrastrukture EU, uz donošenje preporuka i odgovarajućih mera, odgovor su na komercijalne trendove u ishrani životinja i danas. Mnoge članice Svetske trgovinske organizacije pravno uređuju oblast hrane za životinje, radi lakšeg uspostavljanja sistema bezbednosti, odnosno preduzimanja mera i procedura kojima bi se rizici od biološke, hemijske i fizičke kontaminacije životinja i hrane za životinje sveli na što je moguće niži nivo.

Zemlje regiona (bivše republike SFRJ) u osnovi imaju različite pristupe, od Zakona o hrani za životinje ("Zakon o krmi") u Sloveniji, do Zakona o bezbednosti hrane za životinje ("Zakon za bezbednost na hrana za zivotni") u Makedoniji. Na osnovu sugestija (2004. god.) i mišljenja Kancelarije za pridruživanje Srbije i Crne Gore EU pored obaveza nacionalnog zakonodavstva da usaglasi svoje zakone sa zakonodavstvom EU, sa procedurama uspostavljanja pravnih okvira u oblasti hrane za životinje usko je vezan izvoz proizvoda stočarstva u EU. Takođe, zadovoljavajući rezultati u stočarstvu zavise u velikoj meri od upotrebe bezbedne i kvalitetne hrane za životinje. Odnos između stočarstva (stočarske proizvodnje) i biljne proizvodnje u Srbiji je 30:70. Takođe, učešće (industrijskih) proizvođača hrane za životinje u EU u stočarskoj proizvodnji je daleko veći nego u Srbiji gde je učešće oko 30-35% (na osnovu dostupnih podataka iz Statističkog godišnjaka EU i internih analiza o poceni učešća industrijskih proizvoda hrane za životinje u ishrani životinja u Srbiji).

U ovom radu, želimo podeliti mišljenja koliko su sugestije iz 2004. godine realne, a onda i značajne za stabilnost stočarske proizvodnje i tržišnu politiku u oblasti stočarstva, u regionu. Svi koji zastupaju važnost zakonskog uređenja oblasti hrane za životinje, svake godine pa do danas - bez zakona o hrani za životinje, postavljaju ista pitanja: Kakav se trend izvoza proizvoda stočarstva beleži?

U Srbiji, postoje podeljena mišljenja između javnog sektora i nadležnih organa. Nakon dva zvanična postupka izrade teksta zakona o hrani za životinje (2004 i 2007), krajem 2009. godine ministar poljoprivrede otvara mogućnost donošenja Zakona o hrani za životinje, ukoliko se za to ukaže potreba. Stručna javnost i privredni subjekti okupljeni oko Privredne komore Srbije, podržavajući predlog za donošenje Zakona o hrani za životinje, imaju eksplicitni stav da je to "Preduslov za postavljanje visokog kvaliteta proizvoda hrane za životinje, koji bi trebao biti zaštićen u procesu liberalizacije tržišta i predstavljen kao *nacionalni proizvod*".

Ključne riječi: *zakonodavstvo, rizici, zakon o hrani za životinje, stočarstvo, izvoz*

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ABSTRACT

In the description of animal nutrition legislation, a wide range of control activities aim at guaranteeing a high standard of human and animal health. Within the European Union, the various regulatory frameworks of the Member States have been adapted over time to the single harmonized Union system. Continuous risk assessment by the EU's scientific infrastructure, with recommendations and appropriate measures, are in response to the commercial trends in animal nutrition nowadays. Many WTO members legally regulate the field of animal feed in order to facilitate the establishment of a safety system, or to take measures and procedures to reduce the risks of biological, chemical and physical contamination of animals and animal feed to the lowest possible level.

Neighboring countries (the former republics of the SFRY) basically have different approaches, from the Law on Animal Feed ("Zakon o krmi") in Slovenia, to the Law on the Safety of Animal Feed ("Zakon za bezbednost na hrana za zivotni") in Macedonia. Based on the suggestions (2004) and the Opinion of the Serbia-Montenegro EU Integration Office, in addition to the obligations of national legislation to harmonize its legislation with the EU legislation, procedures for the establishment of legal frameworks in the field of animal feed are closely linked to the export of livestock products to the EU. Also, satisfactory results in animal husbandry depend largely on the use of safe and quality animal feed. The ratio between animal husbandry (livestock production) and plant production in Serbia is 30:70. Also, the share of (industrial) animal feed producers in the EU in livestock production is far higher than in Serbia where the participation is about 30-35% (based on the available data from the EU Statistical Yearbook and internal analysis on the share of industrial food products in animal feeding in Serbia).

In this paper, we wanted to share the opinion on how realistic the suggestions from 2004 are and important for the stability of livestock production and the market policy in animal husbandry in the region. Anyone who considers the importance of legal regulation in the field of animal feed, every year to this day - without the law on feeds, asks the same questions: What is the trend of exports of livestock products?

In Serbia, there are divided opinions between the public sector and the competent authorities. After two official procedures for the drafting of the Law on Animal Feed (2004 and 2007), at the end of 2009, the Minister of Agriculture opens the possibility of adopting the Animal Feed Act, if necessary. The expert public and business entities gathered around the Serbian Chamber of Commerce and Industry, supporting the proposal for the adoption of the Law on Animal Feed, have an explicit opinion that this is "a prerequisite for setting a high quality animal feed product, which should be protected in the process of market liberalization and presented as a national product".

Keywords: *legislation, risks, animal feed law, animal husbandry, livestock, export*

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FARMAKOVIGILANCIJO ISTRAŽIVANJE LJEKOVITE HRANE ZA DIVLJAČI

PHARMACOVIGILANCE STUDY OF MEDICINAL FEED FOR GAME ANIMALS

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ABSTRACT

One of main causes of wild game ailments, and above all in ungulate game, and especially in roe deer, are endo- and ectoparasites. In the Czech Republic there are veterinary medicinal products (VMP) with marketing authorisation for these diseases primarily based on ivermectin, one of which VMP Cermix peroral powder has already been used for more than 20 years and concurrently as far back as 2 years similar VMP Ivermix peroral powder for the same indication was granted marketing authorisation.

Aim of the presented study has been monitoring of basic properties of these veterinary medicinal products for treatment of endo- and ectoparasitoses in ungulate game in view of their safety and efficacy, when a peroral powder is administered in form of medicated feed, and simultaneously monitoring parasitoses of ungulate game which was carried out in compliance with the State Veterinary Administration Guideline "Methodology of animal health control for year 2018."

In compliance with assignment of the methodology total 49 specimens of roe dear faeces were collected which were examined by flotation and larva scopic method for content of parasites. The examination was focused to following parasites: eggs of strongyloides type, Trichuris spp., Nematodirus spp., Dictiocaulus spp., Moniezia spp., coccidia.

According to obtained results of presence of parasites in roe deer game it is possible to claim that good anthelmintic efficacy of ivermectin continued even in this year. An increase in number of parasites did not occur in any of the localities. Majority of the results notched up one cross (+) corresponding to a positive finding, which however ought not to cause significant alterations of the state of health in roe deer.

In view of the fact that in this year the game was not treated with antiparasitic medicines, a follow-up concerning safety of the monitored antiparasitic medicines was not possible. At the same time the efficacy a year later from treatment clearly has been proved as very good. Due to low intensity parasites in faeces specimens it was not possible to assess a possible increase in resistance.

Thanks to extensive use of antiparasitic medicines in ungulate game we can report that in the Czech Republic there is situation of the parasitic burden in roe deer relatively good and that single outbreaks caused largely by pulmonary nematodes are generally successfully suppressed.

The results of the submitted study clearly proved suitability of the antiparasitic medicines use in game in the localities with positive findings of parasites and after targeted medication, in addition to improvement of state of health, also weight of hunted game and quality of hunting trophies improved significantly.

SADRŽAJ HRANJIVIH I NEPOŽELJNIH SUPSTANCI U SJEMENU SOJE KOJA NIJE GENETSKI MODIFICIRANA I DORAĐENIH PROIZVODA ZA POTREBE HRANIDBE

NUTRIENT AND UNDESIRABLE SUBSTANCE CONTENTS IN NON-GM NATIVE SOYBEAN SEEDS AND PROCESSED PRODUCTS FOR FEEDING PURPOSE

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ABSTRACT

The aim of the study was to assess non-GM native soybean seeds (21 samples), extruded soybean seeds (16 samples) and extruded soybean expellers (15 samples), available on the Polish market, regarding their basic nutrients, amino acids, macroelements (Ca, P, Mg, Na and K), microelements (Fe, Mn, Zn, Cu, Co, Mo, Se and I), anti-nutritional factor (trypsin inhibitors) and undesirable or harmful substances (Pb, Cd, Hg, As and F).

The content of the basic nutrients in the analyzed samples of non-GM soybean seeds was similar to the contents quoted in earlier studies conducted in NRIAP in Krakow (Brzóska, 2017), indicating that chemical composition of the tested material is stable. Trypsin inhibitor level was about 25 mg/g and indicates that crude soybean seeds can't be used in animal feeding, especially young monogastric animals.

Chemical composition of extruded soybean seeds was similar to the composition of soybean seeds, but lower level of trypsin inhibitor was noted (10.6 mg/g). The content of nutrients and amino acids in extruded soybean seeds was similar to the data quoted by Ajinomoto Eurolysine. Variation coefficients for basic nutrients and amino acids were low, generally below 10%. Metabolizable energy of extruded seeds for poultry amounted 12.6 MJ/kg and was consistent with metabolizable energy of such kind of products, listed in the European Table of Energy Values for Poultry Feedingstuffs, 1989. However, relatively high level of trypsin inhibitors (>5 mg/kg) and high fat content (182 g/kg) can decrease utility of extruded soybean seeds in animal feeding.

Extruded soybean expellers contain lowest fat level (72 g/kg) and trypsin inhibitors level (6.5 mg/g). Variation coefficients of the basic nutrients and amino acids were low, confirming the stability of the material. The results of macroelements in tested soybean products, namely P, Ca, Mg and K, were in conformity with the Poultry Feeding Standards (2005) and INRA tables, with the exception of the content of sodium. The content of Fe, Mn, Zn, Cu, Co, Mo, Se and I in tested materials were similar to the contents quoted by the INRA.

The analyzed non-GM native soybean products included low levels of undesirable or harmful substances (Pb, Cd, Hg, As and F), showing no risk to the animals' health or safety of animal products.

Keywords: *non-GM soybean seeds, extruded soybean seed, extruded soybean expeller, chemical composition, nutrients, trypsin inhibitors*

ANALIZA ŽIVOTINJSKIH FEKALIJA KAO ALAT ZA PRAČENJE KORIŠTENJA ANTIBIOTIKA

THE ANALYSIS OF ANIMAL FAECES AS A TOOL TO MONITOR ANTIBIOTIC USAGE

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ABSTRACT

Veterinary antibiotics are used globally to treat diseases and to protect the health of animals. Antibiotics that frequently used in livestock are tetracyclines, sulfonamides and fluoroquinolones which are active against Gram-negative and Gram-positive bacteria. Most pharmaceutical active ingredients can be excreted by the medicated animals, and depending on the structure up to 90% of the initial compound can be found in the urine and/or faeces afterwards. However if animals are treated, residues of the antibiotic substances can frequently be detected in manure due to poor absorption of the respective substance in the animal gut or unmetabolized extraction. Currently land application of manures is common practice in many parts of the world, including Poland. Manure/slurry is characterized by a high content nutrients making it valuable as a soil fertilize. It is expected that an effective analysis of antibacterial substances in feaces, slurry, manure will be possible in several ways. First, to obtain more insight in the possible formation of bacterial resistance in the animals' gut, leading to valuable information on the relation between residues and resistance. Second, to learn about the dissemination of antibiotics to the environment and possible ecotoxicological effects. Third, to monitor trends in antibiotic usage at the farms using noninvasive sampling and last to enforce policies on the use of antibiotics and thus to prevent illegal and off-label use of antibiotics. We conclude that the analysis of antibiotics in faeces could be very useful and therefore a multi-method to detect a wide range of veterinary antibiotics in faeces is needed. In this paper, a simple and robust method is proposed for the simultaneous analysis of oxytetracycline, tetracycline, chlortetracycline, doxycycline, enrofloxacin, ciprofloxacin, trimethoprim, tiamulin and tylosin from feaces, liquid manure and digestate. These antibacterial agents present a wide range of different physicochemical properties and the method capable of simultaneous analysis was a compromise to accommodate different properties. During the method's development our work was concentrated on the tetracyclines, as strong sorption of these compounds causes difficulties when extracting the antibacterial agents from soil and manure. Extraction methods for antibacterial agents have been developed for several matrices, e.g. animal products and environmental water samples, while only few methods have been developed for extraction of the antibacterial agents from feaces, slurry, manure and digestate. These extraction methods utilize a range of different extraction solvents and are generally based on mechanical shaking, ultrasonication or vortex mixing. The sample preparation was done by using ultrasonic extraction with McIlvaine-Na_2EDTA buffer solution and purified by SPE (Strata-X-CW cartridges) and analysed by HPLC-MS. Validation of the method was performed according to the guidelines indicated in European Commission Decision 2002/657/EC. Recoveries from spiked pig and poultry dung and liquid manures samples were ranged from 76.1 to 112.0% depending on analytes. Quantification limits of the method were measured from 15.1 µg/kg for trimethoprim to 72.3 µg/kg for tylosin.

This study investigated the level of antibacterial contamination in twenty six pig and poultry dungs, four liquid manure samples and eight digestate samples were collected from different sampling areas located in Poland. The residue levels of selected fluoroquinolones, tetracyclines, trimethoprim, tylosin and tiamulin in 26 animal feaces (swine and poultry), 4 liquid manure samples and 8 digestate samples collected in 2018 from large-scale

livestock and biogas plants in Poland. The analysis of 38 samples revealed that 13 samples (34.2%) were positive for the presence of doxycycline, enrofloxacin, oxytetracycline and tiamulin. These analytes were detected in high concentrations reaching level up to 5900 μg/kg (doxycycline). The obtained results in the presented study demonstrated that veterinary antibacterial substances can lead to the contamination of agricultural soils via fertilization with animal manure.

Keywords: *antibacterial substances, organic fertilizer, liquid manure, slurry, feaces, SPE, LC-MS*

NOVI PROPISI EU O VETERINARSKIM LIJEKOVIMA I HRANI KOJA SADRŽI LIJEKOVE

NEW EU REGULATIONS ON MEDICATED FEED AND ON VETERINARY MEDICINAL PRODUCTS

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ABSTRACT

As a part of legislative package on improving of animal and human health two new regulations, both of them regulating the area of animal health were adopted in the beginning of 2019. The first one is the Regulation (EU) 2019/4 on medicated feed which repeals the outdated Directive 1990/167/EEC. The second one is the Regulation (EU) 2019/6 on veterinary medicinal products repealing the Directive 2001/82/EC.

The adaption of these regulation is the reaction on both on general challenges like EU horizontal legislation and its simplification, reduction of administration burden and further approximation of legal regulation in MS on one hand and on the other hand on specific tasks like the fight against antimicrobial resistance or increasing of medicines availability.

Except the general background of this adoption and the reasons which led to it the author will focus on main changes which the legislation will bring. There will be pointed out the new issues regulated by the new pieces of legislation including some problematical points.

TRENUTNA ZAKONSKA REGULATIVA EU NA PODRUČJU ZLOUPOTREBE HRANE I HRANE ZA ŽIVOTINJE

CURRENT EU LEGAL REGULATION THE AREA OF FRAUD FOOD AND FEED

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ABSTRACT

The globalisation of the food and feed supply chain has brought itself a lot of problems and among them the food and feed fraud seem to be one of the most important. There are different definitions what food or feed fraud is, e.g. food fraud is the act of purposely altering, misrepresenting, mislabelling, substituting or tampering with any food product at any point along the farm–to–table food supply–chain[1] or food fraud is a collective term used to encompass the deliberate and intentional substitution, addition, tampering, or misrepresentation of food, food ingredients, or food packaging; or false or misleading statements made about a product, for economic gain[2] but generally acknowledged definition in EU legislation. Nevertheless, it is widely accepted in Member States that food or feed fraud means the acting that intentionally breach the EU food or feed law on economic or financial gain purpose resulting in consumer deception.

Fraud can appear in all stages of production in other words from raw material till the final product. Among the most serious frauds there are substitution of products, mislabelling, counterfeit, misrepresenting, tampering or origin masking. Food and feed frauds are not only the current problem, it had appeared centuries ago but within last decade it the intensity and frequency has multiplied and increases every year. Just for the area of food fraud the estimations speak about 30 to 40 billion of US dollars per year[3].

Unfortunately, and in to contrary to US legislation[4] there is no clear unified legal framework of food and feed fraud. Although there is very broad regulation of food safety the regulation is fragmented in several pieces of legislation. Generally, this topic is covered by the Regulation 178/2002[5] which states in Article 16 that without prejudice to more specific provisions of food law, the labelling, advertising and presentation of food or feed, including their shape, appearance or packaging, the packaging materials used, the manner in which they are arranged and the setting in which they are displayed, and the information which is made available about them through whatever medium, shall not mislead consumers. However, application of this provision including the control differs among individual Members States and its resulting in the situation that a lot of food and feed frauds are not being detected, mainly when there is no harm to human or animal health.

Among other EU legislation covering this area the most important are the Regulation (EC) No 625/2017 on official controls and Regulation (EU) No 1169/2011 on food information.

In my contribution I will focus on the current legal system on food and feed fraud within European Union including its development and comparison US one. Subsequently, The EU Food Fraud Network, established in 2013, will be mentioned including the presentation of practical case. Finally, the Czech legal system will be introduced.

[1]See https://www.cobleskill.edu/about/sustainability/pdfs/FoodFraud_Diana-Monaco.pdf

[2]See https://onlinelibrary.wiley.com/doi/full/10.1111/j.1750-3841.2011.02417.x

[3]See https://www.foodsafetymagazine.com/magazine-archive1/junejuly-2017/tackling-food-fraud-on-a-global-level/

[4]FDA Food Safety Modernisation Act see https://www.fda.gov/food/guidanceregulation/fsma/

[5]Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety, see https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=CELEX:32002R0178

MEĐUODNOS POLJOPRIVREDE I OKOLIŠA
INTERRELATION BETWEEN AGRICULTURE & THE ENVIRONMENT

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ABSTRACT

The links between the richness of the natural environment and farming practices are very old and complex. Needs for food and feed production are always being very important, and today, special emphasis is on its quality. Farming and nature influence each other. Inappropriate agricultural practices and land use can have an adverse impact on natural resources, like soil, water and air pollution, fragmentation of habitats & loss of wildlife. In the same time, agriculture is directly influenced by the nature. For example, regarding the climate change, agriculture is cause but in the same time and the victim of it. In Croatia in 21st century drought caused 51 % of total agricultural damage, hail 16 % and floods 12 % and more than half of the money that Croatia invested through direct payments (CAP) has been "eaten" by weather conditions. European Union as a leader in environment protection within CAP develops two mechanisms (direct and voluntary payments) and defines priority areas for agriculture: soil and water management, biodiversity preservation, landscape and climate change. Agri-environmental indicators (AEIs) are useful tool for analyzing the relationship between agriculture and the environment and identifying trends in this evolving interaction. To provide information on the state of the environment in agriculture and to understand and monitor the linkages between agricultural practices and their effects on environment, different set of indicators are identified: OECD and UN-FAO identified 62 AEIs, EU-EC-EEA 28 AEIs using DPSIR framework and methodology. Some of them will be explain and discussed.

EKOLOŠKI OTISAK PROIZVODNJE HRANE ZA ŽIVOTINJE
ENVIRONMENTAL IMPACT OF CROP PRODUCTION FOR FEED

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SAŽETAK

Obradive površine i pašnjaci zajedno zauzimaju oko 40% kopnene površine. Promjene agrotehničkih mjera unutar sustava proizvodnje hrane za životinje omogućile su da se svjetska proizvodnja žitarica jako poveća u zadnje četiri dekade pa sada iznosi više od 2 milijarde tona zrna godišnje. Jednim manjim dijelom to povećanje proizvodnje žitarica je posljedica povećanja poljoprivrednih površina, dok je najvećim dijelom rezultat „Zelene revolucije" koja podrazumijeva uzgoj visoko-prinosnih kultivara, intenzivnu primjenu mineralnih gnojiva i pesticida, te korištenje suvremene mehanizacije i navodnjavanja. Na svjetskoj razini je tijekom zadnjih 40 godina došlo do velikog povećanja potrošnje mineralnih gnojiva i primjene različitih sustava navodnjavanja. Posljedično je suvremena poljoprivreda bila uspješna u povećanju proizvodnje hrane za životinje, ali je istovremeno dovela i do značajnog onečišćenje okoliša. Tako je primjerice u mnogim regijama svijeta intenzivna primjena mineralnih gnojiva smanjila kvalitetu površinskih i podzemnih voda. Nadalje, do 40% poljoprivrednih površina u svijetu je izloženo eroziji, smanjenoj plodnosti tla i prekomjernom napasivanju. Očito je da u cilju povećanja prinosa po jedinici površine, moderni sustavi proizvodnje hrane za životinje često zanemaruju negativne popratne pojave na prirodne resurse (tlo, vodu i zrak), a koji su osnova poljoprivredne proizvodnje u budućnosti. Proizvodnja hrane za životinje će se očekivano povećavati i u narednom razdoblju pa je, uz agronomsku i gospodarsku, poželjno evaluirati i ekološku komponentu modernih sustava proizvodnje koristeći različite indikatore poput ekološkog otiska.

Ključne riječi: *hrana za životinje, intenzivna proizvodnja, okoliš, ekološki otisak*

ABSTRACT

Croplands and pastures occupy around 40% of the land surface. Changing cropping systems practices for feed production brought about a large increase in world grain harvests in the past four decades, which now exceed 2 billion tons per year. Some of this increment can be attributed to an increase in world cropland area, but most of these production gains resulted from "Green Revolution" technologies, including high-yielding cultivars, chemical fertilizers and pesticides, and mechanization and irrigation. During the past 40 years, there have been huge increases in global fertilizer use as well as in irrigated cropland area. Although modern agriculture has been more than successful in increasing feed production, it has also caused extensive environmental damage. For example, increasing fertilizer use has led to the degradation of ground- and underground water quality in many regions. In addition, up to 40% of global croplands may also be experiencing some degree of soil erosion, reduced fertility, or overgrazing. Consequently, modern agricultural cropping practices may be trading short-term benefits in feed production for long-term losses in quality of natural resources (soil, water and air), which are important for agricultural production. The global feed production is to be increased in the future, and consequently, it is important to evaluate environmental impacts of modern cropping systems for feed production using indicators such as ecological footprint.

Keywords: *feed production, intensive cropping system, environment, ecological footprint*

GLOBALNI EKOLOŠKI OTISAK ANIMALNE PROIZVODNJE
GLOBAL ECOLOGICAL FOOTPRINT OF LIVESTOCK PRODUCTION

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SAŽETAK

Porast stanovništva i udjela animalnih proizvoda u hrani potiče intenzivnu animalnu proizvodnju što zbog porasta broja životinja, velike konzumacije (4.7 – 7.0 milijardi tona ST) i njene loše iskoristivosti značajno doprinosi zagađenju okoline. Kvantitativni pokazatelji zagađenja su doprinosi klimatskim promjenama, eutrofikaciji, acidifikaciji, korištenju energije i tla te bioraznolikosti. Među najnegativnijim indikatorima animalne proizvodnje smatraju se klimatske promjene, odnosno globalno zatopljenje. Klimatske promjene su primarno uzrokovane proizvodnjom stakleničkih plinova (GHG) među kojima iz stočarstva potječu CH_4 i N_20.

Biljojedi, najvećim dijelom preživači, zbog lošeg iskorištenja (<50%) hranjivih tvari i najveće konzumacije suhe tvari su glavni proizvođači GHG, izlučivanja dušika, emisije amonijaka, dok monogastrične životinje imaju veći utjecaj na acidifikaciju, eutrifikaciju i korištenje zemlje. FAO procjenjuje da stočarstvo pridonosi 14.5% [8.0 milijardi tona CO_2 ekvivalenta ($CO_{2eq.}$)] globalnoj antropogenoj produkciji stakleničkih plinova te da je najveći proizvođač N_2O (65%), amonijaka (40%) i CH_4 (35%) od svih ljudskih djelatnosti. Direktna emisija iznosi oko 4.2 milijarde tona $CO_{2eq.}$ dok proizvodnja koncentratne i voluminozne krme proizvodi 3.3 milijarde tona. Dodatno, proizvodnja energije koja se koristi na farmi i u lancu opskrbe životinja hranom te se koristi u preradi animalne hrane i njenom transportu učestvuje u čak 4.7% GHG od ukupne produkcije stočarstva.

Preživači konzumiraju 80% (3.7 milijardi tona ST godišnje) hrane biljnog porijekla proizvedene za hranidbu životinja te enterička fermentacija biljnih vlakana (34-90% od suhe tvari) proizvodi najviše (77%) metana u stočarstvu dok se drugi dio proizvede fermentacijom gnoja. Proizvodnja krme emitira CO_2 i N_2O. Svjetska proizvodnja gnoja još nije procijenjena, ali je procijenjeno u 2018. godini da domaće životinje i ljudi proizvode 3.9×10^{12} kg/g fecesa. Gospodarenje gnojem uglavnom emitira CH_4 i N_2O te najviše doprinosi acidifikaciji i eutrifikaciji. Dodatno, disanje domaćih životinja proizvodi 29.7×10^{12} kg/g $CO_{2eq.}$ što čini oko 14% antropogene emisije GHG.

Zaključno, stočarska proizvodnja značajno doprinosi globalnom zatopljenju kroz emisiju CH_4 i N_2O. Zadovoljenje rastuće populacije zajedno s visokom animalnom proizvodnjom neminovno povisuje GHG emisiju po jedinici proizvoda, a trebala bi se smanjivati. Jedan od glavnih ciljeva je postizanje ekoloških standarda i zahtijeva za prilagodbu animalne proizvodnje učinkovitim strategijama ublažavanja.

ABSTRACT

The increasing human population and incorporation more livestock products in diet drive intensive animal production which significantly contributes to environment pollution due to the large feed consumption (4.7 – 7.0 billion tonnes of DM) of increasing number of animals and low feeds nutrient utilization in livestock. Indicators quantifying impact of animal production on environment are contribution to climate change, eutrophication and acidification potential, energy and land use, and biodiversity. The global climate change, primarily caused by greenhouse gas (GHG) emissions resulting in warming of the atmosphere, is among the most dangerous. The most important greenhouse gases from animal agriculture are CH_4 and N_20.

Herbivore, mainly ruminants, because of low nutrient utilisation (< 50%), generally use the largest amount of feeds and are main producer of GHG, N excretion and ammonia emission. On the other side, monogastric animals have stronger impact on acidification, eutrophication and land use. FAO estimates that animal production contributes 14.5% [8.0 billion tonnes CO_2 equivalents ($CO_{2eq.}$)] to the global GHG emissions and is the largest emitter of N_20 (65%), ammonia (40%) and CH_4 (35%) in global anthropogenic emissions. Direct emissions accounted for 4.2 billion tonnes of $CO_{2eq.}$ while feed and forage production account for additional 3.3 billion tonnes of $CO_{2eq.}$ In addition, energy used on farms and in the supply chains, as well as emissions from processing and transport of animal products, account for 4.7% of the total livestock emissions.

Ruminants consume 80% (3.7 billion tonnes DM/year) of the plant material grown for livestock feeding whereas entheric fermentation of plant fibre (34 -90% of DM) produce 77% of livestock methane production; the remaining is from manure fermentation. From GHG, forage and feed production produce mainly CO_2 and N_2O. The global production of manure has not been estimated yet, but production of domestic animals and human faecal biomass is estimated to 3.9×10^{12} kg/year. Manure management emits CH_4 and N_2O, and the majority of acidification and eutrophication. In addition, breathing of the global livestock population (29.7×10^{12}) makes up about 14% of anthropogenic emissions.

In summary, livestock production significantly contributes to global warming through emissions of CH_4 and N_20. To meet future needs of an expanding population, animal production will need to increase and GHG emission intensity per unit of product will need to decrease. One of the principal ways to achieve this environmental standard is to adopt effective mitigation strategies.

EMISIJA STAKLENIČKIH PLINOVA IZ ANIMALNE PROIZVODNJE U REPUBLICI HRVATSKOJ – ENTERIČKA FERMENTACIJA

GREENHOUSE GASSES EMISSION FROM ANIMAL PRODUCTION IN THE REPUBLIC OF CROATIA – ENTERIC FERMENTATION

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SAŽETAK

Proizvodnja hrane pa tako unutar nje i animalna proizvodnja strateška je grana globalne ekonomije kako u svijetu tako i svake pojedine zemlje. Tvorba metana, kao nusproizvoda normalnog procesa probave u organizmu životinja, zbiva se fermentacijom pojedene hrane od strane mikroorganizama nastanjenih u probavilu životinje domaćina. Taj fermentacijski proces, poznatiji kao fermentacija u predželucima i debelom crijevu (enterička fermentacija), stvara metan kao nusproizvod, koji tada životinja eruktira ili izdahne u atmosferu. Među vrstama domaćih životinja preživači (goveda, ovce i koze) zbog buražne fermentacije proizvode najveće količine metana (80-90%), dok ostale životinje (svinje, perad i konji) proizvode manje količine ovog stakleničkog plina. Broj životinja, vrsta i količina konzumirane hrane te sadržaj ukupnih vlakana primarni su čimbenici koji utječu na razlike u emisiji metana. Stoga, poboljšanja u hranidbenom managementu, te promijene u zahtjevima tržišta za ekološkim animalnim proizvodima mogu utjecati i na emisiju, odnosno, smanjenje emisije metana u budućnosti. Proračuni emisija stakleničkih plinova Republike Hrvatske izrađuju se prema Službenim smjernicama Tajništva Okvirne Konvencije Ujedinjenih naroda o promjeni klime, kao i prema metodologiji Međuvladinog tijela o klimatskim promjenama (IPCC) za izračunavanje emisije metana „IPCC Guidelines for National Greenhouse Gas Inventories". koje preporučuju da se emisija metana iz fermentacije u probavnom traktu domaćih životinja izračunava množenjem broja pojedine vrste životinja s odgovarajućim emisionim faktorom. Unapređenje sustava izračuna stakleničkih plinova i izrada nacionalne strategije smanjenja emisije stakleničkih plinova obaveze je RH kao potpisnice Konvencije UN i Kyoto protokola. Unapređena i preciznija metodologija izračuna dovela je po povećanja emisionih faktora, te posljedično i povećanja emisije po pojedinoj životinji. Posljednjih smo godina (2006.-2016.) svjedoci pada emisija GHG iz enteričke fermentacije mliječnih krava s 52 na 47 kt CH4, no nažalost ovaj pozitivni trend nije rezultat unapređenja sustava i učinkovitosti proizvodnje, već drastičnog pada broja životinja s 250.000 u 2006. godini na 168.000 grla u 2016. godini, posljednjoj godini koja je dokumentirana u Izvješću o nacionalnom inventaru stakleničkih plinova (NIR) RH 2018. godine.

Ključne riječi: *stakleнički plinovi, metan, enterička fermentacija*

ABSTRACT

Food production and so within it animal production is a strategic sector of the global economy in the world and in each country. The formation of methane, as a by-product of the normal process of digestion in an animal organism, occurs by the fermentation of consumed feeds by microorganisms residing in the digestive tract of the host animal. This fermentation process, known as fermentation in intestines and colon (enteric fermentation), produces methane as a by-product, which then animal burps or releases it into the atmosphere. Among domestic animal species, ruminants (cattle, sheep and goats) produce the largest quantities of methane (80-90%) due to heavy fermentation, while other animals (pigs, poultry and horses) produce less quantities of this greenhouse gas. The number of animals, the type and amount of food consumed, and the content of the total fiber are the primary factors that affect the differences in methane emissions. Therefore, improvements in nutritional management and changes in market requirements for organic animal products can also affect emissions, that is, reduce methane emissions in the future. Greenhouse gas emissions calculations in Republic of Croatia are made in accordance with the United Nations Framework Convention on Climate Change, the Official Guidelines of the United Nations Framework Convention on Climate Change and the methodology of the Intergovernmental Panel on Climate Change (IPCC) for the calculation of methane emissions from „IPCC Guidelines for National Greenhouse Gas Inventories" which recommended that methane emissions from fermentation in the digestive tract of domestic animals should be calculated by multiplying the number of animal species with the appropriate emission factor. Improving the greenhouse gas calculation system and developing a national strategy for reducing greenhouse gas emissions is the obligation of the Republic of Croatia as a signatory of the UN Convention and Kyoto Protocol. Upgrading and more precise methodology of calculation has led to an increase in emission factors, and consequently increases in emissions per animal. In recent years (2006 - 2016) witnesses of GHG emissions from enteric fermentation of dairy cows from 52 to 47 kt of CH4 decrease, but unfortunately this positive trend is not a result of the system's improvement and production efficiency, but a drastic decrease in the number of animals by 250,000 in 2006 to 168,000 in 2016, the last year documented in the National Inventory Report of Greenhouse Gasses (NIR) of 2018.

Keywords: *greenhouse gasses, methane, enteric fermentation*

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EMISIJA STAKLENIČKIH PLINOVA ANIMALNE PROIZVODNJE RH – GOSPODARENJA STAJSKIM GNOJEM

ANIMAL PRODUCTION OF GREENHOUSE GASSES EMISSIONS IN THE REPUBLIC OF CROATIA - MANURE MANAGEMENT

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SAŽETAK

Emisija stakleničkih plinova iz animalne proizvodnje izravna je posljedica procesa crijevne fermentacije i dekompozicije stajskog gnoja tijekom čuvanja i primjene na poljoprivredne površine. Dok je crijevna fermentacija glavni je izvor metana (CH4), gospodarenje stajskim gnojivom izvor je emisije amonijaka (NH3), dušikovih oksida (NOx), nemetanskih hlapivih organskih spojeva (NMHOS) i lebdećih čestica (PM). Do emisije NH3, NOx i NMHOS dolazi iz životinjskih izlučevina (feces i urin) odloženih u i oko nastambi, na ispuste, pašnjake te prikupljenih i odloženih u deponije za tekući ili kruti stajski gnoj kao i prilikom njegova iznošenja na tlo u gnojidbi poljoprivrednih kultura. Gospodarenje stajskim gnojem u manjoj mjeri je izvor emisije CH4 kao rezultat bakterijske razgradnje organske tvari iz stajskog gnoja tijekom skladištenja. Stupanj emisije stakleničkih plinova tijekom čuvanja i primjene stajskog gnoja ovisi o vrsti i načinu skladištenja, trajanju skladištenja te transportu i načinu primjene na tlo (raspršivanje, unošenje). Nadalje, okolišni čimbenici (temperatura i vlaga) neophodni za odvijanje ključnih mikrobnih procesa u stajskom gnoju (nitrifikacija i denitrifikacija, metanogeneza, oksidacija CH4) utječu na intenzitet emisije tijekom manipulacije stajskim gnojem. S obzirom na tip gnoja (kruti, tekući), vrstu životinja od koje gnoj potječe te načina spremanja i primjene na poljoprivredne površine, a uvažavajući klimatske specifičnosti za pojedine dijelove RH (kontinentalna, brdsko-planinska i primorska Hrvatska) procjena je da se kao rezultat animalne proizvodnje u RH izlučuje ekskrementima oko 55.000 tona dušika, pri čemu se emisijom u atmosferu gubi oko 34% ili 18.700 tona N. Uz prisutan trend smanjenja broja stoke i podizanje standarda pri skladištenju i primjeni stajskog gnoja ne očekuje se povećanje emisija stakleničkih plinova iz animalne proizvodnje uvjetovanog gospodarenjem stajskog gnoja u narednom razdoblju.

Ključne riječi: *stakleнički plinovi, emisija, animalna proizvodnja, stajski gnoj*

ABSTRACT

The emission of greenhouse gases from animal production is a direct consequence of the process of intestinal fermentation and decomposition of manure during storage and spreading on agricultural land. While intestinal fermentation is the main source of methane (CH4), manure management is the source of ammonia (NH3), nitrogen oxides (NOx), non-methane volatile organic compound (NMVOCs) and particulate matter (PM). The release of NH3, NOx and NMVOCs comes from animal excrements (feces and urine) deposited in and around the farm, to the outdoor area, on pastures or manure collected and deposited on storage, as well as when it is spread to the land. Manure management could be little source of CH4 emissions as a result of bacterial degradation of organic matter from manure during storage. The degree of greenhouse gas emissions during storage and application of manure to the land is dependent on the type of storage, the duration of storage and the method of application in the soil (spraying, incorporation). Furthermore, the environmental factors (temperature and humidity) obligate for the key microbial processes in manure (nitrification and denitrification, methanogenesis, CH4 oxidation) affect the intensity of the emission during manure management. In relation to the type of produced manure (solid, liquid), livestock species from which manure originates, the method of storage and application on agricultural land as well as climate condition characterized for each region (continental, mountainous and Adriatic), it is estimated that N excretion from livestock in Croatia is about 55,000 tons of which 34% or 18,700 tons is emitted into the atmosphere. With the decreasing trend in the livestock production and raising standards in manure management, it is not expected to increase the emissions of greenhouse gases from manure management in the coming period.

Keywords: *greenhouse gasses, emission, animal production, manure management*

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KORIŠTENJE MODELA DINAMIČKOG MEHANIZMA BROJLERA KAKO BI SE SMANJIO UTJECAJ NA OKOLIŠ

USE OF A DYNAMIC MECHANISTIC BROILER MODEL TO REDUCE ENVIRONMENTAL FOOTPRINT

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ABSTRACT

The impact of broiler meat production on the environment can be diminished by the reduction of dietary N and P excretion, using modeling as a tool for understanding and decision-making. Modeling allows integrating knowledge and quantifying metabolic functions and nutrient partitioning, as well as evaluating 'what-if' scenarios. A dynamic mechanistic broiler model was constructed by re-parameterizing a pig growth model. It simulates the partitioning of nutrients between protein and lipid deposition, as well as the digestible P and Ca utilization and retention in body tissues and feathers. It allows forecasting in daily steps the average responses to different dietary strategies by considering the potential of different genotypes. The dynamics of the N and P excretion can be assessed with feeding different diets and examples will be given on the prediction of nutrient requirements.

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ALGE KAO ALTERNATIVNI IZVORI PROTEINA
ALGAE AS ALTERNATIVE PROTEIN SOURCES

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SAŽETAK

Alge čine heterogenu i neistraženu skupinu organizama. Postoje dvije glavne vrste algi: makroalge (morske trave) i mikroalge. Makroalge predstavljaju raznoliku skupinu eukariotskih, fotosintetskih morskih organizama, poseduju biljne karakteristike, a također mogu biti vrlo velikih dimenzija. Nasuprot makroalgama, mikroalge su jednoćelijske alge malih dimenzija, koje se nalaze u bentoskim i primorskim staništima, a poznate su kao fitoplankton. Njihova sustavna klasifikacija temelji se na njihovom sastavu pigmenta koji vodi do različitih klasa. Velika raznolikost vrsta algi je povezana sa velikim brojem metabolita, uključujući proteine, peptide, aminokiseline, ugljikohidrate, polinezasićene masne kiseline, karotenoide, sterole, zasićene lipide, vitamine i druge. S obzirom na to da predstavljaju neiskorišćeni hranjivi izvor, u posljednjih nekoliko godina došlo je do povećanog interesa za njihovu potencijalnu primjenu, posebno mikroalgi kao alternativnih izvora proteina i lipida ili drugih visoko vrijednih spojeva u hranidbi životinja. Sastav hranjivih tvari ovisi o uvjetima uzgoja vrsta, sojeva i algi.

Makro- i mikroalge mogu biti važan izravni ili neizravni izvor hrane za različite razvojne faze mnogih vrsta životinja. Osim toga, mogu se smatrati održivim alternativnim izvorom proteina za hranu za životinje, jer u određenim uvjetima proizvodnja posebno mikroalgi zahtijeva vrlo malo obradive površine, što rezultira i niskom emisijom plinova. Sveukupno, uključivanje makro- i mikroalgi u hranu za životinje predstavlja vrlo obećavajuću strategiju za održavanje i razvoj stočarskog sektora. Iako ih visoki troškovi proizvodnje trenutno čine nekonkurentnom opcijom prehrane, veća dostupnost i niža cijena, putem biogoriva, omogućila bi veću upotrebu u budućnosti.

Ovaj pregled opisuje karakteristike uobičajenog korištenja makro- i mikroalgi, kao i njihov potencijal za uporabu kao sastojak u inovativnim proizvodima hrane za životinje na temelju kvaliteta proteina i aminokiselinskog sastava.

Ključne riječi: *makroalge, mikroalge, hranidba životinja, alternativni izvor proteina*

Napomena: Predstavljeni rad je dio projekta III 46012 koji financira Ministarstvo prosvjete, znanosti i tehnološkog razvoja Republike Srbije.

ABSTRACT

Algae constitute a heterogeneous and unexplored group of organisms. There are two main types of algae: macroalgae (seaweeds) and microalgae. Macroalgae represent a diverse group of eukaryotic, photosynthetic marine organisms and possess plant-like characteristics and can be of very large size. Opposite to macroalgae, microalgae are unicellular small-sized algae which are found in benthic and littoral habitats, known as phytoplankton. Their systemic classification is based on their pigment composition leading to different classes. The large diversity of algal species is correlated with a large variety of metabolites including proteins, peptides, amino acids, carbohydrates, polyunsaturated fatty acids, carotenoids, sterols, saturated lipid, vitamins and others. Considering that they represent an unexploited nutritive source, an increased interest for their potential application as alternative sources of protein and lipids or other high value compounds in animal nutrition has been observed. Nutrient composition depends on species, strain and algae growing conditions.

Macro- and microalgae can provide an important direct or indirect feed source for different developmental stages of many animal species. In addition, they can be regarded as a sustainable alternative protein source for animal feed, due to under certain conditions in particular microalgae production requires very little arable land, and the resulting low gas emissions. Overall, the inclusion of macroalgae and microalgae in feed represents a very promising strategy for the maintenance and development of livestock sector. Although high production cost of macroalgae and microalgae makes them currently an uncompetitive feed option, greater availability / lower price, via biofuels would enable more widespread use in future.

This review describes the characteristics of commonly utilizing macroalgae and microalgae, as well as their potential for use as an ingredient in innovative feed products based on their protein quality and amino acid composition.

Keywords: *macroalgae, microalgae, animal nutrition, alternative protein source*

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MOGUĆNOST KORIŠTENJA ALTERNATIVNIH IZVORA BJELANČEVINA U HRANIDBI ŽIVOTINJA

THE POSSIBILITY OF ALTERNATIVE PROTEIN SOURCES USE IN ANIMAL FEEDING

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SAŽETAK

Porastom broja stanovnika u svijetu povećava se i potrošnja mesa peradi i jaja, što stvara potrebu za novim sastojcima u hranidbi peradi kako bi se podržala održiva intenzivna proizvodnja. Ovakvo povećanje intenziteta proizvodnje zahtijeva upotrebu većih količina proteina za pokrivanje amino-kiselinskih zahtjeva za rast i razvoj peradi te proizvodnju jaja. Temeljem navedenog, konvencionalni izvori proteina korišteni u hranidbi peradi mogli bi biti nedovoljni i iz tog razloga trebalo bi se usredotočiti na alternativne izvore. Alternativni izvor proteina u hranidbi peradi je korištenje insekata, koji su dostupni u prirodi većim dijelom godine. Hranidbena vrijednost jestivih insekata je vrlo raznolika i to uglavnom zbog velikog broja i varijabilnosti vrsta. Nutritivne vrijednosti mogu značajno varirati čak i unutar skupine insekata ovisno o stadiju metamorfoze, porijeklu kukca i njegovoj prehrani. Insekti također imaju visok sadržaj mono- i polinezasićenih masnih kiselina te vitaminima te se pokazalo da mogu parirati ribljem brašnu, koji je glavni izvor životinjskih bjelančevina u hranidbi peradi. Na temelju visoke nutritivne vrijednosti insekta, potrebno je provesti istraživanja o njihovoj proizvodnji kako bi se omogućilo njihovo korištenje na manjim peradarskim farmama. Jedan od alternativnih način uzgoja određenih insekata je hranidba na posliježetvenim ostacima koji sadrže ogromnu količinu potencijalnog supstrata za hranidbu raznih kukaca. Posliježetvena biomasa sadrži različite kemijske skupine i elemente, ovisno o podrijetlu nusproizvoda, te se korištenje supstrata za rast jestivih kukaca može postići na tri načina: a) izravnim korištenjem sirovog organskog materijala, b) prethodnom obradom i/ili konverzijom i c) kombinacija prethodna dva načina. Pojedini insekti imaju sposobnost transformirati nutritivno siromašnu posliježetvenu biomasu s niskim sadržajem proteina i visokim sadržajem antioksidanata i tvrdokornih ugljikohidrata (celuloze i hemiceluloze) u esencijalne hranjive tvari potrebne za njihov rast modulacijom njihove probavne i bazalne diferencijalne ekspresije gena. Konverzija posliježetvene biomase u biomasu jestivih kukaca za hranu za životinje mogla bi značajno pridonijeti zadovoljavanju budućih potreba rastuće svjetske populacije za novim i više životinjskim izvorima proteina. Insekt frass, nusproizvod konverzije, također se može koristiti kao organsko gnojivo za uzgoj usjeva. Stoga je cilj ovog rada pregled mogućnosti korištenja alternativnih izvora bjelančevina, odnosno insekata, u hranidbi peradi te istražiti potencijalnu upotrebu posliježetvene biomase kao novog i inovativnog supstrata za uzgoj jestivih insekata.

Ključne riječi: *insekti, nutritivna vrijednost, proteini, hranidba pilića, supstrat, posliježetvena biomasa*

ABSTRACT

As the number of inhabitants in the world is increasing also the consumption of poultry meat and eggs is increasing, which creates the need for new ingredients in poultry nutrition in order to support sustainable intensive production. This increased intensity of production requires the use of large quantities of protein to cover amino acid requirements for growth and development of poultry and egg production. Consequently, the conventional sources of protein used in poultry nutrition could be insufficient and therefore should focus on alternative sources. Alternative sources of protein in poultry nutrition are the use of insects, which are available in nature for most of the year. The nutritional value of edible insects is very diverse, mainly due to the large number and variety of species. Nutritional values may vary significantly even within the group of insects depending on the stage of metamorphosis, the origin of insect and its diet. Insects also have a high content of mono- and polyunsaturated fatty acids and vitamins and proved that they can compete with fish meal, which is the main source of animal protein in poultry nutrition. Based on the high nutritional value of insects, it is necessary to conduct research on their production in order to provide their use in small poultry farms. One of the alternative breeding ways of certain insects is feeding on postharvest residues that contain a huge amount of potential substrate for various insects feeding. The postharvest biomass contains different chemical groups and elements depending on the by-products origin and the use of substrates for the growth of edible insects can be achieved in three ways: a) by direct use of crude organic material, b) by pretreatment and/or conversion of organic material, and c) combination of previous two ways. Certain insects are capable of transforming nutritionally poor postharvest biomass with low protein content and a high content of antioxidants and dominant carbohydrates (cellulose and hemicellulose) in essential nutrients necessary for their growth by modulating their digestive basal and differential gene expression. The postharvest biomass conversion in the biomass of edible insects for feed could significantly contribute to meeting the future needs of a growing world population for new and more animal protein sources. Insect frass, a by-product of the conversion, can also be used as an organic fertilizer for crop cultivation. Therefore, the aim of this paper is to review the possibilities of alternative protein sources use, i.e. insects, in poultry nutrition and explore the potential use of postharvest biomass as a new and innovative substrate for edible insects growing.

Keywords: *insects, nutritional value, proteins, chicken feed, substrate, postharvest biomass*

INSEKTI- ALTERNATIVNI IZVOR PROTEINA U HRANIDBI ŽIVOTINJA
INSECTS - AN ALTERNATIVE SOURCE OF PROTEIN IN ANIMAL NUTRITION

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ABSTRACT

Decreasing of protein resources and its limited production is one of the most serious economic problems of the world. The percentage of fish meal that is used for aquaculture feeds has increased from 10% in 1988 to 45% in 2002. The increasing global demand for and decreasing availability of fish meal has led to sharp increases in the price of fish meal, and hence, the cost of aquaculture production has increased as well. For this reason there is increasing interest in alternative protein sources to feed the increasing world population. Insects represent one of the potential sources to exploit. Edible insects are a natural renewable resources used as food by humans. Although insects began to be evaluated as a potential foodstuff for animals 40 years ago, the incorporation of insects into fish feed has not received much attention until recently. In the last 10 years there have been several studies of feeding experiments performed in vivo with diets based on insect meal.

In accordance with Commission Regulation (EU) 2017/893 of 24 May 2017 amending Annexes I and IV to Regulation (EC) No 999/2001 of the European Parliament and of the Council as well as Annexes X, XIV and XV to Commission Regulation (EU) No 142 / 2011 with regard to the provisions on processed animal protein, the safety conditions for the production of insects for feeding purposes satisfy the following species: Black Soldier Fly (Hermetia illucens), Common Housefly (Musca domestica), Yellow Mealworm (Tenebrio molitor), Lesser Mealworm (Alphitobius diaperinus), House cricket (Acheta domesticus), Banded cricket (Gryllodes sigillatus) and Field Cricket (Gryllus assimilis). These species were chosen after taking into account the national risk assessments and the EFSA opinion of 8 October 2015. It should not be a species of pathogenic should not have adverse effects on the health of plants, people and animals should not be vectors of human pathogens, animal or vegetable, they should not be protected or identified as invasive alien species.

From the nutritional point of view, depending on species and/or stage, insects are rich in protein and lipids. The most insect species analysed have a high proportion of protein, between 40 and 60% in similar to soy meal levels (50% CP) and lower than fishmeal (73.0% CP). All developmental stages are characterized by a high content of total protein, including exogenous amino acids and fat. The presence of chitin indicates a negative characteristic. However, chitin also is present in crustacean, which are widely consumed by fish.

Insects can play the essential role in animal nutrition, therefore studies on their nutritional value are needed in the context of their use in feed.

VARIJABILNOST U SASTAVU MASNIH KISELINA U UZGOJU KOMERCIJALNO ZNAČAJNIH VRSTA INSEKATA - CRNE VOJNIČKE MUHE (*Hermetia illucens*) I JAMAJČANSKOG POLJSKOG ŠTURKA (*Gryllus assimilis*)

VARIABILITY IN THE FATTY ACID PROFILE OF IMPORTANT INSECT SPECIES IN COMMERCIAL PRODUCTION – BLACK SOLDIER FLY (Hermetia illucens) AND JAMAICAN FIELD CRICKET (Gryllus assimilis)

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SAŽETAK

Insekti postaju na globalnoj razini sve zanimljiviji izvor bjelančevine i masti za ljude, proizvodne životinje (trenutno akvakultura) i kućne ljubimce (insektivori). Između komercijalno zanimljivih vrsta istražili smo Jamajčanskog poljskog šturka (Gryllus assimilis) zbog otpornosti na densovirus (Acheta domesticus densovirus, AdDNV) i Crnu vojničku muhu (Hermetia Illucens) zbog velike raznolikosti u hranidbenim medijima na kojima može biti uzgojena. Cilj našeg istraživanja bilo je utvrđivanje do koje razine je moguće mijenjati masnokiselinski sastav ovih vrsta.

Insekti su uzgojeni korištenjem hrane s različitim mješavinama ulja (suncokretovo, riblje, laneno) dok je Crna vojnička muha dodatno uzgojena i na hranidbenim medijima s nusproizvodima (pogača masline, obrađeni životinjski protein, kategorija 3). Masne kiseline su analizirane korištenjem plinskog kromatografa s masenom detekcijom (GC-MS QP2010 Ultra Gas Chromatograph Mass Spectrometer) s kapilarnom kolonom BPX70. Podaci su statistički obrađeni korištenjem programa Statistica 2012. Srednje vrijednosti su uspoređene analizom varijance i Tukey post hoc testom.

Najveći plasticitet pronađen je kod sedam masnih kiselina i kod n6/n3 omjera. Kod Crne vojničke muhe plasticitet sastava masnih kiselina bio je izuzetno visok s najvećim rasponom kod laurinske masne kiseline. Kod Jamajčanskog poljskog šturka plasticitet je bio niži, a najveći raspon je bio kod linolne masne kiseline.

Korištenjem raznih ulja i nusproizvoda može se postići veliki plasticitet u sastavu masnih kiselina kod vrsta Jamajčanskog poljskog šturka i Crne vojničke muhe. Te promjene mogu predstavljati dodatnu vrijednost pri komercijalnoj proizvodnji insekata putem poboljšavanja njihove kvalitete kao hrane za proizvodne životinje i kućne ljubimce i kao izvora specifičnih ulja za razne industrije.

ABSTRACT

Insects are nowadays becoming globally interesting as a protein and fat source for humans, production animals (currently aquaculture) and pet animals (insectivores). Among commercially interesting species we investigated Jamaican field cricket (Gryllus assimilis) due to the resistance to Acheta domesticus densovirus (AdDNV) and Black soldier fly (Hermetia Illucens) due to the high versatility in feeding media that can be used for its rearing. Our main goal was to investigate to which extent dietary manipulation could improve the fatty acid profile of these species.

The insects were reared using feed with different oil blends (sunflower, fish, linseed oil) and additionally, Black soldier fly larvae were reared using different byproducts (crude olive cake, processed animal protein) as feeding media. The analysis of fatty acid composition was performed using a Shimadzu GC-MS QP2010 Ultra Gas Chromatograph Mass Spectrometer equipped with capillary column BPX70. For statistical data analysis, Statistica 2012 was used. Data were compared by analysis of variance and Tukey post hoc test.

The highest plasticity was found in seven different fatty acids and n6/n3 ratio. In Black soldier fly larvae plasticity was very high and the highest in the content of lauric acid. In Jamaican field cricket plasticity was lower compared to the Black soldier fly larvae and the highest was in the content of linolenic acid.

High plasticity in the lipid profile of Hermetia illucens and Gryllus assimilis could be achieved by using different oils and byproducts in their feed. These changes could add significant value to the insect production including improved quality of insects as the feed for production animals and pets as well as the source of specific oils for different industries.

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KARAKTERISTIKE HRANIDBENOG SASTAVA I AEROBNA STABILNOST SILAŽE TALIJANSKOG LJULJA TE MJEŠAVINE OZIMIH ŽITARICA U HRANIDBI MLIJEČNIH KRAVA

NUTRIENT CONTENT AND FERMENTATION CHARACTERISTICS OF ENSILED ITALIAN RYEGRASS AND WINTER CEREAL MIXTURES FOR DAIRY COWS

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ABSTRACT

The interest in new alternative forages in Europe has increased in recent years. The nutritional composition and fermentation characteristics during the different stages of ensiling were studied with Italian ryegrass (Lolium multiflorum Lam.) and winter cereal mixtures (mixture A: three types Italian ryegrass + two types triticale + two types oats + wheat + barley; and mixture B: three types Italian ryegrass + two types winter oats). The forage mixtures were planted at the same time on the experimental fields (Galgamenti Agricultural Limited Company, Tura, Hungary). Forages were harvested in the heading stage and wilted (24 h) to 35% DM. The wilted forages were chopped to 9 mm length then ensiled in five replications in laboratory silos. Five laboratory silos per mixtures were opened on 7, 14 and 90 days after ensiling. Dry matter (DM), crude protein (CP), crude fiber (CF), neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), ether extract (EE), ash, and total sugar of all treatments were determined with laboratory analysis. Additionally, pH and the concentration of ammonia-N, volatile fatty acids were measured in the ensiled mixtures. The contents of DM, CP and total sugar were not affected by fermentation. While the contents of CF, NDF, ADL, EE, ash of mixture A, and contents of ADF, ADL, EE of mixture B were affected by the ensiling process ($p<0.05$). Ensiling caused a significant decrease in pH ($p<0.05$), due to the production of lactic acid during ensiling and succeeded to achieve lactic acid type fermentation. Values for ammonia-N, ethanol and acetic acid, butyric acid were all low. These results indicated that the fermentation quality of Italian ryegrass and winter cereal silages underwent rapid fermentation and were well-preserved.

Keywords: *fermentation, Italian ryegrass, winter cereals, silage, lactic acid*

PROIZVODNO - HEMATOLOŠKI UČINCI PRIMJENE PIRA (*Triticum aestivum spp. spelta* L.) U TOVU JANJADI

PRODUCTION - HEMATOLOGICAL EFFECTS OF SPELT (Triticum aestivum spp. spelta L.) IN THE FATTENING OF LAMBS

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SAŽETAK

Cilj istraživanja je utvrditi mogućnost upotrebe pira u obrocima janjadi te utvrditi njegov utjecaj na proizvodno hematološke-pokazatelje janjadi. Istraživanje je provedeno na ekološkom obiteljskom poljoprivrednom gospodarstvu u kojem se uzgajaju Merinolandschaf ovce. U istraživanje je bilo uključeno 21 Merinolandschaf janje, prosječne dobi 95 dana. Janjad je ravnomjerno podijeljena prema spolu u tri skupine: I. - kontrolna skupina; II. - skupina s 10 % oljuštenog pira i III. - skupina s 20 % oljuštenog pira. Sijeno i vodu janjad su imala na raspolaganju *ad libitum*. Tjelesne mase, tjelesne mjere i uzorci krvi janjadi uzeti su 0., 15., i 30. dana istraživanja. Nakon toga izračunati su prosječni dnevni prirasti, konverzija hrane i indeksi tjelesne razvijenosti janjadi. Analizom dobivenih rezultata na kraju istraživanja nisu utvrđene značajne (P>0,05) razlike u tjelesnoj masi (35,89 : 34,92 : 34,99 kg), tjelesnim mjerama i indeksima tjelesne razvijenosti janjadi ovisno o skupini. Također, nisu utvrđene značajne (P>0,05) razlike u prosječnom dnevnom prirastu između kontrolne i pokusnih skupina janjadi (237,71 : 209,71 : 207,14 g). Prosječna konverzija je u kontrolne skupine janjadi iznosila 4,40 kg/kg, u II. - skupine 4,97 kg/kg, a u III. skupine 4,99 kg/kg. Zamjenom uobičajenih žitarica (ječam, zob) s pirom kao ekološkom žitaricom u obrocima janjadi nije došlo do promjene proizvodno - hematoloških pokazatelja janjadi. S obzirom na veću otpornost pira na okolišne čimbenike, moguće ga je uzgajati na ekološki način u nepovoljnijim klimatskim uvjetima što još više naglašava kvalitetu janjetine.

Ključne riječi: *janjad, pir, proizvodni pokazatelji, hematološki pokazatelji*

ABSTRACT

The aim of the research is to determine the possibility of using spelt in lamb diets and to determine its effect on productivity and haematological status of lambs. The research was conducted on an organic family farm, which farms Merinolandschaf breed sheep. The research included 21 lambs in the average age of 95 days. Lambs were evenly divided by sex into three groups: I.-control group; II. - group with 10 % of dehulled spelt and III. - group with 20 % of dehulled spelt. Lambs had hay and water available ad libitum. Body weights, measures and blood samples of lambs were taken on the 0^{th}, 15^{th} and 30^{th} day of research. In addition, the average daily gain, feed conversion, and lambs indexes of physical development were calculated. Analysis of the obtained results at the end of the research did not reveal significant (P>0.05) differences in body weight (35. 89 : 34.92 : 34.99 kg), body measures, and indexes of physical development of lambs depending on group. In addition, there were no significant (P>0.05) differences in average daily gain between control and experimental groups of lambs (237.71 : 209.71 : 207.14 g). Average feed conversion in control group of lambs was 4.40 kg/kg, in II. -group 4.97 kg/kg, and in III. group was 4.99 kg/kg. By consuming spelt as organic grain and his substitute for common cereals (barley and oat) in rations of lambs, there was no change in production - haematological parameters of lambs. With regard to the higher resistance to environmental factors, spelt can be cultivated in harsh ecological conditions, on organic way, which even more emphasize quality of lamb's meat.

Keywords: *lambs, spelt, production indicators, haematological indicators*

KORIŠTENJE OBNOVLJIVIH IZVORA ENERGIJE – POTENCIJAL PRIMJENE SUNČEVE ENERGIJE ZA GRIJANJE I HLAĐENJE FARMI - UŠTEDA U POTROŠNJI FOSILNOG GORIVA

USE OF RENEWABLE ENERGY SOURCES – USE OF SOLAR ENERGY POTENTIAL FOR FARM HEATING AND COOLING - SAVINGS IN FOSSIL FUEL CONSUMPTION

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ABSTRACT

Process-Heat / Process-Cooling by SOLID solarinstalation + deisign

Development of our Planet and consequent climate change force us to increasingly introduce renewable sources of energy, such as solar. The current development and consumption of energy imply also that there are no sustainable cities and industry without sustainable heating and cooling systems. The Sun is a free and inexhaustible source of energy that is available for us in unlimited amounts, gives us more than enough energy, and has no harmful environmental impact. The sun radiates 960 billion KWh per day on Earth's surface. This amount of energy could theoretically meet world energy needs for 180 years. Unlike fossil fuels, solar energy is available for all, does not produce harmful emissions of carbon dioxide and is free for all. Modern heating systems can be combined with solar heating and cooling systems, which makes them an excellent option for preparing hot water, cooling and for heating. By using solar energy, the space in which we live and work, we can reduce the consumption of conventional energy sources, reduce environmental pollution, make better place for living and achieve significant savings: at least 60% energy savings.

In order to put the solar energy in our service, we need solar systems. Solar systems are just an example of how energy efficiency can be achieved. The usage of solar systems means the usage of solar energy for heating water, cooling that is needed for consumption in spaces where we live and work. Consequently, the solar system is connected to the already existing system, whether it works on gas, electricity, biomass or solid of liquid fossil fuel (or even if it is combined) and at the end of the installation every part of can still work independently.

SOLID is an Austrian solar engineering company based in Graz specializing in all aspects of large-scale solar thermal energy plants. Since 1992, has been planning, building, delivering, assembling and operating large-scale solar plants around the world, providing hot water, room heating, industrial process heat and district heating for towns and villages. SOLID also designs and builds solar chilled water plants, including the largest commercial solar cooling projects currently worldwide in operating. The project sizes today are typically in a range from 300 kWthermal up to several MWthermal nominal capacity. With its unmatched experience in design and operation of large-scale solar plants, SOLID is both a pioneer and one of the world's leading companies in the solar industry.

Service portfolio We offer our customers the following:

- *Planning + Design*
- *Large-area collectors*
- *Mounting systems*
- *Pipeline construction*
- *Pump units and other components*
- *Controllers*
- *Complete assembly*
- *Monitoring and operating*

SOLID only uses products that conform to the very latest state-of-the-art. By offering the most advanced remote control and maintenance systems available. Research and development is an integral constituent and an initiator of numerous development projects – our know-how is in demand! International network we boast an international network with local partners in many countries around the world.

Definition

Solar Thermal is known for:

- Solar Heating like: Domestic hot water, heating, …

- Solar Cooling like air conditioning, cold storage, …

Solar Thermal is barely known for industrial/commercial uses:

- Heating of process fluids, washing detergents, heating processes, drying processes, …

- Cooling of technical processes

Cooling and heating must be understood in relation to the ambient temperature. (warmer or colder than ambient)

POBOLJŠAVANJE PERFORMANSA RASTA I RAZVOJ CRIJEVA TOVNIH PILIĆA LIZOFOSFOLIPIDOM

LYSOPHOSPHOLIPID IMPROVES GROWTH PERFORMANCE AND INTESTINAL DEVELOPMENT IN BROILERS

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ABSTRACT

A study was conducted to evaluate the effects of supplementing different levels of lysophospholipid (LPL) product (Lipidol) to normal or reduced energy diets on growth performance and carcass characteristics in broilers. A total of 960 one-day-old cobb 500 male birds were allocated a 2 × 4 factorial arrangement with two energy levels (NE: normal and RE: 100kcal/kg metabolic energy reduced) and four LPL supplement levels (0, 0.025%, 0.050%, and 0.075%). Three diet phases were fed throughout the trial: starter (d 0-7), grower (d 8-21), and finisher (d 22-42) phases. Body weight (BW), feed intake (FI), and feed conversion ratio (FCR) were calculated at the end of each phase. At d 7 and d 21, duodenum and jejunum samples were collected for intestinal morphology and claudin-3 expression analyses, and tibia were sampled for bone quality analyses. At d 42, four birds per replicate were selected to measure the carcass characteristics. The results showed the low metabolic energy diet impaired bird's growth performance, intestine health and bone quality. The 0.075% LPL supplement to basal diet in NE improved BW, BWG and FI in the finisher and overall period compared with no LPL supplement in NE (P<0.05). In RE, the 0.025% dosage of LPL supplement significantly improved growth performance compared to the other treatments in RE (P<0.05). The interactions on processing parameters were detected with LPL supplement in NE diets; 0.025, 0.05, and 0.075% LPL supplements significantly increased pectoral major percentages compared to the one without LPL supplement in NE (P<0.05). The 0.075% LPL supplement increased dressing percentage compared with the others (P<0.05). The intestine morphology results showed LPL had positive effects on intestine development mainly during the early age (d 7) and claudin-3 expression at both d 7 and d 21. Furthermore, LPL supplement significantly increased the total Ca and P deposition and positively affected the bone structure development. In summary, dietary LPL supplementation promoted growth performance, meat yield, intestinal development, intestinal health, and bone quality.

Keywords: *lysophospholipids, growth performance, meat character, small intestine, bone quality*

MATRIX FOR FOOD INDUSTRY – SECTOR INFORMATION

		milk products	fruits / vegetables / herbs	sugar	beer	fats / oils	chocolate / cacao / coffee	starch / potatoes / grain mill products	wine / beverage	meat	fish	aroma
UNIT OPERATIONS	Typical processes											
CLEANING	Cleaning of bottles and cases	x	x		x	x			x	x	x	
	Washing products		x	x		x		x	x	x	x	
	Cleaning of production halls and equipment	x	x	x	x	x	x	x	x	x	x	x
DRYING	Drying	x	x	x		x	x	x		x		
EVAPORATION AND DISTILLATION	Evaporation	x	x	x		x	x	x	x	x	x	
	Distillation					x		x	x			x
	Deodorization					x	x					
BLANCHING	Blanching		x					x				
PASTEURISATION	Pasteurization	x	x		x			x	x	x	x	
STERILIZATION	Sterilization	x	x					x	x	x	x	
COOKING	Cooking and boiling		x		x		x	x	x	x	x	
OTHER PROCESS HEATING	Pre-heating	x	x		x							
	Soaking		x				x		x			
	Thawing									x	x	
	Peeling		x									
GENERAL PROCESS HEATING	Boiler feed-water preheating	x	x	x	x	x	x	x	x	x	x	x
HEATING OF PRODUCTION HALLS	Heating of production halls			x			x	x	x			x
COOLING OF PRODUCTION HALLS	Cooling of production halls	x	x						x	x	x	
COOLING PROCESSES	Cooling, chilling and cold stabilization	x	x	x	x	x	x	x	x	x	x	
	Ageing	x							x			
MELTING	Melting	x				x	x		x			
EXTRACTION	Extraction		x	x		x	x		x			x
BLEACHING	Bleaching					x						

"Temperature level"												
20-40°C		x			x		x		x			
40-60°C		x	x	x	x	x	x	x	x	x	x	x
60-80°C		x	x	x	x	x	x	x	x	x	x	x
80-100°C		x	x	x	x	x	x	x	x	x	x	x
100-120°C		x	x	x			x	x	x	x	x	
120-140°C		x	x	x			x	x	x	x	x	
140-160°C		x					x	x				
>160°C		x				x	x	x				

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UTJECAJ DODATKA SPOREDNIH PROIZVODA PRERADE ULJARICA NA FIZIČKE I NUTRITIVNE KARAKTERISTIKE EKSTRUDIRANE HRANE ZA BROJLERE

EFFECT OF OILSEED BY-PRODUCTS ADDITION ON PHYSICAL AND NUTRITIONAL QUALITY OF EXTRUDED FEED FOR BROILERS

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SAŽETAK

U Evropi postoji sve veća potreba za domaćim izvorima proteinima za prehranu životinja, što potvrđuje činjenica da je u većini evropskih zemalja potreba za proteinima nadoknađena uvozom proizvoda od soje. Sporedni proizvodi uljarica, kao što su sačme, predstavljaju značajan izvor proteina i imaju relativno visok sadržaj biološki vrijednih tvari i hranjivih tvari. Uljarice poput suncokreta i uljane repice imaju veliki potencijal kao alternativa proizvodima od soje. Iako sporedni proizvodi prerade suncokreta i uljane repice imaju manji sadržaj proteina od sporednih proizvoda prerade soje, njihov sadržaj proteina je značajan (30-40%) i veći u usporedbi s alternativnim biljnim proteinima. Cilj istraživanja bio je procijeniti utjecaj zamjene sojine sačme suncokretovom sačmom i sačmom uljane repice u prehrani brojlera i utjecaj na fizičke karakteristike i nutritivnu vrijednost ekstrudirane hrane. Sve komponente su samlevene na mlinu čekićaru s prečnikom otvora od 1 mm. Potpune smeše su kondicionirane u dvoosovinskom kondicioneru i zatim ekstrudirane na dvopužnom ekstruderu. Ispitani su kemijski sastav, sadržaj aminokiselina, in vitro probavljivost proteina, želatinizacija škroba i fizička svojstva proizvedene hrane za brojlere. Iako je najveći udio proteina bio u hrani za brojlere koja je u svom sustavu imala sojinu sačmu, hrana sa suncokretovom sačmom i hrana sa sačmom uljane repice su takođe imale značajan udio proteina. Najveći udio lizina imala je hrana sa sojinom sačmom, dok je najveći udio metionina bio u hrani sa suncokretom sačmom. Ekstrudiranje je značajno poboljšalo in vitro probavljivost proteina u svim proizvedenim hranama za brojlere. U usporedbi s sačmama uljarica, najveću vrijednost in vitro probavljivosti proteina imala je hrana sa sojinom sačmom, potom ona sa suncokretovom sačmom i sačmom uljane repice. Najveći stupanj želatinizacije škroba imala je hrana na bazi suncokretove sačme, dok je hrana sa sačmom uljane repice pokazala najniži stupanj želatinizacije škroba. Kada se posmatraju fizičke karakteristike proizvedene hrane, najveću tvrdoća peleta imala je hrana sa suncokretovom sačmom, potom hrana sa sojinom sačmom i sačmom uljane repice. Takođe, hrana na bazi suncokretove sačme je pokazala najveći stupanj otiranja peleta. Predstavljeni rezultati ukazuju da suncokretova i repičina sačma imaju potencijal da zamijene sojinu sačmu u ishrani brojlera, međutim, suncokretova sačma je na osnovu rezultata bila bolja alternativa sojinoj sačmi.

Ključne riječi: *sačme uljarica, ekstrudiranje, svarljivost proteina, želatinizacija škroba*

Napomena: Predstavljeni rezultati su deo istraživačkog projekta III 46012 financiranog od strane Ministarstva prosvete, nauke i tehnološkog razvoja Republike Srbije.

ABSTRACT

In Europe, there is an urgent need for domestic proteins for the nutrition of food producing animals, as the majority of European protein requirements are covered by the import of soy products. Oilseed by-products, such as meals, represent a significant source of protein and have a relatively high content of biologically valuable substances and nutrients. Oilseeds like sunflower and rapeseed have a great potential as alternatives to soy products. Although sunflower and rapeseed by-products have less proteins compared to soybean by-products, their protein content is considerable (30-40%) and higher compared to most plant protein alternatives. This study aims to evaluate the influence of the replacement of soybean meal with sunflower and rapeseed meals in broiler diet and effect on physical properties and nutritional value of extruded feed. All materials were milled on a hammer mill with sieve openings of 1 mm. Complete mixtures were conditioned in a double-shaft steam conditioner and then extruded on a twin-screw extruder. Chemical composition, amino acid content, in vitro protein digestibility, starch gelatinization and physical properties of broiler feeds were examined. Although the highest protein content was found in broiler feed with soybean meal, feed with sunflower and rapeseed meals also had considerable protein content. Feed with soybean meal had the highest level of lysine content, while feed with sunflower meal demonstrated the highest content of methionine. Extrusion significantly improved in vitro protein digestibility in all produced broiler feeds. When compared oilseed meals, feed with soybean meal had the highest in vitro protein digestibility value, followed by feed with sunflower meal and rapeseed meal, respectively. The highest degree of starch gelatinization showed sunflower meal based feed, while feed which contained rapeseed meal showed the lowest degree of starch gelatinization. Regarding feed physical properties, the greatest hardness had pellets with sunflower meal, followed by pellets with soybean meal and rapeseed meal, respectively. Moreover, sunflower meal based feed showed the highest value of pellet durability index. The present data suggest that both sunflower and rapeseed meals have a great potential to replace soybean meal in broiler diet, however, sunflower meal appeared to be more promising as alternative to soybean meal.

Keywords: *oilseed meals, extrusion, protein digestibility, starch gelatinization*

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PROIZVODNJA HRANE ZA ŽIVOTINJE: KAKO PROIZVESTI HRANU SA NAJVIŠIM EKONOMSKIM UČINCIMA?

FEED PRODUCTION: HOW TO PRODUCE FEED FOR THE HIGHEST ECONOMICAL PERFORMANCES?

Ruud Kock

Koudijs Animal Nutrition B.V.

ABSTRACT

Commercial feed mills and integrations will be most successful if they can fulfill the needs of the animals in the most efficient and sustained way. Key factors for success are knowing quality of raw materials, optimal recipes depending on animal needs and feed processing. Koudijs Animal Nutrition has the knowledge as a global player in feed production. We developed tools to support feed mills and integrations to control these key factors. Tools are for example, knowledge of nutritional needs of animals, NIR, feed optimalisation program and support on feed technology.

UTJECAJ PRIRODNOG SOJINOG OBROKA BEZ GM-A I PROTEAZE NA DJELOVANJE BROJLERA

THE INFLUENCE OF NON-GM NATIVE SOYBEAN MEAL AND PROTEASE ON PERFORMANCE OF BROILER CHICKENS

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ABSTRACT

The aim of the paper was to test the influence of non-GM native soybean meal with relatively high antitrypsin activity (9.7 mg/g) and feed additives: microflore stabilizer and protease, added into feed mixtures on the performance of broiler chicken rearing. The non-GM soybean meal was obtained by extrusion of soybean expeller. The experiment involved 640 broiler chickens of the Ross line, divided into 4 groups, consisting of eight replications, each one with 20 birds (10♂ and 10♀). Isoenergetic and isoprotein (isoamino acids) loose feed mixtures were used in conformity with recommendations.

The chickens in the control group (I) were fed the investigated non-GM soybean meal in feed mixture. The experimental groups of birds (II - IV) were fed the same non-GM soybean meal with addition microflore stabilizer of 300 mg/kg (II group), protease of 200 mg/kg (III group) and microflore stabilizer of 300 mg/kg and protease of 200 mg/kg (IV group). All fed mixture were supplemented with typical enzymatic preparations containing phytase and xylanase. The indices of bird rearing were determined, including weight gain and feed conversion, and slaughter yield and dissection analyses were performed. The indices of birds rearing were determined, including mortality, chicken weight gain and feed conversion.

After 42 days of rearing, the chickens' body mass increased up to 2.714 kg on the average, with feed conversion of 1.68 kg per 1 kg of weight gain. Chickens' mortality was low and amounted to 0.78% on the average, and the European Efficiency Index reached 374 points (from 355 to 401 points). Final body mass of broiler chickens from III group with protease addition was higher 4.5% compared to the body mass of birds from control group. Moreover, feed conversion in this group was lower by 3.5% compared to the control group results. The slaughter yield was 82.9% on the average. The dissection parameters were similar on all groups.

Keywords: *broiler chicken, feeding, non-GM soybean meal, microflore stabilizer, protease, performance parameters*

OBOGAĆIVANJE KONZUMNIH JAJA S N-3 MASNIM KISELINAMA
THE ENRICHMENT OF TABLE EGGS WITH N-3 FATTY ACIDS

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SAŽETAK

U radu se istražuje obogaćivanje konzumnih jaja n-3 polinezasićenim masnim kiselinama kombinacijom mikroalge *Schizochytrium limacinum* i ribljeg ulja u smjesama za nesilice. Ukupno 120 Tetra SL nesilica podijeljeno je u tri skupine slučajnim odabirom. Hranidbeni tretmani bili su sljedeći: K-kontrola (sojino ulje), E1 (0,5% mikroalge i 0,5% riblje ulje) i E2 (0,75% mikroalge i 0,75% riblje ulje). Istraživanje je trajalo tri tjedna. Smjese su bile izbalansirane na razini 16.5% sir. proteina i 11.8 ME MJ/kg smjese. Hranidba i napajanje bili su *ad libitum*. Analiza jaja pokazala je da je E1 skupina sadržavala 4,96±0,17%, a E2 4,23±0.97% n-3 PUFA u ukupnim masnim kiselinama. U odnosu na kontrolnu skupinu, to je povećanje za 2 puta u obje pokusne skupine. Alfa-linolenska (ALA) masna kiselina povećana je za 2,46, odnosno 2,23 puta, eikozapentaenska kiselina (EPA) je značajno smanjena, a dokozaheksaenska kiselina (DHA) je povećana za 1,83 odnosno 2 puta u E1 i E2 skupinama u odnosnu na kontrolnu skupinu jaja. Jaja kontrolne skupine sadržavala su n-3 polinezasićenih masnih kiselina 169,01 mg, E1 skupine 339,97 mg, a E2 skupine 335,44 mg/100 g jaja. Naše istraživanje pokazalo je da je za obogaćivanje jaja s n-3 polinezasićenim masnim kiselinama dovoljno upotrijebiti u smjesama za nesilice kombinaciju niže razine mikroalgi i ribljeg ulja.

Ključne riječi: jaja, mikroalga *Schizochytrium limacinum*, riblje ulje, n-3 PUFA

ABSTRACT

The study explores the enrichment of table eggs with n-3 polyunsaturated fatty acids by the combination of microalga Schizochytrium limacinum and fish oil in mixtures for laying hens. A total of 120 Tetra SL laying hens were divided into three groups by random selection. Dietary treatments were: K-control (soybean oil), E1 (0.5% microalgae and 0.5% fish oil) and E2 (0.75% microalgae and 0.75% fish oil). The study lasted for three weeks. The mixtures were balanced at the level of 16.5% raw proteins and 11.8 ME MJ/kg of the mixture. Feeding and watering were ad libitum. Analysis of eggs showed that E1 group contained 4.96 ± 0.17 % and E2 4.23 ± 0.97 % n-3 PUFA in total fatty acids. Compared to the control group, this was an increase of 2 times in both experimental groups. Alpha linolenic fatty acid (ALA) was increased by 2.46 and 2.23 times, eicosapentaenoic acid (EPA) was significantly reduced and docosahexaenoic acid (DHA) was increased by 1.83 and 2 times in E1 and E2 groups when compared to the control group of eggs. Eggs in the control group contained 169.01mg of the n-3 polyunsaturated fatty acids, while E1 group contained 339.97 mg, and E2 group 335.44 mg per 100 g of eggs. Our research has shown that for the egg enrichment with n-3 polyunsaturated fatty acids it is sufficient to use the combination of low-level microalga and fish oil in mixtures for laying hens.

Keywords: *eggs, microalga Schizochytrium limacinum, fish oil, n-3 PUFA*

UTJECAJ NANOČESTICA KLINOPTILOLITA NA PROIZVODNOST I OKSIDATIVNI STATUS TOVNIH PILIĆA

EFFECT OF CLINOPTILOLITE NANOPARTICLES ON PERFORMANCE AND OXIDATIVE STATUS OF BROILER CHICKENS

Valpotić, H., D. Brozić, D. Horvatek, Ž. Gottstein, L. Lozica, S. Vince, D. Đuričić, I. Žura Žaja, M. Đurić Jarić, M. Samardžija, Ž. Mikulec

SAŽETAK

Provedeno je istraživanje primjene različitih koncentracija nanočestica klinoptilolita (Vibrosorb®, Viridisfarm, Podpićan, Croatia) na proizvodne pokazatelje i oksidativni status kod tovnih pilića. Pokus je proveden na 200 muških pilića hibrida Ross 308 koji su nabavljeni iz komercijalne valionice te prebačeni na pokusni poligon Zavoda za prehranu i dijetetiku životinja Veterinarskog fakulteta u Zagrebu. Životinje su raspoređene u skupine od 10 životinja te su im nasumično određeni tretmani (0, 2, 4 i 6 g/t Vibrosorba®) koji su replicirani 5 puta. Pokusni pripravak nije imao utjecaja na tjelesnu masu životinja ali je poboljšao iskoristivost hrane. Skupina koja je u hrani dobivala 6 g/t ostvarila je značajno bolju ($p \leq 0.05$) konverziju hrane u periodu od 0. do 21. dana te tijekom cijelog istraživanja 0. - 42. dan. Oksidativni status pokusnih životinja mjerio se kroz aktivnost enzima superoksid dismutaze (SOD), glutation peroksidaze (GPx) te razine malondialdehida (MDA). Značajno veća ($p \leq 0.05$) aktivnost GPx zabilježena je u skupini koja je dobivala 6 g/t i to 21. i 42. dana dok je skupina sa 4 g/t ostvarila višu aktivnost samo 42. dana pokusa. Vrijednosti MDA posljednjeg dana pokusa bile su značajno niže ($p \leq 0.05$) u skupini koja je dobivala 2 g/t. Tijekom istraživanja nisu zabilježene značajne razlike u mortalitetu.

Ključne riječi: klinoptilolit, proizvodni rezultati, oksidativni status, brojleri

ABSTRACT

A study was conducted to asses different concentrations of clinoptilolite nanoparticles (Vibrosorb®, Viridisfarm, Podpićan, Croatia) on production parameters and oxidative status in fattening chickens. The experiment was carried out on 200 male Ross 308 chickens obtained from commercial hatchery and transferred to the experimental polygon of the Department of Animal Nutrition and Dietetics of Veterinary Faculty in Zagreb. The animals were placed in pens of 10 animals each and were randomly assigned treatments (0, 2, 4 and 6 g/t of Vibrosorb®) that were replicated 5 times. The experimental supplement had no effect on the final body mass of animals but it significantly improved feed efficiency. The group receiving 6 g/t had a significantly better ($p \leq 0.05$) feed conversion between day 0. to 21. and throughout the experiment (day 0. to 42). Oxidative status of experimental animals was measured through the activity of enzymes superoxide dismutase (SOD) and glutathione peroxidase (GPx) and malonaldehyde level (MDA). Significantly higher ($p \leq 0.05$) GPx activity was observed in the group receiving 6 g/t on days 21. and 42., while the group receiving 4 g/t recorded higher activity only on day 42. of the experiment. The MDA values on day 42. of the experiment were significantly lower ($p \leq 0.05$) in the group receiving 2 g/t. There were no significant differences in mortality during the study.

Keywords: *Clinoptilolite, performance, oxidative status, broilers*

USPOREDBA UČINAKA RAZLIČITIH METILNIH SKUPINA NA KVALITETU TRUPOVA BROJLERA U IZAZVANIM UVJETIMA I UTJECAJ NA KVALITETU LEGLA

COMPARING THE EFFECTS OF DIFFERENT METHYL GROUP DONORS ON THE CARCASS QUALITY OF BROILERS IN CHALLENGED CONDITIONS AND THE EFFECT ON THE LITTER QUALITY

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ABSTRACT

The Problem:

Heat stress conditions and wet litter problems, were investigated in Thailand.

How we investigated or researched the problem:

Four hundred newly hatched male broiler chickens (Ross 308) were randomly allocated to five treatments with eight replications, using 10 male birds in a pen as an experimental unit. A practical corn-soybean meal diet was formulated as the positive control (PC) diet as T1 (T-treatment group), for each growing phase. A negative control (NC) diet, with 100 kcal ME/kg lower than that of the PC diet, was formulated for each growing phase, as T2. During the test, the methyl group donor products were supplemented in the NC diet, at the same level of activity: 1000 mg/kg of complete feed (BET1- natural betaine liquid 40% as T3; BET2- natural betaine crystalline 96% as T4, and choline chloride 50% as T5). The trial was conducted during a period of the year when higher ambient temperatures above 35°C were experienced. Unclean conditions were also provided by using 50%/50% used/new litter. Dirty litter should facilitate mild gastrointestinal tract (GIT) disorders, in order to observe the effect of betaine under such conditions. Per pen, bodyweight and feed consumption were measured for growth, feed intake and the feed conversion ratio (FCR) was calculated. For bodyweight measurements on day 38, two birds from each pen, were selected and slaughtered for carcass measurements (breast meat yield, thigh yield, drumstick and abdominal fat). On day 38, the litter in each pen was assessed by visual scoring. Additionally, a litter sample of about 1 kg was collected from each pen for litter moisture content evaluation (80°C for 24 hours). The data was subjected to analysis of variance as a randomised complete block design.

Results:

The results found that supplementation of methyl donor products did not affect all of the carcass traits. A numerical improvement in breast meat yield and lower abdominal fat content were recorded by supplementing natural betaine products (Table 1). The data suggest also improvement on the litter quality by reducing the score of visual litter assessment and the litter's moisture content (Table 2). [1]Litter samples collected from the middle of the pen using a 20 cm diameter sampling ring. Visual scoring on the scale of 1-3, where 1 = Good (light brown color and quite dry), 2 = Fair (brown color and quite wet) and 3 = Poor (dark brown color and wet);

Table 1. Effect of different methyl donor products on carcass traits of broilers (38 day of age)

Treatment group	*Breast meat (%)*	*Thigh (%)*	*Drum stick (%)*	*Abdominal fat (%)*
T1 : PC diet	27.12	16.47	13.25	2.49
T2 : NC diet (-100 kcal ME/ kg)	26.43	16.90	13.83	2.45
T3 : NC + BET1	27.74	16.15	13.38	2.44
T4 : NC + BET2	27.12	16.44	13.49	2.46
T5 : NC + CHOL3	27.09	17.00	13.29	2.58
P-value	0.5359	0.2536	0.1236	0.9948
Pooled SEM	0.520	0.295	0.163	0.046
C.V.%	5.42	5.03	3.42	7.04

Table 2. Effect of different methyl donor products on litter of broilers (38 days of age)

Treatment group	*Litter Score*[1]	*Litter DM (%)*	*Litter Moisture (%)*
T1 : PC diet	1.75	74.70	25.30
T2 : NC diet (-100 kcal ME/ kg)	1.69	74.93	25.07
T3 : NC + BET1	1.44	78.36	21.64
T4 : NC + BET2	1.38	78.07	21.93
T5 : NC + CHOL3	1.56	76.84	23.16
P-value	0.5339	0.5115	0.5175
Pooled SEM	0.178	1.874	1.871
C.V.%	32.20	6.92	22.57

Implications / Conclusions:

Gut health and litter quality are directly linked. Any challenge to the gut can often cause diarrhea, resulting in increased nutrient and moisture excretion into the litter and litter quality, which not only has economic implications but is also relevant to bird welfare. Based on litter score data, the positive effect of natural betaine in managing gut health and related problems caused by wet litter, is evident. As a multi-functional nutrient, betaine is a trusted nutritional aid in managing gut health, litter quality and for optimising the feed efficiency in broiler production.

UTJECAJ KAKVOĆE SJEMENA NA REPRODUKTIVNE REZULTATE NA DVIJE TOPIGS NORSVIN INGENE FARME

THE INFLUENCE OF SEMEN QUALITY ON THE REPRODUCTIVE RESULTS IN TWO TOPIGS NORSVIN INGENE FARMS

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ABSTRACT

The objective of the investigation was testing of the influence of semen quality figures (motility and progressive motility), season of ejaculate collection, boar as individual effect, sow farm and year x season of insemination on the reproductive traits in sows. Investigation is conducted in Eurogen DOOEL AI center for pigs near Skopje and in two Topigs Norsvin InGene farms Žito Maleš, Berovo and Vini Farma, Vinica, all of which are in the Republic of Macedonia.

Investigation of semen quality traits were conducted using referent methods of evaluation with computer-assisted sperm analysis (CASA), while the litter size traits were collected with PigVision.Net program. The evaluation of motility and progressive motility is done on fresh semen and semen after the storage of 72 hours at 17^{0}C.

The analyzed reproductive traits of pigs were: gestation length (GL) and number per litter of total born (TB), live born piglets (BA), still born piglets (SB) and weaned piglets (WP). Collected records were evaluated using standard method univariate analysis of variances under valid models.

Preliminary results of this study emphasize the importance of proper semen processing using AIM technology as an insurance of the semen quality and for the expected reproductive results on-farm.

Keywords: *sows, boars, semen quality, litter size*

ODLUKA O POTICANJU ODRŽIVE PREHRANE SVINJA
A DECISION SUPPORT TOOL FOR SUSTAINABLE SWINE NUTRITION

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ABSTRACT

Precision livestock farming and nutrition has a great potential to contribute to more sustainable animal production systems. In precision nutrition systems, the aim is to feed the animals according to their individual requirements. For that purpose, instead of using static table values, dynamic models are needed to determine the nutrient requirements of a certain genotype. The aim of the presentation is to illustrate the application of a model that predicts the nutrient (energy, protein, and phosphorus) partitioning in growing and fattening pigs. The model integrates different aspects and estimates the animal response to dietary and some environmental factors. Therefore, it seems an appropriate tool to be included in precision feeding systems. A properly calibrated growth model predicts the performance of an individual by simulating changes in daily gain, feed conversion ratio, and the composition of the body in relation to different inputs in a dynamic way. Growth models can, therefore, be used effectively to identify an appropriate strategy for sustainable pig production.

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UPORABA BUTIRATA U PREHRANI SVINJA
USE OF BUTYRATE IN PIG NUTRITION

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SAŽETAK

Alternativne mogućnosti stimulisanja rasta postale su izazov i potreba nakon zabrane uporabe antibiotika i u tom smislu pokazali su se značajni rezultati enzima, probiotika, prebiotika, ljekovitog bilja, eteričnih ulja, ali i organskih kiselina i njihovih soli.

Poznato je da se organske kiseline već desetljećima koriste u hrani za životinje, uglavnom radi konzerviranja hrane, zbog smanjenja pH i puferskog kapaciteta, kao i antibakterijskih i antifungalnih učinaka u hrani. Ovi se učinci butirata manifestiraju i u gastrointestinalnom traktu i deluju na inhibiranje gramnegativnih bakterija (*Salmonella* spp., *Escherichia coli*, *Campilobacter jejuni*).

Cilj pokusa bio je ispitati utjecaj i stimulirajući učinak natrij-butiratnog proizvoda u prehrani svinja. Eksperiment je organiziran u kontroliranim uvjetima eksperimentalnim kontrolnim skupinama na komercijalnoj farmi svinja i trajao je 54 dana. Svinje korištene u pokusu bile su podijeljene u 3 skupine (po 16 prasadi), jedna kontrolna i dve eksperimentalne koje su hranom dobijale preparat natrijum butirata u različitoj količini. Tijekom eksperimenta praćeni su rezultati proizvodnje i zdravstveno stanje prasadi.

Učinkovitost proizvodnje bila je statistički značajno bolja u pokusnim skupinama u odnosu na kontrolnu skupinu, a najbolje rezultate pokazala je skupina prasadi E-I (dodan hrani pripravak u količini od 3 kg/t). Određeni su parametri prinosa mesa, pH u tankom i debelom crijevu, kao i morfometrijski parametri za ileum i cecum te mikrobiološke analize himusa crijeva svinja. Utvrđeno je da je prosječan broj bakterija *E. coli* statistički značajno viši u uzorcima sadržaja ileuma, i cekuma kontrolne skupine prasadi u usporedbi s eksperimentalnim skupinama. Utvrđene su statistički značajne razlike između morfometrijskih parametara eksperimentalnih u odnosu na kontrolnu skupinu prasadi.

Analiza temeljnih financijskih pokazatelja pokazuje da je uporaba natrijeva butirata u prasadi ekonomski isplativa.

Ključne riječi: *prehrana svinja, butirati, proizvodne performanse, mikrobiologija creva, morfometrijski parametri*

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ABSTRACT

Alternative growth stimulating options have become a challenge and need after banning the use of antibiotics and in this sense have been shown significant results of enzymes, probiotics, prebiotics, healing herbs, essential oils, but also organic acids and their salts.

It is known that organic acids have been used in animal feed for decades, mainly for food preservation, due to pH and buffer capacity reduction as well as antibacterial and antifungal effects in food. These effects of butyrate also manifest in the gastrointestinal tract and act to inhibit gram-negative bacteria (Salmonella spp., Escherichia coli, Campilobacter jejuni).

The aim of the experiment was to investigate the effect and the stimulating effect of sodium-butyrate in the pig's diet. The experiment was organized in controlled conditions for experimental control groups on a commercial pig farm and lasted for 54 days. Pigs used in the experiment were divided into 3 groups (16 pigs), one control and two experimental, which provided the sodium butyrate preparation in a different amount of food. During the experiment, the results of the production and the health of piglets were monitored.

Production efficiency was statistically significantly better in the trial groups compared to the control group, and the best results were shown by a group of piglets E-I (3 kg/t feed supplement). The parameters of meat yield, pH in the thin and thick intestine, as well as the morphometric parameters for ileum and cecum and the microbiological analysis of the intestinum were determined. It was found that the average number of bacteria E. coli was statistically significantly higher in the samples of the ileum content, and the cecum of the control group of piglets compared to the experimental groups. Statistically significant differences were found between the morphometric parameters of the experimental groups compared to the control group of piglets.

An analysis of fundamental financial indicators shows that the use of sodium butyrate in piglets is economically viable.

Keywords: *pig nutrition, butyrates, production performance, microbiology of the intestine, morphometric parameters*

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PROBAVLJIVOST HRANJIVIH TVARI UTJECAJEM DODAVANJA KSILANAZE U SVINJAMA KOJE RASTU

EFFECT OF XYLANASE SUPPLEMENTATION ON THE DIGESTABILITY OF NUTRIENTS IN GROWING PIGS

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ABSTRACT

This experiment aimed to study the effect of different xylanase supplementation on the digestibility of nutrients feeding diets contained high crude fibre. The trial was conducted with 3 ileally canullated hybrid ((Landrace x Large White F1)xDuroc)) barrows per treatment, in 2 replicates (6 animals/treatment), with initial live weights in 30±3.5 kg. Diet A was formulated on a corn-soybean basis (control diet). The diets in treatment B were formulated with 15% rapeseed meal supplementation. The rapeseed meal contained diets in treatment C, D and E were supplemented with xylanase in 1750 FXU/kg (C), 3500 FXU/kg (D) and 7000 FXU/kg (E). During the experiment we recorded the live weight of the pigs at the beginning the and the end of the trial and the beginning of the adaptation, the collection and the control feeding period. The trials consisted of a 9 days adaptation, a 4 days feaces collection and a 2 x 8 hours ileum chymus collection period. The ileal digestibility improved significantly (P≤0.05) for DM, CF, NFE, GE, NDF and ADF at the minimal enzyme inclusion level 1750 FXU/kg, but further addition of enzyme did not create a significant effect. Post–ileally, the 3500 FXU/kg enzyme inclusion dose improved digestibility for DM, CP, EE, GE, NDF and ADF. The total digestibility results showed significant (P≤0.05) improvement in digestibility of all nutrients except NFE. In conclusion, xylanase enzyme inclusion improved majority nutrient digestibility in RSM based diets in growing pigs, at ileal, post ileal, and total levels.

Keywords: *growing pig, xylanaze, rapeseed meal, ileal digestibility*

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BASF-OV ENZIM ISTRAŽIVANJE I RAZVOJ. NAJVEĆE PREKRETNICE U TIJEKU

BASF ENZYME RESEARCH AND DEVELOPMENT. LARGEST MILESTONES IN PROGRESS

Zoltan Csillik, Dr.

ABSTRACT

Enzymes as highly efficient biocatalysators are wide-spreadly applied in many practical scopes in industry and agriculture. BASF together with world leading biotechnology research institues and universities stongly carves future for new application possibilities and sees potential synergies between practical areas involve enzyme utilisation. Such areas are food industry, pharmaceutical, detergent industry, water treatment, bioenergy, biofuel production, animal nutrition, paper industry, construction chemicals, oil exploration and production, environmental pollution annulation, biomolecule synthesis for structural and functional reasons.

Methods for gene multiplication and accelerated selection under in vitro conditions require consistent testing systems and common functional criteria to achieve larger breakthroughs for today. In this relation the potential utilisable genom sequences both in quantitative and qualitative efficiency have been multipled dramatically in recent decades.

The methods and development how this accelaration became possible are topic of this presentation with some examples of contributed new and previously unimagined characteristics appeared in biological and biochemical systems.

Milestones in research and develoment were the followings.

Mutation can be multiplied in tubes under defined conditions. Most frequently those mutations are deletious for next generations but if a mutation is positive variant, functional proteins form continuous connected network. Directed evolution is molecular optimisation process for multi-dimensional performace lanscape. In this performance reprogramming we can reoptimise enzyme candidate for a new capability, evolving new functions. This latest potential promiscuity can be a starting point of latent ability expression within several generations. Sequential random mutagenesis of subtilis E ended up in dimetylformamide hydrolisis and acts environment cleaner. Prof. Willem „Pim" Stemmer played determinant role in DNA shuffling – that a driving factor of recombination of genom sequences.

New capabilities provide new functions. Examples of merely new functiions that previously did not exist in biology eg. Citochrom P 450 new transformed feature creating less toxic less reagent metabolites of toxins, creating alternative carbenoid and later on carbocycles (cyclopropene and bicyclobutane) formation that can be integrated into E coli genom.Similarly modified cytochrome C originated from thermohalophilic Gram negative bacteria can form Silicon incorporation into organic molecules.

PRIMJENA RAZLIČITIH KONCENTRACIJA AROME U KRMNIM SMJESAMA NA PROIZVODNE KARAKTERISTIKE ODLUČENE PRASADI

THE APPLICATION OF DIFFERENT CONCENTRATIONS OF FLAVOR IN FEED MIXTURES TO THE PRODUCTION CHARACTERISTICS WEANING PIGLETS

Steiner Zvonimir[1], Ivana Čeh[2], Ivana Prakatur[1], Josip Novoselec[1], Željka Klir[1], Mario Ronta[1], Ivana Mirković[1], Davor Kralik[1], Robert Spajić[1], Sabina Begić[3]

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SAŽETAK

Cilj istraživanja bio je utvrditi utjecaj dodavanja različitih koncentracija arome vanilije u krmne smjese na proizvodne pokazatelje odlučene prasadi. Istraživanje je provedeno na 30 prasadi (starosti oko 40 dana) i trajalo je 37 dana. Prasad je podijeljena u tri skupine: kontrolna i dvije pokusne skupine. Pokusnoj skupini 1 u krmnu smjesu dodana je aroma vanilla buttercream u koncentraciji od 0,05%, dok je pokusna skupina 2 konzumirala smjesu u koju je dodano 0,1% arome vanilla buttercream. Završno vaganje pokazalo je nešto više srednje vrijednosti kod pokusnih skupina, u odnosu na kontrolnu skupinu. Pokusna skupina 2 imala je najviše srednje vrijednosti tjelesnih masa (24,45 kg) u odnosu na pokusnu 1 skupinu (24,28 kg) i kontrolnu skupinu (23,5 kg). Statistički značajnih razlika nije bilo. Kontrolna skupina imala je najmanji prirast od (13,99 kg), nešto veći prirast imala je pokusna skupina 1 (14,37 kg) dok je pokusna skupina 2 mjerila najviši prirast (14,43 kg). Najniža konverzija hrane za kg prirasta izmjerena je u pokusnoj skupini 2 (1,81 kg/kg), u odnosu na pokusnu skupinu 1 (1,84 kg/kg), dok je u kontrolnoj skupini izmjerena najviša konverzija hrane za kg prirasta (1,89 kg/kg).

Ključne riječi: *prasad, odbiće, aroma, prirast. konverzija*

SADRŽAJ BLAGOTVORNIH TVARI U SILIRANOM REHIDRIRANOM ZRNU KUKURUZA

CONTENT OF BENEFICIAL COMPOUNDS IN ENSILED REHYDRATED MAIZE

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SAŽETAK

Zrno kukuruza je najvažnije energetsko krmivo u hranidbi životinja, a može se koristiti kao suho ili silirano zrno pri čemu se nakon postupka rehidracije može silirati i suho zrno. Zrno kukuruza je bogato blagotvornim spojevima iz skupine karotenoida, tokola i fenola, a kiseli uvjeti stvoreni tijekom fermentacije mogu utjecati na njihov sadržaj. Cilj ovog istraživanja je bio ispitati sadržaj ovih blagotvornih spojeva u silaži rehidriranog zrna kukuruza nakon 185. dana skladištenja. Zrno hibrida Bc 344, Bc 418b, Bc 424, Bc 525, Bc 572, Kekec i Pajdaš ubrano je nakon fiziološke zrelosti, rehidrirano do 32% vlage i silirano u vakuum vrećicama na sobnoj temperaturi uz dodatak komercijalnog inokulanta. Sadržaj karotenoida (lutein, zeaksantin, β-kriptoksantin i β-karoten) i tokola (α-, γ- i δ-tokoferol te γ-tokotrienol) određen je HPLC metodom, a slobodnih i vezanih fenola i flavonoida spektrofotometrijskom metodom. Siliranje je utjecalo na sadržaj blagotvornih spojeva silaže rehidriranog zrna istraživanih hibrida kukuruza (P<0,001). Sadržaj karotenoida se smanjio za 8,5 do 28,3% i tokola za 35,3 do 56,2%, a sadržaj ukupnih fenola i flavonoida povisio za 26 i 38% u odnosu na početno stanje. Isto tako, u kiselim uvjetima je i oslobođen veliki dio vezanih te povišen sadržaj slobodnih fenola (66%) i flavonoida (46%). Silaže rehidriranog zrna istraživanih hibrida varirale su u sadržaju blagotvornih spojeva (P<0,001). Rasponi sadržaja istraživanih hibrida iznosili su (μg/g ST) 9,3 – 20,4 za lutein, 7,9 – 21,3 za zeaksantin, 1,2 – 4,7 za β-kriptoksantin, 0,6 – 1,8 za β-karoten, 2,1 – 9,5 za α-tokoferol, 23,1 – 4,8 za γ-tokoferol, 1,1 – 1,7 za δ-tokoferol i 3,0 – 4,5 za γ-tokotrienol, te 3069 – 4506 i 2421 – 3286 GAE/g ST za slobodne i vezane fenole i 460 – 702 i 1384 – 1709 CE/g ST za slobodne i vezane flavonoide. Kiseli uvjeti silaže stvoreni tijekom fermentacije smanjuju sadržaj karotenoida i tokola te povisuju sadržaj slobodnih i ukupnih fenola i flavonoida.

Ključne riječi: *zrno kukuruza, silaža rehidriranog zrna, karotenoidi, tokoli, fenoli*

ABSTRACT

Maize grain is the most important energy feed in animal nutrition, and it can be used as a dry or ensiled grain whereas, after rehydration, even dry grain could be ensiled. Maize grain is rich in bioactive compounds from carotenoids, tocols and phenolics, and acidic conditions created during ensiling could affect their content. The aim of this research was to determine contents of these beneficial compounds in rehydrated maize grain silage after 185 days of storage. Grain of hybrids Bc 344, Bc 418b, Bc 424, Bc 525, Bc 572, Kekec and Pajdaš was harvested after physiological maturity, rehydrated to 32% moisture content and ensiled in vacuum bags at room temperature with the addition of a commercial inoculant. Contents of carotenoids (lutein, zeaxanthin, β-cryptoxanthin and β-carotene) and tocols (α-, γ- and δ-tocopherol and γ-tocotrienol) were determined using HPLC method while contents of free and bound phenolics and flavonoids were determined using the spectrophotometric method. Ensiling affected contents of beneficial compounds in rehydrated maize grain silage (P<0.001). Carotenoid content decreased from 8.5 to 28.3% and tocol content from 35.3 to 56.2% while contents of total phenolics and flavonoids increased for 26 and 38%, respectively, in comparison to fresh grain. Also, acidic conditions released a considerable amount of bound resulting in an increase of free phenolics (66%) and flavonoids (46%). Rehydrated maize grain silages of investigated hybrids varied in contents of beneficial compounds (P<0.001). Ranges for investigated hybrids were (μg/g DM) 9.3 – 20.4 for lutein, 7.9 – 21.3 for zeaxanthin, 1.2 – 4.7 for β-cryptoxanthin, 0.6 – 1.8 for β-carotene, 2.1 – 9.5 for α-tocopherol, 23.1 – 4.8 for γ-tocopherol, 1.1 – 1.7 for δ-tocopherol, 3.0 – 4.5 for γ-tocotrienol, and 3069 – 4506 and 2421 – 3286 GAE/g DM for free and bound phenolics and 460 – 702 and 1384 – 1709 CE/g DM for free and bound flavonoids. Acidic conditions created during ensiling decrease content of carotenoids and tocols and increase content of free and total phenolics and flavonoids.

Keywords: *maize grain, rehydrated grain silage, carotenoids, tocols, phenolics*

HIBRID I DULJINA SKLADIŠTENJA SILAŽE REHIDRIRANOG ZRNA KUKURUZA DJELUJU NA IN VITRO KINETIKU PROBAVLJIVOSTI ŠKROBA

HYBRID AND PROLONGED STORAGE OF REHYDRATED MAIZE GRAIN SILAGE AFFECTS IN VITRO DIGESTIBILITY KINETICS OF STARCH

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SAŽETAK

Zrno kukuruza najvažniji je izvor energije u obliku škroba i najzastupljenije krmivo u potpunoj hrani svinja. Kada se zbog vremenskih (ne)prilika i nedostatka mehanizacije zrno ubire poslije optimalnog roka ono gubi vodu i neprikladno je za siliranje. Rehidriranjem se podiže sadržaj vode na optimalnu koncentraciju za siliranje. S obzirom da je malo podataka o kinetici probavljivosti škroba rehidriranog pa siliranog zrna, cilj ovog istraživanja je bio, koristeći model za svinje, ispitati kinetiku *in vitro* ilealne probavljivosti škroba rehidriranog zrna različitih hibrida kukuruza tijekom siliranja i skladištenja (0., 21. i 95. dan). Zrno hibrida Bc 344, Bc 418b, Bc 424, Bc 525, Bc 572, Kekec i Pajdaš ubrano je nakon fiziološke zrelosti, rehidrirano do 32% vlage i silirano uz dodatak komercijalnog inokulanta u vakuum vrećicama na sobnoj temperaturi. *In vitro* procedura provedena je u kontroliranim uvjetima u dva koraka koji oponašaju probavu u želucu i tankom crijevu svinja, a koeficijenti probavljivosti izračunati su za 0,25, 0,5, 0,75, 1, 2, 3, 4 i 5 sati inkubiranja pri čemu je brzina probavljivosti škroba izračunata prema kinetici prvog reda. Koeficijenti probavljivosti i brzina probavljivosti škroba razlikovala se između hibrida i rasli su s duljinom skladištenja silaže zrna ($P<0,05$). Sav škrob svježe mase za siliranje probavio se nakon četiri sata dok je u silažama probavljen nakon tri sata i 21. i 95. dana nakon početka siliranja. Brzina probavljivosti škroba kretala se u prosjeku od 1,1762 1/h (0. dan) do 2,3548 1/h (95. dan). Probavljivost suhe tvari prosječno je iznosila od 80,81 % (0. dan) do 89,57 % (95. dan). Siliranje značajno povećava brzinu probavljivosti škroba što je potrebno uzeti u obzirom prilikom sastavljanja gotove hrane.

Ključne riječi: *kinetika probavljivosti škroba, silirano rehidrirano zrno kukuruza, in vitro probavljivost*

ABSTRACT

Maize kernel is the most important source of energy in the form of starch and most commonly used feed in complete pig diets. When grain is harvested after the optimal period due to the (un)favourable weather conditions and lack of mechanization, it loses water and is unsuitable for ensiling. Rehydrating increases water content to the optimal concentration for ensiling. Since data about digestibility kinetics of starch from rehydrated and ensiled grain is scarce, the aim of this study, using the pig model, was to investigate the in vitro ileal digestibility kinetics of starch in rehydrated kernel from different maize hybrids during ensiling and storage (0th, 21st and 95th day). Grain of hybrids Bc 344, Bc 418b, Bc 424, Bc 525, Bc 572, Kekec and Pajdaš was harvested after physiological maturity, rehydrated to 32% moisture content and ensiled with the addition of a commercial inoculant in vacuum bags at room temperature. The in vitro procedure was performed under controlled conditions in two steps mimicking digestion in the stomach and the small intestine of pigs, and the starch digestibility coefficients were calculated for 0.25, 0.5, 0.75, 1, 2, 3, 4 and 5 hours of incubation and starch digestibility rate was calculated according to the first order kinetics. The starch digestibility coefficients and the starch digestibility rate differed between the hybrids and increased with the time of ensiling ($P<0.05$). All starch of fresh silage mass was digested after four hours, while it was digested after three hours in silages from both 21st and 95th day of ensiling. Starch digestibility rate ranged from 1.1762 l/h (0th day) to 2.3548 l/h (95th day). Dry matter digestibility averaged from 80.81 % (0th day) to 89.57 % (95th day). Ensiling significantly increases starch digestibility rate which should be considered when formulating complete diets.

Keywords: *starch digestibility kinetics, ensiled rehydrated corn kernel, in vitro digestibility*

KONCENTRACIJA RETINOLA I B-KAROTENA U PLAZMI SISAJUĆE TELADI

CONCENTRATION OF RETINOL AND B-CAROTENE IN PLASMA OF SUCKLING CALVES

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SAŽETAK

Retinol (vitamin A) i **β**-karoten zaštićuju epitel od bakterijskih i virusnih infekcija koje su glavni uzročnik pobolijevanja i uginuća teladi. Koncentracija retinola i karotenoida u krvi teladi određena je u presudnim prvim danima života njihovim sadržajem u kolostrumu i prijelaznom mlijeku, a kasnije u mlijeku/mliječnoj zamjenici i početnoj krmnoj smjesi. Cilj ovog istraživanja bio utvrditi promjene u koncentraciji vitamina A i β-karotena u plazmi i hrani teladi do od rođenja do 42. dana starosti. Pokus je proveden na 12 teladi s farme visokomliječnih krava „Kapelna" hranjene istim izoproteinskim i izoenergetskim obrocima. Krv je vađena na dan rođenja, nakon uzimanja kolostruma, te 3., 21., i 42. dana starosti, a istih dana uzeti su uzorci kolostruma, mlijeka, mliječne zamjenice i starter smjese kojima je telad hranjena. β-karoten i retinol su iz uzoraka ekstrahirani heksanom i kvantitativno određeni HPLC metodom obrnute faze. Koncentracije β-karotena i retinola u kolostrumu su u prosjeku iznosile 73 i 137,3 µg/dL, u prijelaznom mlijeku 9,5 i 27,9 µg/dL, mliječnoj zamjenici 5,2 i 6 µg/dL, dok je njihov sadržaj u starteru bio 16,4 i 57 µg/g ST. Koncentracije β-karotena i retinola u plazmi prvog dana su u prosjeku iznosile 14,3 i 9 µg/dL, trećeg dana 4,9 i 7,3 µg/dL, 21. dana 7,4 i 8,4 µg/dL i 42. dana 3,9 i 9,8 µg/dL. Koncentracija β-karotena i retinola u hrani utjecala je na koncentraciju β-karotena i retinola u plazmi. Najvišu koncentraciju retinola sadržavao je kolostrum pa je i najviša koncentracija bila u plazmi tek rođene teladi. Telad s najnižom koncentracijom vitamina A u plazmi uginula je tijekom pokusnog razdoblja. Koncentracija retinola pa β-karotena u kolostrumu i prelaznom mlijeku važna je za preživljavanje teladi.

Ključne riječi: retinol, β-karoten, telad, plazma

ABSTRACT

Retinol (vitamin A) and β-carotene are protecting epithelia from bacterial and viral infections which are primary causes for sickness and death of calves. The concentration of retinol and β-carotene in blood of calves is determined with their content in colostrum and milk in crucial first days of life and then with their content in milk/milk replacer and starter feed mix. The aim of this study was to determine variations of retinol and β-carotene concentrations in plasma of calves up to 42 days of age. The animal trial was conducted on 12 calves at high milk production dairy farm Kapelna fed the same isoprotein and isoenergetic diets. Blood samples were taken on the first (after calves drank colostrum), third, 21st and 42nd day of calves age, and at the same days, samples of diets (colostrum, milk, milk replacers, and starter feed mix) fed to calves were also taken. β-carotene and retinol were extracted with hexane from all samples and quantified using reverse phase HPLC method. Concentrations of β-carotene and retinol in colostrum were on average 73 and 137.3 μg/dL, in milk 9.5 and 27.9 μg/dL, milk replacer 5.2 and 6 μg/dL, while their content in starter mix was 16.4 and 57 μg/g DM, respectively. Concentrations of β-carotene and retinol in plasma of new-born calves were 14.3 and 9 μg/dL, on the third day of age 4.9 and 7.3 μg/dL, on 21st day 7.4 and 8.4 μg/dL and 42nd day 3.9 and 9.8 μg/dL, respectively. β-carotene and retinol concentrations in the diet affected their respective concentrations in blood plasma of calves. Colostrum had the highest concentration of retinol, and thus the highest concentration was in new-born calves. Calves with the lowest retinol concentration in plasma died before the end of the trial. Concentration of retinol and β-carotene is important for the survival rate of calves.

Keywords: *retinol, β-carotene, calves, plasma*

IN VIVO PROBAVLJIVOST VLAKANA U TOVU JUNADI HRANJENE SILIRANIM REHIDRIRANIM ZRNOM KUKURUZA

IN VIVO DIGESTIBILITY OF FIBERS IN FATTENING BEEF CATTLE FED ENSILED REHYDRATED MAIZE GRAIN

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SAŽETAK

Kukuruzni škrob iz silaže zrna, klipa i cijele biljke kukuruza je glavni izvor energije u tovu junadi. Siliranje povisuje razgradnju škroba zrna u buragu i probavljivost u tankom crijevu čime se povisuje energetska vrijednost kukuruza, ali i opasnost od smanjene probavljivosti vlakana obroka i pojave acidoze. Rehidracija omogućuje siliranje suhog zrna kada su na farmi prisutni objekti za silažu a ne za suho zrno. S obzirom da povišena razgradnja škroba može utjecati na probavljivost vlakana, cilj ovog istraživanja je bio usporediti probavljivost neutralnih detergent vlakana (NDV) obroka junadi hranjene škrobom istog hibrida kukuruza u formi suhog (SZK) ili siliranog rehidriranog zrna kukuruza (SRZK). Zrno hibrida Bc 572 rehidrirano je do 32% vlage i silirano uz dodatak komercijalnog inokulanta. Pokus je proveden na četiri tovna juneta simentalske pasmine slične težine i starosti, koja su bila raspoređena na obrok sa suhim zrnom i siliranim rehidriranim zrnom kukuruza prema cross-over dizajnu u dva perioda od po 17 dana. Obroci su se razlikovali u sadržaju škroba (P<0,05; SZK 38,45% i SRZK 32,46%) i NDV (SZK 27,24% i SRZK 29,48%). Kao indikator probavljivosti korišten je kromov(III)-oksid. Junad hranjena obrokom sa SRZK, u usporedbi sa obrokom sa SZK, je imala manju probavljivost (P<0,05) suhe tvari (57,16% *vs.* 60,21%) i osobito NDV (45,54% *vs.* 57,08%). SRZK nije imalo značajan utjecaj na pH fecesa kao pokazatelja acidoze. Unatoč nižem sadržaju škroba, dodatak SRZK u obrok junadi je smanjio probavljivost vlakana u odnosu na SZK ali nije uzrokovao acidozu.

Ključne riječi: *tov junadi, probavljivost vlakana, silirano rehidrirano zrno kukuruza*

ABSTRACT

Maize starch from the grain, cob and the whole plant silage is the main energy source for fattening beef cattle. Ensiling increases degradability of grain starch in rumen and digestibility in the small intestine, which increases maize energy value, but also the risk of decreased fiber digestibility and acidosis. Rehydration enables ensiling of dry grain when a farm has facilities for silage instead for dry grain. Since higher starch degradability could affect neutral detergent fiber (NDF) digestibility, this study aimed to compare fiber digestibility in beef cattle feed starch from the same maize hybrid in the form of dry (DMG) and ensiled rehydrated grain (ERMG). Grain of hybrid Bc 572 was rehydrated to 32% moisture content and ensiled with the addition of a commercial inoculant. The experiment was carried out using four fattening Simmental beef cattle, similar in weight and age, that were assigned to the ration with dry or ensiled rehydrated maize grain in a cross-over design with two 17-day periods. Rations differentiated in contents of starch (P<0.05; DMG 38.45% and ERMG 32.46%) and NDF (DMG 27.24% and ERMG 29.48%). Chromium(III) oxide was added as digestibility indicator. Beef cattle fed ERMG, compared to DMG, had a lower digestibility (P<0.05) of dry matter (57.16% vs. 60.21%) and NDF (45.54% vs. 57.08%). Treatment with ERMG did not have a significant effect on fecal pH as an indicator of acidosis. Despite lower starch content, the addition of ensiled rehydrated maize grain decreased fiber digestibility in comparison to dry grain, but it did not cause acidosis.

Keywords: *beef cattle, fiber digestibility, ensiled rehydrated maize grain*

UTJECAJ STAJANJA SILAŽE VISOKOVLAŽNOG ZRNA KUKURUZA NA KONCENTRACIJU KAROTENOIDA, TOKOLA I RETINOLA U PLAZMI JUNICA

EFFECT OF PROLONGED STORAGE OF HIGH-MOISTURE MAIZE GRAIN SILAGE ON CONCENTRATION OF CAROTENOIDS, TOCOLS AND RETINOL IN PLASMA OF HEIFERS

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SAŽETAK

Među žitaricama, zrno kukuruza sadrži najviše karotenoida, među kojima i β-kriptoksantina i β-karotena koji su provitamini vitamina A, te tokola, spojeva vitamina E aktivnosti. Skladištenjem silaže visoko vlažnog zrna kukuruza, kiseli uvjeti stvoreni tijekom fermentacije mogu smanjiti sadržaj tih spojeva, ali i povisiti njihovu biodostupnost. Cilj ovog istraživanja je utvrditi utjecaj stajanja silaže visokovlažnog zrna kukuruza na koncentraciju karotenoida, tokola i retinola u plazmi junica hranjenih istim obrokom tijekom četvero-mjesečnog razdoblja. Ukupno 10 junica križanki belgijskog-plavog goveda i holsteina, hranjeno je obrokom s visokovlažnim zrnom (25%) i silažom cijele biljke kukuruza (56%). Svakog mjeseca junicama je vađena krv, a u odvojenoj plazmi je HPLC metodom određena koncentracija retinola, tokola i karotenoida. Navedeni spojevi određeni su u silaži visokovlažnog zrna i cijele biljke kukuruza te u obroku uzorkovanom istog dana. Tijekom promatranog razdoblja nisu utvrđene značajne promjene sadržaja karotenoida i tokola u silažama i gotovom obroku, međutim, brojčane promjene određene su u silaži biljke kukuruza i obroku nakon trećeg mjeseca istraživanja. Najzastupljeniji karotenoid u plazmi junadi bio je β-karoten (0,33 – 0,59 μg/mL), a zatim u znatno manjim koncentracijama β-kriptoksantin, lutein te zeaksantin (> 0,05 μg/mL). Koncentracija α-tokoferola u plazmi junadi kretala se od 0,99 do 1,48 μg/mL, a retinola od 0,29 do 0,53 μg/mL. Koncentracija navedenih spojeva u plazmi varirala je tijekom razdoblja od četiri mjeseca, međutim, promjene nisu bile rezultat promjena u visokovlažnom zrnu uzrokovanim kiselim uvjetima silaže.

Ključne riječi: *silaža visokovlažnog zrna kukuruza, junice, karotenoidi, retinol, tokoli*

ABSTRACT

Maize grain has the highest content of carotenoids among cereals, including β-cryptoxanthin and β-carotene, provitamins of vitamin A, and tocols, compounds of vitamin E activity. Acidic conditions created during fermentation may reduce the content of these compounds during prolonged storage high-moisture maize grain. However, these conditions can also increase their bioavailability. The aim of this study was to determine the effect of high-moisture maize silage storage on the concentration of carotenoids, tocols and retinol in the plasma of heifers fed the same ration during the four-month period. A total of 10 Belgian blue×Holstein heifers were fed rations containing high-moisture maize grain (25%) and maize silage (56%). Blood was taken from each heifer once a month, and concentration of retinol, tocols and carotenoid was determined in plasma using HPLC method. These compounds were also determined in maize silage, high-moisture maize grain and ration sampled on the same day. Significant changes in carotenoid and tocol concentrations in silages and ration were not determined during the trial, however, there were considerable changes in maize silage and ration after the third month. The most abundant carotenoid in heifers' plasma was β-carotene (0.33 – 0.59 μg/mL) while β-cryptoxanthin, lutein and zeaxanthin were in low concentrations (> 0.05 μg/mL). α-tocopherol concentration in plasma was from 0.99 to 1.48 μg/mL while concentration of retinol was from 0.29 to 0.53 μg/mL. Concentration of determined compounds in plasma varied during four-month trial, however, these changes were not a result of changes in high-moisture maize grain caused by acidic silage conditions.

Keywords: *high-moisture maize silage, heifers, carotenoids, retinol, tocols*

TRADICIONALNA HRANA ZA ŽIVOTINJE - ETNOBOTANIČKI ASPEKT KORIŠTENJA BILJA U MEDITERANSKOM DIJELU HRVATSKE

TRADITIONAL FEED FOR ANIMALS - THE ETHNOBOTANICAL ASPECTS OF USING PLANTS IN THE MEDITERRANEAN PART OF CROATIA

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SAŽETAK

Mediteranski dio Hrvatske područje je gdje domaće životinje većinu godine provode na otvorenom i gdje se samonikle biljke tradicionalno i u velikoj mjeri koriste za ishranu te prevenciju zdravlja životinja. Podaci prikazani ovdje sakupljeni su višegodišnjim terenskim intervjuiranjem većinom starijeg lokalnog stanovništa na pojedinim lokacijama u Istri i na području Dalmatinske Zagore, u razdoblju 2015-2018. godine. Cilj istraživanja je bio po prvi puta dokumentirati narodno znanje lokalnog stanovništva o samoniklim biljkama koje se tradicionalno koriste za ishranu životinja. Također zabilježiti lokalne nazive biljaka. Rezultati pokazuju najčešće samonikle biljne vrste korištene za ishranu životinja: *Crithmum maritimum* L. (motar, pazdac, šćulac, rompisano), *Clematis vitalba* L. (povitina, trtorina, trtor, trtina, trta, trtvina, škrabutina), *Arum italicum* Mill. (strtok, kozlac), *Ruscus aculeatus* L. (kataroška, fraterska šparožina), *Urtica dioica* L. (kopriva, pokriva), *Hedera helix* L. (bršljan, bršljen), *Asphodeline lutea* (L.) Rchb. (brdej) i dr. Za jačanje imuniteta životinja koristio se podanak *Iris illirica* Tomm. i *I. germanica* L., a protiv dijareje listovi *Rumex acetosa* L. (šćav) i sjemenke *Amaranthus retrofexus* L. (divlji šćir). Ovi podaci doprinijeti će očuvanju tradicionalnog ekološkog znanja, edukaciji pučanstva i reintrodukciji zaboravljenih upotreba samoniklog bilja u prehranu životinja, te prevenciji i očuvanju zdravlja životinja. Prikupljene biljne svojte su herbarizirane, digitalizirane i pohranjene u herbarij Agronomskog fakulteta te dostupne on-line (http://herbarium.agr.hr/).

Ključne riječi: *tradicionalna upotreba bilja, samonikle biljke, hrana za životinje, narodna medicina, Mediteran*

ABSTRACT

In Mediterranean part of Croatia domestic animals are kept in the open area for most of the year, and the wild growing plants are traditionally and largely used for nutrition and the prevention of animal health.

The data presented here has been collected through several years of field interviewing mostly elderly local indigenous population at individual locations in Istria and in the Dalmatian Zagora area during the period 2015-2018. The goal of the study was to document for the first time traditional knowledge about wild growing plants traditionally used for animal nutrition also note the local plant names.

Results show the most common plant species used for animal nutrition: Crithmum maritimum L. (motar, pazdac, šćulac, rompisano), Clematis vitalba L. (povitina, trtorina, trtor, trtina, trta, trtvina, škrabutina), Arum italicum Mill. (strtok, kozlac), Ruscus aculeatus L. (kataroška, fraterska šparožina), Urtica dioica L. (kopriva, pokriva), Hedera helix L. (bršljan, bršljen), Asphodeline lutea (L.) Rchb. (brdej) ect. The rhizomes from the species Iris illirica Tomm. and I. germanica L. was used to enhance animal immunity, and against the diarrhea the leaves of Rumex acetosa L. (šćav) and Amaranthus retrofexus L. (divlji šćir) seeds were used. These data will contribute to the preservation of traditional ecological knowledge, education of the population and the reintroduction of the forgotten use of wild growing plants in animal nutrition, prevention and preservation of animal health. The collected plant taxa are herbarized, digitized and are available in ZAGR Virtual herbarium (http://herbarium.agr.hr/).

Keywords: *traditional plant use, wild growing plants, animal feed, folk medicine, Mediterranean*

KVALITATIVNA I KVANTITATIVNA SVOJSTVA ETERIČNOG ULJA SAMONIKLOG I UZGOJENOG SMILJA U EKOLOŠKOJ PROIZVODNJI

QUALITATIVE AND QUANTITATIVE PROPERITIES OF WILD AND ORGANIC GROWN HELICHRYSUM ITALICUM IMMORTELLE ESSENTIAL OIL

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SAŽETAK

Mediteransko smilje Helichrysum italicum je ljekovita i aromatična biljka koja je već dugo poznata u svijetu, no tek je u zadnjih desetak godina počela značajnija upotreba u Republici Hrvatskoj.

U ovome radu istraživanja su se provodila na samoniklom smilju i smilju iz ekološkog uzgoja koje je ubrano tijekom ljetne i jesenske sezone. Uzorci smilja osušeni su prirodnim putem i to na dva načina, na suncu i u hladovini. Vrijeme sušenja bilo je od 6 do 12 sati u ovisnosti o sezoni berbe (ljetna ili jesenska). U ovisnosti radi li se o samoniklom smilju ili smilju iz ekološkog uzgoja te načinu sušenja, određen je randman smilja.

Kako bi se dobilo eterično ulje, smilje se destiliralo u proizvodnom postrojenju i laboratorijskom destilatoru, a vrijeme trajanja destilacije za sve uzorke je u oba postupka bilo 90 min. Dobiveno pročišćeno eterično ulje analizirano je na plinskom kromatografu kako bi se utvrdio sastav (α-pinen, linalol, nerol, nerilacetat, γ-kurkumeni, italidioni) i temeljem toga kvaliteta eteričnog ulja.

Rezultati istraživanja pokazali su prosječno viši randman samoniklog smilja u odnosu na uzgojeno. Sušenjem smilja na suncu dobiven je manji randman od randmana smilja u svježem stanju. Jednako tako utvrđeno je da je ulje samoniklog smilja kvalitetnije od ulja uzgojenog smilja. Prema kromatografskoj analizi poželjnih tvari je bilo više u ulju samoniklog smilja, dok ulje dobiveno iz uzgojenog smilja u nekim elementima nije zadovoljilo standarde.

Ključne riječi: *smilje, Helichrysum italicum, eterično ulje, destilacija, uzgoj smilja, analiza eteričnog ulja*

ABSTRACT

Mediterranean immortelle Helichrysum italicum is a medicinal and aromatic plant that has long been known in the world, but only in the last decade has become more significant in the Republic of Croatia.

In this paper, investigations were conducted on wild immortelle and immortelle cultivated on an organic farm, and the harvest take time during the summer and autumn season. Samples of immortelle were dried naturally in two ways, on the sun, and in the shade. The drying time was 6 to 12 hours depending on the harvest season (summer or autumn). Depending on whether it is a wild immortelle or immortelle cultivated on an organic farm and the method of drying, the immortelle yield was determined.

To obtain the essential oil, the immortelle was distilled in the production plant and in the laboratory distillation, distillation time for all samples was 90 minutes in both procedures. The obtained purified essential oil was analyzed on a gas chromatograph to determine the composition (α-Pinene, linalool, nerol, neryl acetate, γ-curcumin, italidione) and based on that quality of essential oil.

The results showed an average higher yield of wild immortelle compared to cultivated immortelle. Drying on the sun has resulted in a lower yield than in the raw material. It was also found that the oil of wild immortelle is better quality than the oil from cultivated immortelle. According to the chromatographic analysis, there were more preferred substances in oil of wild immortelle, while the oil obtained from the cultivated immortelle did not meet the standards in some elements.

Keywords: *immortelle, Helichrysum italicum, essential oil, distillation, immortelle cultivation, essential oil analysis*

UČINCI DODAVANJA ETERIČNIH ULJA U HRANU NA PROIZVODNE REZULTATE I KVALITETU MESA I JAJA PERADI

EFFECTS OF ADDING ESSENTIAL OILS IN FEED TO THE PRODUCTION RESULTS AND THE QUALITY OF MEAT AND POULTRY EGGS

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SAŽETAK

Zbog svojih antioksidativnih svojstava, pozitivnog djelovanja na probavni sustav te sposobnosti povećanja imunološkog odgovora organizma, fitogeni, u koje spadaju i eterična ulja imaju veliki potencijal za primjenu u hranidbi peradi. Osim svojih pozitivnih učinaka, dobro se uklapaju i u trend zdravoga života i hrane, koji je trenutno veoma popularan na tržištu. U ovom preglednom radu iznose se najbitniji podaci vezani uz korištenje eteričnih ulja kao dodatak hrani kokoši nesilica i brojlera, kao i njihovi učinci na proizvodnost i kvalitetu. Iz prikazanih je rezultata vidljivo da dodatak eteričnih ulja u krmne smjese za kokoši nesilice i brojlere imaju značajno antimikrobno djelovanje, te isto tako značajno utječu na proizvodnost i kvalitetu mesa i jaja peradi.

Ključne riječi: *eterična ulja, brojleri, kokoši nesilice, proizvodnost, kvaliteta*

ABSTRACT

Due to its antioxidant properties, the positive effect on the digestive system and the ability to increase the immune response of the organism, the phytogenic ones, including essential oils, have great potential for use in feeding poultry. In addition to their positive effects, they also fit into the trend of healthy lifestyle and food, which is currently very popular in the market. In this review, the most important data related to the use of essential oils as a supplement to the feed of chickens and broilers, as well as their effects on productivity and quality, are presented. From the results shown, it is evident that the addition of essential oils to the feed mixture for hens and broilers has significant antimicrobial activity and also significantly affect the productivity and quality of poultry meat and eggs.

Keywords: *essential oils, broilers, chickens, productivity, quality*

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BRZINA OTPUŠTANJA VODE PRILIKOM SUŠENJA I FIZIKALNA SVOJSTVA ZRNA SOJE

WATER RELEASE SPEED DURING DRYING AND PHYSICAL PROPERTIES OF SOYA SEED

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SAŽETAK

Zrno soje žanje se s povišenim sadržajem vlage te ga je za skladištenje potrebno doraditi, odn. osušiti do ravnotežne vlažnosti. Radi očuvanja kvalitete zrna soje potrebno je osim sušenja provoditi i druge dodatne operacije (npr. predčišćenje), kako bi sirovina bila ispravno skladištena. Prilikom skladištenja treba paziti na jednoliku ravnotežnu vlažnost skladištenog zrna te na količinu primjesa koje utječu na promjene uskladištenog zrna. Temeljem navedenog, cilj rada je utvrditi postoji li razlika u brzini otpuštanja vode dviju istraživanih sorti soje te utvrditi sadržaj primjesa, kao i hektolitarsku i apsolutnu masu. Nadalje, pratit će se utjecaj vlage i sadržaj primjesa na navedena fizikalna svojstva. Prilikom konvekcijskog sušenja dviju sorti zrna soje u debelom sloju (2,6 cm) pri temperaturi zraka od 90 °C i brzini zraka od 2,5 ms^{-1}, približnih početnih vlažnosti zrna dobivene su jednadžbe sušenja koje su kod obje sorte vrlo slične, te su nagibi krivulja gotovo identični, što znači da se obje sorte tijekom sušenja ponašaju slično, tj. da imaju približno istu promjenu vlage u jedinici vremena. Istraživanjem je utvrđeno kako se hektolitarska masa zrna soje koje sadrži primjese smanjuje u odnosu na čisto zrno, a povećava se smanjenjem vlažnosti zrna, dok se apsolutna masa smanjuje sa smanjenjem vlažnosti zrna.

Ključne riječi: *soja, sušenje, primjese, hektolitarska masa, apsolutna masa*

ABSTRACT

Soybean is harvested with higher moisture content and for storage, it should be processed, respectively dried to equilibrium moisture. To preserve the quality of soybeans it is necessary except drying conduct and other additional operations (eg. pre-cleaning) so that raw materials can be properly stored. During storage, it is necessary to pay attention to the uniform equilibrium moisture content of stored grain and amount of impurities that effect on the stored grain changes. Based on the above, the aim of the paper is to determine whether there is a difference in the water release rate from the two investigated soy varieties and to determine the content of the impurities, as well as hectoliter and absolute weight. Furthermore, the influence of moisture and the impurities content on mentioned physical properties will be monitored. During the convection drying of two soybean varieties in the thick layer (2.6 cm) at an air temperature of 90 °C, an air velocity of 2.5 ms^{-1} and approximate the same initial grain humidity, the drying equations that are very similar in both varieties are obtained, and the slope curves are almost identical, which means that both varieties behave similarly during drying, ie. they have approximately the same moisture change in the time unit. Research has established that the soybean hectoliter weight containing reduced impurities compared to pure grain, and it is increased by the reduction of grain humidity, while the absolute weight decreases with the reduction of grain humidity.

Keywords: *soybean, drying, impurities, hectoliter weight, absolute weight*

MOGUĆNOST PROIZVODNJE BIOPLINA IZ MISKANTUSA (*Miscanthus x Giganteus*)

POSSIBILITY OF BIOPLIN PRODUCTION FROM MISCANTS (Miscanthus x Giganteus)

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SAŽETAK

U radu je prikazana mogućnost uzgoja nove energetske biljke, koja je nedovoljno razvijena u Hrvatskoj. Potrebe za obnovljivim izvorima biti će sve veće. Nepoznavanje svojstava biljke i financijska kriza su najveća prepreka za razvoj ove biljke u Hrvatskoj. Velika prednost ove kulture je što za njen uzgoj nije potrebno kvalitetno zemljište. *Miscanthus* se korisi u mnogobrojne svrhe. Neke od njih su: biogorivo, grijanje, dodatak građevinskim materijalima. Kao ekološka biljka očekuje se da će se u budućnosti puno više koristiti jer se EU zalaže za obnovljive izvore energije. Smatra se da bi do 2050. biogorivo od *Miscanthusa* moglo zadovoljavati 12% energetskih potreba u EU. *Miscanthus* se trenutno ne koristi za proizvodnju bioplina zbog niske prikladnosti biomase koja se kosi u zimskim ili rano proljetnim mjesecima., jer tada sadrži visoki udio lignina i odlikuje se malim sadržajem vode. Ranije faze košnje *Miscanthus* pogodnije su za proizvodnju bioplina ali se odlikuju niskim prinosom biomase. U ovom radu utvrđen je bioplinski potencijal *Miscanthus* koji je još u fazi rasta prije cvatnje.

Ključne riječi: *Miscanthus, obnovljivi izvori energije, ekologija, energetske potrebe*

ABSTRACT

This paper presents the possibility of growing new energy plant, which is underdeveloped in Croatia. The need for renewable energy will be increasing. Lack of knowledge of the properties of plants and the financial crisis are the biggest obstacle to the development of the plant in Croatia. Great advantage of this culture is that for this cultivation does not need high-quality land. Miscanthus is used for several purposes. Some of them are: biofuels, heating, addition of building materials. As ecological plant is expected to be in the future a lot more use because the EU commited to renewable energy. It is estimated that by 2050. biofuel from miscanthus could meet 12% of energy needs in the EU. Miscanthus is not currently used for biogas production due to the low suitability of biomass that is worn in the winter or early spring months, as it has a high lignin content and is characterized by a small amount of water. Previously the Miscanthus cuttings are more suitable for biogas production but are characterized by low biomass yield. In this paper, the biogas potential of Miscanthus was determined, which is still in the growth phase before flowering.

Keywords: *Miscanthus, renewable energy, ecology, energy needs*

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PROCJENA NE-PROTEINSKOG DUŠIKA METODOM INFRACRVENE SPEKTROSKOPIJE

ESTIMATION OF NON-PROTEIN NITROGEN BY NEAR INFRARED REFLECTANCE SPECTROSCOPY

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ABSTRACT

INTRODUCTION

Feeds are often adulterated with additives due to economic considerations, which causes a reduction of quality, and can decrease the feed safety. For the needs of agricultural practice, the control of the additives imitating true protein becomes a pressing problem. There is easy to anticipate the using inexpensive substances containing non-protein nitrogen (NPN) to adulterate, especially, the feed materials. Such substances can be melamine, urea, and ammonium sulfate. Melamine, which is widely used in China for the production of resins and plastic household items, is dangerous for people health, and leads, among other, to kidney diseases. Melamine contains as much as 66.6% of nitrogen which makes it a potential feed adulterant. Other inexpensive additives imitating true protein, like urea and sulfates, e.g. ammonium sulfate, are also rich in NPN (more than 20% of N) and can be easy use as the additive for falsification of feed materials. The fast and inexpensive method for non-protein nitrogen estimation in feed materials could be a near infrared reflectance spectroscopy (NIRS). This study was carried out to develop a NIRS calibration model for predicting the content of nitrogen pollution of soybeen meal, fishmeal, and milk replacer.

MATERIALS AND METHODS

A soya cake, soybeen meal, fishmeal, and milk replacer were mixed with urea, melamine, and ammonium sulfate (VI) (25 samples each additive) added to the maximum level of 4.8 g /100g (expressed as non-protein nitrogen, NPN). A total of 300 the homogeneous mixtures (coefficient of variation for homogeneity≤1%) were achieved. The quantity of NPN was calculated based on molecular weights and molar shares of nitrogen in the additive, after which the factor 6.25 was used to convert the nitrogen content into the protein content. The known content of the added substance was controlled by nitrogen determination by Kjeldahl method. The materials were scanned in triplicate by NIRS (InfraXact ™ 7500, 570 – 1850 nm, FOSS, Denmark). Calibrations were developed based on ISO 12099:2010, using the WinISI ver. 4.10. The number of samples N, minimal (MIN) and maximal (MAX) additive concentration in the calibration set, standard error of calibration (SEC), standard error of cross validation (SECV), and coefficient of determination (RSQ) were estimated. The calibration equations were calculated for each additive and feed material.

RESULTS AND DISCUSSION

The summary characteristics of calibration equations was presented in the Table 1.

Tab. 1 Parameters of calibration equations for melamine, urea, and ammonium sulfate (VI) content in feed materials

	melamine	urea	ammonium sulfate (VI)
N	91	91	95
MIN g/100g	0.30	0.43	0.94
MAX g/100g	8.54	10.33	18.73
SEC g/100g	0.21	0.12	0.43
SECV g/100g	0.23	0.14	0.45
RSQ	0.993	0.998	0.994

Keywords: *Melamine, Urea, Non-protein nitrogen, Protein adulteration, NIR*

****This study was financed by National Research Institute of Animal Production, project no. 04-16-02-11.***

UTJECAJ TERMIČKIH TRETMANA NA RAZGRADNJU ŠKROBA U BURAGU

THE INFLUENCE OF THERMAL TREATMENTS ON STARCH RUMEN DEGRADABILITY

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SAŽETAK

Emisija metana (CH_4) iz enterične fermentacije preživara je glavni izvor emisije gasova sa efektom staklene bašte. Povećana efikasnost fermentacije u buragu je najizravniji pristup za smanjenje enterične emisije, što takođe smanjuje emisiju azota i time umanjuje potencijal stajnjaka da emituje CH_4. Među nutritivnim strategijama smanjenja CH_4 manipulacija hranidbom je pojednostavljen i pragmatičan pristup koji može da osigura bolju produktivnost životinja kao i manju emisiju CH_4. U prehrani visokomliječnih krava voluminozni dio obroka se mora dopuniti koncentratima sa većom gustinom hranljivih sastojaka i manje vlakana. Takođe, dokumentovano je da prehrana goveda bogata skrobom smanjuje gubitak energije enteričnog CH_4 u poređenju sa prehranom voluminoznim krmivima.

Cilj ovog istraživanja bio je da se ispita utjecaj različitih termičkih tretmana na razgradnju skroba u buragu koncentrata koji sadrži 59% kukuruza kao jedinog izvora skroba u smeši. Primenjeni termički tretmani bili su parno flekičenje, peletiranje, mikronizacija i ekstrudiranje. Najlonske vrećice sa netretiranim ili termički tretiranim koncentratom su suspendovane u buragu tri Black Pied krave sa buražnim fistulama u trajanju od 0-48 h. Parametri degradacije i efikasna razgradivost skroba izračunati su korišćenjem Neway programa na osnovu jednačina koje su opisali Ørskov i McDonald (1979). Parno flekičenje je jedini termički tretman koji je smanjio frakciju skroba koji odmah nestaje (*a*) u poređenju sa netretiranim uzorkom (24,9 prema 34,7%). Svi ostali termički tretmani su povećali ovu frakciju skroba, a najveća vrednost je određena u ekstrudiranom uzorku (67,9%). Brzina razgradnje potencijalno razgradive frakcije (*c*) dobijena za netretirani uzorak je bila 0,0379h^{-1}, dok su svi termički tretmani povećali ovu brzinu (0,0664-0,0936h^{-1}). Najniža efektivna razgradivost skroba u buragu utvrđena je za netretirani uzorak (57,89%), dok je parno flekičenje, peletiranje, mikronizacija i ekstrudiranje povećalo na 67,12, 72,10, 74,92 i 83,92, respektivno. Dobijeni rezultati, posebno oni za mikronizirani kukuruz obzirom da ne postoje literaturni podaci, su od izuzetnog značaja prilikom formulisanja koncentrovanog dela obroka goveda u smislu da degradacija ugljenih hidrata i proteina treba biti sinhronizovana kako bi se postigao efikasan mikrobni rast i mali gubitak azota u buragu.

Referenca:

Ørskov, E.R., McDonald, I., 1979. The estimation of protein degradability in the rumen from incubation measurements weighted according to rate of passage. The Journal of Agricultural Science 92, 499-503.

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ABSTRACT

Methane (CH_4) emission from the enteric fermentation of ruminant livestock is the main source of greenhouse gas emission. Increased rumen fermentation efficiency is the most direct approach to reduce enteric emissions, which will also, in turn, minimize nitrogen emissions and hence reduce the potential of the manure to emit CH_4. Among the nutritional strategies of CH_4 mitigation, dietary manipulation is a simplistic and pragmatic approach that can ensure better animal productivity as well as a lower CH_4 emission. In high-producing dairy cows, nutrition forages must be supplemented with concentrates with a higher density of nutrients and less fiber. Also, it is well documented that feeding more starch to ruminants reduces enteric CH_4 energy losses compared to feeding a forage diet.

The aim of this research was to investigate the influence of various thermal treatments on ruminal starch degradation of concentrate containing 59% of corn as the only source of starch in a mixture. Thermal treatments applied were steam flaking, pelleting, micronization, and extrusion. Nylon bags of untreated or thermally treated concentrate were suspended in the rumen of three Black Pied cows with rumen fistula for 0–48 h. Degradation parameters and effective degradability of starch were calculated using the Neway programme based on the equations described by Ørskov and McDonald (1979). Steam flaking was the only thermal treatment that reduced the fraction of starch which disappears immediately (a) in comparison to untreated sample (24.9 vs. 34.7%). All the other thermal treatments increased this fraction of starch and the highest value was determined in the extruded sample (67.9%). The degradation rate of the potentially degradable fraction (c) obtained for the unprocessed sample was 0.0379h^{-1}, while all thermal treatments increased this rate (0.0664-0.0936h^{-1}). The lowest effective degradability of starch in rumen was determined in the unprocessed sample (57.89%), whereas steam flaking, pelleting, micronization, and extrusion increased it to 67.12, 72.10, 74.92 and 83.92, respectively. Obtained results, especially the ones for micronized corn since there is no available literature data, are of extreme importance for concentrate formulation in terms that degradation of carbohydrate and protein should be synchronized in order to achieve efficient microbial growth and little nitrogen loss in the rumen.

Reference:

Ørskov, E.R., McDonald, I., 1979. The estimation of protein degradability in the rumen from incubation measurements weighted according to rate of passage. The Journal of Agricultural Science 92, 499-503.

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OTKRIVANJE HLAPIVIH SPOJEVA U MESU WHITE KOLUDA GUSAKA

DETECTION OF VOLATILE COMPOUNDS IN MEAT OF WHITE KOLUDA GEESE

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ABSTRACT

INTRODUCTION

In Poland goose production is based on White Koluda® geese, and more than 95% of all goose meat available in this country is obtained from this breed. This genotype was created as a result of breeding work conducted since 1962 at the National Research Institute of Animal Production at the Experimental Station in Kołuda Wielka. The oat goose production technology developed at the Institute, gives the excellent quality meat and fat with valued sensory properties, which are influenced by volatile organic compounds (VOCs). The main sources of VOCs in food products are: original volatile compounds of the food sample matrix, products of biological processes, and products of chemical reactions. The VOCs precursors in meat are free amino acids, reducing sugars, lipids (in particular fatty acids), vitamins, nucleotides, and peptides. In this study the VOCs detected in the samples of leg meat and abdominal fat of the White Kołuda® goose is presented.

MATERIALS AND METHODS

The oat-fed White Kołuda® goose was produced according to the oat fattening technology developed at the Institute's Experimental Station in Kołuda Wielka in Poland. The animal experimental material comprised of 40 White Kołuda® geese of the W33 genotype. VOCs were analysed in samples of leg muscles and abdominal fat by headspace solid-phase microextraction gas chromatography/mass spectrometry (HS-SPME-GC/MS) using GCMS-QP 2010 Plus chromatograph (Shimadzu, Japan). DVB/CAR/PDMS fibre (Supelco, USA) and non-polar ZB-5MSi, 30m x 0.25mm, 0.25um column (Phenomenex, USA) were applied. Part of the substances were confirmed on the polar ZB-Wax, 30m x 0.25mm, 0.25um, column. The compounds were identified based on mass spectra libraries (NIST08, NIST08s, FF NSC1.3), and by comparison retention index values (RI) with either published values from the National Institute of Standards and Technology (NIST, 2018), or those of authentic standards. The standards for identification of VOCs were purchased from Sigma – Aldrich Co. Supelco (Poznań, Poland). The samples were prepared in 3 (legs) and 2 (fat) variants. There were, for legs: meat without heat treatment, meat subjected to low-temperature heat treatment (30 °C, 24 h) and meat subjected to high-temperature heat treatment (170 °C, 35 min). The fat was subjected to without heat treatment and high-temperature heat treatment (170 °C, 35 min).

RESULTS AND DISCUSSION

The 276 VOCs were determined, out of which 168 were fully identified and further 44 were considered as probably identified and 64 were non-identified. The high-temperature treatment has contributed to the highest number of volatile compounds in the samples. The numbers of VOCs in the meat without heat treatment, in the meat subjected to low-temperature, and in the meat subjected to high-temperature, were 117, 110, and 166 compounds, respectively. The numbers of VOCs in the abdominal fat without heat treatment and subjected to high-temperature, were 19 and 93, respectively. The numbers of volatile compounds in classes, after the high temperature treatment of the meat and fat, was presented in Fig. 1.

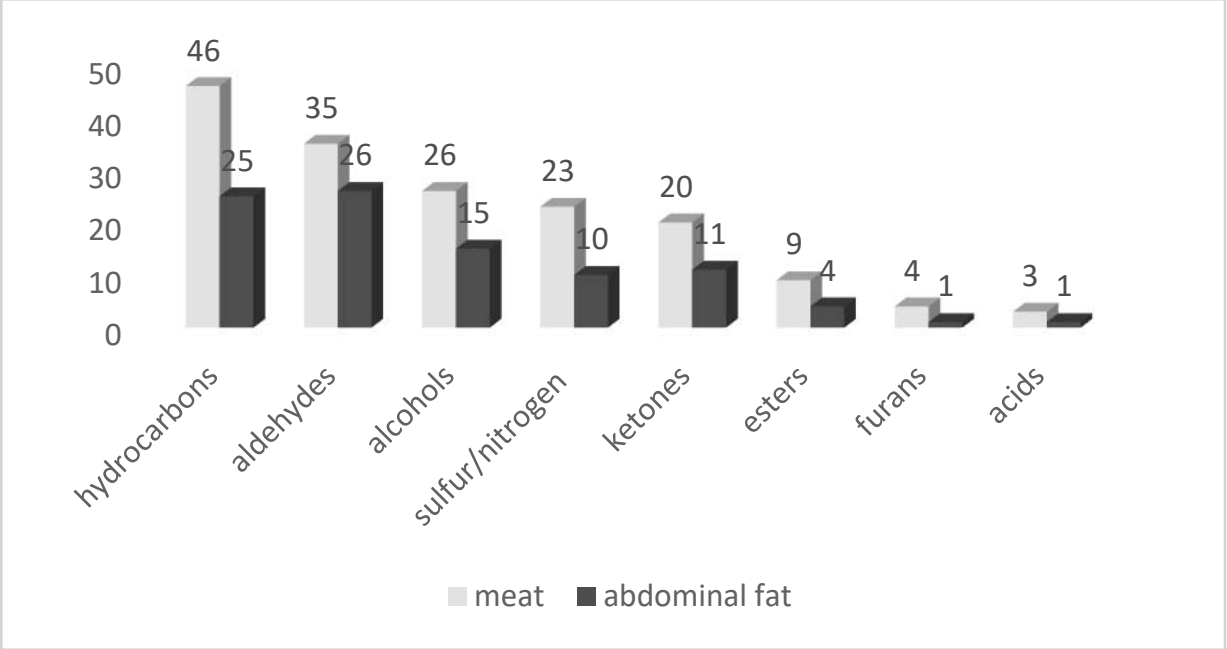

Fig. 1 The number of VOCs in classes, after the high temperature treatment of the meat and fat

Keywords: *White Koluda geese, Meat, Volatile Compounds, SPME-GC/MS*

****This study was financed from statutory activity of National Research Institute of Animal Production, project no. 01-16-04-11.***

OTKRIVANJE HLAPIVIH SPOJEVA U MESU POLISH RED-WHITE I SIMENTALSKOG GOVEDA

*DETECTION OF VOLATILE COMPOUNDS IN MEAT OF POLISH RED-WHITE AND SIMMENTAL CATTLE**

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ABSTRACT

INTRODUCTION

The Polish Red-and-White is breed covered with the conservation programme, It is dual-purpose breed suitable for relatively high milk production profitable rearing of calves and fattening of bulls based on farm-produced feedstuffs. Efforts to increase the added value through proven quality products have been made in many countries that actively protect the local genotypes of farm animals. Thanks to the breeders of Polish Red-and-White cattle, "beef from Polish Red-and-White cow" was included on the list of traditional products by the Ministry of Agriculture and Rural Development. Although the Polish Red-and-White breed has the best fattening capacity of all conservation breeds of the cattle in Poland, there are relatively few studies on the meat quality of this breed, despite the changes that have taken place over the years in research methods, the environment and the genotype of the animals. The volatile compounds in the meat can be determinant of the meat quality. Chromatographic techniques of the analysis of this compounds are used more and more often for detailed analysis of meat properties of different species and breeds. The aim of the study was to analyze volatile compounds in meat of Polish Red and-White and Simmental cattle.

MATERIALS AND METHODS

The experiment involved 12 bulls aged 18 months studied in 2 breeding groups: Polish Red-White and Simmental. During the fattening period, the animals received maize and grass silage, hay, barley rapeseed cake and minerals. Slaughter analysis was performed according to slaughterhouse procedures. For volatile compounds analysis, the ca. 500 g of M. longessimus dorsi leg muscle samples were taken and cut into pieces (ca. 3 cm). Next, they were vacuum-packed and stored at -80 °C. Thawed sample was baked in the sealed vial (170 °C, 35 min) and analyzed by HS-SPME-GC/MS using the gas chromatograph mass spectrometer GCMS-QP 2010 Plus (Shimadzu, Japan), 50/30µm DVB/CAR/PDMS fiber (Supelco, USA), and Zebron ZB-5MSi 30m x 0.25mm, 0.25um column (Phenomenex, USA). The substances were identified based on mass spectra libraries (NIST08, NIST08s, FF NSC1.3), and by comparison retention index values (RI) with either published values from the National Institute of Standards and Technology (NIST, 2018), or those of authentic standards. The standards for identification of volatile compounds were purchased from Sigma – Aldrich Co. Supelco (Poznań, Poland). The differentiation was performed between the groups based on intensity spectral data. The data preselection by use of Fisher's ratio method was done, based on basic functions of Microsoft Excel®. The PCA-LDA analysis and classification was executed using the multivariate statistics package of Statgraphics® Centurion XVI.

RESULTS AND DISCUSSION

Identification and classes of volatile compounds. In this study, 91 volatile compounds analyzed by HS-SPME-GC/MS were found, whereas 20 were verified by using of authentic standards. The most abundant compounds present in the steaks from both breeds were as follows: hexanal, 2-butanone, 2-pentylfuran, acetone, 3-methylbutanal, and nonanal (Fig. 1). The greatest ammounts of aldehydes (above 374 ng/g), ketones (above 87 ng/g), and furans (above 48 ng/g) in steaks were found. The differences in volatile compounds content between breeds and feeding were observed. The first five principal components accounted for 82.5% of the total variance. The classification accuracy values for both dual purpose cattle groups were 100%.

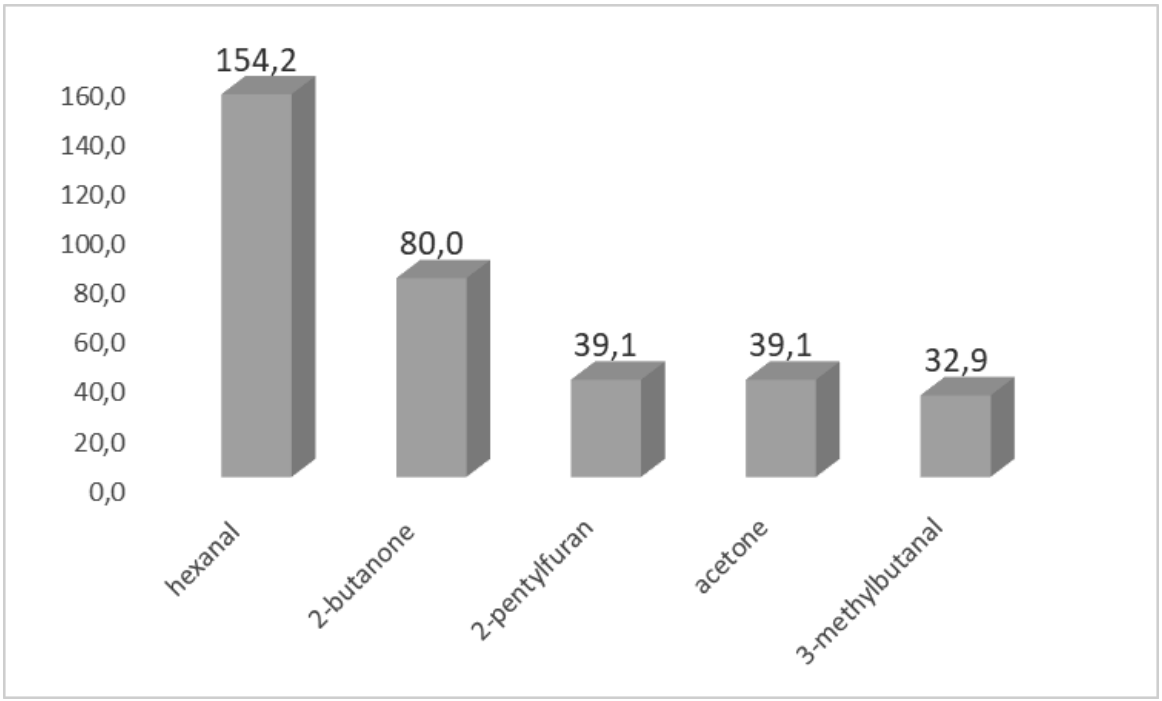

Fig. 1 The most abundant volatile compounds in steaks from the Polish Red-White and Simmental cattle (ng/g, in average)

Keywords: *Polish Red-White beef cattle, Simmental, Meat, Volatile Compounds, SPME-GC/MS*

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KEMIJSKE KARAKTERISTIKE TRADICIONALNIH EUROPSKIH KOBASICA

THE CHEMICAL COMPOSITION OF TRADITIONAL EUROPEAN SAUSAGES

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ABSTRACT

Europe is famous of sausages production such delighted as: rural sausage (kiełbasa wiejska), Žemaitiška dešra, kranjska klobasa, csabai kolbász, mangalica kolbász, slavonski kulen, kulenova seka, češnjovka, domaća kobasica, zlatiborski kulen, levačka kobasica, sremska kobasica, hauswurst, Chorizo and Fuet pork sausage. The aim of work was the assessment of chemical composition of traditional European sausages (produced in Poland, Lithuania, Ukraine, Czech Republic, Slovakia, Hungary, Serbia, Austria, Italy and Spain) obtained from meat of autochthonous pigs bred in a traditional way. The analysed sausages differed in chemical composition and it was caused by different recipes and differences in raw meat chemical composition originating from native pigs breeds. The highest differences were present in the fat content in sausages at average – from 14.74% in jałowcowa sausage to 55.05% sausage from Mangalica pig meat. All analysed sausages fulfilled the new requirements of the European Union concerning maximum PAH levels in the selected foodstuffs as considered in the Commission Regulation (EC) no 835/2001.

Keywords: *traditional sausages, chemical composition, PAHs*

Acknowledgements: Project "The uses and the conservation of farm animal genetic resources under sustainable development" co-financed by the National Centre for Research and Development within the framework of the strategic R&D programme "Environment, agriculture and forestry" – BIOSTRATEG, contract number: BIOSTRATEG2/297267/14/NCBR/2016

UPOTREBA KONOPLJE (*Cannabis sativa L.*) U HRANIDBI DOMAĆIH ŽIVOTINJA

THE USE OF HEMP (Cannabis sativa L.) IN ANIMAL NUTRITION

Željka Klir, Josip Novoselec, Zvonko Antunović

SAŽETAK

Cilj ovoga rada je pregledom dostupne literature istražiti mogućnost upotrebe konoplje (*Cannabis sativa* L.) u hranidbi domaćih životinja. U hranidbi domaćih životinja mogu se koristiti sjemenke, pogača od sjemenki konoplje i ulje konoplje kao dodatak krmnim smjesama. Sjemenke konoplje su bogate sirovim bjelančevinama i sirovim mastima s odgovarajućom koncentracijom nezasićenih masnih kiselina, osobito linolnom (LA, C18:2 n-6) i linolenskom (ALA, C18:3 n-3) kiselinom. U koza u laktaciji utvrđeno je povećanje sadržaja masti i bjelančevina u mlijeku, kao i ukupnih lipida u plazmi uslijed hranidbe krmnim smjesama s dodatkom ulja konoplje (4.79 g/kg ST). Također, ulje konoplje dodano u krmne smjese dovelo je do promjene sastava masnih kiselina u kozjem mlijeku, odnosno do povećanja koncentracije konjugirane linolne (CLA) i polinezasićenih masnih kiselina (PUFA). Pri hranidbi ovaca krmnim smjesama s dodatkom sjemenki konoplje (180 g/dan) ili pogače sjemenki konoplje (480 g/dan) utvrđeno je povećanje količine mliječne masti, kao i povećanje koncentracije LA, CLA i ALA. Dodatak pogače sjemenki konoplje (143 g/kg ST) u krmne smjese povećao je količinu proizvedenog mlijeka u usporedbi s kontrolnom skupinom i skupinom krava koje su konzumirale više razine pogače sjemenki konoplje (233 i 318 g/kg ST). Pogača sjemenki konoplje nije imala negativan učinak na konzumaciju hrane kod janjadi pri dodatku do 200 g/kg ST u krmnim smjesama. Hranidba koka nesilica pogačom sjemenki konoplje (50 i 100 g/kg ST) rezultirala je obogaćivanjem žumanjka s ALA, pri čemu nije utvrđen negativan utjecaj na pokazatelje nesivosti. Navedeno ukazuje na mogućnost upotrebe konoplje u obrocima domaćih životinja bez značajnijih promjena proizvodnih svojstava, uz mogućnost povećanja poželjnih masnih kiselina u animalnim proizvodima.

Ključne riječi: *konoplja, hranidba, domaće životinje, animalni proizvodi*

ABSTRACT

The aim of the present paper was to review available scientific literature and to research possibility of using hemp (Cannabis sativa L.) in animal nutrition. In animal nutrition hemp seeds can be used, as well as hemp seed cake, and hemp oil as supplement in feed mixtures. Hemp seeds are rich in crude protein and crude fat with adequate proportions of unsaturated fatty acids, particularly linoleic (LA, C18:2 n-6) and linolenic (ALA, C18:3 n-3) acid. In lactating dairy goats increased fat and protein content in milk and concentrations of total lipids in plasma were determined when fed with concentrates containing hemp oil (4.79 g/kg DM). Likewise, hemp oil supplementation in concentrate mixture altered fatty acid profile of goat milk, with increasing conjugated fatty acid (CLA) and polyunsaturated fatty acids (PUFA) proportions. When feeding ewes with concentrates containing hemp seeds (180 g/day) or hemp seed cake (480 g/day), higher milk fat was observed with higher proportions of LA, CLA and ALA. Addition of hempseed cake (143 g/kg DM) in concentrate mixture for cows increased milk yield, compared to control and groups of cows fed higher levels of hempseed cake (233 or 318 g/kg DM). Hempseed cake had no detrimental effect on feed intake by lambs when fed up to 200 g/kg DM in concentrate mixture. Nutrition of laying hens with hemp seed cake (50 and 100 g/kg DM) provided enrichment of yolk fat with ALA, and did not negatively influence laying performance. The aforementioned indicate possibility of using hemp in diets of domestic animals without major changes in production traits, and with possible increase of desirable fatty acids in animal products.

Keywords: *hemp, nutrition, domestic animals, animal products*

UTJECAJ DODAVANJA SILAŽE LUCERNE KOŠENE U RAZLIČITIM PERIODIMA DANA NA PROIZVODNA SVOJSTVA KOZA U PORASTU

FEED INTAKE AND GROWTH PERFORMANCE IN GOATS FED ALFALFA SILAGES CUT IN VARIOUS PERIODS OF DAY

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SAŽETAK

Dvanaest koza, alpske pasmine i starosti od 7-8 mjeseci sa prosječnom tjelesnom masom od 24,1 kg, je uzeto da se utvrditi utjecaj dodavanja silaže lucerene košene u različitim periodima dana na proizvodna svojstva koza u porastu. Obroci koza su se sastojali od silaže lucerne (LS), sijena trava i smjese žitarica (kukuruz, zob i triticale) pri čemu je odnos između voluminoznog i koncentratnog dijela obroka iznosio oko 70:30. Pokus je dizajniran kao randomizirani blok sistem sa šest koza u svakom tretmanu. Količina suhe tvari obroka je iznosila oko 1,05 kg. Utvrđeni su početna i završna tjelesna masa, ukupni i prosječni dnevni prirasti te konverzija hrane (silaže). Prethodno, silaže su spravljene od lucerne košene u različitim periodima dana (jutro, popodne) hipotetizirajući da sa dnevnim odlaganjem košnje raste sadržaj nestrukturalnih ugljikohidrata u biljnoj masi što utječe na kvalitet silaže, i posljedično na proizvodna svojstva životinja. Dakle, pokusni obroci su sadržavali silažu lucerne košene ujutro (LS-AM tretman) ili košene popodne (LS-PM tretman). Iako je konzumacija suhe tvari obroka i suhe tvari silaže bila nešto veća u LS-AM tretmanu, koze hranjene LS-PM obrokom su imale viši ukupni prirast (p=0,028), prosječni dnevni prirast (p=0,024) i bolju konverziju hrane (p=0,04).

Ključne riječi: *proizvodna svojstva koza, silaža lucerne, varijacije tijekom dana*

ABSTRACT

Twelve Alpine goats at 7-8 months of age and average body weight of 24.1 kg were used in an experiment to evaluate two diets differing only in alfalfa silage treatment during ensiling. The diets consisted of alfalfa silage (LS), grass hay and grain mixtures (corn, oats and triticale) with forage:concentrate ratio of 70:30 fed (totally 1.05 kg dry matter) to six Alpine goats according randomized block system. Initial and final body weight of goats, total and average daily gain, silage intake as well as silage feed conversion ratio were determined. Prior to the experiment silage was made of alfalfa harvested at different time of day (morning and afternoon) with idea that the diurnal increasing of nonstructural carbohydrates in plant have influence on nutritional characteristics of silage, and consequently on performances of animals. So, experimental diets contained alfalfa silage harvested in the morning (LS-AM) or from evening (LS-PM). Although both, total dry matter intake and dry matter intake from alfalfa silage were slightly higher in LS-AM diets, goats fed by silage from afternoon harvesting (LS-PM) had higher total gain (p=0.028), average daily gain (p=0.024) and silage conversion ratio (p=0.04).

Keywords: *goat performances, alfalfa silage, diurnal variation*

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UTJECAJ MINERALNE GNOJIDBE TLA NA SASTAV KUKURUZNE SILAŽE, PRINOS MLIJEKA I ZDRAVLJE KRAVA

MAIZE SILAGE PROXIMATE COMPOSITION, MILK YIELD AND COWS HEALTH INFLUENCED BY SOIL MINERAL FERTILIZATION

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ABSTRACT

The aim of this research was to investigate the effect of mineral fertilization on the proximate composition of maize silage, milk yield and health of two cows breed Holstein Friesian and Simmental. The main purpose was to analyze the proximate composition of maize silage, to determine the content of maize silage fraction, green and dry matter of maize, the cost of maize silage production, milk yield and their influence on cows health through blood oxidative status. Mineral fertilization showed a very large influence on the yield of the silage material. Green material obtained from maize which was fertilized is characterized by a higher concentration of crude protein, starch, and energy, compared to maize which wasn't fertilized. Total of 60 Holstein Friesian and Simmental cows breed was divided into two treatments which were further divided into three groups each, respectively. Lactating groups of each cow breed was divided into three stages at early lactation, peak lactation, and low lactation. During the experiment, blood samples were collected from cows to determine cows health status. Proximate composition showed a higher nutritive value of silage maize gained from fertilized soil. Cows that were fed with maize silage from fertilized soil showed higher milk yield and better health status compared to cows which in their daily nutrition received maize silage from unfertilized soil, which were more prone for different diseases.

Keywords: *cows, nutrition, maize, milk, health, diseases*

Acknowledgements

The paper is a part of the research work on the COST Action project CA17110 - Standardizing output-based surveillance to control non-regulated diseases of cattle in the EU.

PREFERENCIJE HRANJIVIH SPOJEVA KOJIMA SU GLAVNI SASTOJCI ŽITARICE OD 40 ILI 60% NA RAST SVINJA

PREFERENCES OF GROWING PIGS TO FEED COMPOUNDS CONTAINING 40 OR 60% MAIN CEREAL CONSTITUENT

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ABSTRACT

In commercial pig production, the most important part of total costs is nutrition. In parallel this aspect of production has also the largest impact on performance of growing pigs, as the main environmental factor. One of the important quality unit of the feed compound is its taste.

The aim of the research was to determine the taste preferences of growing pigs to feed mixtures containing standard cereal components (wheat, barley, triticale, maize) and rye in three genetic types, including population rye (PR), hybrid rye (HR) and rye of unknown origin, called also no name rye (NNR).

The experimental material were 26 growing pigs divided into 2 groups. The first group (n=12) was housed in the pen equipped with six automatic feeders, containing different feed mixes each. The difference was the main cereal constituent included in 40% share. Standard mix contained 40% of barley + 40% of wheat (BW). The rest of mixes where composed taking off 20% of barley (B) and 20% of wheat (W), and adding 40% of triticale (T), maize (M), HR, PR or NNR rye. The second group (n=14) was housed with access to 7 automatic feeders, and each compound contained 60% of main cereal constituent. Feed mixtures where isocaloric and isoprotein, and where offered to pigs ad libitum. Feed consumption was controlled day by day in each feeder during grower phase of fattening, lasting 40 days. The percentage structure of consumption was calculated for each group of animals and significance of preferences to feed compounds inside group was analyzed using Chi square test in Brandt and Snedecor formula.

In group 1 (40% of main cereal), the most preferred were mixtures containing HR – 34.69%, PR – 23.46% and BW – 20,69%. The differences were significant (P<0.01) to T, M and NNR (4.11%, 4.87% and 12.18% respectively). The difference was also noticed between HR and BW (P<0.05). In group 2 (60% of main cereal) the most preferred (P<0.01) were mixtures containing HR – 28.67% and W – 23.64%. Least preferred (P<0.01) were mixes containing M and T (5.00% and 8.07% respectively). Consumption of mixes containing PR, NNR and B was medial (11.88%, 10.89 and 11.86% respectively), but significantly lower in compare to HR (P<0.01) and W (P<0.05).

To conclude, independently of the content of mixture component (40 or 60%), the highest palatability was observed in compounds containing hybrid rye. Population rye was willingly eaten, however only up to 40% of the mixture. In highest content (60%) wheat was more preferred than population rye. The last tasty for pigs seem to be maize and triticale grain.

Supported by National Centre for Research and Development, project "ENERGYFEED", contract No BIOSTRATEG/297910/NCBR/2016.

UTJECAJ SUVREMENIH SORTA RAŽI NA HISTOLOŠKU STRUKTURU I CRIJEVNU BARIJERU GASTROINTESTINALNOG TRAKTA SVINJA

THE EFFECT MODERN VARIETIES OF RYE ON THE HISTOLOGICAL STRUCTURE AND INTESTINAL BARRIER OF THE GASTROINTESTINAL TRACT OF PIGS

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ABSTRACT

Traditionally standard varieties of rye had very limited use in livestock feeding, because of high amount of so called "antinutritive substances". However the knowledge on the impact of these crops on the structure of gastrointestinal barrier and related absorption of nutrients is limited. On the other hand available data on the use of modern varieties of rye in feeding are promising. Thus the aim of this study was to assess the integrity and structure of small intestinal barrier after feeding pigs with the rye-based feed ration.

Studies were performed on sixteen 5.5–6 months old pigs. Animals (n = 8 of each group) were fed a barley/wheat (50/50%; control) and barley/wheat/rye (hybrid rye cv. Brasetto) (20/20/60%; rye group) feed from 30–100 kg body weight, and all animals were sacrificed in a local slaughterhouse afterwards. Samples of small intestine (jejunum – middle part) were collected, fixed in formalin and paraffin embedded then subjected to histology and immunohistochemistry analysis. Occludin, claudine 2 and ZO-1 proteins were detected with primary antibodies, to assess the integrity of small intestine barrier, on 4 μm thick sections. Part of intestinal samples were homogenized and subjected to Western Blot analysis referring to the same proteins.

There were no significant changes in the structure of small intestine, barrier integrity and expression of assessed proteins in the rye group comparing to the control. A slight tendency to increase of an absorptive surface was detected in animals fed with 60% rye addition.

In conclusion, since there was no deteriorating effect of the rye addition, on the level of small intestine barrier and structure, the modern varieties of rye may be advised as an energy and protein donor, thus a replacement of corn, in feeding of pigs.

This study was supported by the National Centre for Research and Development, Poland (grant "ENERGYFEED"; number: BIOSTRATEG2/297910/12/NCBR/2016).

KEMIJSKI SASTAV I KVALITETA MESA POLJSKIH IZVORNIH PASMINA SVINJA

THE CHEMICAL COMPOSITION AND QUALITY OF MEAT POLISH NATIVE PIG BREEDS

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ABSTRACT

The homeland breeds of pigs are those that grow in a certain region and / or country as local, primitive breeds. In Poland in above breeds are included 3 breeds: Pulawska, Zlotnicka White and Zlotnicka Spotted pigs. The aim of work was to assess the meat quality of Polish homeland traditionally breed pigs. The meat of Pulawska, Zlotnicka White and Spotted breeds of pigs is a good quality raw material which is used for production of traditional and regional meat products gaining high sensory scores and good recognition among consumers. The meat of Zlotnicka Spotted breed deserves the special attention because of advantages intramuscular fat content, lower thermal losses and smaller shear force. The meat of Pulawska breed, produced for project BIOSTRATEG was characterized by better quality parameters in comparison to meat of fatteners of the same breed bought in a popular shop-network. In order for meat from the Pulawska porkers sold in the Auchan network to compete for meat of very fine meat fatteners, it is necessary to change the requirements for porkers of the Pulawska breed and eliminate the crossing of the Pulawska breed with pietrain boars. Promotion of traditional products obtained from above assessed breeds will favour the development of their breeding and stocks rising.

Keywords: *fatteners, native breeds, meat, quality*

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ODREĐIVANJE HLAPIVIH ORGANSKIH SPOJEVA U MESU NOGE DVIJE SKUPINE GUSAKA POMOĆU MIKROEKSTRAKCIJE - PLINSKE KROMATOGRAFIJE - MASENE SPEKTROMETRIJE

DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN LEG MEAT OF TWO GROUPS OF GEESE BY HEADSPACE SOLID-PHASE MICROEXTRACTION–GAS CHROMATOGRAPHY–MASS SPECTROMETRY COUPLED WITH CHEMOMETRICS

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ABSTRACT

INTRODUCTION

The White Kołuda® goose is the flagship product of the National Research Institute of Animal Production. The particular technology developed at the Institute, that uses oats for fattening, yields the oat White Koluda ® goose. Deviating from this rule mean that goose products can not be named in this way.

The meat from the oat goose carries valued sensory properties, which are influenced by volatile organic compounds (VOCs), which can be analyzed by a headspace solid phase microextraction gas chromatography/mass spectrometry (HS–SPME–GC/MS). The VOCs analysis coupled with multivariate statistical techniques could be used to authenticate and differentiate the product groups. This statistics can include the principal component analysis and classification models, based on the linear discriminant analysis.

The subject of the research is to check the possibility of building a classification models used to confirm the authenticity of oat White Koluda ® goose compared to the goose fed with wheat.

MATERIALS AND METHODS

The same experiment was performed in two successive years to lend credence to the research results. The animal experimental material was comprised of 80 White Kołuda geese (40 fed with oats and 40 fed with wheat). The VOCs in leg meat were analyzed by headspace solid-phase microextraction gas chromatography/mass spectrometry (HS-SPME-GC/MS) using GCMS-QP 2010 Plus chromatograph (Shimadzu, Japan). For analysis DVB/CAR/PDMS fibre (Supelco, USA) and ZB-5MSi 30m x 0.25mm, 0.25um column (Phenomenex, USA) were used.

The results of HS-SPME-GC/MS analysis were a basis for performing the chemometric analysis, which consisted of Fisher's ratio for data pre-selection, followed by principal component analysis (PCA) and linear discriminant analysis (LDA). Models for 4 techniques of data preparing were constructed, based on: relative and absolute data, followed by log-transformation (LOG REL and LOG ABS), and relative and absolute data followed by systematic ratio normalization (SRN REL and SRN ABS). 3 options of comparison: for males, females, and both sexes together were applied. The correct classification rate (CCR), the accuracy for oat grain fattened group (ACCo), and the accuracy for wheat grain fattened group (ACCw) were estimated for meat: without heat treatment, subjected to a low-temperature heat treatment (30 °C, 24 h), and subjected to a high-temperature heat treatment (170 °C, 35 min).

RESULTS AND DISCUSSION

The best classification models were based on the meat analysis from only one sex, independently on the sample meat heat treatment. Slightly more validation parameters with 100% values were obtained for the analysis of female meat. However, rather worse results were obtained for the option of comparison, when the both genders were combined. Then, the performance of prediction models drops to values between 84.5% to 89.3%, compared to values between 91.6% to 96.7% for the male and female options of comparison. In turn, each of the 4 techniques of data preparing (LOG-REL, SRN-REL, LOG-ABS, SRN-ABS) seems to be equally good.

The VOCs-based classification models derived from the meat made it potentially possible to distinguish the oat-fattened White Kołuda geese from the White Kołuda geese fattened using a wheat grain.

Keywords: *Meat, Volatile Organic Compounds, White Kołuda® goose, HS-SPME-GC/MS, Chemometrics, Fisher's ratio*

ODREĐIVANJE HLAPIVIH ORGANSKIH SPOJEVA U MESU OVACA, KOZA I GOVEDA POMOĆU MIKROEKSTRAKCIJE - PLINSKE KROMATOGRAFIJE - MASENE SPEKTROMETRIJE

DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN SHEEP, GOAT AND BEEF MEAT BY HEADSPACE SOLID-PHASE MICROEXTRACTION–GAS CHROMATOGRAPHY–MASS SPECTROMETRY COUPLED WITH CHEMOMETRICS

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ABSTRACT

INTRODUCTION

Polish consumers, looking for food that is not only tasty but also healthy, are increasingly consuming domestic products: local and regional. They pay more and more attention to the nutritional value, which is the resultant of the content of basic nutrients, dietary value and the content of bioactive substances showing a beneficial effect on human health. Products from local breeds of cattle, sheep and goats kept on ecologically clean meadows and pastures, with a diverse botanical composition of the sward, rich in herbs, are fully in line with the current needs of modern consumers. Research on the qualitative characteristics of meat from ruminants with particular reference to the study of volatile compounds responsible for the meat flavor will allow a more complete characterization of animal products, and in the future may be helpful in assessing the authenticity of traditional products from native breeds.

The aim of the research was the determination of volatile organic compounds in sheep, goat, and beef meat by Headspace Solid-Phase Microextraction-Gas Chromatography-Mass Spectrometry coupled with Chemometrics.

MATERIALS AND METHODS

The experiment involved 24 lambs (aged 9 months) of the Wrzosówka (16 rams) and Świniarka (8 rams), and 8 ram lambs of the Wrzosówka (aged 7 months) native sheep breeds; 12 kids (6 - aged 10 months and 6 - aged 12 months) of the Carpathian goat native breed, and 15 Simmental and 13 Polish Red-White bulls. The animals were selected from conservation herds belonging to the National Research Institute of Animal Production. The lambs and goats were maintained in a semi-intensive system (meadow hay and straw ad libitum and 0.4 kg of concentrate per animal). The bulls received maize and grass silage, hay, barley rapeseed cake or linseed cake and minerals.

32 samples of the lamb meat (m. biceps femoris), 12 samples of the goat meat (m. biceps femoris), and 28 samples of the beef cattle (m. longissimus dorsi) were analyzed by HS-SPME-GC/MS using the gas chromatograph mass spectrometer GCMS-QP 2010 Plus (Shimadzu, Japan), 50/30µm DVB/CAR/PDMS fiber (Supelco, USA), and Zebron ZB-5MSi 30m x 0.25mm, 0.25um column (Phenomenex, USA). The ca. 200 g meat samples were taken and cut into pieces (ca. 3 cm), vacuum-packed, and stored at -80 °C. For volatile compounds analysis, samples were baked in the sealed vial (170 °C, 35 min) and analyzed by HS-SPME-GC/MS using the gas chromatograph mass spectrometer GCMS-QP 2010 Plus (Shimadzu, Japan), 50/30µm DVB/CAR/PDMS fiber

(Supelco, USA), and Zebron ZB-5MSi 30m x 0.25mm, 0.25um column (Phenomenex, USA). The substances were identified based on mass spectra libraries (NIST08, NIST08s, FF NSC1.3), and by comparison retention index values (RI) with values from the National Institute of Standards and Technology (NIST, 2018), or those of authentic standards. The standards were purchased from Sigma – Aldrich Co. Supelco (Poznań, Poland). The data pre-selection (Fisher's ratio), and PCA-LDA analysis and classification was executed (Statgraphics® Centurion XVI).

RESULTS AND DISCUSSION

Identification and classes of volatile compounds. In this study, 102 volatile compounds analyzed by HS-SPME-GC/MS were found (22 were verified by using of authentic standards). The most abundant compounds present in the meat were as follows (ng/g, minimum-maximum): hexanal (234.0 – cattle, 756.2 – goats), 2-pentylfuran (37.8 – cattle, 293.9 – goats), nonanal (19.1 – cattle, 127.0 - goats), octanal (8.6 – cattle, 102.7 - goats), heptanal (13.3 – cattle, 97.3 - goats), 2-ethylfuran (8.6 – cattle, 67.3 – goats), 3-methylbutanal (4.9 – lambs, 37.7 – goats), 1-octen-3-ol (5.5 – cattle, 43.1 – goats), benzaldehyde (14.8 – lambs, 32.2 - goats) i acetone (5.3 – lambs, 31.3 - cattle). The 28 aldehydes, 5 furans, 15 alcohols, 14 ketones, 22 hydrocarbons, 14 sulfur/nitrogen compounds, 1 acid, and 2 other compounds were found. Goat's meat was characterized by the highest amount of the volatile organic compounds, intermediate values were shown in the sheep meat, while beef as the least aromatic meat characterized by the lowest content of the volatile compounds.

The greatest ammounts of aldehydes, furans, alcohols, and ketones were identified in the meat, regardless of the species (Fig. 1-2).

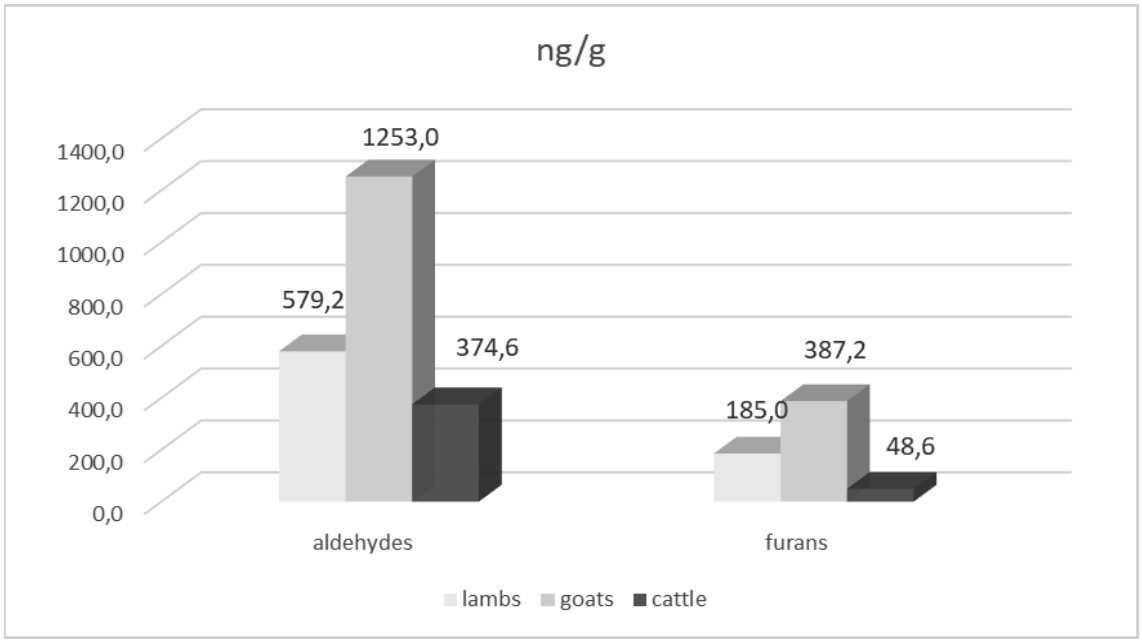

Fig. 1 Aldehydes and furans in meat of lambs, goats, and beef

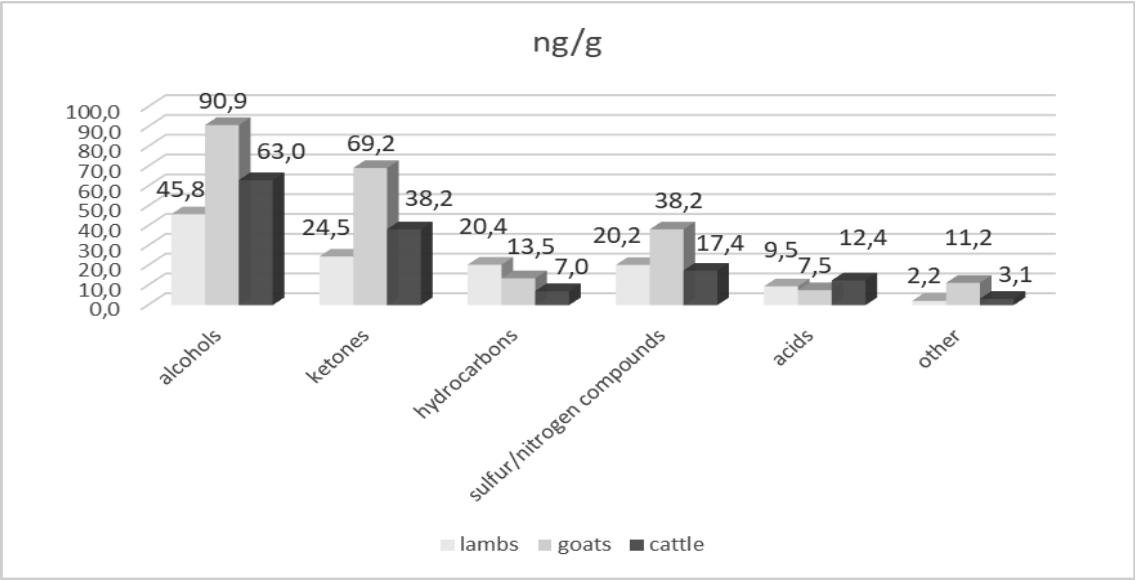

Fig. 2 Other classes of volatile compounds in meat of lambs, goats, and beef

Keywords: *Beef, Sheep, Goat, Meat, Volatile Compounds, SPME-GC/MS*

***This study was financed from statutory activity of National Research Institute of Animal Production, project no. 01-13-01-11.**

OLFAKTOMETRIJSKA ANALIZA SPOJEVA AROMA U MESU WHITE KOLUDA® GUSKE POMOĆU PLINSKE KROMATOGRAFIJE

GAS CHROMATOGRAPHY-OLFACTOMETRY ANALYSIS OF AROMA COMPOUNDS IN MEAT OF WHITE KOLUDA GEESE®

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ABSTRACT

INTRODUCTION

Hundreds of volatile compounds are identified in meat. They belong to many chemical groups, such as: alcohols, aldehydes, ketones, esters, hydrocarbons, furans, pyrazines, pyrroles, pyridines, as well as fatty acids. Those of them, whose content exceeds the flavor threshold are referred to as odor-active compounds. The most active are so-called key aroma compounds that affect the formation of the smell of the meat. It is assumed that raw meat is tasteless and odorless or has a slight sweet-salty taste. On the other hand, the scent profile becomes enriched in the post-mortem ripening period. However, the fullness of sensory values is obtained during culinary thermal treatments such as cooking, baking, frying or stewing. Only a few studies on volatile compounds in geese have been presented. Furthermore, to the best of our knowledge, this work is the first olfactometry study on the goose meat.

The subject of the research is to present key aroma compounds in the meat from White Kołuda goose.

MATERIALS AND METHODS

Animal experiment. The leg meat came from the White Kołuda geese fed with oats grain, according to the particular technology developed at the National Research Institute of Animal Production.

Solvent Assisted Flavour Evaporation (SAFE). The meat was unthawed from -80 °C and samples of 4 animals (ca. 500 g) were baked in a heatproof dish (180 °C, 125 min). Then, the distillation using SAFE distiller (40° C, pressure ca. 10^{-3} Pa) was carried out and the extract was concentrated to 1 ml before the GC-O and GC-MS analyses.

Gas Chromatography–Olfactometry (GC-O) and Aroma Extract Dilution Analysis (AEDA). GC-O was performed on GC-2010 Plus gas chromatograph (Shimadzu, Japan), using a Zebron ZB-5MSi column (30m x 0.25mm, 0.25um, Phenomenex, USA). The GC was equipped with a OP275 olfactometry port (GL Sciences, Shimane, Japan) with a sniffer. The analysis was done at helium flow (purity, 99.999, 1 ml min^{-1}), oven temperature 37 °C (10 min), that then was increased to 132 °C (4 °C/min) and 240 °C (8 °C/min).

For AEDA, the meat SAFE-extract and its dilutions (dichloromethane) were injected (10µL) into a GC column, and aromaa were detected using sniffing port of GC-O. Each diluted (2x, 4x … 1024x) solution was analyzed until no odor was perceptible, after which the flavor dilution (FD) factor was calculated.

Gas Chromatography – Mass Spectrometry (GC-MS). The gas chromatograph was equipped with a splitless injector maintained at 240 °C. The analysis parameters were the same as for GC-O and AEDA. During a run, monitoring the total ion currents in the 35–450 m/z mass range was applied. The retention indices were calculated to compare with either published values from the National Institute of Standards and Technology, or those of authentic standards. They were based on homologous series of C_5-C_{15}, and C_{16}, C_{18}, C_{20}, C_{22}, C_{24} n-paraffins. The aroma active compounds were confirmed, based on mass spectra libraries: NIST08, NIST08s, FF NSC1.3.

RESULTS AND DISCUSSION

42 aroma active compounds in the baked leg of White Kołuda goose were determined using the GC-O and AEDA. They belonged to different chemical groups. Aldehydes, ketones, alcohols, organic acids, esters, lactones, sulfur compounds, as well as terpenes and heterocyclic (containing oxigen, sulfur, and nitrogen) compounds were among them. FD was in the range of 4 to 1024. The γ -hexalactone (17, from Fig. 1) had the bigest FD value (1024). Aroma notes for this major key aroma compound were referred to as: sweet, creamy, lactonic, tobacco, coumarinic, and coconut. The FD value was 512 for methional (7) and 2-acetylthiazoline (23), and was 256 for: hexanal (3), 2-acetylthiazole (15), 2-acetylpyrrole (18), nonanal (24), E,E 2,4-decadienal (32), as well as dodecanoic (37) and tetradecanoic (40) acids.

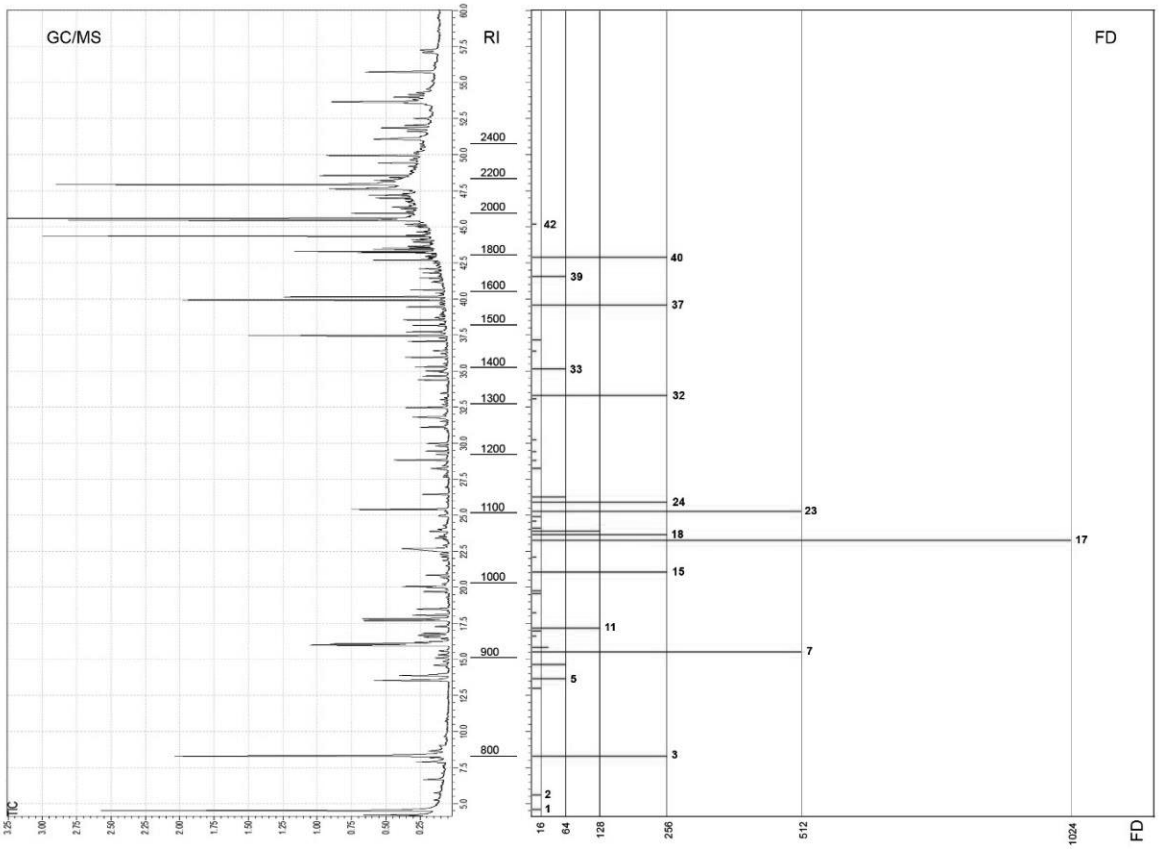

Fig. 1 Chromatogram (left) and aromagram of aroma active compounds isolated from leg meat of White Kołuda goose.

Keywords: *White Kołuda geese, Meat, Key aroma compounds, SAFE, GC-O, AEDA*

UTJECAJ PRIRODNE EKSTRUDIRANE SOJE BEZ GM-A S VISOKOM AKTIVNOŠĆU ANTITRIPSINA NA PERFORMANSE PILIĆA BROJLERA

THE INFLUENCE OF NON-GM NATIVE SOYBEAN EXTRUDATE WITH RELATIVELY HIGH ANTITRYPSIN ACTIVITY ON PERFORMANCE OF BROILER CHICKENS

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ABSTRACT

The aim of the paper was to test the influence of non-GM native soybean extrudate with relatively high antitrypsin activity (12.2 mg/g) added to loose feed mixtures on the performance of broiler chicken rearing. The experiment involved 640 broiler chickens of the Ross 308 line, divided into 4 groups, consisting of eight replications, each one with 20 birds (10♂ and 10♀). Isoenergetic and isoprotein (isoamino acids) feed mixtures were used in conformity with recommendations.

The chickens in the control group (I) were fed a typical feed mixture with a share of commercial soybean meal derived from GM soybean. The other experimental groups (II - IV) were non-GM native soybean extrudate added to feed mixtures for broiler chickens, amounting to, respectively, 5%, 7,5% and 10% in starter mixtures, and 10%, 15% and 20% in grower and finisher mixtures. All fed mixture were supplemented with typical enzymatic preparations containing phytase and xylanase. The indices of bird rearing were determined, including weight gain and feed conversion, and slaughter and dissection analyses were performed. The indices of birds rearing were determined, including mortality, chicken weight gain and feed conversion.

After 42 days of rearing, the chickens' body mass increased up to 2.564 kg on the average, with feed conversion of 1.77 kg per 1 kg of weight gain. Final body mass of broiler chickens from IV group with the highest share of non-GM soybean extrudate was lower by 4,2% compared to the body mass of birds from control group. Moreover, feed conversion in this group was higher by 3,4% compared to the control group results. Chickens' mortality amounted to 2,7% on the average, and the European Efficiency Index reached 333 points (from 321 to 347 points). Non-GM native soybean extrudate with relatively high antitrypsin activity used as partial replacement for soybean meal to feed mixtures affected significantly the performance parameters at the end of the feeding trial than the level of trypsin inhibitors was higher than 1 mg/g of mixed feed.

Keywords: *extruded non-GM soybean, broiler chicken, feeding, performance parameters*

UTJECAJ RAŽI KAO KOMPONENTE U KRMNOJ SMJESI NA RAZINU KADMIJA I OLOVA TE NA ODABRANA TKIVA PILIĆA BROJLERA

THE IMPACT OF RYE ON THE LEVEL OF CADMIUM AND LEAD IN THE FEED MIXTURE AND IN SELECTED TISSUES OF BROILER CHICKEN

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ABSTRACT

The aim:

To determine the content of cadmium (Cd) and lead (Pb) in the feed containing rye seeds and in the kidneys of broiler chickens.

Material and methods:

The study was conducted on 32 broiler chickens that were divided into 4 groups: chicks of the control group (group K - standard feed for broilers), group II (feed with 20% rye), group III (feed with xylanase), group IV (feed with 20% rye and xylanase). The content of Pb and Cd was determined in feed samples and in the kidneys of broiler chickens using atomic spectrometry.

Results:

In feed the lowest Cd content was found in Gr II and amounted to 0.028 mg/kg DM, Group III - 0.052 mg/kg DM. Similar values were found in gr. I and in gr. IV (0.031 and 0.034 mg/kg DM). The lowest Pb content was found in group III (0.052 mg/kg DM), similarly in Group II (0.062 mg/kg DM), in group IV (0.085 mg/kg DM and the highest in the control group (0.28 mg/kg DM). The lowest content of Cd in the kidneys was found in group IV (0.06 mg/kg WM., higher in the group III (0.19mg/kg WM). and group II (0.17 mg/kg DM) and the largest in the control group (0.28 mg/kg DM). The lowest Pb content in the kidneys was determined in group IV (0.27 mg/kg WM.), it increased in the control group (1.48 mg/kg DM), and in group II (3.02 mg/kg DM) and in group III (4.06 mg/kg DM).

Conclusion:

It can be concluded that the use of feed containing 20% of rye in the feeding of broiler chickens reduces the exposure of these animals to Cd and Pb.

The study was financed by BIOSTRATEG2/297910/12/NCBR/2016, ENERGYFEED.

OBOGAČENJE SMJESE KOJA SADRŽI RAŽ S DODATKOM KSILANAZE NA KVALITETU LJUSKE JAJA KOKOŠI NESILICA

SUPPLEMENTATION OF A RYE-CONTAINING DIET WITH XYLANASE INFLUENCES EGGSHELL QUALITY IN LAYING HENS

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ABSTRACT

Corn is the most commonly used as an energy source in the diets for intensively reared poultry. However their presence in diet may decrease the performance parameters, especially in poultry. The main problem connected with inappropriate nutrition in laying hens is eggshell quality. The eggshell needs to be as strong as possible. Eggshell breakage is directly related to the quality of the shell. It is possible to influence eggshell quality through feeding of laying hens.

This study was focused on analyzing effects of dietary inclusion of modern hybrid rye to corn-wheat based diet as an energy source in laying hens on mechanical properties of eggshell quality. These effects were assessed both diets with or without xylanase addition to allow estimation of the interactive effects of hybrid rye and xylanase. Laying hens (n = 224) were fed diet without rye inclusion or diet containing 20 % of hybrid rye cv. Brasetto. Both diets were either unsupplemented or supplemented with xylanase (minimum activity 1000 FXU/g) at the dose of 200 mg/kg of feed. Eggs were collected from laying hens at the age of 50 weeks and after 24 weeks when the experimental diets were started.

Mechanical test was performed to determine the fracture properties of eggshell. Eggshell material properties (Young modulus, toughness) were calculated on the basis of determined structural properties (fracture load, deformation, fracture work, stiffness) and eggshell geometry (length, width, thickness, volume).

Egg weight increased in laying hens supplemented with xylanase irrespective ray inclusion. Mechanical and geometric properties were not changed after rye inclusion irrespective of xylanase supplementation (P >0.05 for all).

This study showed that modern hybrid rye varieties can be introduced to corn-wheat based diets of laying hens as an alternative energy source in the aspect of eggshell quality, irrespective of xylanase supplementation.

This study was supported by the National Centre for Research and Development, Poland (grant "ENERGYFEED"; number: BIOSTRATEG2/297910/12/NCBR/2016).

UTJECAJ DODATKA EKSTRUDIRANOG LANENOG SJEMENA I PRIRODNIH BOJA U ISHRANI KOKOŠI NESILICA NA BOJU ŽUMANJKA I SASTAV MASNIH KISELINA

INFLUENCE OF EXTRUDED FLAXSEED AND NATURAL COLOURANTS ADDITION IN LAYING HENS DIET ON EGGS YOLK COLOUR AND FATTY ACID COMPOSITION

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SAŽETAK

Konzumna jaja mogu igrati važnu ulogu kao funkcionalna hrana ako se za njihovu proizvodnju koriste posebno dizajnirane mješavine obogaćene omega-3 masnim kiselinama, prirodnim pigmentima i vitaminima. Konzumiranjem hrane u kojoj je sadržaj funkcionalnih sastojaka povećan, moguće je spriječiti pojavu bolesti kod ljudi. Stoga je cilj ove studije bio ispitati učinak ugradnje ko-ekstrudata lan-kukuruzna krupica (FCM) u kombinaciji s prirodnim pigmentima u prehrani kokoši nesilica na boju žumanjka i sastav masnih kiselina jaja. U pokusu 120 nesilica Lohmann Brown rase hranjeno je smešom na bazi kukuruza i soje sa dodatkom FCM u različitim razinama: 0% (kontrola C1 i C2), 13,50% (E1) i 22,50% (E2). Kontrolna grupa C1 sadržavala je 3% masti, bez dodanih pigmenata, kontrolna grupa C2 imala je 5% masti i sintetičke pigmente, dok su pokusne grupe E1 i E2 (sa 3% i 5% masti) imale istu količinu dodatih prirodnih izvora pigmenata (1% mrkve i 0,5% paprike). Procesom ekstruzije lanenog sjemena sa kukuruznom krupicom, koji se primjenjuje u ovom istraživanju, uspješno je dobiven novi funkcionalni proizvod s dodanom vrijednošću (FCM) zbog visokih razina PUFA (70,56%) i MUFA (20,62%), kao i niske količine HCN (23,87 mg/kg). Nisu zabilježene značajne promjene ($p>0,05$) na fizičkom kvalitetu jaja kod E1 i E2 u usporedbi s kontrolnim jajima. Pokusne grupe E1 i E2 postigli su poželjnu boju žumanjka koju zahtevaju potrošači od 12,78 po Rocheovoj skali (Hoffmann-La Roche skala). Jaja od kokoši nesilica hranjenih sa FCM imali su značajno višu razinu ($p<0,001$) α-linolenske (6,46% za E1 i 8,87% za E2), dokosaheksaenske (2,01% za E1 i 2,08% za E2) i eikosapentaenske (0,17% za E1 i 0,21% za E2) kiseline nego jaja koja potječu od kokoši nesilica iz kontrolnih grupa. Odnos n-6/n-3 od 1,43 i 1,01 u pokusnim grupama E1 i E2 bili su značajno niži ($p<0,001$) od odnosa n-6/n-3 u kontrolnim grupama C1 i C2 (9,40 odnosno 8,88). Dodavanjem FCM i prirodnih pigmenata u prehranu kokoši nesilica moguće je proizvesti funkcionalno jaje sa željenom bojom žumanjka i sastavom masnih kiselina.

Ključne riječi: *ko-ekstrudat lan-kukuruzna krupica (FCM), mrkva, paprika, funkcionalno jaje*

Napomena: Predstavljeni rezultati su dio istraživačkog projekta III 46012 financiranog od strane Ministarstva prosvete, nauke i tehnološkog razvoja Republike Srbije.

ABSTRACT

Table eggs can play an important role as a functional food, if for their production specially designed mixtures enriched with ω-3 fatty acids, as well as natural pigments and vitamins are used. By consuming foods with increased content of functional ingredients, it is possible to prevent the occurrence of disease in humans. Thus, the aim of this study was to investigate the effects of inclusion of flax-corn meal co-extrudate (FCM) in combination with natural pigments in hens' diet on colour and fatty acid composition of eggs.

One hundred and twenty Lohmann Brown laying hens were fed corn-soybean meal based diet with addition of FCM at different levels: 0% (control C1 and C2), 13.50% (E1) and 22.50% (E2). The control treatment (C1) contained up to 3% fat, without added pigments while control treatment (C2) contained up to 5% fat and synthetic pigments. Experimental treatments E1 and E2 (with 3% and 5% fat, respectively) had the same amount of natural pigments (1% carrot and 0.5% paprika). Extrusion process of flax seed with corn meal applied in this study successfully provided a new functional product with added value, FCM, due to its high PUFAs (70.56%) and MUFAs (20.62%) level, as well as low HCN content (23.87 mg/kg). No significant changes ($p>0.05$) in the internal egg quality characteristics were observed for E1 and E2 eggs when compared with control eggs. Treatments E1 and E2 achieved desirable colour demanded by consumers of 12.78 RYCF value (Hoffmann-La Roche scale). Eggs from hens fed FCM had significantly higher level ($p<0.001$) of α-linolenic (6.46% for E1 and 8.87% for E2), docosahexaenoic (2.01% for E1 and 2.08% for E2) and eicosapentaenoic (0.17% for E1 and 0.21% for E2) acids than eggs originated from hens fed control diets. The ω6/ω3 ratios of 1.43 and 1.01 in treatments E1 and E2, respectively, were significantly lower ($p<0.001$) than ω6/ω3 ratios in the control treatments C1 and C2 (9.40 and 8.88, respectively). By the addition of FCM and natural pigments in hens' diet is possible to produce functional egg with desirable colour and fatty acid composition.

Keywords: *flax-corn meal co-extrudate, carrot, paprika, functional egg*

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POVEĆANJE SADRŽAJA SELENA U JAJIMA KORIŠTENJEM BIOFORTIFICIRANOG KUKURUZA U HRANI KOKOŠI

THE INCREASE OF SELENIUM CONTENT IN EGGS BY USING BIOFORTIFIED CORN IN HENS' FEED

Zlata Kralik, Bojana Ljuboja

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SAŽETAK

Cilj rada bio je utvrditi utjecaj korištenja kukuruza koji je biofortificiran s selenom na dvije razine (nižom i višom), na kvalitetu jaja i povećanje sadržaja selena u jajima. Pokusno razdoblje trajalo je 4 mjeseca, korišteno je ukupno 60 kokoši pasmine hrvatica, crvenog soja. Kokoši su bile podijeljene u tri pokusne skupine (K, P1 i P2). Kontrolnu skupinu predstavljale su kokoši skupine K, i one su konzumirale krmnu smjesu komercijalnog sastava, dok su skupine nesilica P1 i P2 konzumirale smjese u kojima je komercijalni kukuruz zamijenjen s biofortificiranim. Kukuruz hibrida Bergxxon (RWA, FAO grupa 400) je folijarno biofortificiran selenom na dvije razine (P1=10 g Se ha^{-1} i P2= 20 g Se ha^{-1}). Krmne smjese bile su izbalansirane na 18 % sirovih proteina i 11,40 MJ ME/kg hrane. Premiks korišten u smjesama pokusnih skupina u svom sastavu nije imao selena. Korištenjem kukuruza biofortificiranog selenom u hrani kokoši pasmine hrvatica statistički se značajno povećava sadržaj selena u jestivom dijelu jaja ($P<0,001$). Također je utvrđen statistički značajno veći sadržaj selena u žumanjcima jaja (K=0,2156 mg/kg; P1=0,4256 mg/kg i P2=0,5180 mg/kg) u odnosu na bjelanjke (K=0,0619 mg/kg; P1=0,1530 mg/kg i P2=0,2028 mg/kg; $P<0,001$). Korišteni hranidbeni tretmani pozitivno su djelovali na pokazatelje kvalitete svježih i skladištenih jaja. Analizom rezultata preporuča se uporaba biofortificiranog kukuruza u hranidbi kokoši. Razlog preporuke je činjenica da je moguće već s nižom razinom biofortificiranog kukuruza, koji se u količini od 56,5% koristi u krmnoj smjesi, zamijeniti selen u premiksu.

Ključne riječi: *nesilice, kukuruz, biofortifikacija, selen, kvaliteta jaja*

Rezultati korišteni u radu dio su istraživanja na projektu „Obogaćivanje jaja kokoši hrvatice esencijalnim mikroelementima" kojeg je financiralo Vijeće za istraživanje u poljoprivredi u razdoblju od 2015.-2017.

ABSTRACT

The aim of the study was to determine the influence of using corn bio-fortified with selenium at two levels (lower and higher) on egg quality and an increase of selenium content in eggs. The trial period lasted 4 months and a total of 60 hens of Hrvatica breed, red strain, were used. Hens were divided into three experimental groups (K, P1 and P2). Hens from K group represented the control group and they consumed the feed mixture of the commercial composition, while the groups of hens P1 and P2 consumed mixtures in which the commercial corn was replaced with bio-fortified. The corn hybrid Bergxxon (RWA, FAO group 400) was foliarly bio-fortified with selenium on two levels (P1=10 g Se ha^{-1} and P2=20 g Se ha^{-1}). Feed mixtures were balanced on 18% crude protein and 11.4 MJ ME/kg feed. The premix used in the mixtures of the experimental groups in its composition did not contain selenium. The use of corn bio-fortified with selenium in the feed of Hrvatica hens breed statistically significantly increases selenium content in the edible part of eggs (P<0.001). Also, statistically significantly higher selenium content was found in egg yolks (K=0,2156 mg/kg; P1=0,4256 mg/kg i P2=0,5180 mg/kg) compared to egg whites (K=0,0619 mg/kg; P1=0,1530 mg/kg i P2=0,2028 mg/kg; P<0,001). The used feeding treatments had a positive effect on the indicators of the quality of fresh and stored eggs. Based on the results analysis it is recommended to use bio-fortified corn in hens' nutrition. The reason for the recommendation is the fact that it is possible already with a lower level of bio-fortified corn, which is used in feed in the amount of 56.5%, to replace selenium in the premix.

Keywords: *hens, corn, bio-fortification, selenium, egg quality*

The results used in the paper are part of the research on the project "Enriching eggs of Hrvatica hens with essential microelements" funded by The Council for Research in Agriculture in the period from 2015 to 2017.

OBILJEŽJA PROIZVODNJE JAJA KOKOŠI HRVATICE
HRVATICA HEN EGG PRODUCTION

Šilović Borna, Gordana Duvnjak, Janječić Zlatko, Ivica Kos, Bedeković Dalibor

SAŽETAK

Kokoš hrvatica jedina je priznata izvorna pasmina kokoši u Hrvatskoj. Iako je kombinirana pasmina uglavnom se koristi za proizvodnju jaja na malim obiteljskim gospodarstvima. Usprkos brojnim istraživanjima još uvijek nisu poznati potpuni pokazatelji proizvodnje jaja kokoši hrvatice. Stoga je cilj ovog istraživanja bio utvrditi pokazatelje proizvodnje jaja tijekom jednog cijelog ciklusa proizvodnje u razdoblju jedne kalendarske godine kao i fizikalne pokazatelje kakvoće jaja. Istraživanje je provedeno na 4 obiteljska gospodarstva na području Splitsko-Dalmatinske županije. Na svakom je gospodarstvu bilo izdvojeno po 20 pilenki kod starosti 8 tjedana koje su smještene u zaseban objekt uz koji se nalazio ograđeni zatravljeni ispust. Hranidba kokoši je cijelo vrijeme bila *ad libitum*. Tijekom uzgoja praćeni su potrošnja krmne smjese i mortalitet. Nakon proneska koji je nastupio s oko 24 tjedna bio je praćen broj i masa jaja na dnevnoj bazi. Jednom mjesečno izvršeno je ispitivanje fizikalnih pokazatelja kakvoće jaja. Utvrđeno je da je prosječan broj jaja po kokoši u razdoblju od godinu dana iznosio 192, prosječna masa 51 gram, a prosječna dnevna potrošnja krmne smjese 124 grama. Prosječni indeks oblika iznosio je 74 %, čvrstoća ljuske 38,06 N, a debljina ljuske 0,35 mm. Udio bjelanjka u jajetu iznosio je 54,78 %, žutanjka 32,50 %, a ljuske 12,72 %. Prosječan udio zasićenih masnih kiselina u jajima bio je 38,07 %, mononezasićenih 44,07 %, a polinezasićenih 15,69 %, dok je omjer omega-6/omega-3 masnih kiselina iznosio 6,36. S obzirom na troškove i ostvarene prihode napravljena je analiza pokrića varijabilnih troškova koja je u proizvodnji jaja kokoši hrvatice iznosila 178,20 kn po kokoši godišnje.

Ključne riječi: *fizikalni pokazatelji kakvoće jaja, kokoš hrvatica, proizvodni pokazatelji*

ABSTRACT

Hrvatica hen is the only recognized breed of hens in Croatia. Although it is a combined breed, it is mainly used for egg production on small family farms. Despite numerous studies, the egg production indicators of Hrvatica are not still fully know. Therefore, the aim of this research was to determine egg production indicators during one whole cycle of production in the period of one calendar year as well as the physical quality indicators of eggs. The research was carried out on 4 family farms in the Split-Dalmatia County. On every farm 20 hens were separated at the age of 8 weeks and were held in a separate facility with a fenced grass-planted field. Hen feed has been available ad libitum all the time. Feed mixture consumption and mortality rate were recorded during production. After the beginning of egg laying at the age of 24 weeks, the number and weight of eggs were daily recorded. Measurements of physical indicators of egg quality were taken once per month. It was found that the average number of eggs per hen in one-year production was 192, the average egg weight was 51 grams, and the average daily feed consumption was 124 grams. Average shape index was 74%, shell strength 38,06 N, and shell thickness 0,35 mm. The share of egg whites was 54.78%, yolk 32.50%, and shell 12.72%. The average proportion of saturated fatty acids in eggs was 38.07%, monounsaturated 44.07% and polyunsaturated 15.69%, while the ratio omega-6 / omega-3 fatty acids was 6.36. Due to the costs and revenues realized, a cover analysis of the variable cost was made of producing eggs of Hrvatica hens and it was 178.20 kn per hen per year.

Keywords: *hrvatica hen, physical indicators of egg quality, production indicators*

PROMJENE OSTEOMETRIJSKIH, DENZITOMETRIJSKIH I MEHANIČKIH SVOJSTAVA GOLJENICE KOD PILIĆA BROJLERA HRANJENIH HRANOM KOJA SADRŽI 15% RAŽI

THE CHANGES OF OSTEOMETRIC, DENSITOMETRIC AND MECHANICAL PROPERTIES OF TIBIA IN BROILER CHICKENS FED DIET CONTAINING RYE AT THE LEVEL OF 15%

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ABSTRACT

It has been shown that other cereal grains commonly cultivated in Europe, like wheat or rye, can be used as an partial energy replacement of corn. In poultry, one of the main problem connected with inappropriate nutrition are disorders in musculoskeletal system and fed ingredients can exert adverse effect upon bones. When chickens are fed on rye significant deterioration of bone strength and bone mineralization have been reported.

This study was focused on analyzing effects of dietary inclusion of modern hybrid rye to corn-wheat based diet as an energy source on mechanical properties of bones. Broiler chickens (n = 108) were fed diet without rye inclusion or diet containing 15% of hybrid rye cv. Brasetto. On the 42th day randomly selected chickens from each group (n = 7) were slaughtered. Tibiae were subjected to the analysis of mineralization and geometric characteristics of bone mid-diaphysis. Three-point bending test was performed to determine the mechanical properties of bones. Whole-bone material properties (Young modulus, yield strain, ultimate strain, elastic stress, and ultimate stress) were calculated on the basis of determined structural properties and bone mid-diaphysis geometry using engineering beam-theory equations

Bone length and weight, the content of ash, bone mineral density, cross-sectional area, mean relative wall thickness, cortical index were not changed after rye inclusion (P >0.05 for all). Bone structural properties (yield load, ultimate load, elastic energy, work to fracture, stiffness) and whole-bone material properties (Young modulus, yield strain, ultimate strain, elastic stress, and ultimate stress) were also not changed after rye inclusion (P >0.05 for all).

This study showed that modern hybrid rye varieties can be introduced to corn-wheat based diets of broiler chickens as an alternative energy source in the aspect of animal welfare related to the development and homeostasis of musculoskeletal system.

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UTJECAJ ETERIČNOG ULJA ČAJEVCA (*Melaleuca alternifolia*) NA SINTEZU MIKOTOKSINA U HRANI ZA PERAD

EFFECT OF THE TEA TREE ESSENTIAL OIL (Melaleuca alternifolia) ON THE MYCOTOXINS SYNTHESIS IN POULTRY FEED

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ABSTRACT

The aim of this research was to investigate the influence of tea tree essential oil (Melaleuca alternifolia), on the mycotoxins synthesis in poultry feed. The extraction of tea tree essential oil was performed by hydrodistillation over a 2 h period and subsequently analyzed by gas chromatography-mass spectrometry (GC-MS). The toxigenic activity of the essential oil was evaluated by inhibiting the production of mycotoxins in poultry feed. The quantification of the toxin was performed by high-performance liquid chromatography (HPLC). The production of mycotoxins was dependent on the fungal species, incubation temperature and the presence of the essential oil concentrations. In tests carried out at different temperatures, the oil caused a reduction in mycotoxins synthesis that ranged from 55% to 99%, respectively. This research indicated that natural products could be potential biocontrol agents against mycotoxins contamination in poultry feed, eg., animal feed and therefore further in vitro and in vivo experiments are more than necessary.

Keywords: *essential oils, tea tree, feed, nutrition, poultry, mycotoxins*

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KVALITETA OVČJEG MLIJEKA KAO SIROVINE U MLIJEČNOJ INDUSTRIJI U REPUBLICI SJEVERNOJ MAKEDONIJI

QUALITY OF THE SHEEP MILK AS A RAW MATERIAL IN THE DAIRY INDUSTRY IN THE REPUBLIC OF NORTH MACEDONIA

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ABSTRACT

This study is based on analyzing of physico-chemical and microbiological characteristics of sheep milk from three different regions, which is using as a raw material in dairy industry of North Macedonia. All milk samples were collected on dairy reception point of dairy industry in Pelagonia region, in a period of several months. The average values for chemical composition of milk were in the range as following: milk fat from 6.83±0.22% (Region I) to 7.68±0.36% (Region III), proteins from 5.52±0.09% (Region I) to 6.06±0.23% (Region III), lactose from 4.62±0.08% (Region III) to 4.79±0.05% (Region I), DNFM from 11.16±0.11% (Region I) to 11.51±0.24% (Region III), added water from 0 to 0.05% and titrable acidity from 8.61±0.4°SH (Region I) to 8.88±0.47°SH (Region III). The microbiological and hygienic status of examined sheep milk samples was found to be in very bad condition. The average somatic cell count was in the range from 753.333/ml (Region II) to 1.125.000/ml (Region I) and average number of total bacteria count was in the range from 532.444 cfu/ml (Region I) to 1.986.222 cfu/ml (Region III).

Keywords: sheep, *physico-chemical characteristic, milk quality*

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BIOLOŠKE OSOBINE I PRODUKTIVNOST SORTI LUCERKE
BIOLOGICAL PROPERTIES AND PRODUCTIVITY OF SELECTED ALFALFA VARIETIES

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Poljoprivredno-prehrambeni i Prirodno-matematički fakulteti Univerziteta u Sarajevu

SAŽETAK

Uvođenje sorti krmnih kultura na određeni poljoprivredni prostor, pa tako i sorti lucerke, zahtijeva sortni pokus s ciljem da se za uvjete u kojima je istraživanje provedeno i za slične njima, odaberu sorte koje će uz odgovarajuću agrotehniku postići najbolje rezultate i tako omogućiti proizvodnju većih količina kvalitetne voluminozne krme.

Sukladno navedenom postavljen je i proveden pokus s ciljem ispitivanja nekih bioloških, produktivnih i kvalitativnih svojstava 26 sorti lucerke na fakultetskom pokusnom poligonu Butmir – Sarajevo.

Pokus je proveden sa sljedećim sortama lucerke: Stela, Drava, Vuka, Zdravka, Slavonka, Osječka 10, Osječka 11, Osječka 12, Osječka 66, Osječka 70, Osječka 88, NS-Bačka, NS-Banat, NS Vršac, NS Medina, NS Novosađanka (NS-11), Mirna, Debarska, K-1, Zaječarka 83, Krajina, BL-422, BL-P, Olimpik 84, Europa i Elga.

Sa osnovnom obradom u zemljište je unešeno 160kg/ha K2O i 200kg/ha P2O5, a sa dopunskom obradom još 80kg/ha NPK GNOJIVA. U jesen prve godine istraživanja pokusa u prihranu je uključeno 40kg/ha P2O5 i 40kg/ha K2O, a u proljeće druge godine sa 50kg/ha N. Tokom vegetacijskog perioda nije bilo prihranjivanja.

Ispitivane sorte su se među sobom razlikovale, prije svega po produktivnosti i kvalitativnim svojstvima, dok razlika, kada su u pitanju biološke osobine, gotovo da nije bilo.

Sorte su se među sobom neznatno razlikovale u brzini nicanja, nastupanju pojedinih faza u razvoju, početku vegetacije u proljeće, vremenu stasavanja i brzini regeneracije. Iako su kod svih sorti bili prisutni kako ranostasniji, tako i kasnostasniji genotipovi do masovnije butonizacije i cvatnje biljaka kod svih sorti je dolazilo istovremeno.

Najprinosnija sorta u sva četiri otkosa u prvoj godini punog korištenja je bila Zaječarska 83(13,59t/ha). Pored nje, visoku produktivnost su pokazale Mirna (12,19t/ha), Drava (11,71t/ha), Olimpik 84 (11,67t/ha) i Stela (11,61t/ha). Najmanji prinos je ostvarila BL-P(9,01t/ha). Razlike u prinosu suhe mase među sortama su u određenim poređenjima statistički značajne.

Prema sadržaju sirovog proteina (25,02%) i prema njihovoj godišnjoj produkciji (2829,76kg/ha), vodeća sorta u ispitivanju na Butmiru (ogledno fakultetsko imanje) bila je Osječanka 88. Najmanji sadržaj sirovog proteina imale su Zaječarka 83(18,00) i BL-P(18,82%).

Uz navedene rezultate istraživanja analizirani su i drugi parametri bitni za ukupnu ocjenu kvantitativno-kvalitativnih pokazatelja.

Obzirom da je lucerka višegodišnja kultura, dvogodišnji rezultati ne mogu biti pouzdan pokazatelj proizvodno-kvalitativnih osobina sorte. Da bi se izveli sigurni zaključci o osobinama ispitivanih sorti ili nekih od njih u agroekološkim uvjetima sarajevske regije, poželjno bi bilo nastaviti istraživanja.

Ključne riječi: *sorta, lucerka, suha tvar, sirovi protein, prinos*

ABSTRACT

Introduction of fodder crops to certain agricultural areas, including alfalfa varieties requiers a sort trial, with aim to select varieties which will achieve the best results with the appropriate agrotechnics and thus enable the production of large quantities of quality voluminous sterns for the conditions in which the research was conducted and similar conditions.

According to the above, experiments were carried out to examine some of the biological, productive and qualitative properties of 26 varieties of alfalfa on the Butmir-Sarajevo field.

The experiment was carried out with the following varieties of alfalfa: Stela, Drava, Vuka, Zdravka, Slavonka, Osječka 10, Osječka 11, Osječka 12, Osječka 66, Osječka 70, Osječka 88, NS-Bačka, NS-Banat, NS Vršac, NS Medina, NS Novosađanka (NS-11), Mirna, Debarska, K-1, Zaječarka 83, Krajina, BL-422, BL-P, Olimpik 84, Europa and Elga.

With basic processing 160 kg/ha K2O and 200 kg/ha P2O5 were added to the land, and with additional processing 80 kg/ha of NPK fertilizer. In the autumn of the first year of the research 40 kg/ha of P2O5 and 40 kg/ha of K2O were included in the feed, and in the spring of the second year 50 kg/ha of N. During the vegetation period there was no feeding.

Examined varieties differed among themselves in terms of productivity, and qualitative characteristics, while there was almost no difference in biological properties.

The varieties were slightly different in the speed of germination, the occurance of certain phases in development, the beginning of vegetation in the spring and the speed of regeneration. Although in all varieties were present as both early and late maturity genotypes, the more massive butonisation and flowering in all varieties happened simultaneously.

Highest yielding sort in all four mowings in the first year was Zaječarka 83(13,59t/ha). In addition, high yield was shown by Mirna (12,19t/ha), Drava (11,71t/ha), Olimpik 84 (11,67t/ha) i Stela (11,61t/ha). The lowest yield was by BL-P(9,01t/ha). The differences among the dry mass among the varieties are statistically significant in certain comparisons.

According to the content of crude protein (25,02%) and annual production (2829,76kg/ha), the leading variety was Osječanka 88. The lowest content of crude protein was by Zaječarka 83(18,00) and BL-P(18,82%).

In addition to the results of the research, other parameters were analyzed for the overall evaluation of quantitative and qualitative indicators.

Given that alfalfa is a multi-year crop, the two-year results can not be a reliable indicator of production-qualitative characteristics of the variety. In order to make certain conclusions about the characteristics of investigated cultivars in the agro-ecological conditions of the Sarajevo region, it would be desirable to continue the research.

Keywords: variety, *alfalfa, dry matter, crude protein, yield*

PROMJENE KOJE SE JAVLJAJU U KVALITATIVNIM SVOJSTVIMA TRAJNIH SVINJSKIH KOBASICA TIJEKOM FERMENTACIJE

CHANGES THAT OCCURS IN THE QUALITY PROPERTIES OF THE DURABLE PORK SAUSAGES DURING FERMENTATION

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ABSTRACT

The aim of this research was to determine the impact of additive Glucone Delta Lactone (GDL) and Starter cultures on the quality of production batches of durable fermented sausages (A and B) produced in local meat industry in R.N.Macedonia. The chemical composition of raw materials of sausages was analysed in this study. Quantity and quality modifications of physical and chemical parameters of sausages from the beginning until the end of ripening process (3;7; 14; 20-day) were monitoring. The addition of GDL and starter cultures has great influence on the pH value, as well as of the overall enzymatic process and of the achieved degree of ripening and drying. The results indicate more intensive proteolysis during the first seven days of the ripening. The intensity of proteolysis was stimulated by the activity of endogenous proteins and peptides of microorganisms from starter cultures. The results show that sausages from the production batches (A) have a slightly higher percentage of fat compared to (B). The complete chemical composition in all production batches corresponds to the requirements of the Rulebook on quality of minced meat, meat preparations and meat products.

Keywords: *durable sausages, quality, ripening, meat*

PITANJE ANTIMIKROBNE REZISTENCIJE NA NIVOU FARME
THE ISSUE OF ANTIMICROBIAL RESISTANCE ON FARM-LEVEL

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ABSTRACT

Antibiotics are important drugs used in the treatment of bacterial infections in both humans and animals. Emerging antibiotic resistance among certain bacteria is now frequently observed, thereby posing a serious threat to public health. The antimicrobial resistance in particular has become a huge public-health threat globally. The antimicrobial resistance is definitely a 'One Health' issue which envelopes the connections between humans, animals and the environment.

Bacteria can become resistant in different ways – some destroy the antimicrobial, for example by producing enzymes against it, some prevent antibiotic getting into their cells and others get the antibiotic out of their cells before it can harm them. Some bacteria are naturally or innately resistant and new resistances can occur spontaneously by chance mutations and these resistant strains then multiply. In this context, the more antibiotics given to man or animals the greater the selective pressure that favors resistant strains. Reservoirs of resistant bacteria may develop in the gastrointestinal tracts of food-producing animals following misuse of these valuable therapeutic drugs. These resistant bacteria can be transmitted from food-producing animals such as cattle, pigs and poultry, and the environment to humans, via the food chain.

In the initial phase of the production of foods from animal origin, feed quality is the most crucial factor that can lead to exposure of animals to undesirable contaminants. Therefore, within the European feed legislation it is stated that 'products intended for animal feed must be sound, genuine and of merchantable quality and therefore when correctly used must not represent any danger to human health, animal health or to the environment or adversely affect livestock production' (Commission Directive 2002/32/EC).

The term "antibiotic growth promoter" is used to describe any medicine that destroys or inhibits bacteria and is administered at a low, sub-therapeutic dose in pursuit of growth rather than on health grounds. The use of growth-promoters largely occurs in intensive livestock farming and has increased as such methods have expanded worldwide. Use of antibiotics to promote animal growth has been banned in European Union countries since January 1, 2006. Furthermore, the new EU legislation, which is expected to become law by 2022, bans the use of antibiotics for animals that are important for human medicine and prohibits the use of any antimicrobials in livestock without a prescription from a veterinarian.

There is a wide choice of options for minimizing the antimicrobial use: the application of Good Husbandry and Good Hygiene Practices in the animal production establishments and during animal transport; improved animal welfare (e.g. ensuring good air and water supply quality, appropriate ventilation rates and space allocation) during all phases including production, transport and slaughter; rigorous application of disease control measures (e.g. vaccination); the use of feed ingredients or additives that enhance the efficiency of feed conversion (e.g. in-feed enzymes, competitive exclusion products, probiotics, prebiotics, acidifiers, plant extracts, nutraceuticals, essential oils, yeast and many others); the avoidance of ingredients with antinutritional properties (such as lectins, and protease inhibitors); the specific processing and presentation of feed that make its conversion to animal products more efficient and increase growth rates and production yields.

RAZINA PROUPALNIH CITOKINA U KRVNOM SERUMU TOVLJENIKA HRANJENIH MJEŠAVINOM KOJA SADRŽI VISOKU RAZINU (60%) RAŽI

THE LEVEL OF PROINFLAMATORY CITOKINES IN THE BLOOD SERUM OF FINISHING PIGS FED A MIXTURE CONTAINING HIGH LEVEL (60%) OF RYE

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ABSTRACT

The aim was to study the influence of feeding a feed containing rye seeds on citokine concentration in blood serum of fattened pigs.

Material and Methods: Experiment was performed on 32 pigs (30 -100 kg). First group (gr.I) was fed a control feed (gr. KI i KII - wheat/barley-50/50%), second group - a wild type rye seeds (gr. II-wheat/barley/wild type rye -20/20/60%). The third group was fed a feed containing a hybrid type rye (gr. III -wheat/barley/rye-20/20/60%). Blood samples for analysis were collected, centrifuged and serum was frozen for further analysis. Commercial sets of ELISA test (Cloud-Clone corp.) were used for cytokine analyses (IL1, IL2, IL6 i TNFα) in blood serum.

Results: Concentration of TNFα in the blood serum of the first group amounted from 95 to 121 pg/ml., whereas in gr. II and gr. III 93 i 50 pg/ml, respectively. The concentration of IL6 in gr. II was higher than in gr. I - K1 (2010 vs.1100 pg/ml), but in gr. III it was lower than in gr. K2 (450 vs. 300 pg/ml). IL1 concentration was higher in gr. II than in gr. I (3500 vs. 2700 pg/ml), however these values did not differ between gr. K2 and gr. III (1400 i 1300 pg/ml). IL2 concentration was higher in gr. II and gr. III (43 and 58 pg/ml) compared to gr. I K1 and K2 (28 i 23 pg/ml).

Conclusions: Feeding a wild type rye seeds may increase citokine concentration in the blood serum of fattened pigs, whereas feeding a hybrid type rye did not increase pro-inflammatory citokines level.

The study was financed by BIOSTRATEG2/297910/12/NCBR/2016, ENERGYFEED.

HPLC-FLD METODA ZA ODREĐIVANJE ODABRANIH ERGOT ALKALOIDA U HRANI ZA ŽIVOTINJE

HPLC-FLD METHOD FOR DETERMINATION OF SELECTED ERGOT ALKALOIDS IN FEEDS

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ABSTRACT

Ergot is a parasitic fungus that belongs to the Claviceps genus. It forms on various grains and grasses a dark mass of mycelium called sclerotia producing toxic secondary metabolites, the ergot alkaloids (EAs). Ergot alkaloids exert toxic effects in all animal species, and the most prominent toxic signs can be attributed to the interaction of ergot alkaloids with adrenergic, serotinergic and dopaminergic receptors. EAs also have a number of well-established effects on the reproductive process including prevention of pregnancy by interfering with implantation, embryotoxicity, developmental effects and inhibition of lactation. Moreover, there is some evidence of inhibition of ovulation.

Ergot are listed as an undesirable substances in animal feed within European Union Directive 2002/32/EC, and the maximum content of rye ergot in feedingstuffs containing ungrounded cereals has been limited to 0.1% (1000 mg/kg). In 2012 The Commission Recommendation on the monitoring of the presence of ergot alkaloids in feed and food was published. According to Recommendation it is necessary to generate more data on the presence of ergot alkaloids, not only in ungrounded cereals but also in cereal products and compound feed and food and to obtain reliable data on the ergot alkaloid pattern in feed and food (European Commission 2012/154/EU). Thus, it is important to develop reliable methods for the determination of ergot alkaloids that could be introduced to laboratory practice and effectively implemented in the Plan of Official Control of Feedingstuffs. That is why the aim of this study was the development of simple analytical method based on high performance liquid chromatography combined with fluorescence detector (HPLC-FLD) enabling determination of selected ergot alkaloids: ergometrine, ergotamine, ergocornine, ergocrypine and ergocristine in feedingstuffs. The developed method uses QuEChERS methodology. Ergot alkaloids are extracted with the solvent mixture consisting of dichloromethane, acetonitrile and ammonia solution and salts: sodium chloride, magnesium sulphate, sodium hydrogen citrate sesquihydrat and sodium citrate.

After shaking and centrifugation, supernatants are purified using dispersive solid phase extraction. Cleaned extract is evaporated in the nitrogen stream and the residue is reconstituted in mixture of acetonitrile and 2 mM ammonium carbonate, passed through 0.45 µm nylon syringe filter and subjected to the instrumental analysis. Ergot alkaloids are analysed with HPLC-FLD instrument.

Developed method was validated according to the Commission Decision 2002/657/EC. Parameters like method linearity, limits of detection (LODs), limits of quantification (LOQs), repeatability, within-laboratory reproducibility, recovery, specificity, decision limit (CCα) and detection capability (CCβ) were evaluated. All determined parameters fulfilled the document recommendation, confirming the reliability of the developed method.

Keywords: *ergot alkaloids, liquid chromatography, fluorescence detector, feeds*

REZULTATI MEĐULABORATORIJSKIH USPOREDBI U OKVIRU NIR TEHNIKE U ANALIZI HRANE ZA ŽIVOTINJE

RESULTS OF INTERLABORATORY COMPARISONS IN THE SCOPE OF THE NIR TECHNIQUE IN FEED ANALYSIS

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ABSTRACT

Chemical composition of feedingstuffs, particularly the content of crude protein, moisture, crude fat, crude fiber, crude ash and starch, affects their nutritional value. The official control, in order to confirm their compliance with requirements, recommends official methods published in Commission Regulation (EC) 152/2009. However, implementation of such tests using the official methods is usually time consuming and costly. An alternative may be provided by near infra-red spectroscopy which is a cheap, fast and simple technique, increasingly popular in feed industry. It even enables continuous monitoring of the parameters on the production line. One of the methods of assessing calibration quality, used in NIR apparatuses in laboratory practice is comparing results from a number of NIR spectrometers, within interlaboratory comparison ILC. Then, we have at our disposal an objective evaluation of result prediction with the use of the above mentioned NIR technique in our laboratory.

The ILC study we conducted was aimed at assessing the results of feed analyses performed by means of near infrared spectrometry (NIRS). This was the first ILC implemented among laboratories functioning within a network and testing feedingstuffs with the help of NIRS. A total of 8 laboratories participated in the study, including 3 laboratories representing the National Research Institute of Animal Production and the laboratories of Polish feed producers. The ILC was organized and performed in compliance with the requirements outlined by the PN-EN ISO/IEC 17043:2010 standard „Conformity assessment. General requirements for proficiency testing" [1], maintaining confidentiality. The samples, each of 100 g, were delivered to the participants in the study in their unground form. Each laboratory had prepared their samples for tests according to their individual procedures (standards). The range of the test included predicting the content of moisture, crude protein, crude fiber, crude fat, crude ash and starch. Scanning was performed in four replications, within the range accessible to each individual participating laboratory (adequate calibrations of the NIR apparatus). A total number of 136 results was performed; 93.4% of the results were satisfactory, 2.2% were doubtful, and 4.4% were unsatisfactory. In case of unsatisfactory results the participant is supposed to undertake corrective measures, e.g. by applying a correction on the bias. Summarizing, the data from ILC were assessed as satisfactory and useful in refining the functioning of NIRS analyzers in laboratories, as well as in improving result reliability.

Keywords: *feedingstuffs, nutritional value, NIRS, interlaboratory comparison*

OCJENA KVALITETE KUKURUZNE SILAŽE S PODRUČJA CENTRALNE I ISTOČNE HRVATSKE

THE QUALITY EVALUATION OF MAIZE SILAGE FROM CENTRAL AND EASTERN CROATIA

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SAŽETAK

Priprema kukuruzne silaže kao jednog od glavnih krmiva u hranidbi mliječnih krava ima veliki značaj, jer kvaliteta silaže kukuruza može varirati ovisno o različitim čimbenicima. Cilj ovog rada bio je utvrditi kvalitetu kukuruzne silaže proizvedene na području središnje i istočne Hrvatske tijekom 2017. i 2018. godine na obiteljskim poljoprivrednim gospodarstvima koja se bave proizvodnjom mlijeka. Procjena kvalitete kukuruzne silaže se temeljila na ocjeni organoleptičkih svojstava, hranjivih vrijednosti i veličine čestica pripremljene silaže. Ukupno je analizirano 694 uzoraka u Laboratoriju za kontrolu kvalitete stočne hrane, Hrvatske poljoprivredne agencije. Ocjena kvalitete silaže se temeljila na organoleptičkoj ocjeni, određivanju hranjive vrijednosti NIR metodom, pH metriji i određivanju veličine čestica sitima Penn State. Razmatrani su parametri suhe tvari, sirovih proteina, sirovih vlakana, NDF-a, ADF-a, sadržaja pepela, sadržaja škroba i pH vrijednosti. Sadržaj suhe tvari kretao se od 23,18 do 64,09%. Za oko 70% uzoraka određen je manji sadržaj sirovog proteina od optimalnih granica (8,0 - 9,5%) s prosječnom vrijednošću od 7,23% ± 0,84%. Vrijednosti NDF, ADF i škroba iznosile su 39,70% ± 4,82% (25,84% - 66,99%), 23,78% ± 2,41% (18,19% -36,46%), odnosno 32,11% ± 6,77% na suhu tvar. Prosječna vrijednost pH je bila iznad gornje granice, 4,29 ± 0,84. U oko 20% uzoraka pH vrijednost je bila viša od 4,3, potvrđeno organoleptičkom ocjenom (miris na maslačnu kiselinu), što ukazuje na promjene tijekom procesa fermentacije. U više od 50% uzoraka uočene su veće varijacije određenih parametara kvalitete, izvan optimalnih granica, koje su najvjerojatnije posljedica siliranja u različitim fazama zrelosti, a uočena odstupanja pH vrijednosti ukazuju na nepravilne postupke kod spremanje silaže. Postotni udjeli raspodjele čestica po sitima, potvrđuju prethodno dobivene rezultate, odnosno samo 54% uzoraka ima zadovoljavajuću distribuciju na situ promjera 19 mm dok je ta vrijednost nešto niža na sitima promjera 8mm i 4mm. Razlog tome može biti prevelika količina suhe tvari ili mehanički nedostatak silo kombajna što uzrokuje veličinu sječke duže od optimalne. Prilikom pripreme silaže kukuruza jednaku važnost treba pridati svim čimbenicima koji mogu utjecati na kvalitetu pripremljene silaže, kao što su sorta, stupanj zrelosti pri siliranju, gustoća sabijanja, higijenska kvaliteta i drugo.

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ABSTRACT

Maize silage is the main forage in the feeding rations for dairy cows. The preparation of maize silage is of great importance because maize silage quality can vary depending on various factors. The aim of this study was to determine the quality of maize silages produced in 2017 and 2018 on family farms that deals with milk production from central and eastern Croatia. Maize silages were evaluated on the base of organoleptic properties, nutritional values and particle size of the whole silage. A total of 694 samples were analysed in Laboratory for feed analysis of Croatian agricultural agency. The quality evaluation was based on organoleptic assessment, analysis of nutritional values by NIR method, pH meter and determining partical size using Penn State Forage Particle Separator. Quality parameters included dry matter, crude protein, crude fiber, NDF, ADF, ash content, starch content and pH value. Dry matter content ranged from 23.18 to 64.09%. For about 70% of samples the lower content of the crude protein than desired (8.0 - 9.5%) was determined with an average value of 7.23% ± 0.84%. The NDF, ADF and starch values were 39.70% ± 4.82% (25.84% - 66.99%), 23.78% ± 2.41% (18.19% - 36.46%) and 32.11% ± 6.77% on dry matter, respectively. The average pH value was above the upper limit, 4.29 ± 0,84. In about 20% of the samples the pH value was above 4.3, which was confirmed by organoleptic evaluation (odor to the butyric acid) indicating changes during fermentation process. In more than 50% of the samples, larger variations have been observed beyond the optimal limits in the nutritional values of certain quality parameters that are most likely to be due to harvesting at different stages of maturity. Observed pH value deviations point to improper procedures when storing silage. Determined percentages of particle size distribution confirm the previously obtained results. Only 54% of the samples have a satisfactory distribution on the 19 mm diameter sive, while this value is slightly lower on the 8mm and 4mm diameter sives. The reason for this may be excessive amount of dry matter or mechanical defect of combustion silos causing the size of the chopper longer than optimal. When preparing maize silage, the same importance should be attached to all factors that may affect the quality of prepared silage, such as variety, degree of maturity, compression density, hygiene quality etc.

HPLC-MS/MS METODA ZA ISTOVREMENU ANALIZU FENIKOLA U TRAGOVIMA U HRANI ZA ŽIVOTINJE

HPLC-MS/MS METHOD FOR THE SIMULTANEOUS ANLYSIS OF TRACE LEVELS OF FENICOLS IN FEED

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ABSTRACT

In food-production animal the most employed medicines are antibiotics and antiparasitic agents. Different groups antibiotics can be employed with animals food production and always respecting the withdraw periods. In particular, within the group of amphenicols, thiamphenicol and florfenicol are administrated to animal food production through medicated feed. The problems due to carry-over in feed production plants during the production of non-target feed after target feed shown for coccidiostats can also occur for other types of veterinary medicines, including amphenicols. The Annex II of the recent Regulation 2019/4/EC contain a list of antibiotic for which cross-contamination level should be investigated during the production of medicated feed. Florfenicol is one of the antibiotics included in the list and consequently the presence of this active compound should be evaluated in non-target feed.

The objective of this work is to present a sensitive and reliable method based on liquid chromatography tandem mass spectrometry for identification and quantification of trace levels of florfenicol, thiamphenicol and chloramphenicol in animal feed. Ethyl acetate was employed to extract the analytes, once evaporated the ethyl acetate the dry exact was resuspended in Milli-Q water, filtered and transferred to an HPLC vial for analysis. In-house validation of the method was conducted at carry-over levels following the European Commission Decision 2002/657/EC, with concentration ranging from 100–1000 µg/kg. The validation was conducted and all performance characteristics were successfully satisfied. The developed method has been applied to non-compliant feed samples with satisfactory results.

Keywords: *florfenicol, thiamphenicol, feed, LC-MS, validation, Commission Decision 2002/657/EC*

KONTAMINACIJA STOČNE HRANE GENETSKI MODIFICIRANIM SJEMENOM ULJANE REPICE GT73 - REZULTATI STUDIJA NACIONALNOG VETERINARSKOG INSTITUTA

CONTAMINATION OF FEED BY GENETICALLY MODIFIED RAPESEED GT73 - RESULTS OF THE NATIONAL VETERINARY RESEARCH INSTITUTE STUDIES

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ABSTRACT

Particular attention in feeding is paid to deliver easily digestible source of protein and well-balanced amino acid composition. Taking this into account in Poland and other UE countries, apart from soya, oilseed rape plays an important role in animal nutrition. For the production of feed, majority of rapeseed used for this purpose comes from crops grown in our country, but significant import of this raw material is also noted, including countries outside the EU.

The aim of this study was to determine the possible presence of genetically modified rapeseed in feed production and feeding of farm animals in Poland. The studies were focused on screening for GM rapeseed varieties followed by further investigation of positive samples by detection and determination of the genetically modified events like GT73, Ms8, Rf3, T45 and MON 88302. Samples used for this analysis were taken by Veterinary Inspection from 2014 to 2018, with accordance to Multiannual Programme of the National Veterinary Research Institute for GM rapeseed.

From 2014 to 2018, 500 samples of animal feedingstuffs containing rapeseed were analysed for the presence of GM varieties. Positive results were found in 112 cases (22%), and in all of them only GT73 rapeseed event was detected. GT73 is approved for use in the EU, as an ingredient in food and feed, however, GT73 is not approved for cultivation. The percentage of positive samples in five years trial were differ from 14% (2015), through 16% (2017), 18% (2016), and 23% (2018) to 41% of samples were positive in 2014. Only 11 of all 112 positive samples contained more than 0.9% GM rapeseed.

The source of GM line GT73 is probably rapeseed meal imported into Poland from the eastern countries, mainly from Ukraine, which was confirmed in shipping documents attached to the positive sample from 2015. Obtained results indicate a fairly high percentage of samples containing GM rapeseed, but in most cases at very low levels. This is probably the result of technical contamination by GM rapeseed during transport or storage of feedingstuffs.

This situation needs to pay more attention to imported raw feed materials and identification of sources of GMOs in order to monitor the presence of GMOs rapeseed.

LABORATORIJSKO ISKUSTVO S KLASIČNIM PCR I PCR POSTUPCIMA U STVARNOM VREMENU ZA DETEKCIJU PRERAĐIVAČKIH ŽIVOTINJSKIH PROTEINA I IDENTIFIKACIJU VRSTA U HRANI

LABORATORY EXPERIENCE WITH CLASSICAL PCR AND REAL-TIME PCR PROCEDURES FOR RUMINANT PROCESSED ANIMAL PROTEINS DETECTION IN FEEDS

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ABSTRACT

Due to an outbreak of bovine spongiform encephalopathy (BSE) the European Union has taken several decisions in order to avoid the transmission of its most probable causative agent through the food chain. In the future, reducing the restriction of the PAP use is being planned. Cancellation of the ban on the use of PAP from non-ruminant feed could be considered, but without lifting the existing prohibition on intra-species recycling (e.g. poultry MBM only for pigs feeding). Currently, the official control methods in the EU are based on the detection of constituents of animal origin in feeds by microscopic analysis and identification DNA of ruminants by real-time PCR. According to the recommendations European Union Reference Laboratory for Animal Proteins in feedingstuffs method real-time PCR should be applied in analysis of the samples feeds for aquaculture with PAP from terrestrial animals. In laboratory was development PCR-based procedure detection and identification DNA from ruminant.

Examinations were performed applying MBM, fortified compound feeds for pork, poultry and ruminants with MBM of beef, ruminants, ovine, pork and poultry origin. From tested samples DNA was isolated with the commercial test (Wizard Magnetic Purification DNA System for food, Promega). Examinations were performed with fortified of different MBM compound feeds on levels 0.5 %, 0.2 %, 0.1 %, and 0.05%.

Reactions were performed by procedure development in laboratory with optimized parameters of the amplification and EURL-AP SOP "Detection of ruminant DNA in feed using real-time PCR".

In the study the limits of detection for PCR and real-time PCR were determined on 0.05 % for DNA of ovine, beef and ruminant proteins. In all samples feeds for livestock fortified MBM of ruminants DNA from ruminants were detected with using PCR and real-time PCR.

A possibility of achieving correct results irrespective of the presence of elements without the characteristic morphological structure is an additional advantage of the PCR method. Analyzing the results received with the help of the technique of PCR and real-time PCR it is possible to state that methods of the molecular biology are becoming more and more credible and it can be used as supplemental method. It should be noted, the real-time PCR method can detected DNA from ruminants in feeds for livestock.

PRIJENOS NEKIH TEŠKIH METALA IZ TLA U ZRNA ODABRANIH VRSTA ŽITARICA I IZ KRMNIH SMJESA DO ZAVRŠNIH SVINJSKIH TKIVA

THE TRANSFER OF SOME HEAVY METALS FROM SOIL TO GRAINS OF SELECTED CEREALS SPECIES AND FROM FEED MIXTURES TO FINISHING PIGS TISSUES

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ABSTRACT

Introduction:

Heavy metals like cadmium (Cd) and lead (Pb) are naturally present in the earth crust at varied quantity. The anthropogenic activities like mining and production of fertilizers and pesticides contribute to the increasing level of environmental pollution with these metals. The bioavailability of heavy metals for the crop plants depends on soil physicochemical features and plants predilection to their increased uptake and organ accumulation and this facilitate their entrance into the food chain. Rye grows well in much poorer soils than those necessary for most of other cereal plants and require less use of pesticides making this cereal more save and attractive as alternative for energy supply in the food and feed rations.

Aim of the study:

The aim of the study was to estimate the transfer of Cd and Pb from the soil from 3 different places in Poland (Boguszyn, Prusim and Marianowo) to 7 cereal species (Population winter rye, winter heterozygote rye, winter wheat, winter triticale, pseudostratified winter barley).

Material and methods:

The total content of Cd and Pb and their bioavailability was performed using the atomic absorption spectrometry technique (SpektrAA 220Z Varian, Australia).

Results:

The Cd content in the soil samples was from 16.5 to 2791 μg/kg, while bioavailability from 0,7 to 78.2 %. The highest content of Cd in soil samples (2791 μg/kg) was found in Prusin but the bioavailability was only 0.7%. The Pb content in soil amounted between 14.8 and 18.9 mg/kg and the bioavailability 11.5 to 22.6%. The Cd content in the grains of modern rye varieties was between 4 and 6μg/kg, while in wild rye variety it was 36.0 μg/kg. The highest value of Cd (44 μg/kg) was found in barley grains. The Pb content was low in the grains of rye, triticale and wheat (55, 89, 69 μg/kg), while it was high (238 μg/kg) in barley grains.

In conclusion, the transfer of Cd and Pb is the lowest in modern rye varieties and that make these grains safer for human food and animal feeding.

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OVČJA VUNA - PRIRODNI IZOLACIJSKI MATERIJAL – NOVI PROIZVOD

SHEEP WOOL - NATURAL INSULATION MATERIAL – A NEW PRODUCT

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SAŽETAK

Ovčja vuna, do jučer jedna od najdragocjenijih tekstilnih sirovina, danas predstavlja značajan ekološki teret za okoliš u Republici Hrvatskoj, poglavito u južnim, turistički intenzivnim krajevima.

Opće je poznato da je ovčja vuna, vlakno kompleksne građe prvenstveno načinjene od strukturnog proteina keratina. Također se, u ovčjoj vuni nalazi vuneni vosak – lanolin, koji je po sastavu uglavnom smjesa kolesterola i estera različitih viših alkohola, stearinskih sterola i steroida s masnim kiselinama. Vuna je zbog lanolina vodotporna, ima nizak koeficijent paropropusnosti (μ) u rasponu od 1 do 5, tj. dobru paropropusnost. Postupkom pranja lanolin se izdvaja, pa se značajno mijenjaju svojstva vune u pogledu održivosti tj. trajnosti, jer oprana vuna, bez lanolina, znatno je smanjene otpornosti na nametnike (kukci, moljci), a u dodiru s vapnom ili cementom kemijski reagira i time se smanjuje njen vijek trajanja.

Prema Jedinstvenom registru ovaca i koza u RH ima 648.818 grla ovaca, s prosječnom proizvodnjom 1,89 kg_{vune}/grlo, što čini ukupnu proizvodnju od 2.111.346,90 kg vune (2.111,35 tona). Od te se količine do 30% tj. 633,40 tona koristi za raznorazne namjene, ponajviše u tekstilnoj proizvodnji, dok 1.479,95 tona ostaje neiskorišteno i u Hrvatskoj se najčešće, ne vodeći računa o ograničenom prihvatnom kapacitetu okoline, neodgovorno odlaže na divljim odlagalištima (Mioč i sur., 2019.).

Cilj istraživanja bio je utvrditi primjenljivost neobrađene ovčje vune kao izolacijskog materijala u kombinaciji s građevinskim mortovima.

Eksperiment je proveden uporabom ovčje vune pasmine Merinolandschaf koja je nakon striže, jednom isprana (pretpranje) i osušena. Pretpranjem je uklonjeno oko 80% nečistoća, no zadržan je lanolin. U do sada poznatim tehnologijama proizvodnje, nakon pretpranja, vuna je prolazila kroz cijeli niz obrada. U tim postupcima korištene su velike količine zdravstveno ispravne vode. Takvu vodu po završetku postupaka pranja trebalo je posebno obraditi u tzv. tehničku vodu. Svi ti postupci značajno su utjecali na cijenu vune kao izlolacijskog materijala.

Za potrebe dvogodišnjeg istraživanja, načinjeni su šuplji betonski blokovi, u kalupu pa izvaljani, nestandardnih dimenzija 190 * 110 * 65 mm od standardiziranog materijala sastava cement, pijesak granulacije 0/4 mm prema normi HRN EN 14992:2008 i HRN EN 771-3.

Također je, u kalupu pa izvaljan, načinjen uložak vanjskih dimenzija 120 * 60 * 45 mm. Ovojnica uloška načinjena je od produženog (hidrauličkog) morta sastava cement, vapno, pijesak granulacije 0/4 mm, a u skladu sa normom HRN EN 998-1:2016. Debljina sloja ovojnice iznosila je 5 mm, a u nju je utisnuta armaturna tekstilno staklena mrežica, pravokutnog otvora 5.0 * 4.0 mm i debljine 0,5 mm, zbog poboljšanja mehaničkih svojstava. U tako oblikovan uložak i načinjenu masu ovojnice s unutarnje strane tlačno je utisnuta neobrađena vuna. Zbog svojih karakteristika i sastava privlačna je raznim nametnicima i štetočinjama (moljci, kukci, grinje, glodavci i dr.) pa je prskanjem tretirana prirodnim ekološkim repelentima – razrjeđenom mješavinom 25 različitih eteričnih ulja neposredno prije potpunog zatvaranja uložaka i ploča.

Iz uložaka, neposredno prije zatvaranja, izveden je postupak isisavanja zraka – stvaranje podtlaka do p_v = 0,2 $\cdot 10^5$ Pa (p_{aps} = 0,81$\cdot 10^5$ Pa) vakuum crpkom, čime se postže smanjena količina kisika (smanjen stupanj oksidacije) i pravilna distribucija /raspodjela/ vune i njeno zbijanje. U nekoliko uzoraka, u ovojnicu je ugrađen nepovratni ventil zbog provjere stanja tlaka i mirisa repelenata u unutarnjem dijelu uloška. Ulošci su izvedeni od neobrađene vune u 50 i 70% volumnom udjelu, gustoće 50 i 100 kg/m^3.

Također su, identičnog materijala i postupka, kao i predhodni ulošci, načinjene, u kalupu pa izvaljane, izolacijske „sendvič" ploče, nestandardnih dimenzija 310 $\cdot$ 260 $\cdot$ 100 mm. Načinjene su ploče sa dvije debljine sloja ovojnice, i to: 10 i 20 mm, a sukladno tomu i debljine izolacijskog materijala – vune, 60 i 80 mm.

Nakon 30 dana sušenja, mjerene su sljedeće toplinske karakteristike: koeficijent toplinske provodljivosti λ ili k (W/mK); koeficijent toplinskog otpora R (m^{2}K/W); koeficijent otpora difuziji vodene pare μ; toplinska difuzija a (m^2/s); specifični volumni toplinski kapacitet c (J/m^{3}K); koeficijent prolaska topline U (W/m^{2}K) i gustoća ρ (kg/m^3). U navedenim mjerenjima korišten je prijenosni mjerni uređaj ISOMET 2114 sa ubodnom sondom za izravno dinamičko mjerenje svojstava prijenosa topline. U provedenim mjerenjima koeficijent toplinske provodljivosti λ ili k (W/mK) za ovčju vunu kretao se u rasponu od 0,0346 do 0,0618 W/mK.

Temeljem provedenih istraživanja utvrđeno je da ovčja vuna ima zadovoljavajuće toplinske karakteristike kao izolacijski materijal. Primjenom odgovarajućih tehnoloških postupaka i prirodnih repelenata može se koristiti u neobrađenom stanju za izradu izolacijskih ploča zatvorenih mort – ovojnicom, odnosno da ju je moguće koristiti i za izradu izolacijskih uložaka za razne građevinske šuplje elemente, npr. betonski blokovi, blok opeku, cijevi, oplate i niz drugih.

Ključne riječi: *ovčja vuna, izolacija, prijenos topline, ulošci, ploče, ekološki repelenti*

ABSTRACT

Sheep wool, once one of the most precious textile raw materials, today represents a significant ecological burden on the environment in the Republic of Croatia, especially in the southern, tourist-intensive regions. It is commonly known that sheep wool is a fibre with complex structure primarily made of structural protein keratin. Sheep wool also contains wool wax - lanolin, which is mainly composed of cholesterol and esters of various higher alcohols, stearin sterols and steroids with fatty acids. Due to the presence of lanolin wool is waterproof, has a low water vapor diffusion resistance factor (μ) ranging from 1 to 5, i.e. good vapour permeability.

The lanolin can be washed out from wool, thus significantly changing the properties of wool in terms of sustainability i.e. durability, because the lanolin free wool has significantly reduced resistance to pests (insects, moths), and in contact with lime or cement chemically reacts and decreases its lifespan.

According to the Unified Register of Sheep and Goats in the Republic of Croatia, there are 648.818 sheep's, with an average production of 1,89 kg_{wool}/sheep, representing a total production of 2.111.346,90 kg of wool (2.111,35 tons). Of this amount, up to 30%, i.e. 633.40 tons, are used for various purposes, mostly in textile production, while 1.479,95 tons remain unused and in Croatia, most often, without taking into account the limited reception capacity of the environment, irresponsibly disposed of on wild landfills (Mioč et al., 2019).

The aim of the research was to determine the applicability of untreated sheep wool as insulation material in combination with construction mortars.

The experiment was carried out using pre-washed and dried sheep wool from Merinolandschaf breed. By prewashing, about 80% of impurities were removed, but lanolin was retained. Up to now known production technologies, after pre-washing, the wool has passed through the entire range of processing. In these processes, large amounts of hygienic and sanitation safe water were used. This water from washing procedures need to be processed in the so-called technical water. All of these procedures have significantly influenced the price of wool as an insulation material.

For the purpose of two years experiment, hollow concrete blocks have been made. Concrete blocks with non-standard dimensions of 190 × 110 × 65 mm were molded and extruded, from standardized cement composite materials and crushed sand 0/4 mm according to HRN EN 14992: 2008 and HRN EN 771-3.

Also, molded and extruded filler (insertion) with outer dimensions of 120 × 60 × 45 mm was made. The sheet (coat) of the filler is made of the "hydraulic" mortar made of cement, lime and crushed sand 0/4 mm in accordance with HRN EN 998-1: 2016.

The thickness of the sheet (coat) was 5 mm, and it was reinforced with textile glass grid with rectangular opening of 5,0 × 4,0 mm and thickness of 0,5 mm, due to improving of mechanical properties. Untreated wool is pressed into such formed filler sheets. Due to its characteristics and composition, wool is attracted to various pests (moths, insects, mites, rodents etc.). Wool is treated by spraying with natural ecological repellents - diluted mixture of 25 different essential oils just before the complete closure of block filler or panels. Before the closure of the filler (insertion), the air suction procedure with a vacuum pump was performed, creating a vacuum with up to $p_v = 0,2 * 10^5$ Pa ($p_{aps} = 0,81 \times 10^5$ Pa). This procedure has enabled to reduce the amount of oxygen (reduce degree of oxidation) and proper distribution and compression of wool.

In several samples, a non-return valve is installed into the sheet (coat) of the filler to check the pressure and the odor of the repellency in the inner part of the filler. The fillers were made of untreated wool in 50 and 70% volume, density of 50 and 100 kg/m^3. Also, from the identical material and using identical process, insulating "sandwich" boards with non-standard dimensions of 310 × 260 × 100 mm were made. Two different types of plates were mate, one with 10 and 20 mm thicknesses of the sheet (coat) and accordingly 60 and 80 mm thicknesses of insulation material - wool.

After 30 days of drying, the following thermal characteristics were measured: the coefficient of thermal conductivity λ or k (W/mK); coefficient of thermal resistance R (m^{2}K/W); water vapor diffusion resistance factor μ ; thermal diffusion a (m^2/s); volumetric (specific) heat capacity c (J/m^{3}K); thermal transmittance coefficient U (W/m^{2}K) and density ρ (kg/m^3). In the above mentioned measurements, the portable measuring device ISOMET 2114 was used with a needle probe for direct dynamic measurement of heat transfer properties. In the measurements, the coefficient of thermal conductivity of the sheep wool (W/mK) ranged from 0,0346 to 0,0618 W/mK.

Based on the results, sheep wool has satisfactory heat characteristics as insulation material. By using appropriate technological processes and natural repellents wool can be used in the untreated state for the production of insulating plates enclosed by a mortar, and can also be used for making insulating fillers for various building hollow elements, e.g. concrete blocks, block bricks, tubes, plating and a host of others.

Keywords: *sheep wool, insulation, heat transfer, fillers, plates, ecological repellents*

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ODREĐIVANJE GLICEROL TRIHEPTANOATA (GTH) U DERIVATIMA I HRANI ZA ŽIVOTINJE - ŠTO JE NOVO?

DETERMINATION OF GLYCEROL TRIHEPTANOATE (GTH) IN DERIVED PRODUCTS AND FEEDS - WHAT'S NEW?

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ABSTRACT

Animal by-products arise mainly during the slaughter of animals for human consumption, during the production of products of animal origin such as dairy products, and in the course of the disposal of dead animals and during disease control measures. Regardless of their source, they pose a potential risk to public and animal health and the environment. This risk needs to be adequately controlled, either by directing such products towards safe means of disposal or by using them for different purposes, provided that strict conditions are applied which minimise the health risks involved.

The health rules for animal by-products and derived products not intended for human consumption are set out in the Regulation No 1069/2009 of the European Parliament and of the Council. According to the Regulation, we define „animal by – products" as entire bodies or parts of animals, products of animal origin or other products obtained from animals, which are not intended for human consumption, including oocytes, embryos and semen and „derived products" as products obtained from one or more treatments, transformations or steps of processing of animal by-products.

Animal by-products are categorised into specific categories which reflect the level of risk to public and animal health arising from those animal by-products (Cat. 1, 2 and 3). According to Commission Regularion (EU) No 142/2011 in processing plants for the processing of Category 1 or Category 2 material, derived products shall be permanently marked with glicerol triheptanoate (GTH). The minimum content of marker in target materials is 250 mg/kg of fat. For the determination of glyceroltriheptanoate in dry meat and bone meals, rendered fat and soil adjuvants gas chromatography technique combined with mass spectrometry detection is used.

Since 2009, in the Department of Hygiene of Animal Feedingstuffs, 1445 samples have been tested for the determination of GTH content. Detailed data of the samples examined in years 2009-2018 are presented in Table 1.

Table 1. Samples examined at the Department of Hygiene of Animal Feedingstuffs in the years 2009-2018.

Year	Meat and bone meal	Fat	Soil adjuvant	Other
2009	56	7	6	-
2010	119	49	10	-
2011	66	46	12	-
2012	74	49	4	-
2013	72	44	2	-
2014	94	90	0	-
2015	89	90	2	5
2016	83	75	0	1
2017	80	70	0	-
2018	81	69	0	-
Total	814	589	36	6

Despite the mandatory labeling of Category 1 and 2 material in the whole European Union, which was implemented in July 2008, routine and systematic determination of its content is performed by a few laboratories. In view of the fact that it is planned to reinstate Category 3 material for use in animal nutrition, analytical methods should be developed to prevent Category 1 and 2 material from entering the food chain. It will be necessary to develop a method to determine whether in the feed and other materials intended for animal feed there will be no unacceptable products from category 1 and 2. This can be done by improvement the methods of GTH in derived products and feedingstuffs.

Keywords: *GTH, glicerol triheptanoate, animal by-products, derived products*

BAKTERIJSKA MIKROFLORA IZMETA JAMAJČANSKOG POLJSKOG ŠTURKA (*Gryllus assimilis*) IZ UZGOJA

BACTERIAL FLORA IN FAECAL SAMPLES FROM REARED JAMAICAN FIELD CRICKET (Gryllus assimilis)

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ABSTRACT

Alternative feed sources are very popular subject of scientific studies. One of them is Jamaican field cricket (Gryllus assimilis), known for its high protein value, favorable fatty acid profile and amino acid composition. There are numerous advantages regarding use of insects as alternative feed source, however the regulations concerning health safety and hygienic quality are still not completely clear. As a part of our research on the potential of using insects as feed for poultry, we are investigating microbiological safety of crickets for feed and food. In this study, we wanted to explore which bacteria can be found as a part of the physiological microflora of intensively reared crickets, in what amount are those bacteria present and secondly, are some of the detected bacteria possibly harmful.

Faecal samples from a cricket colony at two different ages were analyzed using standard microbiological procedures for the detection of aerobic bacteria. The procedures were done in duplicates. 1 g of faeces was thoroughly mixed in 10 ml of normal saline. Aliquot of 1 ml was transferred into the clean tube and diluted serially in one- tenth stepwise to 10^5 dilution. From the dilution of 10^5, 100 µl aliquot was transferred aseptically to the Brilliant Green Agar and UTI Brilliance Clarity Chromogenic Agar and spread evenly with a sterile loop. The inoculated plates were incubated aerobically at 37°C over the night and afterwards the plates were examined for growth. The non-diluted samples were also plated in order to confirm if there were some pathogenic aerobic bacteria present in the samples in smaller amounts. The identification of the bacteria was done based on morphological characteristics of the colonies and microscopically via Gram staining in addition to biochemical testing. Confirmation of the identification was done using matrix-assisted laser desorption/ionization time of flight (MALDI-TOF) method.

The Brilliant Green Agar plates were negative, as opposed to UTI Brilliance Clarity Chromogenic Agar on which we counted CFU. The microbial load for bacteria ranged from 143 $x10^5$ to 208 $x10^5$ CFU/g. The detected bacteria in the samples were Enterococcus thailandicus, Enterococcus raffinosus, Enteroccocus termitis, Acinetobacter baumannii, Acinetobacter guillouiae, Providencia rettgeri and Providencia alcalifaciens, out of which Providencia spp. were present in the largest amount (75- 96%). Additionaly, from the non-diluted samples Kosakonia cowanii, Klebsiella pneumoniae and Raoultella ornithinolytica were detected in very small amounts. The samples were negative for salmonellae and E. coli. Although the potential of using insects as feed has been greatly explored, there are still no definite regulations regarding microbiological quality and safety. The detected bacteria can mostly be found in soil and water or as a part of normal microflora in insects. Some of the mentioned bacteria are opportunistic pathogens that could potentially be harmful to immunocompromised animals or people. Since there is no official data on the autochthonous microbiota in Gryllus assimilis, these results are valuable for further research on alternative feed sources.

Keywords: *Gryllus assimilis, Jamaican field cricket, alternative feed source, poultry feed*

ZNAČAJKE NEKIH MJEŠAVINA ZA UKRASNI TRAVNJAK POSLIJE DRUGE GODINE RASTA

PROPERTIES OF SOME MIXTURES FOR ORNAMENTAL LAWN AFTER THE SECOND YEAR OF GROWTH

Stanko Kapun, Tatjana Čeh

SAŽETAK

Od svibnja do listopada 2011. godine smo na području sjeverno – istočne Slovenije (Rakičan, 46°65'21" s.g.š., 16°19'13" v.g.d., 188 m n.v.) izveli pokus u kojem smo istraživali značajke tri vrste trava i četiri mješavine trava na srednje intenzivno uzgojenom travnjaku poslije dvije godine rasta. Pokus je bio postavljen u rujnu 2009. godine po metodi slučajnog redosljeda pokusnih jedinica u četiri ponavljanja. Veličina osnovne pokusne jedinice je bila 10 m2. Količina sjemena za sjetvu je bila 250 kg na hektar. Pokus smo gnojili s 200 kg N na ha (u 7 prihrana), 60 kg P2O5 na ha i 120 kg K2O na ha. U pokusu smo ocjenjivali i određivali: boju travnjaka, brzinu rasta, prazna mjesta, gustoću trave, zakorovljenost, otpornost na sušu, otpornost na bolesti, utjacaj vremenskih uvjeta i prinos suhe tvari na ha pojedine mješavine. Analiza rezultata pokusa je pokazala da se je mješavina trava 3, sastavljena iz klupčaste oštrice (*Festuca arundinacea*) – sorta 'Arid 3' (50 %) i engleskog ljulja (*Lolium perenne* L.) – sorta 'Panderosa' (25 %) in sorte 'Mondial' (25 %) značajno isticala u po ocjenjivanim parametrima od ostalih trava i mješavina trava iz pokusa.

Ključne riječi: *ukrasni travnjak/ trave/ značajke trava za formiranje travnjaka/ uvjeti za rast*

RAZINE ZRAČENJA U UZORCIMA DIKALCIJEVOG FOSFATA (DCP) METODOM GAMA SPEKTROMETRIJE

RADIATION LEVELS IN SAMPLES OF DICALCIUM PHOSPHATE (DCP) WITH A GAMMA SPECTROMETRY METHOD

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ABSTRACT

The radioactive contamination of living organisms and body tissues primarily depends on the level of contamination of the food they consume, and to a lesser extent on the drinking water and inhalation. The goal of this study is to determine the level of radioactivity present in samples of dicalcium phosphate (DCP) used as a supplement in animal feed. DCP is used as the main source of phosphorus and calcium because it strengthens the skeleton and accelerates the growth of the animal. It is very important to be familiar with these levels because a part of this radioactivity will likely be transmitted to humans through the food chain. Measurements of 40 samples have been performed in the Laboratory for Radioactivity at the Faculty of Veterinary Medicine Skopje. The radioactivity levels were measured by means of a standard spectroscopic system with a high resolution HPGe detector. The mean values for the measured activities in the DCP samples were 73.6 Bq.kg-1 for 226Ra, 25.8 Bq.kg-1 for 228Th. The mean value measured for 40K was 36.8 Bq.kg-1 respectively. From the very results obtained for DCP, it is observable that the activity of 226Ra is significantly higher than the activity of 228Th while the value measured for 40K in the samples does not pose a risk to human health, even for animals, because potassium is an essential mineral of living organisms. Considering that radioactive contamination of animal body tissues primarily originates from the level of contamination of the used animal feed, as well as the water used for watering animals, a preventive measure would be to control the radioactivity of animal feed in their use i.e. the lower concentration of radioactive isotopes should be as low as possible, making sure that they will not pose a threat to the animal organism.

Keywords: *DCP , gamma spectrometry, feeds*

PREGLED POJAVE *Clostridium perfringens* U SILAŽAMA
SURVEY ON Clostridium perfringens OCCURRENCE IN SILAGES

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ABSTRACT

The proper fermentation process of silages should be carried out under acidic conditions which are obtained with application of adequate starter cultures of lactic acid bacteria. In the inner layer of bale wraps, the anaerobic conditions are predominant and favour anaerobic fermentation process. Fermentation must be carried out under low pH value in order to keep nutrients and provide a form organoleptically attractive for animals. Generally, acidity of ensiling process correlates with occurrence of Clostridium spp. and especially the presence of C. perfingens could be considered as biological marker of contamination with anaerobic bacteria and hygienic quality of ensiling process.

Clostridium perfringens can produce up to 30 potential toxins, and strains are traditionally classified into five categories (A, B, C, D and E) according to the combination of the four major toxins (α, β, ι and ϵ) they produce. These five types can be further subdivided according to the production of two additional toxins: the enterotoxin (encoded by the cpe gene) and the β2 toxin (encoded by the cbp2 gene) and numerous so-called minor toxins. In animals, the five toxinotypes cause numerous forms of enteritis and enterotoxaemia. Clostridium perfringens could be associated with cattle enterotoxemia caused by intensive growth of this microorganism in small intestine conducting to acute or peracute syndrome with a case fatality rate close to 100%. C. perfringens toxins may act both locally and systemically and may cause death within a few minutes to a few hours (5).

The aim of this study was identification and enumeration of Clostridium perfringens isolated from the Polish silages samples used in cattle feeding in order to evaluate their hygienic and microbiological quality.

Material and methods

The analyses were carried out on 147 silages samples. Samples had been collected randomly in the frame of official control of animal feeds in Poland in 2017. Analyses were conducted on 101 samples corn silages, 5 samples alfalfa silages, 1 sample of shamrock and alfalfa silage, 37 samples of grass silages, 1 sample of beet pulp silage, 1 sample of rye silage and 1 sample of crushed grain silage.

Samples were subjected to enumeration analysis of C. perfringens according to the procedure described in PN-EN ISO 7937:2005 standard (5). Subsequently, silages were processed according to PN-R-64791:1994 standard (1). Clostridium perfringens-suspected strains were subjected to DNA extraction according to the procedure described by Kukier and Kwiatek (4). The extracted DNA was examined for the presence of cpa (α toxin), cpb (β), cpb2 (β2), etx (ε), iap (ι), and cpe (enterotoxin) toxin genes by multiplex PCR (mPCR) according to the method of Baums et al. (2).

Results

Clostridium perfringes was isolated from 17% (25/147) samples of silages. Toxin type A was isolated from 21 samples and 9 isolates of type A showed the presence of cpa and cpb2 genes regulating simultaneous secretion of α and β2 toxins, whereas 10 of them shown the presence of cpa gene which determine production of α toxin. Moreover 4 of type A isolates showed in PCR results only the presence of cpb2 gene determining the β2 toxins

release. Two stains of toxin type D with genes cpa, etx, and cpb2 encoding of α, ε, β2 toxins secretion and one classified to type E with the presence of cpa, cpi and cpb2 determining the α, ι, β2 production were isolated. The number of C. perfringens varied between <10 cfu to 2.3x10² cfu. The described contamination of Polish silages indicates that hygienic quality should be monitored. Clostridia number in processed feed materials varies from 10 to 1000 cfu/g and because of high resistance of spores is rather stable (3). However, evidence of A, E, D toxin types occurrence with ability to produce toxins α, ε, β2 indicates a potential risk to cattle's health. The infective number of Clostridium spp. is unknown; however, the obtained results have shown that a risk assessment on the entire ensiling process should be made in order to ensure microbiological safety.

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POTEŠKOĆE S LABORATORIJSKOM DIJAGNOSTIKOM BOTULIZMA U GOVEDA

DIFFICULTIES WITH LABORATORY DIAGNOSTICS OF BOTULISM IN CATTLE

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ABSTRACT

The aim of this study was examination of samples collected from suspicion of botulism case in cattle. Clostridium botulinum species comprises microorganisms able to produce the most potent toxins in environment. This species characterizes genetic variability which cause problem with isolation and identification of this pathogen during laboratory processing. The examination of samples, especially collected from cattle botulism suspicion cases, are examined towards C and D toxin types and their mosaic variants occurrence. Toxinogenic properties of these types are determined by the presence of specific bacteriophages in environment. Taking into account lack of selective media, probability of bacteriophage losing during cultivation process and occurrence of microorganism with similar phenotypic features makes laboratory diagnostics of botulism extremely difficult.

Case description

In the august of 2017, the samples from the cattle with characteristic symptoms were send to the Department of Hygiene of Animal Feedingstuffs of the National Veterinary Research Institute in Pulawy. The subsequent symptoms were observed in the suspected cattle: first symptom was constipation, abundant salivation, after 8h - the death descends were observed. The results of autopsy showed congestion of the abomasum and mucous membrane. About 100 cows fell down.

Material and methods

The samples of blood, fragments of internal organs (liver, small intestine, kidneys, spleen), rumen content and maize silage, rapeseed meal were subjected to the analysis with using real-time PCR and mouse bioassay methods. Mouse bioassay was performed by direct intraperitoneal injection with blood serum or samples extracts in gelatine phosphate buffer according to FDA procedure (3). Real-time PCR analysis was conducted for DNA extracted from liquid culture and from suspected strains of belongings to C. botulinum species. This method was performed with using primers described by Raphael et al. (2) and according to the procedure described by Grenda et al. (1).

Results

Positive results were obtained only for one sample of blood (in MBA test) and maize silage (in real-time PCR test), however none of C. botulinum toxinogenic strains were isolated. The symptoms were not thoroughly specific and course of illness was too acute in comparison to the reported cases. In progress of epidemiological investigation, the probable participation of nitrites addition for feeds quality improvement was considered. The results were inconclusive and laboratory diagnostics indicated only on probability of complex toxication of affected cattle herd.

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SASTAV MASNIH KISELINA I AMINOKISELINA EKSTRUDIRANE POGAČE OD KONOPLJE

FATTY ACID AND AMINO ACID COMPOSITION OF EXTRUDED HEMPSEED CAKE

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SAŽETAK

Posljednjih godina raste zanimanje za korištenje alternativnih proteinskih usjeva u stočarskoj proizvodnji. Konoplja (*Cannabis sativa* L.) je drevna kultura koja se uzgaja zbog vlakna i ulja. Ostatak nakon mehaničke ekstrakcije ulja iz konoplje je pogača bogata proteinima i vlaknima. Nekoliko je studija pokazalo da je konoplja vrijedan izvor proteina u hranidbi ovaca, goveda, mliječnih krava, kokoši nesilica, pilića i riba zbog povoljnog profila masnih kiselina, sastava aminokiselina, kao i dobar izvor proteina koji se ne razgrađuju u buragu.

Različiti termički tretmani često se koriste u proizvodnji hrane za životinje zbog brojnih prednosti. Na temelju dostupnih podataka iz literature postoji indikacija da termička obrada može povećati sadržaj proteina koji se ne razgrađuju u buragu, a koji je vrlo poželjan u prehrani goveda. Cilj ovog istraživanja bio je procijeniti učinak ekstruzije na sastav masnih kiselina i aminokiselina (AK) pogače konoplje (PK). Korištena je eksperimentalna postavka 3x2, koja je varirala dva parametra ekstruzije: vlagu materijala u cijevi ekstrudera (16, 20 i 24%) i temperaturu duž cijevi (90, 110 i 130 °C). Ukupno je proizvedeno 9 ekstrudiranih uzoraka.

Analiza netretirane PK pokazala je da je dominantna masna kiselina linolna (53,98%), sa značajnim količinama α-linolenske kiseline (16,91%), oleinske kiseline (14,02%) i palmitinske kiseline (7,05%), i manjim količinama stearinske kiseline (3,57%) i y-linolenske kiseline (2,92%). Omjer omega-6 prema omega-3 masnim kiselinama u netretiranoj PK bio je 3,36:1, što je dovoljno nisko da eventualno promijeni ravnotežu masnih kiselina u jajima, mlijeku ili masnom tkivu goveda, što će zauzvrat imati pozitivne učinke u prehrani ljudi. Ekstrudiranje PK dovelo je do blagog povećanja odnosa omega-6 prema omega-3 masnih kiselina (3,39-3,74:1), ali to se ne može smatrati štetnim zato što ostaje ispod željenog nivoa od 4:1. Najzastupljenije AK koje se nalaze u netretiranoj i ekstrudiranim uzorcima PK su glutaminska kiselina, asparaginska kiselina i arginin. Ukupni sadržaj AK u analiziranim uzorcima kretao se u rasponu od 627,3 do 738,3 g/kg sirovog proteina. Sadržaj limitirajućih AK metionina, lizina i histidina koji je određen u netretiranoj PK bio je 8,9, 31,9 i 20,0 g/kg sirovog proteina, respektivno. Viša temperatura i vlaga tijekom ekstruzije rezultirale su nižim sadržajem ukupnih AK. Isti zaključak važi i za sadržaj lizina i histidina, dok je sadržaj metionina povećan za 25,7% u uzorku ekstrudiranom na 90 °C uz sadržaj vlage od 20%.

Na temelju dobivenih rezultata može se zaključiti da ekstruzija PK nema negativan učinak na sastav masnih kiselina. Potrebna je daljnja analiza kako bi se odredio učinak ekstruzije na pomeranje mjesta digestije sirovih proteina i digestije aminokiselina iz buraga u tanko crijevo.

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ABSTRACT

In recent years, there has been increasing interest in using alternative protein crops in livestock production. Hemp (Cannabis sativa L.) is an ancient crop, cultivated for fiber and oil. The residue left after mechanical extraction of the oil from hempseed is a cake rich in protein and fiber. Several studies indicate that hempseed is a valuable protein feed in sheep, growing cattle, dairy cows, laying hens, broilers and fish diets due to favorable fatty acid profile, amino acid composition, as well as good source of rumen undegraded protein.

Various thermal treatments are commonly used in feed production because of numerous benefits. Based on available literature data there is an indication that thermal treatments can increase rumen undegraded protein which is highly desirable in ruminant nutrition. The aim of the present research was to evaluate the influence of extrusion processing on fatty acid and amino acid (AA) composition of hempseed cake (HSC). A 3x2 experimental setup was used, varying two extrusion parameters: moisture of the material in extruder barrel (16, 20 and 24%) and temperature along the barrel (90, 110 and 130 °C). Total of 9 extruded samples was produced.

Analysis of untreated HSC revealed that the predominant fatty acid was linoleic acid (53.98%), with important amounts of α-linolenic acid (16.91%), oleic acid (14.02%), and palmitic acid (7.05%), and lesser amounts of stearic acid (3.57%) and γ-linolenic acid (2.92%). The ratio of omega-6 to omega-3 fatty acids in unprocessed HSC was 3.36:1, which is low enough to possibly alter the fatty acid balance in eggs, milk or carcass fat in feedlot cattle, which will in turn have positive effects in human diet. Extrusion of HSC led to a slight increase of omega-6 to omega-3 fatty acids ratio (3.39-3.74:1) but it could not be considered detrimental since it remains below the desired level of 4:1. The most abundant AA found in unprocessed and extruded HSC samples were glutamic acid, aspartic acid, and arginine. Total AA content in analyzed samples ranged from 627.3 to 738.3 g/kg crude protein. The content of limiting AA methionine, lysine and histidine determined in unprocessed HSC was 8.9, 31.9 and 20.0 g/kg crude protein, respectively. The higher temperature and moisture during extrusion resulted in a lower content of total AA. The same conclusion applies to the content of lysine and histidine, whereas the content of methionine was increased for 25.7% in sample extruded at 90 °C and moisture of 20%.

Based on obtained results it can be concluded that extrusion of HSC has no negative effect on the fatty acid composition. Further analysis is required to determine the influence of extrusion processing on shifting the site of crude protein and amino acid digestion from the rumen to the small intestine.

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KUKURUZNI DDGS KAO ALTERNATIVNO KRMIVO ZA ISHRANU SOMA – UTJECAJ UKLJUČENJA RAZLIČITIH NIVOA NA POSTUPAK EKSTRUZIJE I FIZIČKU KVALITETU EKSTRUDATA

CORN DDGS AS AN ALTERNATIVE INGREDIENT IN EUROPEAN CATFISH DIET – INFLUENCE OF VARIOUS LEVEL INCLUSION ON EXTRUSION PROCESSING PARAMETERS AND PHYSICAL QUALITY OF EXTRUDED FEED

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SAŽETAK

DDGS (eng. *distillers dried grains with solubles*) je nusproizvod proizvodnje etanola koji se koristi najčešće kao relativno jeftin izvor proteina i energije u ishrani životinja. Biljna proteinska krmiva opsežno se koriste u akvakulturi i nisu važna samo kao alternativa krmivu za mesožderne vrste, nego predstavljaju važan izvor proteina za sve vrste riba čija je ishrana fleksibilna u izboru krmiva. Procjena potencijalnog novog krmiva za industriju riblje hrane, pored procjene njegovog nutritivnog kvaliteta, treba da obuhvati i procjenu njegove funkcionalnosti u procesu proizvodnje.

Kako se riblja hrana danas najviše proizvodi postupkom ekstruzije u obliku peleta, svrha ovog istraživanja bila je ispitati utjecaj uključenja kukuruznog DDGS-a u hranu za soma (*Silurus glanis*) na parametre ekstruzije i fizičku kvalitetu dobijene riblje hrane, i to nasipne mase, ekspanzije peleta, tvrdoće peleta i njegove otpornosti na otiranje. Formulisane su četiri mješavine za ishranu soma sa istim sadržajem proteina (43%) i masti (9%), uz uključenje 0, 100, 200 i 300 g/kg DDGS-a. Svi sastojci smjesa su fino usitnjeni na mlinu čekićaru, umješani i kondicionirani dodatkom vode i vodene pare do temperature od 95°C i vlažnosti materijala od 25%. Kondicionirane mješavine su procesirane primjenom dvopužnog ekstrudera pri konstantnom temperaturnom profilu cjevi ekstrudera, brzini obrtaja puža (400 obrtaja u minuti) i protoku materijala (25 kg/h). Potrebno je bilo proizvesti potonući riblji pelet prečnika do 5 mm. Temperatura matrice tokom proizvodnje bila je u rasponu od 106–110°C, dok uključenje DDGS-a u smjese nije imalo utjecaj na pritisak matrice koji je iznosio 0,9 bar. Uključenje DDGS-a u hranu za soma na nivou od 200 i 300 g/kg smanjilo je potrošnju specifične mehaničke energije tokom ekstrudiranja, što je značajno ($p < 0,05$) smanjilo radijalnu ekspanziju peleta. Tako, uključenje DDGS-a u riblju hranu nije imalo utjecaja na sposobnost potonuća peleta. Iako je uključenje DDGS-a na nivou od 300 g/kg rezultiralo peletama sa niskom ekspanzijom, što je trebalo da poveća gustinu peleta, ovaj proizvod je imao značajno ($p < 0,05$) nižu nasipnu masu u poređenju sa ostale tri riblje hrane (466,84 kg/m^3). Do ovoga je došlo vjerojatno zbog sklonosti DDGS-a, kada je prisutan u velikoj količini u mješavini, da više doprinese ekspanziji po dužini nego po prečniku, kako su do sada različiti autori prijavili. Duži pelet stvara veće praznine tokom punjenja posude za mjerenje nasipne mase, što rezultira manjom nasipnom masom. Uključenja DDGS-a u smješu za soma rezultirao je peletima sa značajno ($p < 0,05$) boljom tvrdoćom i većim stepenom otpornosti na otiranje. Takođe, povećanje sadržaja DDGS-a u smješi nije značajno utjecalo na tvrdoću i otiranje peleta. Stoga, uključivanje 300 g/kg kukuruznog DDGS-a u prehranu soma povećava sposobnost ekstrudiranih peleta da izdrže mehaničko naprezanje tijekom transporta, skladištenja i pneumatskog hranjenja.

Ključne riječi: *DDGS, som, ekstruzija, fizička kvaliteta*

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ABSTRACT

Distillers dried grains with solubles (DDGS) is the main by-product of ethanol production and it is mostly used as relatively cheap protein source in animal nutrition. Protein rich ingredients of plant origin are extensively used in aquaculture and they are not only important as an alternative protein source to the fish meal for carnivorous species, but also represent main protein sources in nutrition of aquatic species that are more flexible in choice of ingredients. Evaluation of potentially novel feed ingredient for fish feed industry, beside its nutritive quality, should also include assessment of its functionality in the production process of the fish feed.

Since the fish feed is nowadays mostly produced by extrusion process in the form of pellets, the aim of this study was to investigate effect of corn DDGS inclusion in european catfish (Silurus glanis) diets on extrusion parameters and physical quality of obtained feed, specifically product bulk density, pellet expansion ratio, hardness and durability. Four iso-nitrogenous catfish diets (protein content and fat approximately 43% and 9%, respectively) with the inclusion of 0, 100, 200 and 300 g/kg of corn DDGS were formulated and processed by twin screw extruder. All ingredients of the diets were finely ground at the hammer mill, mixed and steam conditioned to a temperature of 95°C and moisture content of approximately 25% prior to the extrusion. The conditioned mixtures were processed by twin screw extruder at constant temperature profile along extruder barrel, screw speed (400 RPM) and material throughput (25 kg/h). The object of the extrusion was to produce sinking pellets with the diameter up to 5 mm. Temperature at die was in the range 106–111°C while generated pressure at the die was not influenced by DDGS inclusion and was 0.9 bar. The DDGS inclusion in catfish diets decreased specific mechanical energy during extrusion, which significantly ($p < 0.05$) decreased radial expansion of the product when DDGS was included in levels of 200 and 300 g/kg. Accordingly, DDGS inclusion has not influenced sinking ability of pellets. Although inclusion of 300 g/kg of DDGS resulted in pellets with low expansion (5.00%), which should contributes to the high pellet density, this product possessed significantly lower bulk density ($p < 0.05$) compared to the other three diets (466.84 kg/m^3). This was possibly due to tendency that high content of DDGS in the diet contributes to the greater longitudinal than radial expansion of the pellets as different authors reported. Longer pellets create larger void spaces during filling of the measuring cup, thus resulting in the lower bulk density. DDGS inclusion gave pellets with significantly ($p < 0.05$) higher pellet hardness and durability compared to the control diet with no DDGS included. Also, Increase in DDGS content did not significantly influenced on pellet hardness and durability. Thus, inclusion of 300 g/kg of corn DDGS in catfish diet increases ability of extruded pellets to withstand mechanical stress during transport, storage and pneumatic feeding.

Keywords: *DDGS, european catfish, extrusion, physical quality*

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PRIMJENA ZELENOG MARKETINGA U FUNKCIJI ZAŠTITE OKOLIŠA

APPLYING OF GREEN MARKETING IN THE FUNCTION OF ENVIRONMENTAL PROTECTION

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ABSTRACT

The application of green marketing today means to satisfy consumer needs in a way that companies are responsive to the environment and to incorporate the term green in the process of product development as well as in the communication with the market.

Ecological awareness today is a planetary phenomenon because it comes as an expression of knowledge about the endangerment of humanity from pollution of soil, water and air due to neglect of the consequences of certain activities in the human environment.

Changes in the environment and society, technology and economic development directly affect both changes in the working and changes in the needs and wishes of consumers. Environmental changes and consumer awareness of the impact they may have on pollution and environmental conservation have created a segment of environmentally responsible consumers. On these consumers also is adapting the marketing by creating and shaping new activities called green marketing. Green marketing is a form of social marketing in which products, services and all marketing activities shape products by taking into account the impact that the environment and the society as a whole can take on.

In modern conditions there are companies that with their actions show responsibility to nature, which can lead to a reduction of pollution.

According that, the aim of the this paper is to present the environmental problems that have occurred and to explain the ways in which marketing participates in solving the difficulties encountered, as well as to show the role, perception and awareness of consumers in the implementation of the green marketing strategy.

In this paper are analyzed data from the conducted primary research in which it tries to determine how consumers notice certain elements of 'green marketing', as well as how much they have stimulated the purchase. The results of the conducted research show that 'green consumers' are dissatisfied with the attention paid to environmental protection in Macedonia, as well as from the offer of 'green products' which is considered to be too small. Also, the results show that environmental labeling is one of the most important elements of 'green marketing, while 'green communication' is an element at which consumers trust the least. The obtained results could indicate the benefits of using 'green marketing' as well as the elements that have greater relevance to others in order to preserve and create a cleaner environment.

Keywords: *green marketing, green customers, green marketing-mix, environmental protection*

TRADICIJA UZGOJA LIPICANACA – NOMINACIJA ZA UNESCO-OVU LISTU SVJETSKE BAŠTINE

THE TRADITIONAL BREEDING OF LIPIZZANERS – NOMINATIONS TO THE UNESCO WORLD HERITAGE LIST

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SAŽETAK

Lipicanska pasmina, kao jedna od najstarijih i najpoznatijih pasmina konja u Europi, rezultat je dugotrajne i sustavne selekcije. Zbog svojih svojstava udomaćila se i postala dominantna u uzgoju na području istočne Hrvatske. Osim kvalitetnog radnog konja, postala je dio tradicije i načina življenja, što je danas najuočljivije na brojnim folklornim manifestacijama koje temom naglašavaju značaj lipicanaca u tradicijskoj kulturi Slavonije, Baranje i Srijema. Razvile su se državne i privatne ergele, privatni uzgajivači i brojne konjogojske udruge vezane za uzgoj ove pasmine i njezino korištenje poznato u cijelom svijetu. U Republici Hrvatskoj se ubraja u skupinu zaštićenih pasmina konja. S obzirom na organiziranost i mjesto uzgoja, dijeli se na uzgoj u državnim ergelama u Đakovu i Lipiku i tradicijski privatni uzgoj u seoskim gospodarstvima. Uzgoj konja lipicanske pasmine je u Republici Hrvatskoj prisutan dva stoljeća. Tradicije uzgoja lipicanaca u Slavoniji, Baranji i Srijemu proglašene su nematerijalnim kulturnim dobrom Republike Hrvatske koje je upisano u Registar kulturne baštine Ministarstva kulture, na Listu nematerijalnih dobara. U tijeku je priprema međunarodne nominacije u cilju upisa na UNESCO–vu Listu svjetske nematerijalne kulturne baštine. Multinacionalnu nominaciju pokrenula je Međunarodna uzgojna organizacija za lipicansku pasminu LIF (Lipizzan International Federation). Projekt okuplja državne ergele i privatne uzgajivače iz Austrije, Slovenije, Slovačke, Mađarske, Hrvatske, Italije i Bosne i Hercegovine, a očekuje se uključivanje Rumunjske i Srbije. Lipicanci predstavljaju veliko genetsko, kulturno blago i jedan su od bitnih identitetskih obilježja kulturne baštine istočne Hrvatske i kultni simbol. Upisom na Listu svjetske nematerijalne baštine čovječanstva ojačat će kulturne, gospodarske i turističke veze europskih lipicanskih ergela i privatnih uzgajivača, a time će osigurati očuvanje i prijenos tradicijskih znanja i umijeća vezanih uz tradicije uzgoja lipicanaca na buduće naraštaje.

Ključne riječi: *lipicanac, tradicija, nematerijalno kulturno dobro, UNESCO*

ABSTRACT

Lipizzaner breed, as one of the oldest and most famous horse breed in Europe, is the result of a long-term and systematic selection. Due to its properties, it has been domesticated becoming dominant breeding in eastern Croatia. Apart from the high quality draft horse, it is a part of the tradition and a way of life. Today it is the most visible on numerous folk events which point out the importance of Lipizzaners in the traditional culture of Slavonia, Baranja and Srijem. State and private stud farms, private breeders and numerous horse-breeding associations related to Lipizzaner breeding have been developed. Thus, its usage is known all over the world. It belongs to a group of the protected horse breeds in the Republic of Croatia. As for the organization and the place of breeding, it is divided into the breeding of the state stud farms in Đakovo and Lipik and traditional private breeding on family farms. The horse breeding of the Lipizzaner breed has been fostered in the

Republic of Croatia for two centuries. Traditional breeding of Lipizzaners in Slavonia, Baranja and Srijem were proclaimed as an intangible cultural property of the Republic of Croatia. It was recorded into the Cultural Heritage Register of the Ministry of Culture on the list of intangible property. It is currently being prepared for the international nomination aiming to be recorded to the UNESCO World Heritage List. The multinational nomination was initiated by the Lipizzan International Federation (LIF). The project includes state stud farms and private breeders from Austria, Slovenia, Slovakia, Hungary, Croatia, Italy and Bosnia and Herzegovina. Romania and Serbia are expected to be joined. The Lipizzaners represent a great genetic cultural property, essential identity of the cultural heritage of eastern Croatia as well as the cult symbol. Cultural, economic and tourist bonds of European Lipizzaner stud farms and private breeders will be stronger if inscribed on the Representative List of the Intangible Cultural Heritage of Humanity. Also, preservation and transfer of traditional knowledge and skills related to the tradition of Lipizzaners to future generations will be secured.

Keywords: *Lipizzaner, tradition, intangible cultural property, UNESCO*

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