



BOOK OF ABSTRACTS



International symposium on animal sciences

16-18.09.2026.
NOVI SAD, SERBIA

#ISAS_2026

www.isas.rs

Organizer



**UNIVERSITY OF NOVI SAD
FACULTY OF AGRICULTURE
DEPARTMENT OF ANIMAL
SCIENCE**

21000 Novi Sad, Trg D. Obradovića 8

Tel.: ++(021) 6350-711; 4853-308;

Fax: ++(021) 6350-019

web: <http://www.polj.uns.ac.rs>

e-mail: stocarstvo@polj.uns.ac.rs

THE INTERNATIONAL SYMPOSIUM ON ANIMAL SCIENCE (ISAS) 2026

16-18.09.2026. Novi Sad, Serbia

BOOK OF ABSTRACTS

Co- Organizers

Research Institute for Animal Production, Nitra - Slovakia

University of Life Sciences “King Mihail” of Timișoara - Romania

University of Sarajevo, Faculty of Agriculture and Food Sciences - Bosnia and Herzegovina

Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek - Croatia

Faculty Member at University of Agronomic Sciences and Veterinary Medicine - Bucharest

Co-Sponsorship

European Society of Agricultural Engineers



ISBN: 978-86-7520-662-0

THE INTERNATIONAL SYMPOSIUM ON ANIMAL SCIENCE (ISAS) 2026

Book of Abstracts

Publisher

University of Novi Sad, Faculty of Agriculture

21000 Novi Sad, Trg D. Obradovića 8

Tel.: ++(021) 6350-711; 4853-308;

polj.uns.ac.rs

On behalf of Publisher

Prof. dr Nenad Magazin

Editor in Chief

Prof. dr Denis Kučević

Paper review

All papers reviewed by The International Board of Reviewers

Recorded by

Faculty of Agriculture, Novi Sad

Cover

Prof. dr Dejan Beuković

Copies

500

CIP - Каталогизacija у публикацији
Библиотеке Матице српске, Нови Сад
636(048.3)

INTERNATIONAL Symposium on Animal Science (2026; Novi Sad)

Book of abstracts [Elektronski izvor] / The International Symposium on Animal Science (ISAS) 2026, 16-18. 9. 2026, Novi Sad, Serbia; [editor in chief Denis Kučević]. - Novi Sad: Faculty of Agriculture, 2026

Način pristupa (URL): <https://www.isas.rs> - Opis zasnovan na stanju na dan 14.09.2026. - Nasl. sa naslovnog ekrana.

ISBN 978-86-7520-662-0

a) Сточарство -- Апстракти б) Анимална производња -- Апстракти

COBISS.SR-ID 200982281

ISAS 2026

Scientific Committee

Prof. dr Denis Kučević, Faculty of Agriculture Novi Sad, Serbia, *chairman*
Prof. dr Vladan Bogdanović, Faculty of Agriculture Beograd, Serbia
Prof. dr Aleksa Božicković, Faculty of Agriculture Beograd, Serbia
Prof. dr Ivan Pihler, Faculty of Agriculture Novi Sad, Serbia
Prof. dr Miroslav Urošević, Faculty of Agriculture Novi Sad, Serbia
Prof. dr Ksenija Čobanović, Faculty of Agriculture Novi Sad, Serbia
Prof. dr Aleksandar Božić, Faculty of Agriculture Novi Sad, Serbia
Prof. dr Saša Dragin, Faculty of Agriculture Novi Sad, Serbia
Prof. dr Mirjana Đukić Stojčić, Faculty of Agriculture Novi Sad, Serbia
Prof. dr Igor Jajić, Faculty of Agriculture Novi Sad, Serbia
Prof. dr Snežana Trivunović, Faculty of Agriculture Novi Sad, Serbia
Prof. dr Ljuba Štrbac, Faculty of Agriculture Novi Sad, Serbia
Dr Dobrila Janković, Faculty of Agriculture Novi Sad, Serbia
Prof. dr Ivan Radović, Faculty of Agriculture Novi Sad, Serbia
Prof. dr Mirko Ivković, Faculty of Agriculture Novi Sad, Serbia
Prof. dr Lidija Perić, Faculty of Agriculture Novi Sad, Serbia
Doc. dr Mile Mirkov, Faculty of Agriculture Novi Sad, Serbia
Dr Bojana Kokić, Institute of Food Technology Novi Sad, Serbia
Dr Nedeljka Spasevski, Institute of Food Technology Novi Sad, Serbia
Prof. dr Zvonko Antunović, Faculty of Agrobiotechnical Sciences Osijek, Croatia
Prof. dr Klemen Potočnik, Biotechnical faculty Ljubljana, Slovenia
Prof. dr Peter Chrenek, Research Institute for Animal Production Nitra, Slovakia
Prof. dr Ranko Gantner, Faculty of Agrobiotechnical Sciences Osijek, Croatia
Prof. dr Vesna Gantner, Faculty of Agrobiotechnical Sciences Osijek, Croatia
Prof. dr Zvonimir Šteiner, Faculty of Agrobiotechnical Sciences Osijek, Croatia
Prof. dr Muhamed Brka, Faculty of Agricultural and Food Sciences Sarajevo, BIH
Prof. dr Ervin Zečević, Faculty of Agricultural and Food Sciences Sarajevo, BIH
Prof. dr Admir Dokso, Faculty of Agricultural and Food Sciences Sarajevo, BIH
Prof. dr Vedad Škapur, Faculty of Agricultural and Food Sciences Sarajevo, BIH
Prof. dr Zoran Luković, Faculty of Agriculture Zagreb, Croatia
Prof. dr Istvan Komlosi, Faculty of Agricultural and Food Sciences and Environmental Management, University of Debrecen, Hungary
Prof. dr Dubravko Škorput, Faculty of Agriculture Zagreb, Croatia
Prof. dr Mirjana Baban, Faculty of Agriculture Osijek, Croatia
Prof. dr Pero Mijić, Faculty of Agriculture Osijek, Croatia
Prof. dr Karoly Dublec, Department of Animal Science and Animal Husbandry, University of Pannonia, Veszprem, Hungary
Prof. dr Stoja Jotanović, Faculty of Agriculture Banja Luka, Bosnia and Herzegovina
Prof. dr Gjoko Bunevski, Faculty of Agricultural Sciences and Food Skopje, North Macedonia
Prof. dr Kristijan Tomljanović, Faculty of Forestry and Wood Technology Zagreb, Croatia
Doc. dr Yasin Demirbaş, Kırıkkale University Kırıkkale, Turkey

Prof. dr Vladimir Maletić, Hans Em Faculty of Forest Sciences, Landscape Architecture and Environmental Engineering Skopje, North Macedonia

Dr Kristijan Cokoski, Hans Em Faculty of Forest Sciences, Landscape Architecture and Environmental Engineering, Skopje, North Macedonia

Dr Paula Poșan, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Dr Nicoleta Defta, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Dr Dana Cătălina Popa, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Dr Răzvan Popa, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Dr Ion Răducuță, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Dr Daniela Ianițchi, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Dr Nela Dragomir, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Dr Monica Marin, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Dr Elena Narcisa Pogurschi, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Dr Minodora Tudorache, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Dr Livia Vidu, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Dr Gratiela Victoria Bahaciu, University of Agronomic Sciences and Veterinary Medicine of Bucharest

Organizing Committee

Prof. dr Nenad Magazin, Faculty of Agriculture Novi Sad, Serbia

Prof. dr Dejan Beuković, Faculty of Agriculture Novi Sad, Serbia - *president*

Prof. dr Mirjana Đukić Stojčić, Faculty of Agriculture Novi Sad, Serbia

Prof. dr Mila Grahovac, Faculty of Agriculture Novi Sad, Serbia

Prof. dr Miroslav Urošević, Faculty of Agriculture Novi Sad, Serbia

Doc. dr Mile Mirkov, Faculty of Agriculture Novi Sad, Serbia

Dr Miroslava Polovinski Horvatović, Faculty of Agriculture Novi Sad, Serbia

MSc Tamara Papović, Faculty of Agriculture Novi Sad, Serbia

Secretariat

Tamara Veličković, Faculty of Agriculture Novi Sad, Serbia

Dragana Mitošević, Faculty of Agriculture Novi Sad, Serbia

CONTENT

1. Curik I., Mijadžiković Z., Dominiković D., Shihabi M., Curik T. J., Mikulec N., Novosel D., Špehar M., Raguž N., Lukić B., Ferencaković M. : RETHINKING DAIRY CATTLE BREEDING THROUGH GENOMICS AND PHENOMICS	1
2. Wisely S.: INNOVATIONS IN WILDLIFE SURVEILLANCE SYSTEMS FOR A CHANGING WORLD	2
3. Christos R.: RETHINKING ANIMAL FEED: THE ROLE OF INSECTS IN SUSTAINABLE LIVESTOCK NUTRITION	3
4. Kralik Z., Djurkin Kušec I., Gvozdanović K., Košević M., Škrtić Z.: MICROPLASTICS IN POULTRY PRODUCTION: BIOLOGICAL EFFECTS AND IMPACT ON FOOD SAFETY	4
5. Ivković M.: AGAINST COMPLEX MATHEMATICAL MODELS, EXAMPLE OF NASEM DAIRY NET ENERGY MODEL	5
6. Saltamarski D., Silovska Nikolova A., N., Tuna E.: FOREIGN TRADE DYNAMICS AND STRUCTURAL IMPORT DEPENDENCE IN MEAT SECTOR: EVIDENCE FROM NORTH MACEDONIA	6
7. Baban M., Mijić P., Bogut I., Prlić P., Ristić T.: CHALLENGES OF PRESERVING GENETIC DIVERSITY, SUSTAINABLE DEVELOPMENT, AND CULTURAL HERITAGE VALORISATION OF LIPIZZAN HORSES IN CROATIA	7
8. Plemenitaš E., Skok J., Prevolnik Povše M.: IMPACT OF COW CLEANLINESS AND LYING SURFACE HYGIENE ON SOMATIC CELL COUNT AND MILK YIELD IN DAIRY COWS	8
9. Jusupović A., Marinović M., Milišić A., Begić M., Oras A., Dizdarević T., Martinović A., Brka M., Sarić Z.: ANALYSES OF PHYSICAL AND SENSORY PROPERTIES OF YOGURT AND KEFIR ON BOSNIA AND HERZEGOVINA AND MONTENEGRO MARKET	9
10. Perić L., Spiridonović S., Đukić Stojčić M., Žikić D.: EFFECT OF BEDDING MATERIAL ON SOME PARAMETERS OF LEG QUALITY IN BROILERS	10
11. Janković D., Trivunović S., Štrbac Lj., Šaran M., Đedović R., Božičković I., Samolovac Lj.: PHENOTYPIC PARAMETERS OF TYPE TRAITS IN HOLSTEIN-FRIESIAN PRIMIPAROUS DAIRY COWS	11

12. Žikić D.: METHODOLOGICAL PRINCIPLES AND GHG EMISSION SOURCES IN THE DAIRY SECTOR ACCORDING TO THE ISCC CFC STANDARD.....	12
13. Đukić Stojić M., Spiridonović S., Perić L., Žikić D.: EFFECT OF STOCKING DENSITY ON GAIT SCORE AND OCCURRENCE OF FOOTPAD DERMATITIS IN BROILERS.....	13
14. Ludoški I., Praschl C., Schedl D., Urošević M.: NON-INVASIVE MONITORING AND COUNTING OF RED DEER USING UAVs EQUIPPED WITH VISIBLE-LIGHT AND THERMAL CAMERAS.....	14
15. Vukadinović M., Santrač N., Benka P., Polovinski Horvatović M., Nikolić K., Petrović M., Beuković D.: PRECISION INSECT FARMING: AUTOMATED LARVAL ESTIMATION USING MULTI-CHANNEL YOLOv11.....	15
16. Pihler I., Plavša N., Purać J., Kojić D., Spremo D., Đurđievski S., Vukašinović E.: ANALYSIS OF WINTER SURVIVAL OF HONEY BEE COLONIES IN THE SOUTH BAČKA DISTRICT.....	16
17. Čobanović K., Kučević D., Ivković M., Papović T., Davidov N.: INFLUENCE OF FARM ON THE FATTY ACID PROFILE OF COW'S MILK.....	17
18. Chitambala T., Musa A. S., Luciano G.V., Bureš D., Hoffman L. C., Skrivanova E., Urbanova K., Kokoskova T.: WET VERSUS DRY AGEING: EFFECTS ON PHYSICOCHEMICAL, MICROBIAL, AND SENSORY QUALITY OF COMMON ELAND (<i>Taurotragus oryx</i>) MEAT.....	18
19. Chitambala T., Ny V., Ceacero F., Barton L., Bureš D., Kotrba R., Kokoskova T.: IMMUNOCASTRATION AS A WELFARE MANAGEMENT TOOL IN FALLOW DEER (<i>Dama dama</i>).....	19
20. Ivanković A., Ivkić Z., Kelava Ugarković N., Konjačić M.: PEDIGREE-BASED ASSESSMENT OF THE GENETIC STATUS OF BUŠA CATTLE IN CROATIA..	20
21. Pećina M., Šubara G., Ramljak J., Ivanković A.: FATTY ACID PROFILE AND HEALTH LIPID INDICES OF HORSE AND DONKEY MEAT.....	21
22. Damjanović M., Guljaš D., Nikolić K., Ilić B., Beuković D., Petrović M.: EFFECTS OF PHOSPHORUS-ENRICHED AGAR ON THE POPULATION DYNAMICS OF TENEBRIO MOLITOR.....	22
23. Urošević M., Mrdak D., Gvozdenović Nikolić S., Mikoš R., Rogosić M.: THE AQUACULTURE IN MONTENEGRO: CURRENT STATE, CHALLENGES, AND EU PERSPECTIVES.....	23

24. Ilić B., Nikolić K., Vukadinović M., Guljaš D., Damjanović M., Beuković D.: INTEGRATION OF CAMERA-TRAP WILDLIFE MONITORING AND OPEN SCIENCE PRINCIPLES FOR BIODIVERSITY DATA MANAGEMENT.....	24
25. Lavadinović V., Beuković D., Popović Z., Milić M., Vlajnić B.: COMPARATIVE ANALYSIS OF RED DEER GAME MANAGEMENT (<i>Cervus elaphus L.</i>) IN HUNTING GROUNDS „VALMIŠTE“ AND „KARAKUŠA“.....	25
26. Cvijanović D., Ostojić B., Cvijanović G.: RURAL TOURISM AS A DRIVER OF AGRICULTURAL DEVELOPMENT.....	26
27. Vizzari F., Formelova Z., Mlynekova Z., Mlynar R., Ondruska L.: NATURE-BASED SOLUTIONS FOR CLIMATE-RESILIENT RUMINANT PRODUCTION: THE SLOVAKIAN CASE OF LIFE+ PROJECT.....	27
28. Stanojević D., Gligović N., Đedović R., Bogdanović V., Zeljic Stojiljković K., Štrbac Lj.: USE OF GENOMIC DATA TO ESTIMATE THE EFFECTIVE POPULATION SIZE OF THE VLAŠKO-VITOROGA PRAMENKA SHEEP POPULATION.....	28
29. Kovačević Z., Pajić M., Ružić Z., Kladar N., Knežević S., Rikić M., Todorović D.: ESSENTIAL OIL FORMULATIONS AS ANTIBIOTICS ALTERNATIVES: ANTIMICROBIAL ACTIVITY AND PHARMACOECONOMIC EVALUATION AGAINST AVIAN PATHOGENIC ESCHERICHIA COLI.....	29
30. Demirbaş Y., Özkan Koca, A., Gümüş H., Akyüz E., Suchentrunk F., Stefanović M.: GENOME-WIDE GENETIC DIVERSITY AND POPULATION STRUCTURE IN WILD BOARS FROM TÜRKİYE.....	30
31. Wu B., Ivetić A., Lalevi B., He M.: BIOCONVERSION OF NON-FOOD BIOMASS FOR AGRICULTURAL DEVELOPMENT.....	31
32. Zhang M., Wang H.: FROM WASTE TO SOIL: THE BIOGAS-BASED CIRCULAR AGRICULTURE IN CHINA.....	32
33. Mijić P., Baban M., Antunović Z., Budimir D., Bogdanović V., Bobić T.: PRODUCTION AND ECONOMIC SUSTAINABILITY OF FAMILY DAIRY FARMS IN SOUTHEASTERN EUROPE.....	33
34. Bobić T., Mijić P., Gregić M., Gantner V.: PRECISION LIVESTOCK FARMING IN LAMENESS PREVENTION.....	34
35. Mrdalj V., Jovičić M.: ANALYSIS OF PRODUCER INCENTIVES IN THE MILK SECTOR OF BOSNIA AND HERZEGOVINA.....	35

36. Bunevski G., Ivanković A., Mergedush A., Radevski B., Klincarov A.: AUTOCHTHONOUS CATTLE BREEDS IN FUNCTION OF RURAL DEVELOPMENT.....	36
37. Jovičić M., Vekić M.: EFFECT OF SEX ON CARCASS QUALITY AND GASTROINTESTINAL TRACT MORPHOMETRY OF ROSS 308 BROILERS IN SEMI-INTENSIVE REARING SYSTEM.....	37
38. Vekić M., Jovičić M.: COMPARATIVE ANALYSIS OF JAPANESE QUAIL EGG QUALITY AMONG COMMERCIAL PRODUCERS IN BOSNIA AND HERZEGOVINA.....	38
39. Krznarić D., Gantner V., Gavran M.: MARS SHEEP ON THE ISLAND OF PAG....	39
40. Mihajlović N., Ignajtović A., Stepć S., Beuković D., Lavadinović V., Vukadinović M., Popović Z.: REAL GROWTH RATE OF THE BROWN HARE (LEPUS EUROPAEUS) IN HUNTING GROUNDS OF THE BELGRADE HUNTING AREA IN 2025.....	40
41. Cokoski K., Beuković D., Polovinski Horvatović M., Popović Z., Lavadinović V., Vukadinović M.: RISK ASSESSMENT OF HEAVY METAL EXPOSURE THROUGH WILD BOAR (SUS SCROFA L.) MEAT AND LIVER CONSUMPTION AMONG HUNTERS IN NORTH MACEDONIA.....	41
42. Polovinski Horvatović M., Vukadinović M., Petrović M., Laćarac N., Beuković D., Jajić I., Đurić S.: POTENTIAL OF CELLULOLYTIC BACTERIA IN ENHANCING THE UTILIZATION OF FIBROUS FEED INGREDIENTS BY <i>Tenebrio molitor</i>.....	42
43. Lučić S., Kopitović O., Mirecki S., Radonjić D., Đokić M.: PRLJO - TRADITIONAL MILK PRODUCT OF MONTENEGRO AND ITS PROTECTION.....	43



RETHINKING DAIRY CATTLE BREEDING THROUGH GENOMICS AND PHENOMICS

Plenary lecture

INO CURIK^{1,2}, ZVONIMIR MIJADŽIKOVIĆ¹, DARIO DOMINIKOVIĆ¹ MARIO SHIHABI¹, TIN JOSIP CURIK³, NATAŠA MIKULEC¹, DINKO NOVOSEL⁴, MARIJA ŠPEHAR⁵, NIKOLA RAGUŽ⁶, BORIS LUKIĆ⁶, MAJA FERENČAKOVIĆ¹*

¹University of Zagreb, Faculty of Agriculture, Svetošimunska 25, Zagreb, Croatia

²Hungarian University of Agriculture and Life Sciences (MATE), Guba Sándor u. 40, Kaposvár, Hungary

³Maastricht University - Faculty of Science and Engineering, Paul-Henri Spaaklaan 1, Maastricht, The Netherlands

⁴Croatian Veterinary Institute, Savska cesta 143, Zagreb, Croatia

⁵Croatian Agency for Agriculture and Food, kardinala Alojzija Stepinca 17, Osijek, Croatia

⁶University of Josip Juraj Strossmayer in Osijek, Faculty of Agrobiotechnical Sciences, Vladimira Preloga 1, Osijek, Croatia

*Corresponding author: icurik@agr.hr

SUMMARY

Cattle are the most important domestic animal species, and their domestication ranks among the most significant innovations shaping human civilisation. Yet their historical importance offers no guarantee that established breeding practices will meet future needs. This plenary presentation challenges conventional thinking in dairy cattle breeding by exploring the potential of emerging technologies to expand the information available for breeding decisions. First, we evaluate machine learning for predicting milk coagulation properties, measured using a Formagraph, from mid-infrared spectra of raw milk. Second, we explore whether sequencing DNA extracted from milk can deliver information beyond standard SNP arrays at a comparable cost (approximately €30 per cow). Using low-pass whole-genome sequencing at approximately 1× coverage, we aim to: (i) impute genotypes at high-density SNP markers; (ii) retrieve complete mitogenomes to investigate their underexplored associations with production traits and identify potentially detrimental variants; (iii) estimate mitochondrial DNA copy number as a candidate phenotype related to production and health; and (iv) screen microbial DNA in milk, including potential mastitis pathogens. By revealing possibilities beyond familiar practices, these approaches invite scientists and breeders to rethink what is technically achievable and seek solutions beyond conventional boundaries.

Keywords: dairy cattle, machine learning, milk coagulation properties, next generation sequencing, phenomics



INNOVATIONS IN WILDLIFE SURVEILLANCE SYSTEMS FOR A CHANGING WORLD

Plenary lecture

*SAMANTHA WISELY¹**

¹University of Florida, Institute of Food and Agricultural Sciences, Dept. Of Wildlife Ecology and Conservation, Gainesville, Florida, USA

*Corresponding author: wisely@ufl.edu

SUMMARY

Global change has increased disease transmission resulting in a redistribution of pathogens to new regions and spillover of pathogens between species. The resulting disease emergence in humans, livestock and wildlife invites a One Health systems approach that increases surveillance capacity. Emerging technologies can reinvigorate traditional surveillance approaches such that they become more robust. I will discuss three surveillance approaches that use novel methods to strengthen surveillance. 1) Sentinel species that serve as indicators of disease emergence have long been used in surveillance systems. Broadening the scope of sentinel species to include additional livestock, harvested wildlife and companion animals can increase surveillance capacity. 2) Using naturally occurring surrogate microbes that mimic pathogens of concern can be used to better understand the potential for pathogen outbreaks and reemergence. 3) Advances in environmental DNA have created the opportunity to better understand host, vector and pathogen communities. Examples of all three surveillance systems will be discussed.

Keywords: emerging pathogens; environmental DNA; OneHealth; surveillance



RETHINKING ANIMAL FEED: THE ROLE OF INSECTS IN SUSTAINABLE LIVESTOCK NUTRITION

Plenary lecture

*CHRISTOS RUMBOS**

*International Hellenic University, School of Geosciences, Department of Agriculture, Alexander University
Campus, 57400 Thessaloniki, Greece*

**Corresponding author: crumbos@ihu.gr*

SUMMARY

The transition towards more sustainable animal production requires the development of alternative feed resources that can reduce dependence on conventional protein sources. Insects offer considerable potential in this context, owing to their nutritional value, efficient biomass conversion, and relatively low requirements for land and water. However, translating this potential into a resilient and economically viable insect sector remains challenging. The insect industry is still developing and remains relatively volatile, with market projections and expectations for future growth subject to considerable uncertainty. Further advances therefore depend not only on market development but also on a better understanding and optimisation of insect production systems. In particular, insect nutrition is central to achieving consistent growth, survival, reproduction, feed efficiency, and product quality, yet the dietary requirements of many commercially important species remain insufficiently characterised. Moreover, current EU regulatory provisions restrict the substrates that can be used for insect rearing, limiting opportunities for greater resource circularity and diversification. Expanding the range of safely authorised feed substrates could improve both the resilience and sustainability of insect production. Genetic improvement represents another largely underexploited opportunity, as systematic breeding could enhance growth, feed utilisation, reproductive performance, robustness, and product quality. This presentation aims to critically examine these opportunities and challenges, highlighting the need for integrated advances in nutrition, breeding, substrate utilisation, regulation, and production technology to move insect farming from a promising alternative towards a robust and sustainable component of future animal feed systems.

Keywords: alternative proteins, circular economy, insect farming, insects as feed, sustainability

Acknowledgements: This research was supported by the EU-PRIMA program and specifically the projects CIPROMED “Circular and Inclusive utilisation of alternative PROteins in the MEDiterranean value chains”, Grant Agreement (GA) No 2231 (PRIMA Call 2022 Section 1 Agri-food IA) and OLIWA “Repurposing OLive WASTE in circular economy solutions for feeds, additives, packaging, and biogas”, GA No 2432 (PRIMA Call 2024 Section 1 Food Value Chain in Nexus).



MICROPLASTICS IN POULTRY PRODUCTION: BIOLOGICAL EFFECTS AND IMPACT ON FOOD SAFETY

ZLATA KRALIK*, IVONA DJURKIN KUŠEC, KRISTINA GVOZDANović, MANUELA KOŠEVIĆ, ZORAN ŠKRTIĆ

Faculty of Agrobiotechnical Sciences, University of Josip Juraj Strossmayer in Osijek, Vladimira Preloga 1, Osijek, Croatia

**Corresponding author: zlata.kralik@fazos.hr*

SUMMARY

The widespread use of plastics and their persistence in the environment have led to growing concern about microplastic (MP) contamination in food systems, including poultry production. Microplastics include particles smaller than 5 mm, and the most common polymers are polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), and polyvinyl chloride (PVC). Poultry is exposed to MPs through feed, water, litter, and equipment. After ingestion into the digestive system, MP particles can damage the intestinal mucosa, disrupt the epithelial barrier, and alter the composition of the gut microbiota. Research shows that MPs in poultry organisms can cause oxidative stress, inflammatory processes, metabolic disorders, and changes in muscle tissue and gene expression. Such changes may pose a risk to animal health, but also a potential risk to food safety. Poultry meat and eggs represent important sources of high-quality protein in human nutrition. Contamination levels range from 0.03 to 1.19 MP particles/g in meat and about 11.7 particles/g in eggs. The aim of this study was to present the sources of microplastics in poultry production, their effects on poultry, and to assess potential risks to food safety and consumer health.

Keywords: microplastics, poultry production, health, food safety, environment

Acknowledgment: This work is supported by the European Union - NextGenerationEU (NRRP project Standardization and modelling of meat freshness indicators for labeling purposes – SiMPSOM; 581-UNIOS-22)



AGAINST COMPLEX MATHEMATICAL MODELS, EXAMPLE OF NASEM DAIRY NET ENERGY MODEL

MIRKO IVKOVIC^{*}

¹University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

^{*}Corresponding author: mirko.ivkovic@stocarstvo.edu.rs

SUMMARY

The National Academies of Sciences, Engineering, and Medicine (NASEM) publications, previously known as the National Research Council (NRC) Nutrient Requirements series, are among the most important publications in global animal nutrition. The Eighth edition of the Dairy Cattle report, the newest one, published in 2021, contains mathematical models that are the current worldwide standard for predicting nutrient and energy utilization and requirements in dairy cows. However, its increasing complexity makes this and similar models prone to errors.

In this study, a serious inconsistency was identified in Equation 20-308, used for the calculation of urinary nitrogen. It was described how it arose from an attempt by a model developer to overcome a small imprecision of the original Equation 3-10a and how it went unnoticed in the official NASEM software. The magnitude of consequences of this error was demonstrated using the NASEM software default dairy cow. It was found that error resulted in a 71 g/day urinary nitrogen excretion underestimation, compared to the original equation, leading to a 4,3 MJ/day energy overestimation. The magnitude was shown to be nutritionally relevant and influencing ration formulation, energy balance predictions, and model-based research conclusions.

More broadly, this case was used to illustrate how large, multi-layered nutritional models are inherently prone to hidden inconsistencies, many of which probably still lurk in the dark. Our findings emphasize the need for careful equation tracing and independent validation when developing and implementing complex nutritional models, and, more importantly, avoiding unnecessary complex models in situations where they can be successfully replaced with simpler ones.

Keywords: nutritional models, dairy, NRC, urinary nitrogen, net energy



FOREIGN TRADE DYNAMICS AND STRUCTURAL IMPORT DEPENDENCE IN MEAT SECTOR: EVIDENCE FROM NORTH MACEDONIA

DAVID SALTAMARSKI^{1*}, ALEKSANDRA SILOVSKA NIKOLOVA², EMELJ TUNA²

¹*Institute of Animal Science and Fisheries, Ss. Cyril and Methodius University in Skopje*

²*Faculty of Agricultural Sciences and Food, Ss. Cyril and Methodius University in Skopje, North Macedonia*

*Corresponding author: davidsaltamarski@yahoo.com

SUMMARY

This paper examines the production and trade dynamics of meat and meat preparations in North Macedonia, with a particular focus on export, import, and trade balance trends over the period 2005–2025. The analysis is based on secondary data from the State Statistical Office and relevant international sources, applying descriptive statistical methods and the author's own calculations.

The findings reveal a persistent and widening trade deficit in the meat sector, driven by consistently higher imports than exports. While exports have shown moderate growth, import expansion has been significantly stronger, indicating a high dependence on foreign supply. This imbalance reflects structural weaknesses in the domestic livestock sector, including limited production capacity, declining livestock numbers, insufficient feed resources, and rising production costs. Within this context, lamb meat stands out as a strategically important product, closely linked to export performance, rural livelihoods, and traditional consumption. However, declining production and unfavourable price trends have increasingly constrained its role. The combination of rising retail prices and stagnant or decreasing output points to growing supply-side pressures, raising concerns about the sector's long-term sustainability and competitiveness.

Overall, the results underscore the structural nature of import dependence in the meat sector and highlight the need to strengthen domestic production capacity and improve competitiveness in order to enhance the country's external trade position.

Keywords: meat trade, meat and meat preparations, trade balance, North Macedonia



CHALLENGES OF PRESERVING GENETIC DIVERSITY, SUSTAINABLE DEVELOPMENT, AND CULTURAL HERITAGE VALORISATION OF LIPIZZAN HORSES IN CROATIA

MIRJANA BABAN¹, PERO MIJIĆ¹, IRELLA BOGUT², PETRA PRLIĆ^{1*}, TIHANA
RISTIĆ^{2**}

¹Faculty of Agrobiotechnical Sciences, University of Josip Juraj Strossmayer in Osijek, Vladimira Preloga 1, Osijek, Croatia

*Doctoral student of Agricultural Sciences, majoring in Animal Husbandry

²Faculty of Education, University of Josip Juraj Strossmayer in Osijek, Cara Hadrijana 10, Osijek, Croatia,

*Doctoral student in Educational Sciences and Perspectives of Education

**Corresponding author: tihana.ristic@gmail.com

SUMMARY

The Lipizzaner breed represents one of the most significant components of the cultural, genetic, and socioeconomic heritage of continental Croatia. In the Republic of Croatia, 2,297 Lipizzaner horses are currently registered, positioning the country among the leading European breeders of the breed. The largest concentration of breeding is located in Slavonia, particularly in Osijek-Baranja County, where the Lipizzaner has become an integral component of traditional lifestyle, cultural identity, and rural tourism development. The international importance of the breed was additionally confirmed through the inscription of the “Traditions of Lipizzaner Breeding” on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity in 2022.

Owing to its favourable morphological and functional characteristics, the Lipizzaner is widely utilised in carriage driving, dressage, folklore manifestations, recreational riding, and equine-assisted activities, thereby contributing to the diversification of sustainable rural and equestrian tourism. The State Stud Farm Đakovo, together with numerous equestrian associations, clubs, and family farms, represents a key stakeholder in the preservation, promotion, and tourism valorisation of the breed.

Furthermore, the implementation of national breeding support programmes and increasing scientific interest in genetic conservation emphasise the importance of sustainable breeding management and the preservation of genetic diversity. The increasing integration of the Lipizzaner breed into tourism, sport, and cultural heritage sectors confirms its strategic importance for sustainable rural development, economic resilience, and the long-term preservation of traditional and genetic heritage in Croatia.

Keywords: Lipizzaner breed, genetic diversity, sustainable breeding, equestrian tourism, cultural heritage



IMPACT OF COW CLEANLINESS AND LYING SURFACE HYGIENE ON SOMATIC CELL COUNT AND MILK YIELD IN DAIRY COWS

ERNEST PLEMENITAŠ^{1*}, JANKO SKOK¹, MAJA PREVOLNIK POVŠE¹

¹University of Maribor, Faculty of Agriculture and Life Sciences, Pivola 10, Hoče, Slovenia

*Corresponding author: ernest.plemenitas@student.um.si

SUMMARY

The study aimed to evaluate the association between dairy cow cleanliness, lying surface hygiene, and milk yield in relation to milk somatic cell count (SCC). Data were collected on 12 commercial dairy farms with balanced feeding rations in tie-stall and free-stall housing systems included in the national milk recording scheme, comprising a total of 368 cows, with an average of 31 cows per farm and a farm-level range of 13 to 49 cows. Farms were divided into two groups according to the average somatic cell count: farms with an average SCC below 150,000 cells/mL of milk (n=5) and farms with an SCC above 150,000 cells/mL of milk (n=7). The proportion of tie-stall and free-stall farms was comparable in both groups. The cleanliness of individual cows was assessed using a scoring system based on the Welfare Quality protocol, with individual body parts evaluated, including the udder, hindquarters, and lower hind limbs. The cleanliness and moisture of the lying areas were assessed directly in the barn using a self-designed questionnaire. We obtained data on SCC and milk yield from the milk yield monitoring program. The results indicated that wetter and less clean lying areas were associated with higher somatic cell counts. A tendency toward higher milk production was also observed in cows on dry and cleaner lying surfaces. In contrast to expectations, the udder cleanliness score alone did not show any pronounced association with somatic cell count, which could be related to the sensitivity of the scoring system used, where even minor local contamination may affect the final cleanliness score. Based on these findings, we can conclude that cow hygiene and the condition of lying areas play an important role in ensuring milk quality and udder health.

Keywords: dairy cows, cleanliness, somatic cell count, milk yield



ANALYSES OF PHYSICAL AND SENSORY PROPERTIES OF YOGURT AND KEFIR ON BOSNIA AND HERZEGOVINA AND MONTENEGRO MARKET

AMINA JUSUPOVIĆ¹, MIRKO MARINOVIĆ², AMILA MILIŠIĆ¹, MUNEVERA BEGIĆ¹,
AMILA ORAS¹, TARIK DIZDAREVIĆ¹, ALEKSANDRA MARTINOVIĆ², MUHAMED
BRKA¹, ZLATAN SARIC^{1*}

¹University of Sarajevo, Faculty of Agriculture and Food Sciences, Zmaja od Bosne 8, Sarajevo, Bosnia and Herzegovina

²University of Donja Gorica, Faculty for Food Technology, Food Safety and Ecology, Donja Gorica, Podgorica, Montenegro

*Corresponding author: z.saric@ppf.unsa.ba

SUMMARY

The physical characteristics of fermented milks are an important element in quality assessment and are directly related to their sensory impression. The aim of this work was to analyze the physical properties and sensory quality of fermented milk on the market of Bosnia and Herzegovina and Montenegro.

7 samples of yogurt and kefir collected from markets in Bosnia and Herzegovina and 7 samples of yogurt from markets in Montenegro were tested. The samples had different fat contents. For the purpose of checking the declaration and for a more accurate sensory evaluation, bearing in mind the fat content, the fat content of the samples was analyzed. The following physical properties were tested: pH, titration acidity, viscosity, and water activity. The sensory evaluation was done by an expert team.

The average fat content in yogurt samples from the Bosnia and Herzegovina market was 3.08%, in kefir samples 3.14%, while in samples from the Montenegro market it was an average of 2.49%. The viscosity in yogurt samples from the Bosnia and Herzegovina market averaged 771.43 mPas, in kefir samples 722.86 mPas, while the average viscosity in yogurt samples from the Montenegro market was 806.43 mPas. Average pH and titration acidity were 4.36, 4.45 and 4.40 and 36.86, 43.14 and 38.05°SH respectively. The average water activity was 0.969, 0.892 and 0.852, respectively. According to the expert overall sensory evaluation, all samples were classified as first or extra class. The average overall ratings were 17.11 and 18.57 for yogurt and kefir from the market of Bosnia and Herzegovina, while it was 18.71 for yogurt from the Montenegro market. It can be concluded that the values for the physical properties were within the expected limits, while all samples of fermented milk were rated highly sensory.

Keywords: properties, physical, sensory, yogurt, kefir



EFFECT OF BEDDING MATERIAL ON SOME PARAMETERS OF LEG QUALITY IN BROILERS

LIDIJA PERIĆ^{1*}, SAVA SPIRIDONOVIĆ¹, MIRJANA ĐUKIĆ STOJČIĆ¹, DRAGAN ŽIKIĆ¹

¹University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

*Corresponding author: lidija.peric@stocarstvo.edu.rs

SUMMARY

The goal of this study was to determine the effect of bedding materials on body weight, gait score and footpad dermatitis in broilers.

A total of 170 Ross 308 broilers were allocated to 2 treatments with 5 replicates, with 17 chickens per replicate. Two bedding materials were used: wheat straw (WS) and peat mixed with wood shavings (PW) which contained 10% of shavings in the total weight of the litter. Birds were fed by commercial feed. The incidence of FPD was measured at 6 weeks of age by the method described by Eichner (2007): no lesions (0), lesions cover less than 25% of the footpad (1), lesions covering between 25% and 50% (2) and lesions covering more than 50% (3). The gait score was evaluated at 6 weeks of age according to the method described by Kestin et al. (1992) on a scale from 0 (normal walk) to 5 (bird unable to walk). Body weight was analyzed by ANOVA followed by Fisher LSD post hoc test. FPD and gait score were analyzed using the Mann-Whitney test in STATISTICA 14.0 (Tibco software Inc.).

No effect of bedding material was found on final body weight (2,737g (WS) vs. 2,814 (PW)). Bedding material significantly affected the occurrence and severity of FPD ($P < 0.01$) at 6 weeks of age. At 6 weeks of age the mean score of FPD was 1.30 (WS) vs. 0.44 (PW). No effect of bedding material was found on gait score ($P > 0.05$): 2.75 (WS) vs. 2.60 (PW). It can be concluded that peat with wood shavings had a positive effect on decreasing FPD in broilers.

Keywords: bedding, footpad dermatitis, gait score, straw, peat



PHENOTYPIC PARAMETERS OF TYPE TRAITS IN HOLSTEIN-FRIESIAN PRIMIPAROUS DAIRY COWS

DOBRILA JANKOVIĆ ^{1*}, SNEŽANA TRIVUNOVIĆ ¹, LJUBA ŠTRBAC ¹, MOMČILO ŠARAN ¹, RADICA ĐEDOVIĆ ², IVANA BOŽIČKOVIĆ ², LJILJANA SAMOLOVAC ³

¹University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

²University of Belgrad, Faculty of Agriculture, Nemanjina 6, Belgrade, Serbia

³Institute for Animal Husbandry, Autoput Beograd – Zagreb 16, Belgrade, Serbia

*Corresponding author: dobrila.jankovic@stocarstvo.edu.rs

SUMMARY

The aim of the research was to estimate the phenotypic parameters of Holstein-Friesian primiparous dairy cows for type traits, as well as the deviation of the average linear scores from the ideal scores defined by the WHFF (World Holstein Friesian Federation).

The research was conducted on a dataset of linearly evaluated cows provided by the Central Cattle Breeding Organization in AP Vojvodina. The data comprised 127,053 primiparous cows from 4,012 breeders, linearly evaluated between 2012 and 2025 by 33 evaluators across 12 regions of Vojvodina. Primiparous cows were individually evaluated for 18 type traits, classified into 4 functional units (frame, dairy character, feet and legs, udder) on a numerical scale from 1 to 9. Phenotypic parameters of type traits, including average scores for these traits, were analyzed using standard statistical procedures in Statistica 13.2 (StatSoft, 2017). The average linear scores of type traits for the 127,053 evaluated cows ranged from 4.49 for rear teat length to 6.79 for angularity. The greatest differences between average and ideal scores were observed in udder traits, specifically fore udder attachment and the suspensory ligament. Based on the calculated averages of the linear trait scores of Holstein-Friesian cows in Vojvodina and their deviation from the ideal scores, it can be concluded that selection should focus on improving type traits, primarily those of the udder. A well-conformed udder ensures high milk yields and is less prone to diseases, while a strong udder attachment protects it from bacterial contamination.

Keywords: Holstein-Friesian, primiparous cows, type traits, linear evaluation, phenotypic parameters



METHODOLOGICAL PRINCIPLES AND GHG EMISSION SOURCES IN THE DAIRY SECTOR ACCORDING TO THE ISCC CFC STANDARD

DRAGAN ŽIKIĆ¹*

¹ University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

*Corresponding author: dragan.zikic@stocarstvo.edu.rs

SUMMARY

In the contemporary animal production, quantifying greenhouse gas (GHG) emissions has become a key element of market differentiation and alignment with global climate goals. This paper analyzes the ISCC Carbon Footprint Certification (CFC) as a leading international framework for the verification of carbon footprints in agriculture and food production.

The focus of the paper is on the identification and analysis of key emission sources within the milk supply chain, with special emphasis on the specificities of family dairy farms. The paper elaborates in detail on the "Cradle-to-Gate" methodological principles, encompassing direct emissions from enteric fermentation and manure management, as well as indirect emissions resulting from feed production and dairy processing.

A specific segment of the paper is dedicated to certification models, analyzing the role of the dairy plant as the system user within the group certification of suppliers. The discussion covers emission burden allocation rules between milk and co-products, the importance of data standardization through FPCM (Fat and Protein Corrected Milk) correction, and the process of independent third-party verification (audit).

The paper concludes by highlighting the strategic importance of early implementation of these principles to ensure transparency, eliminate "greenwashing," and strengthen the export capacities of domestic dairies to the demanding markets of the European Union.

Keywords: GHG emissions, ISCC CFC, dairy farming, certification methodology



EFFECT OF STOCKING DENSITY ON GAIT SCORE AND OCCURRENCE OF FOOTPAD DERMATITIS IN BROILERS

MIRJANA ĐUKIĆ STOJČIĆ, SAVA SPIRIDONOVIĆ, LIDIJA PERIĆ, DRAGAN ŽIKIĆ

¹University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

*Corresponding author: mirjana.djukicstojcic@stocarstvo.edu.rs

SUMMARY

The main type of bedding used in Serbia and many other European countries is wheat straw. However, numerous studies have shown that much better results in terms of footpad dermatitis (FPD) incidence can be achieved when peat is used as bedding. The question remains whether similarly good results can be achieved at higher stocking densities as well. This study was conducted to evaluate the impact of stocking density on the occurrence of FPD and gait score in broilers raised on peat bedding. Ross 308 broilers were randomly allocated to two treatments with five replicates. Broilers were kept in floor pens with peat bedding. The treatments consisted of two stocking densities: 33 kg/m² (LD group) or 39 kg/m² (HD group). The trial lasted for 42 days. Birds of both groups were fed by the commercial feed: starter (1-10 days), grower 1 (11-21 days) grower 2 (22-31 days) and finisher (32-42 days). Housing conditions were controlled automatically and adjusted according to ROSS 308 recommendations. The incidence of FPD was evaluated at the age of 3, 4, 5 and 6 weeks by the method described by Eichner (2007): no lesions (0), lesions cover less than 25% of the footpad (1), lesions in wide areas, covering between 25% and 50% of the footpad (2), more than 50% lesion on the footpads (3). The gait score was evaluated at 6 weeks of age according to the method described by Kestin et al. (1992) on a scale from 0 (normal walk) to 5 (bird unable to walk). Results of final body weights were analyzed by ANOVA followed by Fisher LSD post hoc test. FPD and gait score were analyzed using the Mann-Whitney test (STATISTICA 14.0, Tibco software inc.). No significant influence of stocking density was established on body weight (2814g (LD) vs. 2756 g (HD)). FPD score slightly increased from 3rd to 6th week in both groups, but there was no effect of stocking density on average FPD score ($P>0.05$) at any week of age. Although the lower stocking density group at 6 weeks of age had a numerically lower FPD value (0.25) compared with the higher stocking density group (0.40), no significant difference was found between the groups ($P>0.05$). No significant effect of stocking density was found on gait score. The average gait score of chickens in LD group was 2.40 and for HD group 2.75 ($P>0.05$). Since the influence of stocking density on body weight, FPD and gait score was not significant, it can be concluded that birds can be raised on peat at higher stocking density without detrimental effect on body weight and leg quality.

Keywords: body weight, footpad dermatitis, gait score, peat



NON-INVASIVE MONITORING AND COUNTING OF RED DEER USING UAVs EQUIPPED WITH VISIBLE-LIGHT AND THERMAL CAMERAS

IVAN LUDOŠKI^{1*}, CHRISTOPH PRASCHL², DAVID C. SCHEDL²
MIROSLAV UROŠEVIĆ¹

¹University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

²University of Applied Sciences Upper Austria, Softwarepark 11, Hagenberg, Austria

*Corresponding author: ivan.ludoski@gmail.com

SUMMARY

Modern ecosystem management and wildlife conservation rely heavily on accurate and reliable population monitoring methods. Traditional wildlife counting techniques, such as direct ground observations or track counts, are often time-consuming, spatially constrained, prone to human error, and can induce significant stress and disturbance to the animals. This paper aims to present an innovative, non-invasive remote sensing method for monitoring, identifying, and counting wildlife, with a specific focus on red deer (*Cervus elaphus*), while maintaining adaptability for other large mammal species. The proposed methodology is based on the deployment of unmanned aerial vehicles (UAVs) equipped with an advanced dual-camera system: a thermal (infrared) sensor and a high-resolution RGB (standard visual light) camera. During autonomous flights over selected habitats, the thermal sensors enable the detection of the animals' distinct heat signatures, successfully overcoming challenges posed by dense canopy cover, undergrowth, and low-visibility or nocturnal conditions. Simultaneously, the high-definition RGB camera provides sharp visual data used for detection validation, precise species identification, age and sex structure estimation, and detailed terrain analysis. By integrating and synchronizing these recordings, the system allows for precise spatial mapping and real-time counting of individuals without disrupting their natural behavior or habitat. Field testing conducted across diverse forest layouts confirmed that the dual-sensor integration significantly reduces false positives caused by inanimate thermal objects. Across four test flights comprising 5,802 synchronized RGB–thermal frame pairs and 26 detectable individuals, the two sensors produced 94 raw detection tracks, while cross-modal confirmation retained 30 tracks, all of which corresponded to ground-truth individuals. The results of this study demonstrate that this combined approach significantly optimizes data collection efficiency compared to traditional methods, while maintaining high detection accuracy. Furthermore, it substantially reduces field survey time and minimizes operational costs. The proposed model is intended to prove highly reliable and efficient, establishing new standards in the fields of sustainable game management, biodiversity conservation, and ecological monitoring.

Keywords: Unmanned aerial vehicles (UAVs), thermal imaging, red deer (*Cervus elaphus*), wildlife counting, non-invasive monitoring



PRECISION INSECT FARMING: AUTOMATED LARVAL ESTIMATION USING MULTI-CHANNEL YOLOv11

MARKO VUKADINović^{1*}, NIKOLA SANTRAC¹, PAVEL BENKA¹, MIROSLAVA POLOVINSKI HORVATOVIĆ¹, KONSTANTIN NIKOLIĆ¹, MILOŠ PETROVIĆ¹, DEJAN BEUKOVIĆ¹

¹University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

*Corresponding author: marko.vukadinovic@stocarstvo.edu.rs

SUMMARY

Driven by rising global food demand, insects are gaining traction as an alternative protein source for food and feed. Today, the insect industry is at a crossroads, mirroring the status of poultry production six decades ago. Given that the yellow mealworm is among the most widely cultivated species, maximizing its production yield requires a better understanding of its nutritional needs. Investigating these needs involves rigorous experimentation, where precise population tracking is fundamental for obtaining reproducible results. Counting larvae has been limited to total manual counting or sample-based estimation. Manual counts are impractical for large-scale operations, whereas approximation methods frequently reduce measurement accuracy and experimental repeatability. To automate larval abundance estimation, this study applied a computer vision-based detection approach using a YOLOv11n model. The image dataset consisted of two subsets: Dataset 1 contained 108 images of yellow mealworm larvae, while Dataset 2 contained 24 additional images of the same larvae photographed several weeks later. During data preparation, five images were first manually annotated and used to train an initial model, which then supported and accelerated the labeling of the remaining images. All annotations were subsequently checked and corrected manually using bounding boxes. The final dataset was split into 91 training images, 19 validation images, and 22 test images. Model training was performed using eight-channel input data composed of R, G, B, SobelX, SobelY, Canny, BlackHat, and Saturation channels. Although the maximum number of training epochs was set to 200, training stopped after 138 epochs because no further improvement was observed. At a confidence threshold of 0.57, the trained model achieved a test counting accuracy of 97.5%, with a mean per-image accuracy of 97.9%. Individual-image counting accuracy ranged from 95.1% to 100%. The confusion matrix included three classes: worm, worm-under, representing larvae positioned below or overlapping with other larvae, and background. It showed 4,146 correctly detected worm instances and 3 correctly detected worm-under instances. In addition, 244 worm and 23 worm-under instances were missed as background, while 352 background detections were classified as worm and 14 as worm-under. Misclassification between the two larval classes was limited, with 5 worm instances predicted as worm-under and 28 worm-under instances predicted as worm.

Keywords: Yellow mealworm, Larval abundance estimation, Computer vision, YOLOv11



ANALYSIS OF WINTER SURVIVAL OF HONEY BEE COLONIES IN THE SOUTH BAČKA DISTRICT

IVAN PIHLER^{1*}, NADA PLAVŠA¹, JELENA PURAĆ², DANIJELA KOJIĆ², JELENA SPREMO², SRDANA ĐURĐEVSKI², ELVIRA VUKAŠINOVIĆ

¹ University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

² University of Novi Sad, Faculty of Science, Trg Dositeja Obradovića 3, Novi Sad, Serbia

* Corresponding author: ivan.pihler@stocarstvo.edu.rs

SUMMARY

The aim of this study was to analyze the causes of honey bee colony losses during the winter of 2024/2025 in the South Bačka District. Data were collected through surveys of beekeepers and by assessing the condition of honey bee colonies after the wintering period. The study included apiaries of different sizes and production orientations.

The results showed that colony losses during the observed period were significantly higher than the long-term average. The most frequently identified causes of colony mortality were high infestation with *Varroa destructor*, the occurrence of viral diseases associated with varroa infestation, a lack of high-quality pollen sources during the previous season, unfavorable climatic conditions, as well as deficiencies in beekeeping management practices and colony preparation for wintering.

The obtained results indicate the need to improve varroa control measures, ensure adequate bee nutrition throughout the year, and apply modern beekeeping practices in order to reduce winter losses. This study provides valuable information on the current state of beekeeping in the South Bačka District and may serve as a basis for developing strategies aimed at preserving the health and productivity of honey bee colonies.

Keywords: honey bee colonies, winter losses, climate change, *Varroa destructor*, South Bačka District.



INFLUENCE OF FARM ON THE FATTY ACID PROFILE OF COW'S MILK

KSENİJA ČOBANOVIĆ¹, DENIS KUČEVIĆ, MIRKO IVKOVIĆ, TAMARA PAPOVIĆ,
NIKOLA DAVIDOV*

¹University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

*Corresponding author: ksenija.cobanovic@stocarstvo.edu.rs

SUMMARY

Many studies have indicated a relationship between enteric methane production and milk fatty acid compositions in milk. This work aims to determine the influence of the farm on the fatty acid composition in cow's milk, which is correlated with methane emission. Milk samples were taken from 13 farms as part of regular dairy herd improvement (DHI) control of milk production; a total of 5702 samples were analyzed. The content of milk fat, as well as short-chain (SCFA), medium-chain (MCFA), and long-chain (LCFA) fatty acids, as well as the content of fatty acids C14:0, C16:0, C18:0 and C18:1 was determined using a MilkoScan analyzer (FTIR). The average content of milk fat in the analyzed milk samples was $3.82 \pm 0.93\%$, while the content of SCFA was $0.34 \pm 0.11\%$, MCFA $1.48 \pm 0.42\%$, and LCFA $1.44 \pm 0.47\%$. The average content of fatty acids positively correlated with methane emission was $0.38 \pm 0.10\%$ for C14:0 and $0.96 \pm 0.30\%$ for C16:0, whereas fatty acids negatively correlated with methane emission averaged $0.42 \pm 0.14\%$ for C18:0 and $0.86 \pm 0.32\%$ for C18:1. The results showed that the farm has a significant influence ($p < 0.01$) on the content of the observed groups of fatty acids, as well as on the content of individual fatty acids. Farm management, particularly nutrition, can influence the profile of specific fatty acids in milk, suggesting that dietary adjustments may reduce methane emissions.

Keywords: milk fat, fatty acids, methane emission



WET VERSUS DRY AGEING: EFFECTS ON PHYSICOCHEMICAL, MICROBIAL, AND SENSORY QUALITY OF COMMON ELAND (*Taurotragus oryx*) MEAT

THONISO CHITAMBALA¹, ABUBAKAR .S. MUSA¹, GLINDYS .V. LUCIANO¹, DANIEL BUREŠ^{2,3}, LOUWRENS.C. HOFFMAN⁴, EVA SKŘIVANOVÁ^{5,6}, KLÁRA URBANOVÁ⁷, TERSIA KOKOŠKOVÁ^{1,*}

¹Department of Wildlife and Animal Sciences, Faculty of Tropical Agrisciences, Czech University of Life Sciences, Prague, Kamýcká 129, Prague – Suchdol, 165 00, Czech Republic;

²Department of Food Science, Faculty of Agrobiology, Food and Natural Sciences, Czech University of Life Sciences Prague, Kamýcká 129, Prague – Suchdol, 165 00, Czech Republic.

³Department of Cattle Breeding, Institute of Animal Science, Přátelství 815, 104 00 Prague, Czech Republic;

⁴Centre for Nutrition and Food Sciences, Queensland Alliance for Agriculture and Food Innovation (QAFI), The University of Queensland, Digital Agricultural Building, 8115, Office 110, Gatton 4343, Australia;

⁵Department of Microbiology, Nutrition and Dietetics, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague, Czech Republic;

⁶Department of Nutritional Physiology and Animal Product Quality, Institute of Animal Science, Přátelství 815, 104 00 Prague, Czech Republic

⁷Department of Sustainable Technologies, Faculty of Tropical Agrisciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 21 Prague-Suchdol, Czech Republic.

*Corresponding author: email address: kokoskova@ftz.czu.cz

SUMMARY

This study evaluated the effects of wet and dry ageing on the physicochemical, microbial, volatile, and sensory quality of common eland (*Taurotragus oryx*) *longissimus lumborum* (LL) muscle, focusing on safety, tenderness, color, flavor, and acceptability. Female eland ($n = 6$) LL muscles were aged using wet (vacuum-packed) and dry ageing at 4°C for 14 days post-mortem. Meat quality was assessed using pH, cooking loss, weep loss, CIE Lab* color, Warner–Bratzler shear force, total bacterial load, volatile compounds and descriptive sensory analysis. Both wet and dry ageing produced microbiologically safe eland meat ($<7 \log \text{CFU/g}$). Dry ageing led to greater moisture and weep loss, indicating higher processing losses, while both treatments resulted in darker, redder meat, with minimal differences between ageing methods. Tenderness improved during ageing, but shear force values remained above the consumer acceptability threshold ($>49\text{N}$), indicating persistent toughness. Although sensory scores for tenderness and flavor intensity were similar between treatments, dry-aged meat showed improved aroma quality, with lower levels of abnormal and liver-like flavors, leading to higher overall acceptability. Volatile analysis supported these results, suggesting that wet ageing may contribute to the formation of less desirable aroma compounds. Dry ageing enhanced selected sensory attributes, particularly aroma and acceptability, but increased processing losses. While ageing enhances eland meat quality, additional processing strategies or optimized ageing systems, such as semi-permeable packaging, are required to improve tenderness and balance flavor development with economic efficiency.

Keywords: meat ageing, alternative livestock, food chemistry, game meat, *Longissimus lumborum* muscle



IMMUNOCASTRATION AS A WELFARE MANAGEMENT TOOL IN FALLOW DEER (*Dama dama*)

THONISO CHITAMBALA¹, VEIT NY^{1,3}, FRANCISCO CEACERO¹, LUDEK BARTON³,
DANIEL BUREŠ^{2,3}, RADIM KOTRBA^{1,4} AND TERSIA KOKOŠKOVÁ^{1,*}

¹Department of Wildlife and Animal Sciences, Faculty of Tropical Agrisciences, Czech University of Life Sciences, Prague, Kamýcká 129, Prague – Suchbát, 165 00, Czech Republic;

²Department of Food Sciences, Faculty of Agrobiological Sciences, Food and Natural Sciences, Czech University of Life Sciences Prague, Kamýcká 129, Prague – Suchbát, 165 00, Czech Republic.

³Department of Cattle Breeding, Institute of Animal Science, Přátelství 815, 104 00 Prague, Czech Republic;

⁴Department of Ethology, Institute of Animal Science, 104 00 Prague, Czech Republic

*Corresponding author: e-mail address: kokoskova@ftz.czu.cz

SUMMARY

Immunocastration is a non-surgical method of reproductive control with potential applications in the welfare-oriented management of captive ungulates. This study evaluated the effects of immunocastration on reproductive function in captive fallow deer (*Dama dama*). Forty-four bucks (10 months old; 22.9 ± 2.4 kg) were assigned to immunocastrated and intact treatment groups within a factorial experimental design. Immunocastrated animals received Improvac[®] at weeks 1, 8 and 20. At slaughter, body size, antler development, testicular characteristics, sperm quality, and seminiferous tubule morphology were assessed. Immunocastration did not reduce gross testis size; however, it resulted in marked impairment of reproductive function. Immunocastrated animals exhibited reduced sperm viability, atrophied seminiferous tubules, and paler testicular tissue, suggesting reduced testicular activity. Sperm morphology remained largely unaffected. Animals with greater body size and antler development also exhibited more advanced testicular development.

These findings demonstrate that immunocastration can effectively impair reproductive function in captive fallow deer despite limited effects on testis size, supporting previous evidence that morphological measures alone are unreliable indicators of immunocastration efficacy. Immunocastration therefore represents a promising welfare-oriented reproductive management strategy for captive deer populations and may provide a practical alternative to surgical castration in managed systems.

Keywords: cervids, reproduction, animal welfare, immunocastration



PEDIGREE-BASED ASSESSMENT OF THE GENETIC STATUS OF BUŠA CATTLE IN CROATIA

ANTE IVANKOVIĆ^{1*}, ZDENKO IVKIĆ², NIKOLINA KELAVA UGARKOVIĆ¹,
MILJENKO KONJAČIĆ¹

¹Department of Animal Science and Technology, University of Zagreb Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia

²Croatian Agency for Agriculture and Food, Vinkovačka Cesta 63c, Osijek, Croatia

*Corresponding author: aivankovic@agr.hr

SUMMARY

Buša is one of three autochthonous Croatian cattle breeds. Due to its frugality, adaptability, and the support of current livestock production support schemes, it has been recognised as a valuable breed in terms of genetic resources and the concept of sustainable production. Over the past two decades, its population has grown from only around a hundred animals to nearly 6,200 breeding-valid adult animals in 2025. The aim of this study was to determine the current status of the Buša population based on available pedigree data. Pedigree analysis was conducted using the ENDOG v4.8 software and included approximately 20,500 pedigree records. The mean inbreeding coefficient (F) was 2.43%, while the mean average relatedness coefficient was 3.84%. The generation interval was estimated at 5.69 ± 3.44 years, and the mean age of parents at offspring birth was 5.67 ± 3.29 years. The annual rate of increase in inbreeding (ΔF) was +0.12% per year, corresponding to approximately 0.7% per generation. The results indicate a moderate but controlled level of inbreeding within the Buša population, which is a favourable indicator given the breed's substantial population growth over the past period. Continuous monitoring of pedigree parameters, together with appropriate breeding management measures, is essential for preserving genetic diversity and ensuring the long-term sustainability of this autochthonous breed.

Keywords: autochthonous breed, pedigree analysis, inbreeding, genetic diversity



FATTY ACID PROFILE AND HEALTH LIPID INDICES OF HORSE AND DONKEY MEAT

MATEJA PEĆINA^{1*}, GORDAN ŠUBARA², JELENA RAMLJAK¹, ANTE IVANKOVIĆ¹

¹Department of Animal Science and Technology, University of Zagreb Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia

²Agency for Rural Development of Istria, Ulica Tugomila Ujčića 1, 52000 Pazin, Croatia

*Corresponding author: matejapecina@agr.hr

SUMMARY

The consumption of equid meat often raises ethical dilemmas among consumers regarding its appropriateness, although research indicates their unquestionable nutritional value. In Croatia, autochthonous coldblood horse and donkey breeds are mainly used for meat production destined for export to foreign markets. The aim of this study was to examine the fatty acid composition of horse and donkey meat. The study was conducted on *m. longissimus thoracis* meat samples taken from 10 Croatian Posavina horses and 10 Istrian donkeys. Total lipids were extracted from the meat using a chloroform/methanol solvent system. Lipid extracts were analysed by gas chromatography (Agilent 8860). The fatty acid composition of horse and donkey muscle tissue showed a similar share of total saturated and total unsaturated fatty acids, as well as a comparable atherogenic index ($p=0.974$). Donkey meat contained a higher proportion of linoleic acid ($p<0.01$) and a lower proportion of α -linolenic acid ($p<0.001$) compared to horse meat, resulting in a considerably less favourable ω -6/ ω -3 fatty acid ratio (9.8 vs 3.4; $p<0.001$) and a higher thrombogenic index ($p=0.012$). Horse meat additionally contained a higher proportion of monounsaturated fatty acids ($p<0.05$). Although horse and donkey meat did not differ in atherogenic potential, the more favourable ω -6/ ω -3 ratio and lower thrombogenic index indicate a nutritionally more favourable, cardioprotective fatty acid profile of horse meat compared to donkey meat.

Keywords: equid meat, fatty acid profile, index, ω -6/ ω -3 ratio



EFFECTS OF PHOSPHORUS-ENRICHED AGAR ON THE POPULATION DYNAMICS OF *TENEbrio MOLITOR*

MARKO DAMJANOVIĆ, DARKO GULJAŠ, KONSTANTIN NIKOLIĆ, BORISLAV ILIČIĆ, DEJAN BEUKOVIĆ, MILOŠ PETROVIĆ

University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

*Corresponding author: marko.damjanovic@stocarstvo.edu.rs

SUMMARY

Edible insects have attracted considerable attention in sustainable agriculture due to the high protein and lipid content of their larval stage, making them a promising source of animal feed. Optimizing their production requires a better understanding of nutritional factors, especially minerals which play essential roles in regulating physiological processes. This study evaluated the effects of phosphorus supplementation, an essential macro mineral involved in numerous metabolic processes, on the population performance of *Tenebrio molitor*. The experiment was conducted at 25 °C and 60% relative humidity, using 50 g/tray of wheat bran as dry feed and an agar cube as the moisture source. Four replicates were established, each consisting of 25 adults of undetermined sex, reared under controlled laboratory conditions at 26 °C and 55% relative humidity. The experimental groups received agar cube weighing approximately 2 g supplemented with ten different phosphorus concentrations (0.05; 0.1; 0.2; 0.35; 0.5; 0.6; 0.7; 0.8; 0.9 and 1%), while the control group received agar cubes without phosphorus supplementation. However, the agar cube mass was increased from approximately 2 g to 3 g by the end of the experimental period to maintain an adequate moisture supply. Larval number and average individual larval mass were recorded for each treatment; individual mass was calculated by dividing total larval biomass by the number of larvae produced. Larval number was highest in the control group (1028.5 ± 186.78 larvae/tray) and gradually declined with increasing phosphorus concentration, with 878.5 ± 149.09 larvae/tray at 0.1% and an intermediate value of 416.0 ± 169.22 larvae/tray at 0.5%, whereas the lowest value was observed at 62.5 ± 14.73 larvae/tray at 1%. Individual larval mass was highest at 0.2% phosphorus (0.0259 ± 0.003 g) and lowest at 1% phosphorus (0.0138 ± 0.003 g). Although mean larval mass was numerically higher at 0.05%, 0.1%, and 0.2% phosphorus than in the control, the difference was not statistically significant (Tukey's post hoc test, $P > 0.05$). No pupae were recorded in any treatment by the end of the experimental period. Overall, phosphorus supplementation did not improve larval production or reproductive performance of *T. molitor*, suggesting that additional phosphorus in agar-based supplementation may not be necessary for optimizing mealworm rearing systems.

Keywords: edible insects, mealworms, minerals



THE AQUACULTURE IN MONTENEGRO: CURRENT STATE, CHALLENGES, AND EU PERSPECTIVES

MIROSLAV UROŠEVIĆ^{1*}, DANILO MRDAK², SLADANA GVOZDENOVIĆ NIKOLIĆ³,
RADOŠ MIKOVIĆ⁴, MILAN ROGOSIĆ⁵

¹University of Novi Sad, Faculty of Agriculture, Dep. of Animal Science, Trg Dositeja Obradovića 8, Novi Sad, Serbia

²University of Montenegro, Faculty of Natural Sciences and Mathematics, Bul. Džordža Vašingtona, bb., Podgorica, Montenegro

³University of Montenegro, Institute of Marine Biology Kotor, Put I bokeljske brigade 68, Dobrota, Kotor, Montenegro

⁴Specialist Veterinary Laboratory, Bul. Džordža Vašingtona, bb., Podgorica Montenegro

⁵Directorate for Food Safety, Veterinary and Phytosanitary Affairs, Srdara Jola Piletića 26, Podgorica, Montenegro

*Corresponding author: miroslav.urosevic@stocarstvo.edu.rs

SUMMARY

The aquaculture sector in Montenegro demonstrates stable economic vitality, serving as an important pillar of national agricultural production. According to MONSTAT data for 2024, freshwater production reached 842 tonnes of rainbow trout (*Oncorhynchus mykiss*), valued at EUR 3.92 million. Conducted within the COST Action "BIOAQUA," this study evaluates operational performance across ten representative farms utilizing concrete raceways and hatcheries. A primary focus is the integration of European biosecurity and animal welfare standards, guided by the principle that prevention outweighs cure. Disease control aligns with European Union regulations, reinforced by regular inspections from the Specialist Veterinary Laboratory in Podgorica and supervision by the State Food Safety, Veterinary and Phytosanitary Administration. While management remains largely practical and self-taught, producers show a proactive transition toward professionalization and express strong optimism regarding EU accession for modernization support. Furthermore, the research highlights sector resilience, noting low mortality rates (3 - 5%) and the implementation of fundamental food safety principles. By addressing educational gaps and waste management infrastructure, Montenegro is well-positioned to optimize its aquatic resources. Ultimately, strategic modernization will transform domestic aquaculture into a competitive, sustainable agriculture sector, enhancing its presence in regional trade.

Keywords: Rainbow Trout, biosecurity protocols, veterinary control

Acknowledgments: This publication is based upon work from COST Action "BIOAQUA", CA22160, supported by COST (European Cooperation in Science and Technology) and funded by the Ministry of Education, Science and Technological development of Serbia (The Contract No. 451-03-34/2026-03/200117 dated 05.02.2026.)



INTEGRATION OF CAMERA-TRAP WILDLIFE MONITORING AND OPEN SCIENCE PRINCIPLES FOR BIODIVERSITY DATA MANAGEMENT

BORISLAV ILIČIĆ, KONSTANTIN NIKOLIĆ, MARKO VUKADINOVIĆ, DARKO
GULJAŠ, MARKO DAMJANOVIĆ, DEJAN BEUKOVIĆ*

University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

**Corresponding author: borislav.ilicic@stocarstvo.edu.rs*

SUMMARY

Long-term wildlife monitoring provides essential information for understanding biodiversity dynamics and forms the basis for evidence-based decision-making in nature conservation and wildlife management. Camera traps are among the most effective non-invasive methods for collecting reliable field data; however, the long-term scientific value of camera-trap datasets depends on standardized documentation, metadata quality, and public accessibility. The aim of this study was to demonstrate how Open Science principles can improve the accessibility, transparency and long-term usability of wildlife monitoring data. Between 2023 and 2025, within the DALIA project, a network of ten camera traps was deployed during 17 camera-trap deployments across an approximately 4.9 km² area of Begečka Jama Nature Park, Serbia. A total of 621 images and videos representing 12 wildlife species were collected, providing valuable information on species occurrence and spatial distribution. Images and videos were manually identified to species level and organized using standardized metadata, including species identification, geographic coordinates, number of individuals, date and time of recording, habitat description, and a unique record identifier. The complete dataset was deposited in the Zenodo repository and assigned a persistent Digital Object Identifier. This workflow demonstrates how Open Science practices and camera-trap monitoring can be used to create a long-term, reusable, and accessible scientific resource that supports data sharing, research transparency, biodiversity assessment, and integration with global biodiversity databases.

Keywords: camera traps, open science, zenodo, wildlife management



COMPARATIVE ANALYSIS OF RED DEER GAME MANAGEMENT (*Cervus elaphus* L.) IN HUNTING GROUNDS „VALMIŠTE“ AND „KARAKUŠA“

VUKAN LAVADINOVIC¹*, DEJAN BEUKOVIC², ZORAN POPOVIC³, MILAN MILIC⁴,
BORKO VLAJNIC⁵

¹ University of Belgrad, Faculty of Forestry, Kneza Višeslava 1, Belgrade, Serbia

² University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

³ University of Belgrad, Faculty of Agriculture, Nemanjina 6, Belgrade, Serbia

⁴ Forest Management „Srbijašume“ LLC Belgrade, FE „Šuma“ Leskovac, Deligradska 1, Leskovac, Serbia

⁵ Public enterprise „Vojvodinašume“, FE „Sremska Mitrovica“, Parobrodska 2, Sremska Mitrovica, Serbia

*Corresponding author: vukan.lavadinovic@sfb.bg.ac.rs

SUMMARY

Red deer (*Cervus elaphus* L.) is considered one of the most important game species in the Serbian hunting sector. It is one of the four autochthonous wild ruminants and the largest herbivore in Serbian forest ecosystems, where it is regarded as a keystone species. Moreover it has a considerable economical value and represents a symbol of prestige and traditional hunting. Despite its importance, the red deer population remains below the carrying capacity of suitable habitats, while the abundance was until recently restricted to fenced hunting grounds managed by state forest enterprises and national parks. In recent years several reintroduction programmes tended to restore red deer populations in various areas from which it had disappeared. In this study we analyzed the red deer management in two ecologically different habitats in order to identify impact of habitat characteristics on game management practices. Data were collected from the management plans of two fenced hunting grounds: the mountainous hunting ground "Valmište", managed by the state-owned limited liability company "Srbijašume", and the lowland hunting ground "Karkuša", managed by the public enterprise "Vojvodinašume". The management plans have similar durations (2021–2031 for "Valmište" and 2024–2034 for "Karkuša"), making them suitable for comparative analysis. The findings indicate that similar management practices are implemented in both hunting grounds, resulting in similar sex ratio, population structure and reproductive coefficient. However the outcome of management are not similar, since the difference between planned and realized shooting quota in mountainous hunting ground is much higher.

Keywords: Red deer, fenced hunting grounds, game management, hunting



RURAL TOURISM AS A DRIVER OF AGRICULTURAL DEVELOPMENT

DRAGO CVIJANOVIĆ^{1}, BOJANA OSTOJIĆ², GORICA CVIJANOVIĆ³*

¹ University of Kragujevac, Faculty of Hotel Management and Tourism, Vrnjačka Banja, Serbia

² Educons University, Faculty of Project and Innovation Management, Belgrade, Serbia

³ University of Bijeljina, Faculty of Agriculture, Bijeljina, Republika Srpska - Bosnia and Herzegovina

*Corresponding author: dvcmmv@gmail.com

SUMMARY

Rural tourism represents an important instrument for income diversification and the advancement of sustainable agricultural development. In contemporary conditions, agricultural holdings face numerous challenges - from declining profitability of traditional production to the need for innovation and adaptation to market demands. In this context, rural tourism enables farmers to expand their activities through the provision of tourist services, promotion of local products, and preservation of cultural and natural heritage. The aim of this paper is to analyze the significance of rural tourism as a factor in agricultural development, to identify key economic, social, and ecological effects, and to highlight opportunities for improving support policies.

The analysis was conducted through a case study of Gralo Farm in Divci near Valjevo and a review of relevant literature, providing insight into practical models of circular rural tourism and sustainable agriculture. The integration of tourism and agriculture enhances economic diversification, creates new jobs, and strengthens local communities. At the same time, it fosters the development of short supply chains, direct sales of domestic products, and greater recognition of agricultural resources in the market. Rural tourism also has a broader social dimension - it strengthens the identity of rural areas, promotes social responsibility, and contributes to environmental protection through sustainable practices. Findings indicate that integrating tourism into agriculture contributes to greater stability of farms, increased visibility of local products, and new opportunities for community development. Rural tourism, through synergy with agriculture, can become a strategic mechanism for competitiveness, innovation, and long-term sustainability of rural holdings.

Keywords: rural tourism, agriculture, sustainable development, local community, economic diversification



NATURE-BASED SOLUTIONS FOR CLIMATE-RESILIENT RUMINANT PRODUCTION: THE SLOVAKIAN CASE OF LIFE+ PROJECT

FRANCESCO VIZZARRI *, ZUZANA FORMELOVA, ZUZANA MLYNEKOVA, ROMAN MLYNAR, LUBOMIR ONDRUSKA

Division of Animal Nutrition and Small Livestock, National Agricultural and Food Centre (NPPC), Hlohovecká 2, 951 41 Lužianky, Slovak Republic

**Corresponding author: francesco.vizzarri@nppc.sk*

SUMMARY

The valorisation of agricultural by-products represents a promising nature-based solution that supports circular bioeconomy principles while reducing waste generation and dependence on conventional feed resources. This communication presents the research framework of the LIFE24-IPC-SK-NatAdaptSK project, coordinated by the National Agricultural and Food Centre (NPPC), which aims to promote climate change adaptation in Slovak agriculture through innovative nature-based solutions. Within the livestock production component, the project focuses on the utilisation of fruit processing by-products, including apple, aronia, and blackberry residues, as alternative feed resources for dairy cows and sheep. The planned research combines laboratory characterisation, feed technology development, and on-farm validation. Fruit agro-by-products and experimental silages will be comprehensively evaluated for their chemical composition, fermentation quality, antioxidant properties, fatty acid and amino acid profiles, ruminal degradability, intestinal digestibility, and biological activity. Innovative silages incorporating fruit residues, microbial inoculants, and wheat straw will be optimised through controlled fermentation trials to identify formulations that maximise nutritional value, stability, and animal acceptability. The developed feeding strategies will subsequently be assessed in dairy cattle and sheep under commercial farming conditions. Animal trials will investigate productive performance, milk quality, reproductive efficiency, welfare indicators, blood biochemical profiles, and responses to climatic stress. Simultaneously, environmental and farm management parameters, including temperature-humidity index, seasonal effects, and milkability characteristics, will be monitored to evaluate the effectiveness of the proposed adaptation measures under practical production conditions. By transforming underutilised fruit by-products into valuable feed ingredients, the project seeks to improve feed resource efficiency, lower production costs, reduce environmental impacts, and strengthen climate resilience within livestock systems. The expected outcomes include validated feeding technologies, technical guidelines for farmers, and transferable nature-based solutions that contribute to sustainable animal production and support the transition towards a circular and bio-based agricultural economy.

Keywords: nature-based solutions, circular bioeconomy, climate adaptation, innovative feed systems



USE OF GENOMIC DATA TO ESTIMATE THE EFFECTIVE POPULATION SIZE OF THE VLAŠKO-VITOROGA PRAMENKA SHEEP POPULATION

DRAGAN STANOJEVIĆ^{1*}, NIKOLIJA GLIGOVIĆ¹, RADICA ĐEDOVIĆ¹, VLADAN BOGDANOVIĆ¹, KRSTINA ZELJIĆ STOJILJKOVIĆ², LJUBA ŠTRBAC³

¹ University of Belgrad, Faculty of Agriculture, Nemanjina 6, Belgrade, Serbia

² Institute for Animal Husbandry, Autoput Beograd Zagreb 16, Belgrad, Serbia

³ University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

*Corresponding author: stanojevic@agrif.bg.ac.rs

SUMMARY

The Vlaško-Vitoroga Pramenka is a sheep genotype highly adapted to harsh climatic conditions and low-input production systems. Today, it is predominantly raised in the Deliblato Sands region of the Republic of Serbia. According to official records, the total population of this genotype comprises approximately 1,000 animals. Given its small population size, knowledge of its effective population size is essential for its long-term conservation and the efficient management of this important genetic resource. The aim of this study was to use genomic data to estimate the effective population size as accurately as possible. Biological samples were collected from 30 animals (28 ewes and two rams) using nasal swabs. Following DNA extraction, the animals were genotyped using the GGP Ovine 50K chip. SNP data quality control showed that all animals had call rates above 90%, while 3,572 SNPs had a minor allele frequency below 0.01 and were therefore excluded from further analysis. Effective population size was estimated using NeEstimator v2.1. The contemporary effective population size, estimated using the linkage disequilibrium method with an allele frequency threshold of $P_{crit} = 0.02$, was $N_e = 97.7$, with a jackknife 95% confidence interval ranging from 70.9 to 152.1. The effective population size is close to the threshold of 100, below which the loss of heterozygosity accelerates. This does not mean that the breed is at immediate risk of extinction; rather, without appropriate management, it will gradually lose genetic diversity and adaptive capacity. Therefore, particular attention should be devoted to the genetic management of this highly valuable genetic resource.

Keywords: Effective population size, SNP, vlaško-vitoroga pramenka



**ESSENTIAL OIL FORMULATIONS
AS ANTIBIOTICS ALTERNATIVES: ANTIMICROBIAL ACTIVITY
AND PHARMACOECONOMIC EVALUATION AGAINST
AVIAN PATHOGENIC *ESCHERICHIA COLI***

ZORANA KOVAČEVIĆ^{1*}, MARKO PAJIĆ², ZORAN RUŽIĆ¹, NEBOJŠA KLADAR³,
SLOBODAN KNEŽEVIĆ², MILENKO RIKIĆ², DALIBOR TODOROVIĆ²

¹ Department of Veterinary Medicine, Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia

² Scientific Veterinary Institute Novi Sad, Novi Sad, Serbia

³ Center for Medical and Pharmaceutical Investigations and Quality Control / Department of Pharmacy, Faculty of Medicine, University of Novi Sad, Novi Sad, Serbia

*Corresponding author: zorana.kovacevic@polj.edu.rs

SUMMARY

Avian colibacillosis, caused by avian pathogenic *Escherichia coli* (APEC), is one of the most economically significant diseases in poultry production due to mortality, decreased production and antibiotic treatments cost. Zoonotic potential of *Escherichia coli*, high degree of antimicrobial resistance and ban on antibiotic growth promoter in poultry has prompted search for effective, natural alternatives. Antibacterial activity of selected essential oils (EOs) against multidrug-resistant (MDR) APEC isolates and pharmacoeconomic analysis parameters of alternative and conventional antibiotic therapy were assessed. Antimicrobial activity of oregano, thyme, cinnamon, rosemary, lavender and lemon EOs was determined against seven MDR APEC isolates using broth microdilution method according to standard CLSI guidelines. Minimum inhibitory concentrations (MICs) were recorded after incubation. Based on *in vitro* efficacy, two oregano-thyme formulations were developed, with Formulation 2 containing twice the amount of oregano while maintain same quantity of thyme. Cost-benefit analysis (CBA) evaluate relevant pharmacoeconomic parameters. Oregano and thyme EOs exhibited highest antimicrobial potency (MIC <1%) against all tested MDR APEC isolates, while other EOs did not inhibit bacterial growth at initial concentration of 1%. Both formulations retained inhibitory activity, although Formulation 1 showed one-dilution higher MIC, indicating lower potency due to reduced oregano content. CBA incorporated direct treatment costs, mortality, feed conversion ratio, production losses, and reduced antibiotic consumption, with all outcomes converted into monetary units for comparative evaluation. Oregano-thyme EOs formulations demonstrated *in vitro* and *in vivo* efficacy against MDR APEC supporting their use in antimicrobial stewardship strategies.

Keywords: avian colibacillosis, antimicrobial stewardship, cost-benefit analysis

Acknowledgements: This work was supported by the Provincial Secretariat for Higher Education and Scientific Research of the Autonomous Province of Vojvodina, Republic of Serbia, under the project "Pharmacological and pharmacoeconomic potential of essential oils as an alternative to antibiotics in the control of poultry colibacillosis" (Project No. 003877403 2025 09418 003 000 000 001 04 002), and by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia under Contract No. 451-03-34/2026-03/200117, dated 05 February 2026.



GENOME-WIDE GENETIC DIVERSITY AND POPULATION STRUCTURE IN WILD BOARS FROM TÜRKİYE

YASİN DEMİRBAŞ^{1*}, AYÇA ÖZKAN KOCA², HİLAL GÜMÜŞ¹, ELİF AKYÜZ¹, FRANZ SUCHENTRUNK³, MILOMIR STEFANOVIĆ⁴

¹Department of Biology, Faculty of Engineering and Natural Sciences, Kırıkkale University, 71450 Yahşihan, Kırıkkale, Türkiye

²Department of Gastronomy and Culinary Arts, Faculty of Fine Arts, Maltepe University, 34857 Maltepe, İstanbul, Türkiye

³Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, 1160 Vienna, Austria

⁴Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, 21000 Novi Sad, Serbia

*Corresponding author: ydemirbas71@hotmail.com; yasdemirbas@kku.edu.tr

SUMMARY

Wild boar (*Sus scrofa*) is widely across Turkish Thrace and Anatolia and represents one of the most important game species in the region. Previous research based on mitochondrial DNA sequences revealed genetic differentiation between wild boars from Thrace and Anatolia, with the Bosphorus, Sea of Marmara, and Dardanelles waterway acting as an effective barrier to natural gene flow. However, studies based on nuclear molecular markers are still lacking. Here, we analyzed 48 wild boars (11 from Thrace and 37 from Anatolia) using the Illumina Porcine SNP Array to assess genetic diversity and population structure using the hierfstat, ADMIXTURE and TESS R packages. Overall observed heterozygosity (H_o) and expected heterozygosity (H_e) were 0.304 and 0.341, respectively. Genetic structure analyses indicated two genetic clusters corresponding to Turkish Thrace and Anatolia, with moderate genetic differentiation between them ($F_{ST} = 0.065$). Wild boars from Turkish Thrace exhibited slightly higher genetic diversity ($H_o = 0.308$, $H_e = 0.344$) than those from Anatolia ($H_o = 0.301$, $H_e = 0.339$). Individuals from Turkish Thrace showed signatures of admixture with wild boars from the Balkan Peninsula (based on analyses of an additional dataset including publicly available SNP genotypes from Balkan wild boars obtained from the corresponding publications), suggesting historical or ongoing gene flow across the region. These findings provide the first insights into the genetic structure of Turkish wild boars based on genome-wide SNP markers, while further analyses with broader geographic sampling will help to better resolve demographic history, gene flow and admixture across the Balkans and Asia Minor.

Keywords: Wild boar, genetic diversity, population structure, SNPs, Türkiye



BIOCONVERSION OF NON-FOOD BIOMASS FOR AGRICULTURAL DEVELOPMENT

BO WU¹*, ALEKSANDRA IVETIC², BLAZO LALEVI,³ MINGXIONG HE¹

¹ Biogas Institute of the Ministry of Agriculture and Rural Affairs (BIOMA), 4-13 Renmin Rd. Chengdu 610041, China

² Institute for Science Application in Agriculture, Belgrade, Serbia

³ University of Belgrade-Faculty of Agriculture, Zemun, Serbia

*Corresponding author: wubo@caas.cn

SUMMARY

Food security is a major strategic issue for China. Developing biomanufacturing based on non-food biomass resources such as straw offers an important pathway toward green and sustainable agricultural development. In the past two decades, our team has focused on the bioconversion of non-food biomass by microorganisms. In this presentation, both irrational and rational biotechnologies for engineering microbial strains will be introduced. "Irrational" technologies are based on mutagenesis and evolution methods that introduce broad genetic diversity, combined with selection for desired phenotypes. These methods do not require prior knowledge of genomic information, making them well-suited to improving cellular tolerances. Rational strategies, which are based on molecular manipulations such as CRISPR-mediated gene editing and synthetic biology enabling tools, also help improve strain capabilities. Then, several examples of non-food biomass valorization by engineered microbial strains are presented. For instance, these include the development of an integrated process for ethanol-biogas-biofertilizer co-production, green biomanufacturing of lactic acid, and levan production from sucrose-rich industrial wastewater. In addition, challenges in manufacturing with non-food biomass is also discussed.

Keywords: Non-food biomass, synthetic biology, biomanufacturing, sustainable agriculture.



FROM WASTE TO SOIL: THE BIOGAS-BASED CIRCULAR AGRICULTURE IN CHINA

MINGMING ZHANG¹*, HUIQIAO WANG¹

¹ Biogas Institute of Ministry of Agriculture and Rural Affairs, China

*Corresponding author: zhangmingming@caas.cn

SUMMARY

This paper presents a case study of the Dayi biomethane circular agriculture project in Sichuan Province, China, to systematically illustrate the transformative logic and practical outcomes of China's biogas industry shifting from an 'energy-first' to a 'soil-first' paradigm. China faces the dual pressures of energy security and food security, with vast rural areas generating enormous quantities of agricultural waste that urgently require resourceful utilization. The Dayi project employs mesophilic wet anaerobic digestion technology, producing biomethane along with substantial digestate solids and liquids for farmland application. This project identifies four key factors underpinning the commercial viability of biogas-based circular agriculture projects in developing countries: First, the foundational enabler lies in the integration of appropriate technologies that effectively link the biogas facility with decentralized livestock farms and dispersed farmland, establishing a complete material-energy recycling chain. Second, the core driver is the alignment of corporate business objectives with the needs of smallholder farmers and community development, achieved through a benefit-sharing mechanism that enables all stakeholders to realize increased economic returns, thereby forming a sustainable industrial value chain. Third, the project's success depends on favorable socioeconomic conditions, among which robust policy support at both national and local levels is particularly critical. Fourth, to address the current challenges of the biogas industry, future efforts should further clarify the roles and responsibilities of governments, enterprises, research institutions, and other stakeholders.

Keywords: Biogas-based Circular Agriculture, Benefit-Sharing Mechanism, Policy Enablement, China Case Study



PRODUCTION AND ECONOMIC SUSTAINABILITY OF FAMILY DAIRY FARMS IN SOUTHEASTERN EUROPE

*PERO MIJIĆ¹, MIRJANA BABAN¹, ZVONKO ANTUNOVIĆ¹, DRAŽENKO BUDIMIR²,
VLADAN BOGDANOVIĆ³, TINA BOBIĆ¹*

¹ *University of J. J. Strossmayer in Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, 31000 Osijek, Croatia*

² *University of Banja Luka, Faculty of Agriculture Banja Luka, Bulevar vojvode Petra Bojovića 1A, 78000 Banja Luka, Republic of Srpska, BiH*

³ *University of Belgrade, Faculty of Agriculture, Nemanjina ul. 6, 11080, Beograd, Serbia*

**Corresponding author: pmijic@fazos.hr*

SUMMARY

Milk production represents an important sector of livestock production in the countries of Southeast Europe, where small and medium-sized family farms play a significant economic and social role. The aim of this paper was to analyse the production and structural indicators of the dairy sector in selected Southeast European countries (Croatia, Serbia, Bosnia and Herzegovina, Slovenia, North Macedonia, and Montenegro) and to identify the key factors influencing the competitiveness and sustainability of milk production. The results of the analysis revealed a common characteristic across the dairy sector in all observed countries, namely a decline in milk production. Considerable differences exist among these countries in terms of farm size, productivity, and the level of technological development. Slovenia achieves the highest production efficiency, whereas smaller, traditionally managed farms predominate in the remaining countries. The main challenges facing the sector include a decreasing number of dairy producers, rising production costs, rural depopulation, and insufficient modernization of production systems. The future competitiveness and viability of family dairy farms will depend on farm modernization, the digitalization of production processes, the strengthening of producer organizations, sustainable resource management, and more effective utilization of national and European support measures.

Key words: milk production, economic sustainability, family farms, Southeastern Europe



PRECISION LIVESTOCK FARMING IN LAMENESS PREVENTION

TINA BOBIĆ*, PERO MIJIĆ¹, MAJA GREGIĆ¹, VESNA GANTNER¹

¹Faculty of Agrobiotechnical Sciences Osijek, Josip Juraj Strossmayer University of Osijek, Vladimira Preloga 1, 31 000 Osijek, Croatia

*Corresponding author: tbobic@fazos.hr

SUMMARY

This paper discusses the application of Precision Livestock Farming (PLF) in modern dairy production, with a focus on the early detection of lameness in dairy cows thru kinematic and kinetic methods. Intensive livestock production requires continuous investment and optimization, and PLF enables improved management, cost reduction, and better animal health control through the use of sensors, algorithms, and digital systems. Lameness is one of the most significant issues in dairy farming, with high prevalence rates and considerable economic losses. Traditional visual assessment methods are often insufficient for early detection, which has led to the development of automated detection systems. Kinematic methods include automatic recognition and analysis of temporal and spatial movement parameters such as cow gait analysis, which tracks changes in the position of specific body segments over time. Systems based on computer vision and deep learning achieve very high precision in identifying and tracking cattle. Kinetic methods analyze forces applied to the body during movement. These methods also show high sensitivity and specificity in detecting lameness, although they are less effective in identifying mild cases without long-term monitoring. the integration of these technologies can significantly reduce economic losses, improve animal welfare, and optimize production. Further development and adaptation of these systems will be essential for their wider implementation in dairy farming.

Key words: PLF, lameness, dairy cows, kinematic methods, kinetic methods



ANALYSIS OF PRODUCER INCENTIVES IN THE MILK SECTOR OF BOSNIA AND HERZEGOVINA

VESNA MRDALJ¹*, MARIJA JOVIČIĆ¹

¹Faculty of Agriculture, University of Banja Luka, vojvode Petra Bojovića 1 A, 78 000 Banja Luka, Bosnia and Herzegovina

*Corresponding author: vesna.mrdalj@agro.unibl.org

SUMMARY

The milk sector of Bosnia and Herzegovina plays an important role in agricultural production, yet it remains exposed to significant market and policy – related distortions. This paper aims to assess producer incentives in the milk sector over the period 2005 – 2024. The analysis is based on a combination of macroeconomic indicators and policy support measures, using data obtained from the Agency of statistics of Bosnia and Herzegovina, FAOSTAT and the APM database. Macroeconomic trends were analysed through production, trade and self-sufficiency ratio, while producer incentives were evaluated within the OECD PSE framework. The assessment is based on the calculation of the Nominal Rate of Protection (NRA) and Nominal Rate of Assistance (NRA), derived from a comparison of domestic farm gate prices and reference prices, complemented by budgetary transfers. The results indicate that the milk sector in Bosnia and Herzegovina has been characterised by predominantly negative price incentives, indicating the lack of effective price protection for producers. Budgetary transfers for milk production have increased over time, partially offsetting negative price incentives. Despite this, overall producer incentives remain unstable and insufficient to fully compensate for unfavourable market conditions. The findings highlight the importance of policy measures in shaping producer incentives and point to the need for more consistent and market-oriented agricultural policies aimed at improving competitiveness in the domestic milk sector.

Key words: milk sector, Self-Sufficiency Ratio, producer incentives, Nominal Rate Protection, Nominal Rate Assistance, Bosnia and Herzegovina



AUTOCHTHONOUS CATTLE BREEDS IN FUNCTION OF RURAL DEVELOPMENT

GJOKO BUNEVSKI^{1,4}, ANTE IVANKOVIĆ², ANDREJ MERGEDUSH³, BOBI
RADEVSKI⁴, ALEKSANDAR KLINCAROV⁴

¹*Faculty of of agricultural sciences and food, Skopje, RN Macedonia*

²*Faculty of agriculture, Zagreb, Croatia*

³*Faculty of agriculture and life sciences Maribor, Slovenia*

⁴*NGO NOVA KREATIVA, Skopje, RN Macedonia*

*Corresponding author: bunevskigjoko@gmail.com

SUMMARY

Animal resources were improved throughout the previous century in the direction of greater production and better quality of animal products. In this way, numerous highly productive breeds were created, which could express their productive potential only in much improved conditions of nutrition, accommodation and care. All this caused the disappearance of a large number of old autochthonous, archaic, low-productive, but mostly resistant breeds and strains of autochthonous (domestic) breeds, depopulation of rural and mountainous areas, as well as the abandonment of animal production in marginal areas. Autochthonous breeds play an important role, considering natural potentials, economic and social environment, with historical and cultural heritage, which influenced on rural tradition and agro diversity that developed over the centuries. At the end of 2025 there are only 368 registered Busha cattle and 19 domestic buffaloes in the program of book recording in the RN Macedonia. In this paper is explained first the present state of domestic cattle breeds in the RN Macedonia (two representatives of bovine species of autochthonous breeds – Busha cattle and Domestic buffalo), and in the second part is given model of protection and reaffirmation of autochthonous breeds - Istrian cattle from Croatia and Cika cattle from Slovenia. The protection and preservation of autochthonous bovine breeds contributes to the sustainability of agrobiodiversity and rural development, through their better use in organic food production, processing of their primary product to some final processed product and participation in agro tourism by forcing the sustainable concept “from field till table”, not exact like Istrian and Cika cattle example, but on its own traditional and creative way connected with our rural tradition and market demand.

Key words: Animal resources, protection, autochthonous cattle breeds, rural development



EFFECT OF SEX ON CARCASS QUALITY AND GASTROINTESTINAL TRACT MORPHOMETRY OF ROSS 308 BROILERS IN SEMI-INTENSIVE REARING SYSTEM

MARIJA JOVIČIĆ¹, MARINKO VEKIĆ^{1*}

¹ University of Banja Luka, Faculty of Agriculture, Bulevar vojvode Petra Bojovića 1A, 78000 Banja Luka, Bosnia and Herzegovina

*Corresponding author: marinko.vekick@agro.unibl.org

SUMMARY

To improve feeding and production results, it is important to know how male and female broilers differ in body growth and gastrointestinal tract (GIT) development in semi-intensive systems. Therefore, this study aimed to evaluate the effect of sex on the carcass conformation and GIT morphometric traits of Ross 308 broilers. A total of 60 broilers (30 males and 30 females), reared under semi-intensive production conditions for 49 days were analyzed. Male broilers achieved significantly higher final body and carcass weights, breast circumference, drumstick and shank measurements, as well as higher massiveness and shape indices ($P < 0.05$). However, no significant differences were found between sexes concerning carcass yield, trunk length, breast length, and compactness index ($P > 0.05$). Regarding the GIT morphometric traits, males exhibited greater absolute weights of the liver, proventriculus, and gizzard. However, when expressed relative to body weight, these differences were not significant ($P > 0.05$). While the absolute lengths of the intestinal segments were uniform across sexes ($P > 0.05$), females displayed significantly greater relative lengths of all intestinal segments ($P < 0.05$). Also, the proportional distribution of individual segments (duodenum, jejunum, ileum, ceca, and colorectum) within the total intestinal tract was similar between males and females ($P > 0.05$). Obtained results indicate sexual dimorphism in the morphological development of Ross 308 broilers reared under semi-intensive production conditions. Despite their lower body weight, female broilers achieve equivalent carcass yield and compactness, accompanied by an adaptive increase in the relative intestinal lengths. This reveals that female broilers have an equally potential for meat production, making them an acceptable choice for semi-intensive rearing systems.

Key words: broilers, sexual dimorphism, carcass quality, gastrointestinal tract, semi-intensive rearing



COMPARATIVE ANALYSIS OF JAPANESE QUAIL EGG QUALITY AMONG COMMERCIAL PRODUCERS IN BOSNIA AND HERZEGOVINA

MARINKO VEKIĆ*, MARIJA JOVIČIĆ¹

¹ University of Banja Luka, Faculty of Agriculture, Bulevar vojvode Petra Bojovića 1A, 78000 Banja Luka, Bosnia and Herzegovina

*Corresponding author: marinko.vekick@agro.unibl.org

SUMMARY

The quality of Japanese quail eggs is of great economic and nutritional importance, directly affecting profitability of farm and consumer acceptance. This study aimed to evaluate external and internal egg quality traits, determine the influence of different commercial producers on these traits, and compare these findings with current scientific data. A total of 180 eggs, laid on the same day, were collected from three commercial producers in Bosnia and Herzegovina. Birds (26–31 weeks of age) were housed in cage systems under identical farm conditions. Results showed that while average egg weight (12.16–12.28 g) did not differ significantly among producers ($P > 0.05$), significant variations ($P < 0.05$) were observed in the egg shape index (78.51–81.15%) and most structural components. Eggshell weight varied from 0.98 to 1.02 g (8.04–8.32%), and albumen weight ranged from 7.10 to 7.50 g (58.41–61.08%). Despite these structural variations, excellent quality was confirmed across all producers by high Haugh units (91.92–93.50) and Internal Quality Units (64.34–67.16). Yolk weight amounted to 3.76–4.05 g (30.60–33.35%), with a yolk index of 45.79–47.46%. Also, yolk color assessed by the Roche yolk color fan (12.98–14.43) and CIELab system was intense, aligning with consumer preferences. Given the scarcity of such data in Bosnia and Herzegovina, these findings establish an important scientific basis. While confirming the high overall quality of the evaluated eggs, the observed variations among producers indicate potential for further optimization of production. These results provide valuable contributions for producers aiming to standardize egg quality and serve as indicator of sensory value for consumers.

Key words: Japanese quail, egg quality, commercial producers



MARS SHEEP ON THE ISLAND OF PAG

DOMAGOJ KRZNARIĆ¹, VESNA GANTNER¹, MIRNA GAVRAN¹

¹Faculty of Agrobiotechnical Sciences Osijek, Josip Juraj Strossmayer University of Osijek, Vladimira Preloga 1, 31000 Osijek, Croatia

^{}Corresponding author: mgavran@fazos.hr*

SUMMARY

The Pag sheep is an important indigenous Croatian sheep breed, particularly because of the high quality of the livestock products obtained from it. The purpose of this study was to investigate the relationship between the breeding system and productive performance. The review is based on an analysis of Pag sheep production on the island of Pag over a long period. In order to make the data relevant, a systematic review and selection of scientific studies on breeding indigenous breeds, the influence of environmental conditions on production characteristics, and the importance of indigenous breeds for the economy of the Republic of Croatia were conducted. The analysis shows that the Pag sheep originated from crossbreeding Pramenka sheep with Merino Negretti and Bergamo rams, which significantly affected its wool yield, fattening and milk productivity. Furthermore, the high quality of its products and lower quantity reflect the long-term impact of the breed's exposure to poorer breeding conditions and its ability to adapt to them. The Pag sheep is today an important breed in the Republic of Croatia because its products carry protected designations of origin and geographical indications.

Key words: Pag sheep, indigenous breed, adaptation, high-quality products, karst environment



REAL GROWTH RATE OF THE BROWN HARE (*LEPUS EUROPAEUS*) IN HUNTING GROUNDS OF THE BELGRADE HUNTING AREA IN 2025

NIKOLA MIHAJLOVIĆ¹, ALEKSANDAR IGNJATOVIĆ¹, STEFAN STEPIC¹, DEJAN BEUKOVIĆ², VUKAN LAVADINOVIĆ³, MARKO VUKADINOVIĆ³, ZORAN POPOVIĆ³

¹University of Belgrade, Faculty of Agriculture, Nemanjina 6, Belgrade, Serbia

²University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

³University of Belgrade, Faculty of Forestry, Kneza Višeslava 1, Belgrade, Serbia

*Corresponding author: nikola.mihajlovic@agrif.bg.ac.rs

SUMMARY

The real growth rate, expressed as the proportion of individuals younger than one year in the total sample, represents one of the most important indicators of the population status of the brown hare (*Lepus europaeus*) and provides an important basis for planning management measures for this game species. The aim of this study was to determine the real growth rate of brown hare populations in seven hunting grounds of the Belgrade Hunting Area in 2025. The analysis included 598 individuals. The age of harvested hares was determined using the dry eye lens weight method, after which the real growth rate was calculated for each hunting ground. The calculated real growth rates ranged from 41.18% to 70.53%, with values of 41.18%, 49.33%, 50.54%, 51.72%, 51.80%, 60.00% and 70.53% recorded across the seven hunting grounds. In four out of seven analyzed hunting grounds, the real growth rate was approximately 50%, whereas lower or higher values were recorded in the remaining hunting grounds. The observed range from 41.18% to 70.53% indicates that the population status of brown hare may differ even among hunting grounds belonging to the same hunting area. Although the analyzed hunting grounds belong to the same geographical unit, the observed differences in real growth rate may reflect variation in local conditions. Some hunting grounds are located in areas exposed to a higher degree of anthropogenic impact, whereas others are characterized by more favorable habitat conditions and greater availability of food resources. In addition, differences in previous management practices may have contributed to the observed differences in real growth rate.

Keywords: *Lepus europaeus*, age structure, eye lens weight, hunting ground, game management



RISK ASSESSMENT OF HEAVY METAL EXPOSURE THROUGH WILD BOAR (*SUS SCROFA* L.) MEAT AND LIVER CONSUMPTION AMONG HUNTERS IN NORTH MACEDONIA

KRISTIJAN COKOSKI^{1*}, DEJAN BEUKOVIĆ², MIROSLAVA POLOVINSKI HORVATOVIĆ², ZORAN POPOVIĆ³, VUKAN LAVADINOVIĆ⁴, MARKO VIKADINOVIĆ²

¹Ss. Cyril and Methodius University in Skopje, Hans Em Faculty of Forest Sciences, Landscape Architecture and Environmental Engineering, 16 Makedonska brigade St. No. 1, Skopje, 1000, Republic of North Macedonia

²University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, 21000 Novi Sad, Serbia

³University of Belgrad, Faculty of Agriculture, Nemanjina 6, 11080 Belgrade, Serbia

⁴University of Belgrad, Faculty of Forestry, Knez Visislav 1, 11030 Belgrade, Serbia

*Corresponding author: kristijancokoski@hotmail.com

SUMMARY

Among possible contaminants in wildlife, heavy metals are of particular concern because they can accumulate in food and subsequently enter the human body through dietary consumption. During the 2023/2024 hunting season, a total of 60 samples were collected from 30 wild boars harvested in hunting grounds in the Republic of North Macedonia. Two samples were collected from each harvested animal: liver and muscle tissue. In collaboration with the Hunting Federation of Macedonia, an online questionnaire consisting of 15 questions was conducted to assess the weekly dietary intake of wild boar meat and liver among hunters and their immediate family members. A deterministic approach using fixed values of the investigated parameters, including mean, P10, and P95 concentrations of Cd and Pb in wild boar meat and liver, average weekly consumption of meat and liver, and an assumed average body weight of 70 kg, was applied to estimate the total weekly intake of Cd and Pb among hunters and their family members. The exposure assessment was conducted under three consumption scenarios: occasional, moderate, and frequent consumption. The calculations were based on the EFSA tolerable weekly intake (TWI) for Cd (0.0025 mg/kg bw/week) and for Pb (0.025 mg/kg bw/week). Weekly exposure to Cd and Pb through the consumption of wild boar meat and liver was expressed as a percentage of the respective reference values. The average weekly intake of wild boar meat ranged from 12.25 g (occasional consumption) to 163 g (frequent consumption), while liver intake ranged from 0.97 g to 10.05 g per person. Weekly Cd exposure, expressed as % of TWI, ranged in meat from 0.03–0.5% (P10), 0.26–3.44% (mean), and 0.6–8.2% (P95), and in liver from 0.07–0.7%, 0.16–1.7%, and 0.2–2.1%, respectively. For Pb, exposure ranged in meat from 0.004–0.05% (P10), 0.1–1.5% (mean), and 0.1–1.5% (P95), and in liver from 0.0008–0.008%, 0.004–0.04%, and 0.016–0.17%, respectively. The risk assessment of heavy metal intake through wild boar meat and liver consumption indicates a very low, yet not negligible, risk for consumers in North Macedonia.

Keywords: wild boar, heavy metals, tissue samples dietary exposure, hunters



POTENTIAL OF CELLULOLYTIC BACTERIA IN ENHANCING THE UTILIZATION OF FIBROUS FEED INGREDIENTS BY *Tenebrio molitor*

MIROSLAVA POLOVINSKI HORVATOVIĆ¹, MARKO VUKADINOVIĆ¹, MILOŠ PETROVIĆ¹, NIKOLA LAĆARAC¹, DEJAN BEUKOVIĆ¹, IGOR JAJIĆ¹, SIMONIDA ĐURIC¹

¹ University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia

*Corresponding author: miroslavapolovinski@yahoo.com

SUMMARY

The commercial production of edible insects is challenged by high feed costs, making underutilized fibrous plant ingredients a promising low-cost alternative, despite their potentially limited digestibility. Supplementation with cellulolytic *Bacillus spp.* may improve fiber degradation, nutrient utilization, and feed efficiency. Therefore, this study evaluated the effects of different fibrous substrates and *Bacillus* supplementation on the growth performance and feed conversion ratio (FCR) of *Tenebrio molitor* larvae. The experiment included six dietary treatments: wheat bran, flaxseed, and sunflower meal, each offered either without or with cellulolytic *Bacillus spp.* supplementation. Each treatment was replicated four times. Every replicate contained approximately 272 larvae, estimated by counting and weighing a representative sample of 50 individuals, with an initial biomass of 2 g. Larvae were reared for four weeks under controlled environmental conditions. Final biomass and feed conversion ratio were determined, and the effects of substrate, bacterial supplementation, and their interaction were analyzed. Substrates significantly affected both larval growth and FCR, whereas *Bacillus spp.* supplementation significantly influenced only FCR. The greatest response was observed in larvae reared on the flaxseed-based diet, where bacterial supplementation increased final biomass from 6.74 to 11.15 g and reduced the FCR from 5.48 to 3.21. In contrast, only marginal changes were recorded in wheat bran and sunflower meal diets. The results demonstrate the effectiveness of cellulolytic *Bacillus spp.* supplementation depends on the rearing substrate and may substantially enhance the utilization of fibrous feed ingredients. Optimizing the combination of low-cost substrates and cellulolytic bacterial supplementation could contribute to more economically sustainable *T. molitor* production.

Keywords: *T. molitor*, feeding trial, cellulolytic bacteria



PRLJO - TRADITIONAL MILK PRODUCT OF MONTENEGRO AND ITS PROTECTION

SAVA LUČIĆ¹, OLGA KOPITOVIC¹, SLAVKO MIRECKI¹, DUŠICA RADONJIĆ¹, MILENA DJOKIĆ¹

¹Biotechnical Faculty, University of Montenegro, Mihaila Lalića 15, 81000 Podgorica

^{*}Corresponding author: jokanovicolga@gmail.com

SUMMARY

Prljo low-fat cheese is an indigenous hard cheese characteristic of the Piva region in Montenegro, with a long-standing production tradition deeply rooted in the local culture. It is made from cow's milk or a mixture of cow's and sheep's milk using a specific production technology that includes thermal treatment of the milk and ripening in sheep skins for 2–3 months. The uniqueness of Prljo cheese lies not only in its sensory and nutritional properties but also in its strong connection with the natural conditions of the Piva region, including its distinctive meadow and pasture vegetation, climatic conditions, terrain, soil characteristics, and the traditional mountain pastoral system known as “katunarenje.”

Prljo cheese possesses all the key characteristics that justify protection through a geographical indication scheme: a clearly defined geographical area of production, specific natural conditions that influence the quality of the raw material, and a traditional production technology that has been passed down through generations. Protection as a Protected Designation of Origin (PDO) or a Protected Geographical Indication (PGI) would contribute to preserving the authenticity of the product, preventing imitation and misuse on the market, and increasing its recognition and market value. Beyond its economic significance, such protection would also play an important role in safeguarding rural heritage, traditional knowledge, and the sustainable use of natural resources, which is particularly important in the context of increasingly pronounced negative demographic and economic trends in rural areas.

Research on the production of the indigenous low-fat hard cheese Prljo has shown that the traditional production process has remained essentially unchanged in practice and that this cheese is still produced on the mountain pastures (katuns) of the Piva region.

Preserving the traditional production technology and securing protection through a geographical indication or designation of origin represent key measures for maintaining the authenticity of Prljo cheese, enhancing its value, and improving its market competitiveness.

Keywords: : indigenous dairy products, Prljo, Piva, katuns, quality schemes