



81st International Scientific Conference of the University of Latvia 2023

Inovātīvie un Pielietojamie Pētījumi Bioloģijā
Innovative and Applied Research in Biology



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Programma un tēzes/ Programme and abstracts

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Conference of the
University of Latvia 2023

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Ceturtdien, 2023. gada 2. februārī. 10:00, ZOOM
Thursday, 2 February 2023 10.00 AM, ZOOM

Programma / Programme

10.00–10.05	Līga Jankevica Institute of Biology, University of Latvia (UL)	Atklāšana Opening
Vadītājs/Chair: Prof. Īzaks Rašals		
O1 10.05–10.25	Ieva IGNATAVIČIENĒ Nature Research Centre, Vilnius, Lithuania	Genetic diversity of <i>Rutilus Rutilus</i> population in Lithuania based on mtDNA D-loop and ATP6 marker
O2 10.25–10.45	Elmīra BOIKOVA Institute of Biology, UL	Upper Daugava and meanders on the way to World Heritage nomination
O3 10.45–11.05	Dāvis OZOLIŅŠ Institute of Biology, UL	Ecological quality of Latvian-Lithuanian transboundary lakes according to benthic macroinvertebrates and macrophytes
O4 11.05–11.25	Dalius BUTKAUSKAS Nature Research Centre, Vilnius, Lithuania	Evaluation of the effects of electromagnetic radiation and assessment of the protective properties of 3D Bio-textile based on model species <i>Lemna minor</i> and <i>Drosophila melanogaster</i>
O5 11.25–11.45	Tatjana GRIGORJEVA Daugavpils University	Phototactic behaviour of fruit flies (<i>Drosophila melanogaster</i> Meigen, 1830) study with the automated system
11.45–12.00	Virtuālā kafijas pauze Coffee break	
Vadītājs/Chair: Dr. Oskars Keišs		
O6 12.00–12.20	Antra STĪPNIECE Institute of Biology, UL	Bag harvest monitoring in Latvia by means of sent-in photos
O7 12.20–12.40	Ronalds KRAMS Daugavpils University	Passerine (Passeriformes Linnaeus, 1758) bird survival and reproduction in ecological trap conditions
O8 12.40–13.00	Oskars KEIŠS Institute of Biology, UL	Our cherries and starling's blood – summary of the research on Common Starling <i>Sturnus vulgaris</i> in Latvia 2020–2022
O9 13.00–13: 15	Gunta ČEKSTERE Institute of Biology, UL	Impact of <i>Phalacrocorax carbo</i> on soil and vegetation on Abelu Island of Lake Kanieris during 2010-2022
13:15–13:45	Stenda referātu prezentācijas vai īsie ziņojumi (līdz 5 min) Short talks or poster presentations (5 min)	
Vadītājs/Chair: Dr Zigmunds Orlovskis		
P1	Kristē STRAVINSKAITĒ Lithuanian Zoological Gardens	Effective Breeding Methodology for Conservation of Lithuanian <i>Osmoderma barnabita</i> Populations

P2	Arturs ŠILAKS Institute of Biology, UL	Development of biological control technology to regulate the populations of ticks <i>Ixodes</i> spp. (Acari, Ixodida)
P3	Elīna AŽĒNA Institute of Biology, UL	Succinate, silicon dioxide, aluminum oxide, and silver nanoparticle influence on the model organism <i>Drosophila melanogaster</i>
P4	Maksims KUDEIKINS Institute of Biology, UL	Long-term effects of the extremely low-frequency electromagnetic radiation (50 Hz, 500 μT) on the <i>Drosophila melanogaster</i>
P5	Kristaps NEIBERTS Institute of Biology, UL	Use of microalgae biomass as agriculture plants biostimulants
P6	Arturs SERGEJEVS Institute of Biology, UL	Mixotrophic and heterotrophic cultivation of different microalgae species for utilisation of dairy by-products
P7	Irīna Kujikova Institute of Biology, UL	Long –term changes in the macrophyte communities in the Gulf of Riga, Baltic Sea.
13:45–14:00	Virtuālā kafijas pauze Coffee break	
Vadītājs/Chair: Dr Zigmunds Orlovskis		
O10 14:00 - 14:20	Ilva TRAPIŅA Institute of Biology, UL	Report on the project's first year "Development of an innovative approach to identify biological determinants involved in the between-animal variation in feed efficiency in sheep farming"
O11 14:20 - 14:40	Ilva TRAPIŅA Institute of Biology, UL	Difference of Latvian dark-headed rams according to lamb fattening data and feed efficiency indicators
O12 14:40 - 15:00	Kaspars KAMPUSS	Effect of treatments with <i>Spirulina</i> sp., <i>Dunaliella</i> sp., and <i>Chlorella</i> sp. extractions to raspberry growth, development, and harvest potential
O13 15:00 - 15:20	Sergejs KOĻESOVŠ	Production of lipid-enriched microalgae biomass as an additive in trout's diet using lactose containing substrates
O14 15:20 - 15:40	Laura ĀBOLIŅA Institute of Biology, UL	Typical berries of the hemiboreal zone: traditional use and the potential for cultivar
15:40 -16 -	Noslēgums, diskusijas Conclusions, discussions	

<https://conferences.lu.lv/e/294>

ABSTRACTS

Oral presentations

O1

Genetic diversity of *Rutilus rutilus* population in Lithuania based on mtDNA D-loop and ATP6 marker

Authors: BUTKAUSKAS, Dalius; IGNATAVIČIENĖ, Ieva; RAGAUSKAS, Adomas

Affiliation: Institute of Ecology, Nature Research Centre, Akademijos St. 2, Vilnius, LT-08412, Lithuania

Presenter: IGNATAVIČIENĖ, Ieva

The common roach (*Rutilus rutilus*) is widely distributed freshwater fish which can be found in Europe. Although this ecologically flexible cyprinid fish is widespread in various Lithuanian water bodies, due to its limited economic value, this species does not receive much attention, and little is known about their genetic diversity as well there is no data about attempts to use *R. rutilus* as a model species in genetic testing. Construction of haplotype networks based on molecular data including D-loop and ATP6 gene fragments revealed potential of two genetic markers to be applied in the studies of phylogenetic relationships among of *R. rutilus* populations. In total 70 specimens were collected from 4 locations in Lithuania and analyzed using mitochondrial DNA (mtDNA) D-loop and ATP6 gene markers. The number of point mutations established based on the alignment of DNA sequences was higher in D-loop in comparison to ATP6 fragment. D-loop network encompassed several more frequent haplotypes connected with other phylogenetically and geographically related rare haplotypes forming separate haplogroups on the contrary to star-like haplotype network of ATP6 consisting of the single most frequent haplotype surrounded by rare haplotypes, usually singletons, respectively. The possibility to establish relationships of different haplotypes and attribution to one of distinguished haplogroups in haplotype network revealed potential of D-loop be used as suitable marker in the studies of population genetic structure of *R. rutilus* especially for searching of evolutionary significant units distributed in geographically closely related areas.

Keywords: *Rutilus*, mtDNA D-loop, ATP6, phylogeny

Upper Daugava and meanders on the way to World Heritage nomination

Authors: BOIKOVA Elmīra¹, ENĢELE Lelde²

Affiliations: ¹Institute of Biology, University of Latvia; ² The Latvian Fund for Nature

Presenter: BOIKOVA Elmīra

In 2011 the UNESCO world committee approved the upper Daugava landscape area with nine impressive river meanders on a UNESCO tentative list. This means that this area belongs to the UNESCO National heritage. Although the protected landscape area “Augšdaugava” was established in 1991 and belongs to the NATURA 2000 network from 2004, the nature protection plan was only for the nature park “Daugavas loki” (2010-2022). The new nature protection plan (2023-2035) presents the research results of EU habitat types, their quality, flora and fauna species lists, as well as the state of the EU level protected species and habitats, their challenges. Landscape planning, functional zonation and large programme of management activities are offered for Augšdaugava and Krāslava municipalities to promote tourism industry in future and protect the nature values. This area under UNESCO umbrella was nominated as mixed because of unique combination of nature, geology, long time history of different nations, their religion, culture. The nomination criteria during last years are enriched both for nature and culture. This means that this is time to start the process to the nomination of the Upper Daugava and meanders to the UNESCO World Heritage.

Keywords: Protected landscape area “Augšdaugava”, EU habitats, landscape planning, nature park “Daugavas loki”

Ecological quality of Latvian-Lithuanian transboundary lakes according to benthic macroinvertebrates and macrophytes

Authors: OZOLIŅŠ, Dāvis; GRĪNBERGA, Laura; KOKORĪTE, Ilga; SKUJA, Agnija

Affiliations: Institute of Biology, University of Latvia

Presenter: OZOLIŅŠ Dāvis

Macroinvertebrates and macrophytes were used as indicators to assess ecological quality of five Latvian-Lithuanian transboundary lakes. The aim of the study was to ensure joint quality assessment of trans-boundary lake water bodies which pose a risk for not meeting good status according to requirements of EU Water Framework Directive. Macroinvertebrates were sampled in May and October 2021. Macroinvertebrates showed good ecological quality at all studied lakes using both, Latvian and Lithuanian multimetric macroinvertebrate indices. The non-biting midges Chironomidae as well as mayfly species *Caenis horaria* and *Cloeon dipterum* were dominant in macroinvertebrate communities of the studied lakes. Invasive species zebra mussel *Dreissena polymorpha* was present in four lakes while spiny-cheek crayfish was observed in two out five lakes. In addition, the medical leech *Hirudo medicinalis* was found in Lake Lielais Kumpinišķu which is a species protected under Habitats directive (Annex V) and species protected under Regulation of the Cabinet of Ministers No 396.

Assessment of macrophyte species abundance and diversity was carried out in August 2021. Ecological quality in the investigated lakes differs. In turbid lakes with low light availability, the colonization depth of submerged macrophytes and macrophyte-covered area decreases. One of the dominating species in such lakes is *Ceratophyllum demersum* - an indicator of eutrophic waters.

In the clear water lakes, the diversity of submerged macrophyte species is high, the density of stands and species composition indicate ecological quality. During the study, a new plant species in the Latvian flora was discovered. *Caldesia parnassifolia* is a rare and protected species in Europe.

This species is listed on Annex II of the Habitats Directive and under Appendix I of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention).

Acknowledgments: The research was carried out in the frame of the project “Joint management of Latvian – Lithuanian transboundary river and lake water bodies” (LLI-533 TRANSWAT).

Keywords:

Evaluation of the effects of electromagnetic radiation and assessment of the protective properties of 3D Bio-textile based on model species *Lemna minor* and *Drosophila melanogaster*

Authors: Dalius BUTKAUSKAS^{1,2}; Dace GRAUDA²

Affiliations: ¹Nature Research Centre, Vilnius, Lithuania; ²Institute of Biology, University of Latvia, Riga, Latvia

Presenter: Dalius BUTKAUSKAS

To evaluate protective properties of 3D Bio-textile produced during the first year from the beginning of implementation of the project 3DNano-HPC woven fabrics with incorporated nanoparticles of succinite and succinic acid were tested to elucidate whether newly produced bio-textile materials have an impact on the growth parameters of common duckweed (*Lemna minor*) and fruit flies (*Drosophila melanogaster*) cultivated in Petri dishes or tubes wrapped into different types of bio-textile. During the experiment, plates or tubes with model organisms were placed inside Helmholtz coil generating low frequency (50 Hz) electromagnetic field (EMF). The produced bio-textile samples were tested in the Laboratory of Molecular Ecology of the Nature Research Center (Lithuania) and the Laboratory of Environmental Genetics of the University of Latvia, which both are equipped with specially designed testing system with regulated current frequency and intensity of magnetic flux. The impact of EMF on test organisms was evaluated based on the comparison of growth parameters in the non-affected control group with the growth parameters calculated for experimentally affected group that represented organisms cultivated inside Helmholtz coil generating experimentally enhanced EMF.

The primary results of the performed testing experiments revealed the growth-inhibiting effect of the increased electromagnetic radiation (1,3-1,4 mT) in the exposed to EMF colonies of common duckweed, i.e., changes were recorded in the growth rate, number of fronds and the frond area of these organisms. Results of three consequently repeated experiments revealed that the bio-textile with incorporated succinite particles reduces the growth-inhibiting effect, and protective effect depended on the concentration of particles incorporated into different bio-textile samples. Similar experiments were carried out based on application of *D. melanogaster* as test organisms to study reproductive success of fruit flies cultivated in Helmholtz coil. It was found that significantly lower number of families that survived in affected by EMR group in comparison to control group confirmed negative effect of EMR when magnetic flux intensity was set to 0,5 μ T. The experiments are being continued to test protective properties of bio-textile, such as mitigation of negative impact of EMR on survival rate of *D. melanogaster* based on proposed testing system. Molecular studies including examination of the enzyme systems involved in the regulation of oxidative stress are scheduled. Flow cytometry and other research methods will be used to determine the trends in occurrence of significant changes of fluorescence, generation of point mutations and indication of other informative parameters. The results collected and methods established during implementation of this project will provide the basis for the development of the system suitable for testing of protective properties of bio-textile.

Acknowledgments: The research is supported by project Nr. ES RTD/2022/7 "3D Biotextile with Technological Composition of nano particles to enhance the protecting properties" (3DNano-HPC)

Keywords: LF-EMF, *Drosophila melanogaster*, *Lemna minor*, bio-textile, bio-testing, amber particles.

Phototactic behaviour of fruit flies (*Drosophila melanogaster* Meigen, 1830) study with the automated system

Authors: GRIGORJEVA, Tatjana¹, MAĻUTINA, Vita Viktorija², KOTOVA, Annija², KRAMA, Tatjana^{3,4}, MUNKEVICS, Māris^{2,3}, POPOVS, Sergejs³, KRAMS, Ronalds^{3,4}, KRAMS, Indriķis^{2,3,5}

Affiliations: ¹Daugavpils University, Faculty of Natural Sciences and Mathematics, Daugavpils, Latvia; ²University of Latvia, Faculty of Biology, Rīga, LV-1010, Latvia; ³Daugavpils University, Institute of Life Sciences and Technologies, Daugavpils, LV-5401, Latvia; ⁴Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences, Tartu, 51014, Estonia; ⁵University of Tartu, Institute of Ecology and Earth Sciences, Tartu, 51014, Estonia.

Presenter: GRIGORJEVA, Tatjana

The basic chemical reactions in the fruit flies (*Drosophila melanogaster* Meigen, 1830) brain are similar to those occurring in the human brain. This study is about *Drosophila* fly phototactic behaviour (phototaxis) - movement towards (positive phototaxis) or away (negative phototaxis) from the light source.

During the study we used 2 types of *Drosophila* flies – the wild type and the white eyed flies, that were divided in 4 groups – 1 control group and 3 experimental groups, that experienced different specific chemicals (Escitalopram, Tryptophan and Alpha-methyltryptophan) added to their food. These chemicals are supposed to have different effect on the serotonin concentration in fly body, affecting their behaviour. The aim of this study was to determine the effect of these chemicals on the fruit fly light and dark preferences. We predicted that antidepressant Escitalopram and Alpha-methyltryptophan will increase the variability of phototactic behaviour in fruit flies and make their motions towards light or dark less predictable. In order to test this hypothesis, we used a high-throughput real-time automatic phototactic behaviour assay device called “FlyVac”. During the trials we recorded and registered turns - phototactic choices, of flies from different study groups. Exact serotonin concentrations in the fruit fly brain were not directly measured. The main result of this study is that we didn't determine any effect of antidepressant Escitalopram or Alpha-methyltryptophan on flies, because the phototactic variability of *drosophila* didn't increase in comparison to flies exposed to Tryptophan. It may mean that the Escitalopram and Alpha-methyltryptophan have a similar effect on body serotonin concentration.

Keywords: *Drosophila melanogaster*; serotonin; phototaxis; antidepressants; behaviour.

Bag harvest monitoring in Latvia by means of sent-in photos

Authors: STĪPNIECE, Antra; STĪPNIEKS, Andris; ENDZIŅŠ, Toms; JANAUS, Māra

Affiliations: Institute of Biology, University of Latvia

Presenter: STĪPNIECE, Antra

According to Article 12, Birds Directive all EU member states are requested to monitor bird species and send a report every 6 years following an agreed format which for huntable species includes also totals of hunting bag. Several studies have shown, that hunters are not 100% correct in species identification (Christensen et al. 2017). Countries overcome this by more precise subsamples as wing surveys (Denmark, Great Britain, Finland) or by requests to send photos of the bag (Russia, Canada). In 2019 a website www.nomeditie.org was established with two goals 1) identification manual 2) a site for sending photos to ornithologists. The results of the first four years of this reporting scheme are discussed.

Acknowledgments: This study was supported by the Ministry of Agriculture, MSAF (Game Management Development Fund), and Rural Support Service of the Republic of Latvia.

Keywords: hunting statistics, waterfowl

Passerine (Passeriformes Linnaeus, 1758) bird survival and reproduction in ecological trap conditions

Authors: KRAMS, Ronalds^{1,2}; KRAMA, Tatjana^{1,2}; ELFERTS, Didzis³; BRŪMELIS, Guntis³; DAUŠKANE, Iluta³; CĪRULE, Dina⁴; DAUKŠTE, Janīna⁴; RAIBARTE, Patrīcija⁴; STRODE, Linda⁵; ŠMITS, Agnis⁶; KRAMS, Indriķis^{1,3,7}

Affiliations: ¹Daugavpils University, Institute of Life Sciences and Technologies, Daugavpils, Latvia; ²Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences, Estonia; ³University of Latvia, Faculty of Biology, Rīga, Latvia; ⁴Institute of Food Safety, Animal Health and Environment BIOR, Rīga, Latvia; ⁵National Botanic Garden of Latvia, Salaspils, Latvia; ⁶Latvian State Forest Research Institute "Silava", Salaspils, Latvia; ⁷University of Tartu, Institute of Ecology and Earth Sciences, Tartu, Estonia.

Presenter: KRAMS, Ronalds

In general animals prefer habitats of the highest quality. Less favoured habitats may become more attractive, caused by rapid environmental changes. Habitats that reduce animal survival, reproduction and fitness can also be populated. Such habitats are defined as ecological traps.

The aim of the study was to find whether human nature conservation activities can lead to ecological traps for bird populations and whether areas around forest water bodies with high levels of biodiversity can cause reduced survival of the bird offspring.

At first, we assayed whether breeding great tits (*Parus major*) in Scots pine (*Pinus sylvestris*) forests severely damaged by an outbreak of the great web-spinning sawfly (*Acantholyda posticalis*) suffer fitness costs.

Second, we investigated whether there is a positive relationship between distance to the nearest forest water bodies and the prevalence of blood parasites in nesting European Pied Flycatcher (*Ficedula hypoleuca*), and are the tree stands further away from wetlands considered as areas free from avian parasites.

Lastly, we researched whether the prevalence of bird blood parasite infection is associated with the proximity to hydrological objects where the parasites breed, from the wintering sites of the willow tit (*Poecile montanus*) and the crested tit (*Lophophanes cristatus*) flocks.

In the first study we discovered that great tits inhabiting sawfly outbreak territories had a similar clutch size compared to birds that reproduced in intact forest areas. In the affected parts of the forest the number of new-borns was significantly lower and the condition of them was worse.

Secondly, parasite prevalence and their transmitter profusion decreased overall with distance increase from the water sites. New-borns were less numerous and in poorer condition near water bodies compared to those in areas 1 km from lakes, streams, and bogs.

Third, we found that outside the bird reproductive season the avian blood infection prevalence reduced with the distance increase from forest water objects. Infectious parasite distribution was connected with low survival of willow tits compared to crested tits near the forest water sites.

Keywords: Blood parasites; Parasite vectors; Ecological traps; Cavity-nesting birds; Passerine birds; Crested tit; Willow tit; European pied flycatcher; Distance to water bodies; Non-reproductive season; Predation; Survival; Fitness cost; Resources; Behavioural ecology.

Our cherries and starling's blood – summary of the research on Common Starling *Sturnus vulgaris* in Latvia 2020–2022

Authors: KEIŠS, Oskars; BRIEDIS, Mārtiņš; VĪGANTS, Viesturs; DINSBERGS, Ivo; ZACMANE, Elza; RIMŠA, Antonija; JAUNZEMIS, Valts; PRIEDNIECE, Ance; JAUNZEMIS, Māris

Affiliations: Institute of Biology, University of Latvia

Presenter: KEIŠS, Oskars

During the breeding seasons of 2020–2022, we did study breeding population of the Common Starling *Sturnus vulgaris* in Latvia at two localities – surroundings of Lake Engure near the Gulf of Riga and Zeltaleja (Gulbene district, Northeast Latvia). Additionally, we did analyse historical data on Starling arrival to the breeding range in Spring, possible changes in migration distance to wintering grounds by EURING database recoveries, as well as possible changes in clutch size of Latvian Starling population over time. During the last three years we did deploy light multisensory geolocators to investigate bird's activity during the breeding time as well as migration strategy to wintering places. Additionally, we did look for Malaria blood parasites and how they might affect starling's breeding and migration performance. Main findings of our study are as follows: (1) starlings are advancing their arrival date to Northern Europe, but advancement of climatic spring is faster; (2) at least in some countries in Northern Europe starlings overwinter closer to the breeding sites in comparison to 1950ies; (3) we do observe two migration strategies of Latvian Starlings in modern days – one is “classical” by leaving breeding grounds immediately after fledged young (and eating cherries “in Poland and Germany”); but the other part of Latvian starlings stay in Latvia (to eat “our cherries”) until October-November and migrate straight to wintering grounds in British isles; (4) during the breeding season the activity of females was higher only in the period before nesting, males were more active in the seven-day period before the first egg was laid, during the laying and incubation of eggs, however no significant differences were found in the three feeding periods of nestlings; (5) out of all 210 samples that were PCR tested in 2020 and 2021, 0.95% were infected with *Leucocytozoon*, 1.9% with *Plasmodium* and 7.6% with *Haemoproteus haemosporidian* parasites. An increased proportion of leukocytes was observed in the blood of the infected birds. No association was observed between the genus of *Haemosporida* and the level of parasitaemia, as well as between the proportion of young erythrocytes and the infection status of the bird.

Acknowledgements: The study is carried out with financial support of the Latvian Science Council, project Nr.: LZP-2019/1-0242

Key words: starling, *Sturnus vulgaris*, geolocators, nesting, migration, Malaria

Impact of *Phalacrocorax carbo* on soil and vegetation on Abelu Island of Lake Kanieris during 2010-2022

Authors: ČEKSTERE, Gunta¹; LAIVIŅŠ, Māris²; OSVALDE, Anita¹

Affiliations: ¹Institute of Biology, University of Latvia; ²Latvian State Forest Research Institute "Silava"

Presenter: ČEKSTERE, Gunta

Great cormorant *Phalacrocorax carbo* is one of the bird species nesting in colonies on lake islands raising concern to their impact on the environment. The objective of the study was to assess the effect of *P. carbo* colony on the vegetation and soil chemical composition on Abelu Island of Lake Kanieris in Latvia during 2010-2022. On the island, *P. carbo* started nesting in 2005, negatively affecting mix-stands of *Fraxinus excelsior*. The most intensive nesting was in 2009-2011, when the patches without vegetation occupied half of the island. In 2017, some *F. excelsior* remained on the island. A few young *F. excelsior* were found in the shrub layer, while dense stands of *Urtica dioica* and *Rubus idaeus* dominated in the herbaceous layer. In 2022, no nesting of *P. carbo* was observed.

In general, the vegetation of Abelu Island has become hypereutrophic, the prevailing role in the vegetation is currently relatively stable tall grass communities with a tendency to diverge the sinuous structure of the perennial plant floor. During the last years, after *P. carbo* had left the island, a stand of *Sambucus racemose*, *S. nigra* and *Populus tremula* begun to form and *F. excelsior* had restored. Along with the changes in the number of bird nests on Abelu Island, changes were also found in the chemical composition of the soil. From 2010 to 2017, the accumulation of guano resulted in significantly increased content of several chemical elements (N, P, S, etc.) in the island soil. Whereas in 2022, the content of elements had significantly decreased due to stopped nesting and leaching from the topsoil.

Keywords: great cormorant, bird colonies, vegetation, soil

Report on the project's first year "Development of an innovative approach to identify biological determinants involved in the between-animal variation in feed efficiency in sheep farming"

Authors: TRAPIŅA, Ilva¹; KAIRIŠA, Daina²; PARAMONOVA, Natalia¹

Affiliations: ¹Genomics and Bioinformatics Lab., Institute of Biology, University of Latvia, Riga, Latvia; ²Department of Animal Sciences, Latvian University of Life Sciences and Technologies, Jelgava, Latvia

Presenter: TRAPIŅA, Ilva

Cooperation project (lzp-2021/1-0489) is interdisciplinary research related to economic activity in agriculture and biotechnology, implemented by the University of Latvia in collaboration with the Latvian University of Life Sciences and Technologies. This study aims to determine genetic and molecular markers to identify individual animals in sheep herds with the maximum predisposition to feed digestibility or efficiency (FE) and weight gain, with the aim of their introduction into breeding.

In the project's first year, a collection of biological material (Blood, DNA, RNA, and blood serum) was created from 76 lambs at the fattening station "Klimpas" of the Latvian Sheep Association, as well as seven sire rams and ten lambs fattened on farms.

A methodology for sequencing whole or exon parts of ten genes was developed. RNA was isolated from a collection of experimental animals for expression analysis. In addition, all lambs have been analyzed for six hormones. In addition to laboratory analyses, phenotypic measurement has been performed before and after fattening. The obtained data have been used to calculate seven indicators of feed efficiency. Feed efficiency indicators can be loosely described as (1) ratio traits: Feed efficiency (FE), Feed conversion ratio (FCR), Relative growth rate (RGR), Kleiber's ratio (KR), or (2) regression or residual traits: Residual feed intake (RFI), Residual weight gain (RWG) and Residual intake and body weight gain (RIG).

The results obtained in the first year have already been presented at an international conference and confirmed at another conference in 2023. Also, the results are collected in scientific publications. In 2023, it is planned to perform (1) DNA sequencing and (2) RNA expression from the first year's collection of lamb samples. Then, after (3) summarizing all results obtained for FE scores, biochemistry, DNA, and RNA analyses, (4) algorithm prototypes (including markers/outcomes statistically significant with FE scores) will be developed and tested on (5) the second-year sample collections of lamb. At the end of the project's second year and the beginning of the third year (6), selected biochemistry, DNA, and RNA analyses, which we will find a statistically reliable relationship with the first-year sample collections, will be performed for the second-year sample collection to testing the algorithm prototype.

Acknowledgments: The study was funded by the LZP-2021/1-0489 project: "Development of an innovative approach to identify biological determinants involved in the between-animal variation in feed efficiency in sheep farming".

Keywords: sheep, feed efficiency, markers, DNA, phenotypic, genotypic

Difference of Latvian dark-headed rams according to lamb fattening data and feed efficiency indicators

Authors: TRAPIŅA, Ilva¹; KAIRIŠA, Daina²; PARAMONOVA, Natalia¹

Affiliations: ¹Genomics and Bioinformatics Lab., Institute of Biology, University of Latvia, Riga, Latvia; ²Department of Animal Sciences, Latvian University of Life Sciences and Technologies, Jelgava, Latvia

Presenter: TRAPIŅA, Ilva

Raising lambs for selection purposes and meat production is the daily routine of modern sheep farmers. Every day, in a growing economy, it is necessary to keep low production costs, of which about 70% is animal feeding cost. Breeders are showing an increased interest in breeding sire rams with better feed efficiency (FE) because of the possibility that the offspring will have a higher value of this indicator. The result shows that the progeny indicators tend to be variable for the ram of one breed. Breeding of Latvian Dark-Head (Latvijas tumšgalve; LT) sheep in Latvia is carried out according to phenotypic and bloodline data without carrying out genetic breeding.

This study aimed to analyze the Latvian dark-headed breed's rams according to the FE values of their offspring.

We analyzed the fattening data of 48 lambs, offspring from 13 rams of Latvian dark-head breed, to determine the difference in Feed efficiency, Feed conversion ratio (FRC), Relative growth rate (RGR), Kleiber's ratio (KR) and average daily gain (ADG) and other data of controlled fattening.

The average birth weight of 13 Latvian Dark-Head ram's lambs was 4.08 ± 0.08 kg with an interval from 2.80 to 5.40 kg. LT lambs were fattened for 73.27 ± 8.90 days. On average, all lambs' ADG was 334.70 ± 9.96 g per day with 2.13 ± 0.02 kg dry matter intake per day. The mean ADG of the rams' offspring is statistically significantly different ($p = 7.66 \times 10^{-4}$) between rams. In the LT breed, the average FCR was 6.60 ± 0.20 kg with intervals from 4.10 to 10.57. That means that 1 kg of weight gain requires an average of 6.60 kg dry matter. The best FRC was found in a ram with the highest average RGR score, which is 430.57 ± 13.49 g on average for all lambs. The average KR value for LT lambs' was 18.46 ± 0.49 . The average value of this indicator in seven rams was higher than the average for the breed, which means that the offspring of these rams will also potentially have a higher value from the average of this indicator. Thus, in the experiment, the sheep of the LT breed with the lowest and highest values of the FE indicator were identified. It seems possible to improve the values of this indicator in the selection process without losing the breed specificity. Selection for breeding rams should be based on a clear phenotypic description of the breed, thoroughbreds, and a genetically determined genotype associated with high FE rates.

Acknowledgments: The study funded the LZP-2021/1-0489 project: "Development of an innovative approach to identify biological determinants involved in the between-animal variation in feed efficiency in sheep farming."

Keywords: Feed efficiency, Latvian Dark-Head, sheep, controlled fattening, rams.

Effect of treatments with *Spirulina* sp., *Dunaliella* sp., and *Chlorella* sp. extractions to raspberry growth, development, and harvest potential

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Presenter: KAMPUSS Kaspars

The experiments were done at two farms, located in Jelgava and Dobeles municipalities. Raspberries were sprayed weekly with the solution of ethanol extractions of microalgae species of *Spirulina*, *Dunaliella* and *Chlorella* during stages of shoot growth, flowering and fruit development (June to August), in total 8 times in 2021 and 9 times in 2022. Three concentrations of the extracts were compared to sprays with corresponding ethanol solution as a control. During the season dynamics of shoot growth were recorded, as well as beginning of flowering and fruit ripening. After sprays, the following parameters were measured: productive length of the shoots, number of flower trusses and leaves per shoot, number of productive shoots per plot, at Leaf index (describing plant health, based on chlorophyll contents in leaves), average fruit weight, and sugar content in the fruits.

Certain positive effects of the treatments with one or another algae extraction were observed, increasing plant height and the proportion of the productive part of the shoot, number of leaves and flower trusses per shoot, at Leaf index, average berry weight, ripening of the first berries. Moreover, no negative effects of any tested treatments were observed. However, the positive effects differed in different farms and years and therefore were not proved statistically significant after data analysis. That can be explained by uneven growth of plants in farms, which was not visible before the establishment of the trial, weed and disease spread, changing weather conditions. Therefore we can conclude that since the results are strongly promising, further experiments in controlled environments using preparations of varied extraction types, microalgae species, and different treatment protocols should be carried out, to maximize the observed effects in respect of distinct farming conditions.

Acknowledgments: This study was performed within the framework of the project no. 19-04-A01620-000072 "Development and testing of microalgae originated prototype of plant growth stimulant and antimicrobial agent for autumn raspberries" co-financed by European Agricultural Fund for Rural Development (EAFRD) and supported by the Ministry of Agriculture and Rural Support Service of the Republic of Latvia.

Keywords: raspberry, microalgae, biostimulants, harvest potential, plant development

Production of lipid-enriched microalgae biomass as an additive in trout's diet using lactose containing substrates

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Presenter: KOLESOV Sergejs

Production of fish meal and oil for fish feed used in aquaculture, causes a significant threat to marine biodiversity due to overfishing. Use microalgae-derived supplements, such as proteins, lipids, and vitamins, can significantly decrease the share of fish meal and oil in the composition of trout's feed thus providing the required nutrients and mitigating the problems for marine ecosystems. However, microalgae production is still associated with several difficulties, such as high prices of cultivation media and low yields of microalgae biomass. Therefore, different alternative and cost-effective substrates, such as dairy processing by-products, can be used to decrease the production costs and therefore, increase biomass productivity when mixotrophic cultivation employed. Currently, microalgal metabolism of lactose, as main carbohydrate originated from dairy by-products, i. e. whey remains understudied while the ability to utilise lactose still has been confirmed only in several microalgal species. This study focuses on the potential of microalgae *Chromochloris zofingiensis* CCAP 211/14 to utilise glucose, galactose, and lactose as a sole C sources in the modified Bold's basal medium. It was shown, that *C. zofingiensis* CCAP 211/14 possesses the ability to utilize all three C sources for mixotrophic growth resulting in significant increase of biomass production. The highest biomass synthesis was achieved with galactose (2.96 ± 0.12 g/L biomass dry weight), which is significantly higher compared with the autotrophically grown control (0.08 ± 0.01 g/L). Moreover, biomass produced on lactose was also significantly higher compared with the control, reaching 0.45 ± 0.07 g/L (d.w.). Furthermore, the addition of different C sources also significantly promoted the production of lipids (up to 18.46 ± 1.02 % of dry weight in glucose group) compared with the control group (7.14 ± 0.83 %), respectively. Consequently, the ability of mixotrophically grown *C. zofingiensis* CCAP 211/14 to synthesise β -galactosidase, reaching 40.90 U/L/d on the medium supplemented with lactose as the sole C source during this study was demonstrated for the first time. Results of the study indicate that *C. zofingiensis* CCAP 211/14 is able to utilise C sources characteristic for dairy by-products and synthesise higher amounts of lipid-enriched biomass. Thus, further optimisation is required in order to achieve increased microalgal biomass and lipids production for use in fish feed.

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Keywords: microalgae, lactose, *Chromochloris zofingensis*, β -galactosidase, dairy by-products, fish feed

Typical berries of the hemiboreal zone: traditional use and the potential for cultivation

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Presenter: ĀBOLIŅA, Laura

Wild berry species such as *Vaccinium myrtillus*, *Oxycoccus palustris*, *Vaccinium vitis-idaea*, and *Rubus chamaemorus* are typical boreal forest species in the subarctic-temperate zone, however, their distribution and use differ throughout regions. Wild berries have been used as a source of food and medicine for thousands of years, including both berry fruits and leaves. In Latvia, the most popular have been wild blueberries and cranberries, although many other species in the hemiboreal zone can sustain good harvests. This review article analyzes the use among different species of wild berries in Latvia, comparing their medicinal use, the number of mentions in the literature, and the latest scientific research on the cultivation and use of wild berries. In general, the literature suggests that the popularity of berries depends on the yield. Average yields of *Vaccinium myrtillus*, *Oxycoccus palustris*, and *Vaccinium vitis-idaea* can be similar from year to year, while the yields of *Rubus chamaemorus* are highly variable with reported results ranging from 2 to 300 kg/ha. However, each species has a unique set of compounds associated with specific taste and health benefits. Therefore, although yield variability and distribution affect availability, some wild berry species are still widely sought after for their taste and health benefits. Latvia is located in the hemiboreal zone and the climate is suitable for various berry crop cultivation. In recent years, the research of cloudberry in Latvia has become more relevant and the first studies on cultivation possibilities have been started.

Keywords: boreal forests, cloudberry, blueberry, cranberry, lingonberry

Poster presentations

P1

Effective breeding methodology for conservation of Lithuanian *Osmoderma barnabita* populations

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The hermit beetle (*Osmoderma barnabita*) is an endangered species whose survival is dependent on microhabitats. Such species are the most vulnerable and their conservation is highly important. *O. barnabita* species is included in The Red Book of Lithuania and assigned to the vulnerable (VU) category, in annexes II and IV of the EU Habitat Directive (92/43/EEC) on the conservation of natural habitats and of wild fauna and flora. Veteran broad-leaved trees, most often oaks are natural habitats of *O. barnabita*. The cycle of beetle development takes 2–4 years. The biggest Lithuanian population of this species is found in Kaunas, in the large Oak Park called Ažuolynas. In other parts of the country, it is spread fragmentary. *O. barnabita* is a classic umbrella species, therefore conservation of this species helps to save other species whose survival is dependent on the same habitat. The objective of the Lithuanian Zoological Gardens as a partner institution of the project was to establish an ex-situ population of *O. barnabita* in captivity and release the bred individuals to the restored historical habitats of the species.

O. barnabita individuals were collected in Oak Park and the surroundings of the Lithuanian Zoological Gardens during the summer months of 2019–2021. Pheromone traps placed on the old oak tree trunks growing in the open sunny locations were used to capture adult beetles. Then beetles were transferred to breeding containers. The substrate consisted of 50–60 % composted for 6–12 months and shredded oak leaves, the rest 40–50 % of the substrate was made of oak rot affected by brown-rot fungi, which was collected from old or fallen oaks. The eggs laid in the substrate were left undisturbed until they hatched. After 60–90 days larvae were transferred to the rearing containers. The containers were prepared as the others and 5–6 litres of the old substrate naturally containing microorganisms was added from the breeding container. The larvae were ready for release after 1–3 years. The larvae were placed in specially crafted nesting boxes and transferred to nature during the months of May and June. A high number of *O. barnabita* larvae (758) and pupae

(160) were released during the project period, in Verkių Regional Park, which is located in Vilnius, the capital of Lithuania. The beetles and larvae have been seen in that area during the recent years.

This suggests that the beetles laid eggs in the nesting boxes in which the larvae hatched and overwintered successfully.

The project “Ecological Network for *Osmoderma eremita* and Other Species Dependent on Veteran Trees” (LIFE OSMODERMA LIFE16 NAT/LT/000701) was funded by the EU LIFE programme and the Ministry of Environment of the Republic of Lithuania.

Development of biological control technology to regulate the populations of ticks *Ixodes* spp. (Acari, Ixodida)

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Presenter: ŠILAKS, Arturs

In cooperation with LTD Kukaiņu garāža Institute of Biology, University of Latvia started a study of biological control of hard ticks *Ixodes* spp. in Latvia. Project was supported by the Investment and Development Agency of Latvia and started in 2021. The goal of the project was the development of biotechnology for combating *Ixodes* spp. ticks using their natural enemies and development of a prototype for the feeding and reproduction of *Ixodes* spp. ticks as host of parasitic wasps.

We studied natural enemies of *Ixodes* spp. in climatic conditions of Latvia. More than 1000 *Ixodes* spp. ticks (nymphs and larvae), were collected by the flag dragging method. Fed ticks were collected from cats and migrating birds. The presence of entomopathogenic fungi was found in 6% of collected *Ixodes* ticks. 36 pure culture isolates of entomopathogenic fungi were obtained. The results revealed presence of the parasitic wasps in Latvia, some individual specimens with signs of parasite infestation were observed.

A methodology was developed for rearing ticks in laboratory conditions. We developed a special feeding solution for feeding ticks, as well as a solution for increasing tick attraction and feeding activity. In order to realize the artificial feeding of ticks, a prototype of a tick feeding device using skin-imitating membrane was created.

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Keywords: parasitic wasps, natural enemies, entomophagous fungi, skin-imitating membrane

Succinate, silicon dioxide, aluminum oxide, and silver nanoparticle influence on the model organism *Drosophila melanogaster*

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Presenter: AŽĒNA Elīna

To produce 3D biotextile with enhanced protecting properties, novel material with integrated succinate, silicon dioxide, aluminum oxide, and silver nanoparticles is being developed. The manufactured 3D biotextile is necessarily be subjected for biological testing to collect results both for its safety and proving of protective properties. The current study was designed to determine the impact of succinate, silicon dioxide, aluminum oxide, and silver nanoparticles on development of the *Drosophila melanogaster*. *Drosophila* is a commonly used non-mammalian model organism in biological and medical research, including toxicology and evaluation of biological activity of different substances. It's well-studied biology and evolutionary conserved basic biochemical and genetic processes are shared with higher eukaryotes. Tests on wild type *drosophila* (Canton-S) were carried out at $25\pm 1^\circ\text{C}$, under 12:12 h light: dark cycle and 60% relative humidity. Nanoparticles were added to banana medium to final concentration 0,01% and 0,1% in total setting eight experimental groups containing nanoparticles (NP). Fifty fertilized eggs per vial were placed in NP containing media and the control media without NP. In total three hundred eggs were used to set experimental and control groups per generation. Larvae were allowed to hatch, feed, and undergo a metamorphosis. Primarily, parameters characterizing the *drosophila* overall physiological state were examined. F1 flies were counted after their emergence to calculate the viability. Fertilized eggs produced by generation F1 were collected and after hatching the F2 generation was obtained. F1 males and females were separated for locomotor activity assay and body size measurements. Additionally, F1 and F2 imagoes were screened for deviations in external morphology seen as visual mutant phenotypes, the presence of which could indicate a genotoxicity of NP. The F1 egg to pupa viability of Canton-S in control group was on average 55%. In the aluminum oxide and silver NP 0,1% groups were observed slight reduction of viability up to 15%. Sexual dimorphism of locomotor activity and body size was observed in all groups. Male flies have faster movements and smaller body size. No clear reduction of the given parameters was observed in the NP groups. In all groups of F1 and F2 generation fly external morphology matched the wild type. To further characterize the impact of NP incorporated in the 3D biotextile on fruit fly as model organisms, additional studies are needed, paying attention to biochemical and molecular markers participating in the processes of regulation of oxidative stress.

Acknowledgments: The research is supported by project Nr. ES RTD/2022/7 "3D Biotextile with Technological Composition of nano particles to enhance the protecting properties".

Key words: succinate, silicon dioxide, aluminum oxide, silver, *drosophila*

Long-term effects of the extremely low-frequency electromagnetic radiation (50 Hz, 500 μ T) on the *Drosophila melanogaster*

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Presenter: KUDEIKINS, Maksims

As the electromagnetic radiation consists of two parts, the electric field, and the magnetic field, they are considered together as an electromagnetic field (EMF). To determine the long-term effect of extremely low-frequency (50 Hz, 500 μ T) electromagnetic field (LF-EMF) on reproductive and biochemical parameters the fruit fly (*D. melanogaster*) was chosen as model organism due to its relatively short reproductive cycle length. The number of offspring in each generation was compared between control and experimental groups: control group comprised set of tubes with not treated fruit flies grown on the same medium as insects of experimental group grown placed inside Helmholtz coil generating extremely low LF-EMF. During the first part of the experiment, we evaluated dynamics of reproductive success in 18 generations of fruit flies cultivated in LF-EMF. The Clearly evident differences between control and experimentally affected groups have become evident in the fifth generation obtained from the beginning of the experiment: reproductive capacity reduced by half in the continuously affected by LF-EMF group. To determine the potential effects of stress on the genome, the part of gene phospholipid hydro peroxide glutathione peroxidase (enzyme that neutralize reactive oxygen species), was sequenced and compared between control and affected groups. The DNA was extracted from fruit flies representing seventh (F7) generation. In comparison to DNA sequences obtained from the control group at the beginning of the experiment some nucleotide substitutions were detected in homologous sequences of affected by LF-EMF experimental group indicating potential of LF-EMF to accelerate changes of DNA generating genetic mutations. The number of tubes with reproducing fruit flies remained higher in control group and just one family (reproducing in one tube) of flies out of 13 survived after fifteenth generation was obtained. Representatives of this family are used further in the experiment to determine the effects related with possible adaptability to the enhanced magnetic field density generated by LFEMF radiation. The study was continued by launching the second part of the experiment. Out of four experimental groups two were established as control groups (one of them – earlier affected by LF-EMF, other consisted of non-affected fruit flies) and similarly two groups were cultivated in LF-EMF. The reproductive capacity and differences in catalase activity between all four groups were studied in each generation until F3 generation was obtained. Catalase activity was increased approximately about 25% in comparison to both control groups. This phenomenon was observed already in first generation in the group that was for a long time grown (16 generations) affected by continuously LF-EMF.

Acknowledgments

The research is supported by project Nr. ES RTD/2022/7 “3D Biotextile with Technological Composition of nano particles to enhance the protecting properties

Key words: LF-EMF, *Drosophila melanogaster*, reproductive capacity, catalase

Use of microalgae biomass as agriculture plants biostimulant

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Presenter: NEIBERTS, Kristaps

As the global human population grows rapidly, so does demand for a variety of resources, such as energy, food, water, medicine and other. Microalgae is a valuable but at the same time still understudied group of microorganisms which is attracting the attention of scientists around the world.

Microalgae produce complex compounds such as lipids, proteins, vitamins, antibacterial compounds, carbohydrates, and other useful substances. Photosynthetic microalgae use atmospheric carbon to provide themselves with energy. However, there are also some microalgae that can use organic carbon sources such as sugars to for this purpose.

Microalgae can be used as a source of phytohormones which, together with other substances from microalgae, contributes to germination and further plant development. This way microalgae can be helpful replacing chemical biostimulants or biofertilizers with nature-friendly ones.

Our research shows that use of live microalgae cells suspension in water can promote garden cress seeds (*Lepidium sativum*) germination by 20 – 40% in fifth day using *Chromochloris zofingiensis* CCAP 211/14 and *Scenedesmus quadricauda* CCAP 276/16. In experiments performed in controlled environment chambers, on sand growth substrate live microalgae suspension prompted plant growth by 86% with *S. quadricauda* CCAP 276/16 and 77% with *Chlorella vulgaris* CCAP 211/11, compared to control group. It has been observed, that use of live microalgae suspensions increased water holding capacity of sand growth substrate in 24-hour period which could be explained by presence of polysaccharides in suspended microalgal biomass.

In experiments using controlled environment chambers, commercially produced peat substrate for growing plants, live microalgal suspension did not show great impact on plant growth comparing to sand growth substrate. Plant length was about 10% higher than for the control group, using both *S. quadricauda* CCAP 276/16 or *Ch. vulgaris* CCAP 211/11 Plant dry biomass (without roots) was increased by 16,7% after treatment with *Ch. vulgaris* CCAP 211/11.

In further research use of microalgal extracts, which could help to enhance impact on plant growth and determine specific growth promoting compounds should be evaluated and clarified. It also has been reported that certain cyanobacteria can fix nitrogen from atmosphere and therefore, plant treatment with them could enhance plant growth by supplying it with additional nitrogen.

Acknowledgments: This study was performed within the framework of the project no. 19-04-A01620-000072 “Development and testing of microalgae originated prototype of plant growth stimulant and antimicrobial agent for autumn raspberries” co-financed by European Agricultural Fund for Rural Development (EAFRD) and supported by the Ministry of Agriculture and Rural Support Service of the Republic of Latvia.

Key words: Microalgae, *Chlorella vulgaris*, *Scenedesmus quadricauda*, *Chromochloris zofingiensis*, germination, biostimulants, biofertilizers

Mixotrophic and heterotrophic cultivation of different microalgae species for utilisation of dairy by-products

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Presenter: KOLESOV, Sergejs

Currently commercial production of many microalgae species is considered economically unfeasible. In order to facilitate commercial application for such microalgae species, use of different agricultural and food processing by-products, e. g. whey, can be considered as more cost-effective cultivation media. Furthermore, studies show that some microalgae species are able to synthesise biomass and bioactive components, i.e. lipids, proteins, vitamins, and pigments etc. mixotrophically and heterotrophically – surpassing their ability to grow autotrophically. Nevertheless, there are still little knowledges currently on an ability of microalgae to efficiently utilize lactose. It should be taken into account however, that lactose is considered a problematic substrate due to inability of many microalgal species to hydrolyse this disaccharide due to lack of β -galactosidase enzymes. This study focuses on microalgal strains obtained from culture collections or environmental isolates obtained by ourselves (Latvia), to evaluate the ability to grow mixotrophically or heterotrophically on lactose, glucose and galactose as main C sources, in a semisynthetic growth media. This study has demonstrated the ability of certain microalgae to utilise residual sugars from dairy by-products and convert it into additional biomass. Screening experiments indicated that the utilisation of all assessed carbohydrates was confirmed only in *Chromochloris zofingiensis* CCAP 211/14. In turn, *Chlorella vulgaris* CCAP 211/111 showed an enhanced ability to utilize glucose and galactose as main C sources, which may be considered as beneficial for microalgal consortia formation further. Obtained results are presented as an initial stage evaluation for further in-depth study of lactose metabolism, biomass and its constituent substances synthesis - for poultry feed with prospected microalgal strains.

This study was performed within the project “Development of plant origin feed supplement for strengthening poultry immunity and increasing nutritional value of eggs with omega-3 fatty acids (grant Nr.: 22-00-A01612-000015) co-financed by European Agricultural Fund for Rural Development (EAFRD) and supported by the Ministry of Agriculture and Rural Support Service of the Republic of Latvia

Keywords: microalgae, lactose, dairy processing by-products, feed