



INTERNATIONAL SCIENTIFIC SYMPOSIUM

**“SCIENCE TO STRENGTHEN SUSTAINABLE
AND SAFE FOOD SYSTEMS”**

BOOK OF ABSTRACTS

**30-31 JANUARY, 2020
RIGA**

Dear Colleagues,

Research in food safety, veterinary medicine, fisheries, public and environmental health areas is in the focus of the Institute of Food Safety, Animal Health and Environment "BIOR" to create a comprehensive platform within the One Health framework. Our goal is to achieve better public health outcomes as well as to strengthen sustainable food systems in the future.

Currently the Institute carries out high quality research of international significance as well as implements risk assessment projects and provides scientific advice to a number of governmental agencies under the Ministry of Agriculture, the Ministry of Health, the Ministry of Environmental Protection and Regional Development. All departments, including laboratories, fishery and aquaculture research units, have an in-depth professional experience gained over several decades, in some areas even from 1920ies.

The Institute was established in 2010 by merging the National Diagnostic Centre (the National Reference laboratory for animal health and food safety) with the Latvian Fish Resources Agency and National Aquaculture infrastructure. This was a significant step towards establishing the National research institute with a new strategy, clear vision and ambitious goals.

Over the last 10 years, since the establishment of Institute "BIOR", new generation of scientists have joined our team, cross-appointments of our research staff with universities were established, up-to-date laboratory technologies and infrastructure were introduced and international partnership networks were significantly broadened.

We are proud of our achievements reached so far and we are constantly building our reputation towards scientific excellence, support in decision making, policy impact and independence.

January 2020 is the month when we celebrate our 10th Anniversary in the International Scientific Symposium "Science to Strengthen Sustainable and Safe Food Systems" where around 250 participants from 15 countries will join us. This will be also an occasion where we would like to thank our scientific collaborators, colleagues from governmental agencies, industry and NGOs for cooperation to make safer and more sustainable food systems and environment in Europe.

Prof. Aivars Bērziņš, Dr. med. vet., PhD
Director of Institute of Food Safety, Animal Health and Environment "BIOR"



International Scientific Symposium
“Science to Strengthen Sustainable and Safe Food Systems”
PROGRAMME
Riga, National Library of Latvia

Thursday, 30th January

Registration and Coffee 11:30 – 12:30

Plenary Session – Hall Ziedoņa zāle

12:30 – 13:00

Welcome and Opening of the Symposium, Musical performance

13:00 – 13:20

Welcome address

Minister Mr. Kaspars Gerhards, Ministry of Agriculture of Latvia

Chief Veterinary Officer (CVO), Dr. Māris Balodis, Director General of Food and Veterinary Service

13:20 – 13:40

10 years of Institute of Food Safety, Animal Health and Environment “BIOR”

Prof. Dr. Aivars Bērziņš (Director of Institute of Food Safety, Animal Health and Environment (BIOR), Latvia)

13:40 – 14:00

Scientific advice for safe food – a European perspective

Dr. Bernhard Url (Executive Director of European Food Safety Authority (EFSA), Italy)

14:00 – 14:20

European and global partnerships to strengthen food and feed safety systems: A need to have.

Prof. Dr. Dr. Andreas Hensel (President of Federal Institute for Risk Assessment (BfR), Germany)

14:20 – 14:40

Plenary discussion I

14:40 – 15:00

Musical performance

15:00 – 15:40

Coffee Break and Poster Session

15:40 – 16:00

Guaranteeing Safe Food - Yesterday, Today, Tomorrow

Prof. Dr. Thomas Blaha (University of Veterinary Medicine Hannover, Germany)

16:00 – 16:20

History of the Dutch Food Safety laboratory system, from > 50 laboratories to one internationally renowned food safety institute

Dr. Robert van Gorcom (Managing Director of Wageningen Food Safety Research, The Netherlands)

16:20-16:50

Big Data in food safety

Dr. Hans Marvin (DLO Researcher at Wageningen Food Safety Research, The Netherlands)

16:50 – 17:20

Trust in food integrity by new analytical approaches?

Dr. Carsten Fauhl-Hassek (Head of Unit Product Identity, Supply Chains and Traceability of Federal Institute for Risk Assessment (BfR), Germany)

17:20-17:40 **Plenary discussion II and Closing**

17:50-21:00 **Welcome reception**

Friday, 31th January

9:00 – 15:00

**Session I Conference Centre
One Health**

‘One Health’ is an approach to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes (WHO, 2019). Animal and public health, zoonoses and their epidemiology, antimicrobial resistance are in focus of ‘One Health’ research. ‘One Health’ session will consist of various oral presentations covering a wide range of the topics mentioned above.

**Session II Conference Centre
Water Resources and Environmental Safety**

A wide range of environmental resources and ecosystems are influenced by various factors, including anthropogenic impact, industrial pollution, climate change and others. Therefore there is a worldwide continuous need for new knowledge and research to ensure and improve healthy and sustainable ecosystems and rich biodiversity keeping in mind economical needs of countries. This session will cover some of the most important aspects of sustainable and safe water, environmental and related food systems

Session III Conference Centre

Posters and scientific discussions will be presented during the whole Symposium.

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Wifi

Name: Konference
Password: LNB_kcentrs

| | Session I "One Health" Hall AB | Session II "Water Resources and Environmental Safety" Hall CD |
|---------------------|--|--|
| 9.00- 9.30 | Registration and Poster session | |
| 9.30- 9.50 | <p>ANTIBIOTIC USAGE AND RESISTANCE IN FARM ANIMALS – IS THIS PART OF THE ONE HEALTH PROBLEM?</p> <p>Prof. Dr. rer. nat. Lothar Kreienbrock <i>WHO Collaboration Centre for Research and Training for Health at the Human-Animal-Environment Interface, University of Hannover, Germany</i></p> | <p>MOOMINS V. HUMANS: SCIENCE FOR SUSTAINABILITY OF THE BALTIC SEA ECOSYSTEM SERVICES</p> <p>Prof. Dr. Andris Andrusaitis <i>Acting Executive Director of BONUS EEIG, Coordinator of BANOS CSA, Finland</i></p> |
| 9.50- 10.10 | <p>ANTIMICROBIAL RESISTANCE AND SAFE FOOD SYSTEMS</p> <p>Prof. Dr. DVM Annamari Heikinheimo <i>University of Helsinki, RUOKAVIRASTO, Finland</i></p> | <p>HISTORICAL BASELINES IN MARINE BIOINVASIONS: IMPLICATIONS FOR POLICY AND MANAGEMENT</p> <p>Prof. Dr. Henn Ojaveer <i>Technical University of Denmark, DTU Aqua/ University of Tartu, Estonia</i></p> |
| 10.10- 10.30 | <p>BOTULISM – NOVEL ASPECTS OF THE OLD THREAT</p> <p>Prof. Dr. Miia Lindström <i>Department of Food Hygiene and Environmental Health, Faculty of Veterinary Medicine, University of Helsinki, Finland</i></p> | |
| 10.30- 10.50 | <p>WHOLE GENOME SEQUENCING IN SURVEILLANCE AND OUTBREAK INVESTIGATION OF <i>SALMONELLA ENTERICA</i> - EXPERIENCE IN LATVIA</p> <p>MSc. Irēna Meistere <i>Institute of Food Safety, Animal Health and Environment "BIOR", Latvia</i></p> | <p>SCENARIO-BASED SIMULATION OF THE GULF OF RIGA FUTURE FOOD WEB USING THE ECOPATH WITH ECOSIM MODELLING APPROACH</p> <p>MSc. Ivars Putnis <i>Institute of Food safety, Animal Health and Environment "BIOR", Latvia</i></p> |
| 10.50- 11.10 | <p>LAB-ON-CHIP PLATFORM FOR RAPID FOODBORNE PATHOGEN DETECTION</p> <p>Dr. Georgia Kaprou, PhD <i>Institute of Nanoscience and Nanotechnology, Greece</i></p> | <p>RIVER LAMPREYS - THE FISH CONNECTING BALTIC PEOPLE</p> <p>Dr. Robertas Staponkus <i>Klaipeda University, Lithuania</i></p> |

| 11.10- 11.40 | Coffee break and Poster session | |
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| 11.40- 12.00 | WILDLIFE DISEASE SURVEILLANCE AS A PART OF ONE HEALTH Dr. Erik Ågren, PhD <i>National Veterinary Institute (SVA), Sweden</i> | SEALS AND COASTAL FISHERY IN LATVIA: CAN WE MITIGATE SEAL IMPACT? BSc. Inese Ozoliņa, Dr. biol. Maris Plikšs <i>Institute of Food Safety, Animal Health and Environment „BIOR”, Latvia</i> |
| 12.00- 12.20 | BEES IN THE ONE HEALTH CONCEPT Dr. Boris Yakobson <i>Kimron Veterinary Institute, Bet Dagan, Israel</i> | STORY ABOUT ROUND GOBY Dr. biol. Didzis Ustups <i>Institute of Food Safety, Animal Health and Environment „BIOR”, Latvia</i> |
| 12.20- 12.40 | WILDLIFE AND ONE HEALTH IN THE NORTH AND THE ARCTIC – AN ECOSYSTEM IN CHANGE Dr. Merete Hofshagen <i>Norwegian Veterinary Institute, Norway</i> | CONTRIBUTION OF THE INSTITUTE BIOR IN LONG-TERM MAINTENANCE OF SALMON AND SEA TROUT STOCKS Dr. med. vet. Ruta Medne, Dr. biol. Santa Purviņa <i>Institute of Food Safety, Animal Health and Environment „BIOR”, Latvia</i> |
| 12.40- 13.00 | OVERVIEW OF MOST IMPORTANT FOODBORNE PARASITES IN LATVIA Dr. biol. Gunita Deksnē <i>Institute of Food Safety, Animal Health and Environment „BIOR”, Latvia</i> | SUSTAINABLE SALMONID FISH MANAGEMENT SOLUTIONS IN LITHUANIA: TRADITIONAL STOCKING OR HABITAT RESTORATION? Dr. Nerijus Nika <i>Klaipeda University, Lithuania</i> |
| 13.00- 13.20 | PREVALENCE OF HEPATITIS E VIRUS IN DOMESTIC PIG AND WILD BOAR POPULATIONS AND MEAT PRODUCTS IN LATVIA (TBC) MSc. Žanete Šteingolde <i>Institute of Food Safety, Animal Health and Environment „BIOR”, Latvia</i> | RIVER AND FISH FAUNA SPECIFIC ESTIMATION OF ECOLOGICAL FLOW IN SEVERAL SMALL HYDROELECTRIC POWER STATIONS MSc. Kaspars Abersons <i>Institute of Food Safety, Animal Health and Environment „BIOR”, Latvia</i> |
| 13.20- 13.50 | Light lunch/ coffee break and Poster session | |

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| <p>13.50- 14.10</p> | <p>IMPACT OF FOOD CONTROL RESEARCH ON RISK MANAGEMENT STRATEGIES</p> <p>Assoc. Prof. Dr. Janne Lundén, PhD</p> <p><i>Department of Food Hygiene and Environmental Health, Faculty of Veterinary Medicine, University of Helsinki, Finland</i></p> | <p>IMPLEMENTATION OF THE WATER FRAMEWORK DIRECTIVE (WFD) IN THE BALTIC SEA REGION COUNTRIES</p> <p>Dr. chem. Dzintars Začs</p> <p><i>Institute of Food Safety, Animal Health and Environment „BIOR”, Latvia</i></p> |
| <p>14.10- 14.30</p> | <p>NOVEL APPLICATIONS OF WASTEWATER-BASED EPIDEMIOLOGY FOR PUBLIC HEALTH MONITORING</p> <p>Assoc. Prof. Dr. Vadims Bartkevics</p> <p><i>Institute of Food Safety, Animal Health and Environment “BIOR”, Latvia</i></p> | <p>OCCURRENCE OF ANISAKIDAE NEMATODES IN EASTERN BALTIC COD (<i>GADUS MORHUA</i>) IN EASTERN PART OF BALTIC SEE</p> <p>Dr. biol. Gunita Deksnė</p> <p><i>Institute of Food Safety, Animal Health and Environment „BIOR”, Latvia</i></p> |
| <p>14.30- 14.50</p> | <p>COMPLEX INVESTIGATION ABOUT Q-FEVER DISTRIBUTION AND RISK FACTORS IN DAIRY CATTLE SHEDS IN LATVIA</p> <p>Dr. biol. Lelde Grantiņa-Ieviņa</p> <p><i>Institute of Food Safety, Animal Health and Environment „BIOR”, Latvia</i></p> | <p>LIVER, BLOOD AND BONE ARE THE MAJOR COMPARTMENTS FOR PERFLUOROOCCTANOIC AND PERFLUOROSULFONOIC ACID DISTRIBUTION IN ADULT C57BL/6 MICE</p> <p>Prof. Dr. Jasna Bogdanska</p> <p><i>Department of Biochemistry and Biophysics, Stockholm University, Sweden</i></p> |
| <p>14.50- 15.10</p> | <p>ALIMENTARY EXPOSURE OF POLYCYCLIC AROMATIC HYDROCARBONS AND NITRATES/NITRITES IN THE REPUBLIC OF BELARUS</p> <p>Dr. Natalia Tsemborevitch, PhD</p> <p><i>Scientific and Practical Center of Hygiene, Belarus</i></p> | <p>SCIENTIFIC EXPEDITION TO THE KINGDOM OF THE POLAR BEARS</p> <p>MSc. Ingus Pērkons</p> <p><i>Institute of Food Safety, Animal Health and Environment „BIOR”, Latvia</i></p> |
| <p>15.10- 15.20</p> | <p>Discussion and closing of Paralell sessions</p> | |

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Prof. Dr. Aivars Bērziņš, Dr. med. vet., PhD



Dr. Aivars Bērziņš is currently Director of the Institute of Food Safety, Animal Health and Environment “BIOR” and Professor at the Latvia University of Agriculture, Faculty of Veterinary Medicine. He represented Latvia as a Member of EFSA’s Advisory Forum from 2013 to 2016. Currently he is a Member of EFSA’s Management Board.

Previously, he was the Head of Department of Research and Development at BIOR and took different academic positions at the Latvia University of Agriculture and the University of Helsinki. Moreover, he was a visiting researcher at Purdue University (USA) and the Norwegian School of Veterinary Science. From 2006 to 2008, Dr. Bērziņš worked for the Latvian Ministry of Agriculture as Deputy State Secretary responsible for veterinary and food control matters.

Dr. Bērziņš graduated at the Latvia University of Agriculture, Faculty of Veterinary Medicine and obtained his PhD degree in Veterinary Medicine and Food Hygiene at the University of Helsinki, Faculty of Veterinary Medicine.

Dr. Bernhard Url



Dr. Bernhard Url was appointed Executive Director of EFSA in June 2014, having served as Acting Executive Director for seven months. His mandate for a second term in office was renewed in June 2019 for another 5 years.

Dr. Url joined EFSA in June 2012 as Head of the Risk Assessment and Scientific Assistance Department. A qualified veterinarian by training, he brings high-level management experience from food-safety organisations to his role at EFSA.

Prior to joining the Authority, Dr. Url was Managing Director of the Austrian Agency for Health and Food Safety (AGES), which represents Austria on EFSA’s Advisory Forum. From 2008 to March 2012, he also served as a member of EFSA’s Management Board.

During his 10 years at AGES, he was in charge of technical and scientific affairs with a remit that included the timely delivery of risk assessment and risk management services across a wide range of areas. This included ensuring effective risk communications during urgent food safety-related events.

Prior to AGES Dr. Url spent five years as an Assistant Professor at the Institute of Milk Hygiene and Milk Technology at the University of Veterinary Medicine in Vienna before running a food quality control laboratory from 1993 to 2002.

Dr. Url graduated from the University of Veterinary Medicine in Vienna in 1987 and became a Doctor of Veterinary Medicine in 1990. He has published in the field of veterinary medicine with a particular focus on listeria and milk hygiene.

Prof. Dr. Dr. Andreas Hensel



Since 2003, Professor Dr Dr Andreas Hensel is the first and acting president of the then newly founded German Federal Institute for Risk Assessment (BfR) in Berlin which is an institution of the German Federal Ministry of Food and Agriculture. Subsequent to tertiary qualification and specialised studies from 1979 to 1988, which culminated in the title Dr. med. vet from the University of Veterinary Medicine Hannover, Dr Hensel went on to attain a PhD title from the University of Utrecht. Further scientific qualifications include his habilitation as university lecturer for Microbiology in 1997 and his qualification as veterinary specialist in Microbiology, Animal Hygiene, Clinical Laboratory Medicine, Epidemiology and Food Hygiene. He is also a Diplomate of the European College of Veterinary Public Health (ECVPH). Before having taken office as president of the BfR, Dr Hensel held positions of senior scientist at the University of Vienna (1990-1997) as well as at the University of Veterinary Medicine in Vienna in the position of full professor for “Animal Hygiene and Federal Animal Pest Control”. At the same time he had the position of Director and Chair at the “Institute for Animal Hygiene and Veterinary Public Health” at the University of Leipzig (1997-2003).

In 2004, he continued his academic activities in the position of appointed honorary professor for consumer protection and risk assessment. Dr Hensel is Germany's representative in the scientific council (Advisory Forum) of the European Food Safety Authority (EFSA).

Prof. Dr. Thomas Blaha, Dr. med. vet., PhD



Prof. Dr. Thomas Blaha graduated in veterinary medicine from the University of Leipzig, Germany, in 1971. At the Institute of Applied Animal Hygiene (Eberswalde, Germany) he got the academic title “Dr. med. vet.” in 1973. After some years in veterinary practice he joined the Institute of Bacterial Animal Diseases (Jena, Germany), where he achieved his PhD. in 1983 – there he was first junior, and later until 1991 senior scientist in the area of infectious intestinal and respiratory pig diseases. From 1991 to 1996, and from 2001 to 2015, Thomas was Professor of Applied Epidemiology and Preventive Veterinary Medicine at the University of Veterinary Medicine, Foundation, of Hannover, Germany. From 1996 to 2001 he held as Full Professor the renowned Endowed “Al Leman Chair” in Swine Health and Epidemiology at the College of Veterinary Medicine of the University of Minnesota, USA. During his years as university professor both in Germany and in the USA, he was several times consulting the WHO, the FAO and the European Union in various countries on preventive veterinary medicine, zoonoses and especially Salmonella control, reduction of antimicrobial use, and animal welfare in food animals.

Dr. Robert van Gorcom, PhD



Robert van Gorcom graduated in Molecular Sciences at Wageningen University (1981) and got a PhD in Molecular Genetics at the University of Amsterdam (1997) on the analysis of gene expression in filamentous fungi. He worked for 20 years at the Dutch Organization of Applied Scientific Research TNO as project leader and department manager on microbial and plant biotechnology. In 2000 he became managing director of the glasshouse horticulture research stations of Wageningen University & Research and in 2002 he joined Wageningen UR's food safety research institute RIKILT as BU manager. He was appointed as general director of RIKILT on 1-1-2010. RIKILT merged on June 1st, 2019 with the Food Safety Laboratory of the Netherlands Food and Consumer Product Safety Authority (NVWA). Robert was appointed as general director of this new institute called Wageningen Food Safety Research. He is also member of the Board of Directors of Wageningen University & Research. He is and has been member of several management boards of professional organizations in his domain.

Dr. Hans Marvin, PhD



Hans Marvin studied chemistry at Free University of Amsterdam (VU) and received his MSc in 1985. Following, he studied Biotechnology at University of Groningen and received his PhD in 1988. Following a few Post-doc positions, he started in 1991 as senior scientist (biochemistry) at Centre for Plant Breeding and Reproduction Research (CPRO) in Wageningen, the Netherlands and lead the section Quality Improvement. In 1999, he started at RIKILT Wageningen UR, now called Wageningen Food Safety Research (WFSR). At present, Dr. Hans Marvin is a senior scientist and is specialized in many aspects of food safety, including analysis of foods, research on safety, and risk assessment for authorities. Dr. Marvin works on a number of food safety issues, including emerging risk, big data, food/ feed issues related to biotechnology & nanotechnology and risk analysis and has initiated various activities within the Netherlands and EU in these fields. Dr Marvin's personal research specialisms are (i) methods for emerging risk identification, (ii) application of a system approach to food safety and modelling, (iii) application of Bayesian Networks in prediction models for food safety and food fraud, iv) introduction of big data analytics in food safety research including big data infrastructure, and (v) development of decision support systems. On these topics he has organized and chaired numerous workshops and is author and co-author of > 50 peer-reviewed scientific publications (see below a few recent examples).

Dr. Carsten Fauhl-Hassek



Carsten Fauhl-Hassek is a food chemist and works at the department for Safety in the Food Chain based within the German Federal Institute for Risk Assessment (BfR) in Germany. He is head of the unit Product identity, supply chains and traceability as and has special expertise in authentication of food and feed, wine analysis and appreciation, method development and validation (ring trials), NMR and stable isotope analysis. In addition he was involved in the risk assessment of mycotoxins and responsible for the national reference laboratory for mycotoxins in food and feed in the past.

Prof. Dr. Lothar Kreienbrock, Dr. rer. nat.



Lothar Kreienbrock is a Professor for Biometry, Epidemiology and Information Processing, University for Veterinary Medicine, Hannover.

After a diploma and doctorate in statistics, he habilitated in 1995 in Wuppertal in the subject epidemiology. His work focuses on sampling and monitoring methods, epidemiological methods, risk assessment, cancer epidemiology, environmental (especially radiation) epidemiology, empirical methods at the human-animal-environment interface and antibiotics consumption and resistance.

Prof. Dr. Annamari Heikinheimo, Dr. med. vet., PhD



Annamari Heikinheimo holds a position of assistant professor (tenure track) in the University of Helsinki and a research professor in the Finnish Food Authority.

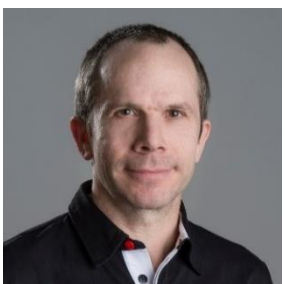
Her research focuses on Antimicrobial Resistance (AMR) from One Health perspective, on the area of zoonoses and food safety. Her research group belongs to the Helsinki One Health (HOH) research network.

Prof. Dr. Miia Lindström, Dr. med. vet., PhD



Miia Lindström is Professor of Dairy Processing Hygiene in University of Helsinki. She leads a research group at the Department of Food Hygiene and Environmental Health in the Faculty of Veterinary Medicine. Prof. Lindström's research is focused on spore-forming and psychrotrophic foodborne pathogens. Key research topics include mechanistic and evolutionary aspects of *Clostridium botulinum* neurotoxin production, the epidemiology of *C. botulinum* and *Listeria monocytogenes*, and control of food safety risks caused by these pathogens. The group is one of world-leading *C. botulinum* laboratories and is funded by the European Research Council and Academy of Finland. Prof. Lindström is a Directorate Board member of International Neurotoxin Association, and a regular member of organizing committees of international conferences on the Molecular Biology and Pathogenesis of the Clostridia, and the Basic Science and Clinical Aspects of Botulinum and Other Neurotoxins.

Dr. Erik Ågren, PhD



Erik Ågren is a European specialist in veterinary pathology, and is also specialised in wildlife health and diseases, working at the National Veterinary Institute in Sweden, heading the Section of wildlife at the Department of Pathology and Wildlife Diseases. He is the OIE National Focal point for wildlife diseases in Sweden. Special interests are wildlife disease surveillance and diseases in reindeer.

Dr. Boris A. Yakobson, Dr. med. vet., PhD



Boris A. Yakobson is a head of the NRL for rabies, Kimron Veterinary Institute, Veterinary Services & Animal Health and Project Manager, National Oral Rabies Vaccination Programme, Ministry of Agriculture, Israel His expertise covers field diagnosis of diseases and enemies of honeybees, advising beekeepers on their treatment and prophylaxis. Control of sanitary conditions of apiaries, bumble bee production laboratories, honey extraction houses and wax production factories.

Establishment of laboratory diagnosis of honey bee pathogens, mites and others enemies. Control of export and import of honey and bumble bees. Developing, testing and registration of different types of *Varroa mite* control preparations. Developing novel environmentally friendly wax moth storage techniques. Research on biological control of Chalkbrood disease of honeybees. Establishment of acaricide and antibiotic residue monitoring program. Local and international training in the field of honeybee pathology.

Dr. Merete Hofshagen, PhD



Merete Hofshagen is Head of Department for Animal health, Animal Welfare and Food Safety at the Norwegian Veterinary Institute. She is also the Deputy Director of the Institute.

She is a veterinarian with a PhD in microbiology and has been supervisor for several PhD students and coordinator for several international research projects. Hofshagen is also member of the Scientific Steering Committee for the Norwegian Scientific Committee for Food and Environment. Her main interests are surveillance, zoonoses and antimicrobial resistance.

Assoc. Prof. Dr. Janne Lundén, Dr. med. vet., PhD



Janne Lundén is an associate professor in risk management in food safety in the Department of Food Hygiene and Environmental Health, Faculty of Veterinary Medicine, University of Helsinki. Lundén has worked with risk management questions both in academia and in central and local food control for 20 years. The thesis considered *Listeria monocytogenes* risk management in food industry. Following the thesis Lundén has carried out food control research with the aim to increase the science-base in official food control.

Lundén has supervised four PhD thesis and five thesis are being prepared on food control. He has published over 50 research papers and book chapters. Current research projects concern the disclosure system of food control inspections, food fraud prevention and the role of different parties in risk management in food safety.

Dr. Natalia Tsemborevitch



Medical Doctor in the Field of Hygiene and Epidemiology, Candidate of Medical Science (PhD), Head of the Laboratory For Population Food Status Assessment of the Republican Scientific-Practical Centre of Hygiene, Minsk, Republic of Belarus.

Investigation in the field of food safety and nutrition including microbiological food safety and risk assessment, cooperation with the Eurasian Economic Commission in the development of requirements for food safety, elaboration of national documents with determinate hygienic requirements for food stuffs, implementation of Risk Analysis into the legislative and practical activity of the Ministry of Public Health, training of food business operators and inspectors in the field of food safety.

Prof. Dr. Andris Andrusaitis, PhD



Andris Andrusaitis serves as the Acting Executive Director of BONUS EEIG since August 2018. His responsibilities include the oversight and leading the BONUS EEIG's strategic development and coordination and monitoring of the BONUS EEIG's activities as well as organising the preparation and implementation of the Steering Committee decisions. He leads implementation of the coordination and support action BANOS CSA "Towards the joint Baltic Sea and the North Sea research and innovation programme". This action

prepares a framework for launching the joint Baltic Sea and the North Sea research and innovation programme as a successor of the Baltic-Sea-focused BONUS Art. 185 programme. Andris joined the BONUS Secretariat in 2008 after having been involved with BONUS since the ERA-NET times. Until August 2018 Andris served as the Programme Manager, being responsible for the scientific coordination of the programme including development of the strategic research agenda, implementation of the Steering Committee's decisions related to the programme management, organisation of the programme's scientific workshops and conferences, monitoring and following up of the projects, and organising programme's scientific reporting to the EU and national funding agencies.

Andris received his degree in hydrobiology in 1987 from Shirshov Institute of Oceanology in Moscow. He initiated the establishment of the Latvian Institute of Aquatic Ecology, where he served as the Director from 1995 to 2003 continuing his research in plankton ecology of the Baltic Sea, mostly the Gulf of Riga. During 2003-2007, he worked as the Assistant Coordinator of the Baltic Sea Regional Project funded by the World Bank and the Global Environment Facility, and implemented jointly by HELCOM and ICES. In 2006-2009 Andris coordinated Latvian national research programme on impact of climate change on aquatic systems (KALME). Andris was an associate professor and the head of Department of Hydrobiology, Faculty of Biology, University of Latvia.

Prof. Dr. Henn Ojaveer



Henn Ojaveer is a professor at University of Tartu and senior research scientist at Danish Technical University. He is currently Vice-chair of the Advisory Committee of ICES and past chair of ICES Steering Group on Human Activities, Pressures and Impacts. He is a member of the Group of Experts of the UN Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects and a lead author of IPBES assessment of alien invasive species. He has over 25 years' experience in research in marine ecology and published over 100 research papers. His main research interests are: i) dynamics of intermediate and upper trophic levels of the Baltic Sea in relation to natural and human factors at various spatial and temporal scales, ii) biology, ecology, assessment and management of non-indigenous species; and 3) indicators for management of ecosystems and fisheries.

Dr. Robertas Staponkus



Robertas Staponkus' experience includes variety of issues concerning aquatic biodiversity research and conservation on national and regional level. The specific fields of interest conservation and management of aquatic species of Habitat Directive and national concern, fishing gear selectivity on inland and marine fish stocks and fish population genetics.

Dr. Nerijus Nika



Nerijus Nika is a head of Fisheries and Aquaculture Laboratory of Marine Research Institute (KU). His research field and expertise is mostly relevant to aquatic ecology, riverine fish biology, early ontogeny and physiological status, fish stock assessment and fishery management. Last few years is more involved in aquaculture projects, like probiotic in aquaculture, saltwater recirculating aquaculture and shrimp cultivation, but since the start of his career he is always working with salmonid fish and rivers management solutions. Based on Nerijus Nika expertise on salmonid fish reproductive ecology, artificial spawning habitats were created in small Smeltaite stream, within Interreg BSR RetROUT project activities.

Prof. Dr. Jasna Bogdanska



Jasna Bogdanska is a medical doctor, specialist in clinical chemistry and her research interest is pointed towards oxidative stress and peroxisomal proliferation caused by different xenobiotics (perfluorinated compounds). She was also interested in the effect of these compounds on innate immunity in experimental models. She has been participating in the research projects at Stockholm University, Sweden, presently working as a full time professor at University “Ss Cyril and Methodius”, Medical Faculty in Skopje, North Macedonia. Her special interest is focused on the distribution of perfluorinated compounds in the tissues and organs in mice.

Dr. Georgia Kaprou, PhD



Chemical engineering diploma from the National Technical University of Athens, 2010 (majored in Food Science and Biotechnology). Masters degree in Biotechnology from the University of Edinburgh, 2012. Ph.D. in Biology from the University of Crete, 2018.

Research expertise and interests focus on microfluidics and Lab-on-a-Chip technology for Food Safety, Healthcare and Environmental applications. Design, fabrication (development), validation and optimization of integrated microdevices. Adjustment and optimization of biological protocols for microfluidics.

SCIENTIFIC ADVICE FOR SAFE FOOD – A EUROPEAN PERSPECTIVE**Dr. Bernhard Url***Executive Director of European Food Safety Authority (EFSA), Italy**- What is Risk Assessment*

Risk Assessment supports policy makers by informing value-based decisions with fit for purpose scientific advice. Different to hypothesis driven academic science it answers to politically framed questions by critically appraising and integrating streams of evidence by use of methodological rigour, transparency and public engagement. It strives to be objective, as value-free as possible and open about assumptions and uncertainties. Communicating the results of risk assessment transparently, timely and accessibly is an essential part of the risk analysis process.

- Threats and Challenges

Numerous opportunities and challenges are ahead of EU risk assessors: increasing complexity linked, for example, with the combined assessment of multiple chemicals; changing climate conditions that may favour the establishment of invasive alien species impacting on plant and animal health; or the management of vast amounts of often unstructured data, requiring continuous availability of enhanced expertise and of harmonised methodologies. The fast-paced environment and the speed of innovation requires an agile risk assessment process, able to adapt constantly, and new scientific knowledge arising, for example, from genome editing, synthetic biology or engineered nanomaterials to address new risks.

- How EFSA contributes to finding ways to adapt

It is anticipated that scientific and technological advances in the science of regulatory risk assessment will not be enough to fulfil the needs of policy makers in the future. Society asks for additional evidence to be transparently assessed and integrated in policy decisions. Therefore, it should be considered to complement risk and food safety deliberations with the assessments of benefits and alternatives, and, even a step further, the socio-economic impact of their uptake. In the future, food safety risk assessment will have to be an integral part of the design of sustainable food systems. The prospect of nearly 10 billion people living on the planet in 2050 and their needs for plant-based food, clothes and housing materials exposes societies to an unprecedented challenge in terms of plant production, agricultural land use, biodiversity conservation and greenhouse gas reduction. The preparedness for the “unknowns” along this journey can only be achieved by limitless cooperation. As trivial as the usefulness of “connecting, cooperating and co-designing” might be, its systematic application will be an indispensable success factor for mastering the future food safety challenges.

THE EU'S HARMONISED SYSTEM HAS LIFTED FOOD AND FEED SAFETY TO A LEVEL ACHIEVED NEVER BEFORE IN HISTORY

Prof. Dr. Dr. Andreas Hensel

Federal Institute for Risk Assessment (BfR), Germany

Likewise, food security, i. e. the availability of a sufficient amount of supplies, is no longer a problem to worry about in our countries. Despite this wealth in products, distributors and providers, fear and doubt among consumers about both issues clearly lacks any foundation in basic facts. Large parts of the population perceive justified warnings about individual and select incidents of rotten, mislabelled or adulterated food as an indication of a general danger – instead of what they really are: proof of a well-functioning and elaborate system among the network of European food safety agencies. Of course, food and feed safety may never be taken for granted, but require a constant effort by official authorities; not least due to arising trends, such as internet-based trade or the advent of novel foods (insects, clean meat). The talk addresses one example of these, viz. the transfer of ciguatera-infected fish from tropical regions to Europe. More generally, it analyses if and how complete safety is ever obtainable and what role the precautionary principle plays in this."

GUARANTEEING SAFE FOOD – YESTERDAY, TODAY, TOMORROW**Prof. Dr. Thomas Blaha***University of Veterinary Medicine Hannover, Germany*

The methods to “guaranteeing” safe food have remarkably changed over time. Trial and error and preventing to eat food that had others killed or sickened prevailed the early days of mankind. The rules for what to eat and what not by the founders of major religions in e.g. the Tora, the Bible and the Koran were a next step in the attempt to protect people against harmful food. The self-proclaimed good management practices by e.g. the butchers’ guilds in the middle ages were a further progress, but far from guaranteeing that food was safe. The real breakthrough in reducing the health risks due to meat products was the “invention” of the meat inspection by Robert von Ostertag. His suggestions to inspect each carcass with the purpose to have veterinarians to decide “fit for consumption” or “not fit for consumption”, and the German first “Meat Inspection Law” in 1900 became the blue print for making meat safer all over the world. This principle was a sheer success story: major food-borne diseases and parasitosis were even eradicated. This success made this method obsolete (which is as great as the smallpox story). The “old” risks are gone thanks to the “classical” meat inspection. Meat has never been as safe as today! And: this means that we can now focus on the “hidden” risks due to meat: zoonotic pathogens and chemical contaminants by optimizing the production processes throughout the entire food chain. However, the future of providing safe food from animals is to make sure by innovative methods that all animals used for food production are healthy and free from any latent infection.

HISTORY OF THE DUTCH FOOD SAFETY LABORATORY SYSTEM, FROM > 50 LABORATORIES TO ONE INTERNATIONALLY RENOWNED FOOD SAFETY INSTITUTE

Dr. Robert van Gorcom

Wageningen Food Safety Research (WFSR), the Netherlands

At the 10th anniversary of BIOR I am asked to look back in history. Not the history of BIOR and its predecessors, but the history of the food safety and food fraud laboratory system in the Netherlands.

At the end of the nineteenth century both local and national governments realised that something had to be organised in order to improve the quality and safety of food and to prevent food fraud. Within 15 years a large number of institutes were initiated under the umbrella of city councils and the ministries of agriculture and health. In the second decade of the twenties century important food safety laws were issued and over the years two separated systems evolved. A feed and meat related system under the ministry of agriculture and a food related system under the ministry of health. Both systems had their own regional and central laboratories, including, often local, routine laboratories and more central reference laboratory like institutes.

In the first years of this century the first steps in the merger of these two systems were made and over the last twenties years this process continued. In 2012 a national inspection service was formed and the laboratory landscape was further centralised. As the last step in 2019 all food and feed safety laboratories were combined in one new institute, Wageningen Food Safety Research. This institute is the only official laboratory for the country, the major national reference laboratory (including 2 EU-RL tasks) and a research institute.

This process of concentration and the reasons behind it will be discussed.

BIG DATA IN FOOD SAFETY

Dr. Hans Marvin, Anand Gavai, Ningjing Liu & Yamine Bouzembrak

Wageningen Food Safety Research (WFSR), the Netherlands

Big Data refers to large amounts of different types of data produced with high velocity from a high number of various types of sources. Handling today's highly variable and real-time datasets requires new tools and methods, such as powerful processors, software and algorithms¹. In various domains, Big Data technologies are being developed that can handle vast amounts of structured and unstructured data from diverse sources and origins. However, a recent review of the scientific literature revealed that "Big Data" is seldom being used in relation to food safety although some promising trends and developments were identified². Future trends on on-site analysis using smartphones -such as developed in the H2020 project FoodSmartPhone³, sharing data in the food supply chain using blockchain technology and social media use for food safety identification will stimulate Big Data approaches. At WFSR, Big Data analytics are applied as tools to integrate the factors driving food safety risks in a systemic manner, which also will take advantage of the vast amount of data that is available. Recent developments have shown that Bayesian Networks (BNs) allow such approach^{4,5}. BN prediction models have been developed to predict the presence of food safety hazards in various supply chains, to predict food fraud type and to select the sampling site. The models integrated monitoring data with data from influencing factors such as climate, economy or agricultural parameters and often high prediction accuracies are obtained (generally > 90%). In addition, a Big Data infrastructure has been developed allowing easy access to a large number of publically available data sources, automatic collection of data, processing, visualization and an automatic feeding the food safety prediction models. These on-site detection technologies, together with e-infrastructure, improved data aggregation, analysis and smart decision support systems using Big Data analytics, will lead to a paradigm shift in improved food safety control systems and authenticity.

¹ <https://ec.europa.eu/digital-single-market/en/big-data>

² Hans J.P. Marvin, Esmée M. Janssen, Yamine Bouzembrak, Peter J.M. Hendriksen and Martijn Staats. (2017). Big data in food safety; an overview. *Critical Reviews in Food Science and Nutrition*, 57:11, 2286-2295, DOI: 10.1080/10408398.2016.1257481

³ <http://www.foodsmartphone.eu/>

⁴ Hans J. P. Marvin & Y. Bouzembrak (2020). A system approach towards prediction of food safety hazards: Impact of climate and agrichemical use on the occurrence of food safety hazards. *Agricultural Systems*, Volume 178, February 2020, 102760. <https://doi.org/10.1016/j.agsy.2019.102760>

⁵ Bouzembrak, Y., Hans J.P. Marvin. (2019). Impact of drivers of change including climate factors on the occurrence of chemical food safety hazards in fruits and vegetables: Bayesian Network approach. *Food Control* 97 (2019) 67–76. doi.org/10.1016/j.foodcont.2018.10.021

⁶ H.J.P. Marvin, Y. Bouzembrak, E.M. Janssen, H.J. van der Fels Klerx, E.D. van Asselt & G.A. Kleter (2016). A holistic approach to food safety risks: Food fraud as an example. *Food Research International* 89: 463–470. DOI: 10.1016/j.foodres.2016.08.028

TRUST IN FOOD INTEGRITY BY NEW ANALYTICAL APPROACHES?**Dr. Carsten Fauhl-Hassek***German Federal Institute for Risk Assessment (BfR), Germany*

Food integrity describes “the state of being whole, entire or undiminished or in perfect condition” and considers apart from food safety also quality and authenticity as holistic approach. Currently, in terms of food safety well evolved analytical methods are most often used to verify maximum levels of undesired substances ensuring legal compliance. Though, the risk is high that new or unexpected ingredients or contaminations due to fraud, mistakes, accidents etc. will not be revealed in time as exemplified in the cases of melamine or fipronil. This stands in contradiction to the increasing complexity of supply chains in the global market. Not at least due to the more and more involved operators and respective opportunities the risk for contaminations by non-intentional incidences increases on the one hand, but on the other hand the risk of fraudulent practices is enhanced as well. There is consequently a need for strategies to be able to act more proactively rather than, as it is currently the case, reactively.

Food fingerprinting is an evolving trend in food and feed authentication and is considered to be especially advantageous in the detection of unknown and unforeseen adulterants. Its principle, the non-targeted analysis, further allows pinpointing unexpected contaminations within certain limits of sensitivity. However, the use of these methods in routine analysis and surveillance is so far limited because important prerequisites are still lacking, such as method validation strategies and reliable databases. The talk will discuss the need for new analytical strategies, requirements, current developments and bottlenecks regarding the verification of food integrity.

ANTIBIOTIC USAGE AND RESISTANCE IN FARM ANIMALS – IS THIS PART OF THE ONE HEALTH PROBLEM?

Prof. Dr. rer. nat. Lothar Kreienbrock, Svetlana Kasabova, Katharina Hommerich, Katja Hille, Nicole Werner

Institute for Biometry, Epidemiology und Information Processing

WHO Collaborating Centre for Health at the Human-Animal-Environment Interface

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It is evident, that the development of antimicrobial resistance is related to the magnitude of antibiotic use. This is true for human as well as for veterinary medicine. To analyze associations between rising antimicrobial resistances and usage of antimicrobial agents, data from monitoring and surveillance systems are crucial.

In this overview, data on antibiotic usage and resistance in farm animals in Germany is presented. Within the project VetCAb (Veterinary Consumption of Antibiotics), antibiotic usage data in German livestock is regularly collected and evaluated. Based on a cross-sectional study in 2011, the project is continued as a longitudinal study VetCAb-Sentinel with ongoing participant recruitment and data collection since 2013. The project RESET (Resistance in *Enterobacteriaceae*) gives an overview on the resistance situation in Germany in the mid-2010th.

By contrasting these results with data from human medicine, a "problem overlap" is shown as well as a series of very distinct differences in resistance patterns. Therefore, a so-called "One-Health-Y-Approach" is identified, which suggests similar actions to fight antimicrobial resistance separately in human and veterinary medicine, as well as mutual actions in both fields.

ANTIMICROBIAL RESISTANCE AND SAFE FOOD SYSTEMS

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Antimicrobial resistance (AMR) is a global health challenge without borders (WHO 2016, WHO, FAO, OIE 2018). Approximately 400 000 people in EU suffer annually from infections caused by multidrug resistant bacteria and more than 25 000 people die of these. Infections due to these bacteria result in extra healthcare costs and productivity losses of at least €1.5 billion (EU 2017). The epidemiology and ecology of AMR is complex and includes human behaviour at many levels of the society (Laxminarayan et al. 2013, Lazarus et al. 2015). The main driver for the development of AMR is the worldwide use of antimicrobials. Other factors such as sanitation, quality of governance, public spending on health, poverty, education, and community infrastructure have also been identified as linked to AMR increase (Collignon et al. 2018, Hendriksen et al. 2019). AMR is linked closely to food systems by the use of antimicrobials in agriculture, further release of these antimicrobials to the nature (affecting environmental resistome) and the infection prevention and hygienic interventions along the food chain (Van Boeckel et al. 2015). The global movement of foods has a massive and rapid impact over a wide area, enabling wide spread of AMR bacteria (Levy and Marshall 2004, Aarestrup 2015). Microbial DNA sequencing techniques offer a powerful tool to understand AMR gene evolution and microbial transmission between different ecosystems (Schürch and Van Schaik 2017).

One Health is a holistic and interdisciplinary concept based on the idea that human and animal health are interdependent as well as linked to the ecosystems of which they are part of. The development, spread and maintenance of AMR depends on the interaction between ecologically connected bacterial populations and colonized human and animal hosts (Munk et al. 2018, Hernando-Amado et al. 2019). One Health approach has been adopted in AMR tackling in Europe (ESVAC 2015, EU 2017, FINRES-Vet 2018). It includes AMR surveillance, research and education. For example AMR aspect is present in Erasmus+ funded project "Learning Genomics for Food Safety" an eLearning platform which is developed to teach microbial DNA sequencing and bioinformatic analyses for students from multiple disciplines (<https://www.learn-genomics.eu/>).

Achieving better knowledge on AMR background and prevention is essential to be able to tackle AMR globally. Healthy animals and proper hygiene measures along the food chain are essential, as well as controlling the use of antimicrobials (especially when using to promote animal growth) and avoiding the release of these antimicrobials to the nature (Marshall and Levy 2011). Both clinical and environmental aspects of AMR, multisectoral work and better coordination between these sectors are needed to overcome this major challenge jeopardizing global health and the achievements of sustainable development.

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BOTULISM – NOVEL ASPECTS OF THE OLD THREAT**Prof. Dr. Miia Lindström***Department of Food Hygiene and Environmental Health, Faculty of Veterinary Medicine, University of Helsinki, Finland*

Botulism risk related to processed and anaerobically stored foods is known for centuries. Botulism is a result of the botulinum neurotoxin (BoNT) blocking neurotransmission and causing a flaccid paralysis that may lead to death upon respiratory muscle collapse. BoNT was first extracted from blood sausages and described by Justinus Kerner in the early 19th century, and a BoNT-producing bacterium, first called *Bacillus botulinus* and later renamed as *Clostridium botulinum*, was isolated almost a century later by the Belgian Emile Pierre-Marie Van Ermengem from a contaminated ham. Research since those days has identified an ever-growing selection of bacterial species able to produce BoNTs, a vast diversity of BoNTs with distinct target species and toxic properties, and several disease forms of botulism with distinct aetiology and epidemiology. While the classical food poisoning botulism with dramatic symptoms remains as the most common form of botulism worldwide, the increasing number of cases with toxicoinfectious botulism, mild intoxications, and atypical symptomologies raise the question if the epidemiology of botulism is yet fully understood. Recent findings of novel BoNT types and non-clostridial species with BoNT genes, in parallel with population aging, growth of risk groups, dietary changes, and sustainable solutions in food production, are prone to create novel niches for growth and toxin production by BoNT-producing bacteria. This may introduce emerging public health risks. The presentation discusses emerging aspects of botulism in light of state-of-the-art research findings in the field.

WHOLE GENOME SEQUENCING IN SURVEILLANCE AND OUTBREAK INVESTIGATION OF *SALMONELLA ENTERICA* - EXPERIENCE IN LATVIA

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Salmonellosis is the most common foodborne bacterial gastroenteritis in Latvia, and there are several large outbreaks each year, mainly in educational institutions and social care centres. Whole genome sequencing (WGS) is a powerful tool that can provide wide information about bacterial genotype, including virulome and resistome, and relationships between strains. It is widely used in investigation of outbreaks and epidemiological tracking; however, several issues are still under discussion.

BIOR is the Latvian National Reference laboratory for zoonoses including *Salmonella*. Bacterial WGS was introduced in 2016 and so far, BIOR database contains close to 400 *Salmonella* whole genome sequences obtained from food and veterinary samples and human clinical samples in 2017 - 2019. Bacterial isolates are collected within framework of national food safety monitoring programmes and outbreak investigations. Standard characterization procedure for each isolate includes species confirmation by MALDI-TOF, library preparation for NGS sequencing according to *Nextera XT* library construction protocol and sequencing with *Illumina Miseq* to obtain 2x300 bp paired-end reads. For data analysis commercial software *Ridom SeqSphere+* is used with built-in *Velvet* sequence assembler and typing approaches for 7-gene MLST and cgMLST.

Here we will share our experience investigating several salmonellosis outbreaks using WGS. Two main benefits of WGS approach are i) precise genetic characterization of *Salmonella* strains related to the certain outbreak and ii) indication of potential infection source type through bacteria sequence similarity even when bacterial strains from epidemiological investigation are lacking. However relevant epidemiological data are necessary before making final conclusions.

LAB-ON-CHIP PLATFORM FOR RAPID FOODBORNE PATHOGEN DETECTION

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According to the European Food Safety Authority (EFSA), more than 100.000 food-poisoning cases are reported each year, causing an economic burden as high as 3 billion €. Thus, exposure of consumers to food biological hazards should be prevented by a strict food safety policy, achieved by applying holistic approaches towards food hygiene from farm to fork. In order to enable efficient and rapid controls in all levels of the food chain, portable, low cost and user friendly platforms for biological hazard detection are required.

Recently, we have proposed a modular integrated Lab-on-Chip (LoC) for sample preparation and a micro-nano-bio acoustic system for the detection of foodborne pathogens. In the present work, we present an integrated, compact, LoC platform performing rapid pathogen analysis in food samples at an unprecedented record time of 4.5 hours. The novelty of the herein LoC lies in the compact design of the sample preparation chip and the integration with an acoustic sensing device, employing a hybridization-free acoustic detection scheme, capable of handling complex unpurified samples. The proposed LoC is based on a polymeric microfluidic chip combining on-chip immunoaffinity-based bacteria capturing, chemical lysis and DNA isothermal amplification, all three steps performed in a single microfluidic chamber, followed by label-free detection with a Surface Acoustic Wave (SAW) biosensor. Thanks to oxygen plasma nanotexturing of the polymeric microfluidic chip, antibody binding at high densities is achieved, resulting in efficient on-chip bacteria capturing. Moreover, freeze-dried antibody-functionalized chips were shown to offer good capture efficiency even after 26 months of storage. The chosen method for DNA amplification is Loop mediated amplification (LAMP) due to its robustness and high yield. Resistive microheaters with very low power consumption (2W) were fabricated on a PCB substrate below the microfluidic chip, providing the heat needed for performing the LAMP. The operation protocol includes: 1) a short (3h) off-chip pre-culturing step, starting from 1-5 CFUs in 25ml of spiked fresh or pasteurized milk, followed by a brief centrifugation step for sample concentration and, 2) on-chip automated bacterial capture, lysis, DNA amplification and acoustic detection. For amplicon detection, a Love wave SAW device was used to monitor changes in the energy of the acoustic wave in real time following their binding to a PLL-PEG-modified device surface. This surface was shown to be able to detect specific *S. Typhimurium* amplified DNA and discriminate it from any non-specific binding even inside unpurified complex samples (in this case, milk spiked with *S. Typhimurium*).

The sample-to-answer analysis time was less than 4.5 h, at least 5-times faster compared to conventional methods used for foodborne pathogens analysis. The on-chip sample preparation and detection was accomplished within 70 min. In the future, following appropriate food processing protocols for solid food samples, the chip can be validated also for other food matrices. This work paves the way to integrated sample preparation and label-free DNA analysis, addressing not only food safety, but also point-of-care diagnostics.

WILDLIFE DISEASE SURVEILLANCE AS A PART OF ONE HEALTH**Dr. Erik Ågren***National Veterinary Institute (SVA), Sweden*

Seek and you shall find. To work with wildlife surveillance is to be part of the One Health concept. But it takes a lot of work to document what diseases wildlife have or carry. Relevant competence, infrastructure, and funding is vital, as well as establishing and maintaining networks of collaborators for reporting and transporting samples and carcasses to a diagnostic laboratory. There are many examples of infectious diseases originating from wildlife that affect humans or domestic animals. But to find diseases, you have to look to know what you have, what is emerging, or to show freedom of a disease. Wildlife disease surveillance in Sweden and neighbouring Nordic countries is heavily focused on pathology as a base for sampling and further tests. With a long-term continuous general (passive) surveillance focusing on found dead or euthanized sick wildlife, the chance of finding emerging diseases or outbreaks increase. Pathology adds value to any surveillance, compared to only working with molecular studies of samples from apparently healthy animals such as hunted wildlife. Web-based surveillance and networks on a regional, national, and international scale, with integrated work between public and animal health sectors are important newer tools when working with wildlife diseases. Utilizing other tools such as participatory epidemiology with mobile phone apps for citizen science reporting, systems for syndromic surveillance and disease modelling has made the work more effective, with many opportunities for further development. Early warning and rapid response systems for early detection of disease outbreaks in wildlife gives early warning of possible outbreaks in livestock, which also gives the opportunity of early response activities to avoid outbreaks in humans. Improved human health as well as lowered costs for disease outbreaks should be important outcomes for policy makers and funding agencies, well motivating the work with wildlife disease surveillance. Surveillance of emerging infectious diseases that are threats to biodiversity and human health in common ecosystems should be an easy priority.

BEES IN THE ONE HEALTH CONCEPT

Dr. Boris Yakobson

Kimron Veterinary Institute, Bet Dagan, Israel

The problem of safely feeding the world while preserving the environment requires cooperative scientific problem-solving. One Health partnerships enable cumulative actions that are essential to ensure the health and safety of humans. The One Health concept recognizes that the health of people is connected to the health of animals and the environment. Honeybees are domestic animals and should be included in the One Health concept. The OIE recently reaffirmed its commitment to the beekeeping sector by making bee mortality and diseases one of the priorities of its Strategic Plans. Preserving the health of bees both bred and wild, is an integral part of good environmental management, food security and enhanced global agriculture. Neglecting bee health and allowing our planet's bee populations to collapse would have a far-reaching impact on the environment, the agriculture and the economy. There is an expression attributed to Albert Einstein: *"If the bee disappeared off the surface of the globe, then man would have only four years of life left. No more bees, no more pollination, no more plants, no more animals, no more man."* Starting in last decade, bee colonies have been disappearing at alarming rates in many parts of the world due to the cumulative effects of parasitic mites, viral and bacterial diseases, and exposure to pesticides and herbicides. Pathogen loads were highly covariant in Colony Collapse Disorder (CCD), suggesting that CCD colonies rapidly become susceptible to a diverse set of pathogens, or that co-infections can act synergistically to produce the rapid depletion of workers that characterizes the disorder. The beekeeper plays a key role in maintaining the health status of managed honeybee colonies and ensuring their productivity. Disease management of honeybee populations is nearly impossible without regular disease reporting and the participation of beekeepers themselves in this management. The risk of transmission of pathogens to honey bees through the international trade of bee products such as honey, bee-collected pollen, propolis, beeswax, royal jelly and honey bee venom as well as food safety for humans will be discussed. Human health hazards that may arise from bees, such as allergy to bee stings, infant botulism, residues of drugs and environmental pollutants, will be addressed. Agricultural practices influencing habitat loss, such as the decline of flowers due to ruminant grazing, herbicides, pesticides and crop monoculture, have a crucial effect on the numbers and diversity of bees, especially wild ones. A study examined 224 types of food in 156 countries, and what might happen to the people in these countries if there was a 50 percent, 75 percent or a 100 percent decline in animal pollinators. The outcome of these nutrient deficiencies would likely mean increased birth defects, and child mortality rates. According to the study, if there is a 100 percent decline in pollinators, 71 million people around the world would face vitamin A deficiency, and 130 million people would face folate deficiency. This would be in addition to the one to two billion people who already suffer from these deficiencies. In most parts of the world, annual colony losses make commercial bee keeping a risky occupation, and as a hobby it becomes unpleasant. Thus, the number of people involved in bee keeping is declining. Mankind's influence, which rapidly transforms all the planet's natural systems and has been viewed for decades as causing a growing environmental crisis, needs to be viewed also as the cause of a growing public health crisis. The climate change is also making life harder for bees. As average monthly temperatures rise, flowers bloom earlier in the spring, creating a potential mismatch in seasonal timing between when flowers produce pollen and when bees are ready to feed on that pollen. Even a mismatch of three to six days could negatively affect bees' health, making them less likely to reproduce and less resistant to predators and parasites. As the OIE (the World Organisation for Animal Health) puts it: *"Human health and animal health are interdependent and bound to the health of the ecosystems in which they exist."*

WILDLIFE AND ONE HEALTH IN THE NORTH AND THE ARCTIC – AN ECOSYSTEM IN CHANGE

Dr. Merete Hofshagen

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Northern latitudes are vulnerable to climate changes with several pathogens extending their distributions northerly and infecting naïve animal populations. Simultaneously, human activities change habitats, reduce resources or introduce additional stresses to wild species, which leads to changes in infection patterns. More than 70% of emerging diseases have origin in wildlife species, which strengthens the importance of surveillance for up keeping wildlife health, but also as early detection of outbreaks, potentially dangerous for production animals or even humans.

The Norwegian Veterinary Institute runs a wildlife health monitoring program, which in the last years has identified pathogens/disease outbreaks, that help implement the One Health approach in the country, including in the Arctic, a pristine ecosystem under great pressure. In this presentation we will use different examples to show the benefits of integrating wildlife health monitoring and research in broader surveillance and research programmes (aimed at husbandry, human or ecosystem health). A special focus will be given to health threats affecting the Arctic.

OVERVIEW OF MOST IMPORTANT FOODBORNE PARASITES IN LATVIA

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Food borne parasites (FBP) include protozoa, nematodes, cestodes and trematodes. Although a significant public health issue, FBP have been neglected compared with other foodborne pathogens such as viruses or bacteria.

The overall objective of the present study is to use a multi-disciplinary, One Health approach to tackle issues associated with foodborne parasites, addressing existing gaps in our knowledge regarding occurrence, transmission, epidemiology, harmonization of methods, and prevention.

The pathogens that are taken into the spotlight in present study are *Cryptosporidium*, *Giardia*, *Toxoplasma*, *Sarcocystis*, and *Echinococcus* spp. Globally, they are ranked high among the most important foodborne pathogens by FAO and WHO.

Retrospective data shows that during the previous 15-year period only few cases per year were notified which demonstrates the presence of the mentioned pathogens in the country and possibility of undiagnosed clinical cases. However, information regarding other foodborne parasites, like sarcocystosis, the information is lacking. Also no published information is available about circulation of the mentioned pathogens in animal hosts.

In the present study we found: the high prevalence of *Toxoplasma gondii* in humans; *Cryptosporidium* spp. and *Giardia duodenalis* are common in livestock and species/assemblages pathogenic for humans are prevalent; *Sarcocystis* spp. and *Echinococcus* spp. are underreported in livestock.

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PREVALENCE OF HEPATITIS E VIRUS IN DOMESTIC PIG AND WILD BOAR POPULATIONS AND MEAT PRODUCTS IN LATVIA

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Hepatitis E virus (HEV) is a foodborne and waterborne pathogen that can be divided at least in seven genotypes 1 - 7. The most prevalent HEV genotypes in developed countries are 3 and 4 that naturally circulate in various animal populations. Most of the human HEV cases are related to the consumption of undercooked animal meat and meat products. In this study we analysed prevalence of HEV in domestic pig and wild boar populations and in meat products of pig origin available in retail in Latvia.

Two parameters were analysed to characterize HEV in animal populations. Seroprevalence was analysed in 1254 and 450 sera samples from domestic pigs and wild boars, respectively. HEV specific antibodies were detected using PrioCHECK® HEV Ab porcine (Prionics, Switzerland). In total 46.4% of domestic pig and 40.9% of wild boar samples contained antibodies against HEV.

For HEV molecular detection and genotyping animals from herds and geographic regions with the highest seroprevalence were selected. Nested PCR for HEV ORF1 region (Huang, 2002) was performed on 270 domestic pigs' and 361 wild boars' sera and tissue samples and 6.9% and 10.5% of domestic pigs and wild boars, respectively, were tested positive.

Additionally, we analysed 57 food samples (29 paté, 15 liver, 12 ground meat, 1 fermented sausage) for the presence of HEV RNA using nested PCR for ORF1 region. One paté sample was tested positive for HEV.

This study reveals noteworthy presence of HEV in Latvian swine and wild boar population. Although prevalence of the virus in animals at slaughter age is low, evidence of HEV in food requires further research to evaluate possible HEV transmission routes and risk factors as well as to compare food and veterinary data with HEV cases in humans.

IMPACT OF FOOD CONTROL RESEARCH ON RISK MANAGEMENT STRATEGIES

Associate professor, DVM Janne Lundén

University of Helsinki, Finland

The main responsibility for risk management in food safety lies on food businesses. Official food control (food control) authorities' role is to ensure that food businesses' risk management is sufficient, and if not act with appropriate measures. Food control is carried out in some form in all societies to protect the consumer health, which is the main task. In the European Union food control is based on common legislation, which sets strict demands on the structure and quality of food control. Although food control is an important pillar in risk management, there is not a strong practice in performing food control research. Therefore, food control is exposed to inconsistent opinion-based development instead of science-based improvement.

Food control research is multidisciplinary aiming at developing food control models and methods. The risk management problems are multifaceted and must be examined from the viewpoints of both food businesses and food control. Examples of poorly managed risks are many. Here I will discuss the importance of food control research in developing the risk management by presenting three examples. These examples consider a) the risk management of *Listeria monocytogenes*, b) food fraud prevention and c) the balance of the responsibilities of risk management between food businesses, food control and third parties.

NOVEL APPLICATIONS OF WASTEWATER-BASED EPIDEMIOLOGY FOR PUBLIC HEALTH MONITORING

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Wastewater-based epidemiology (WBE) is a novel method of sampling and analyzing chemical residues in wastewater samples to measure a population's consumption of or exposure to chemicals. This methodology was outlined for the first time as a potential tool to evaluate the use of illicit drugs and misused therapeutic drugs within a community in 2001. The major advantage of wastewater-based epidemiology is that it enables estimation of chemical exposure or consumption as a function of time, providing crucial information on the relation between compounds loads in wastewater, public health, and socioeconomic status for specific sewer sheds.

WBE could provide the analysis of temporal trends, which can monitor population chemical consumption or exposure over time, such as changes in drug use in response to government interventions. In addition a spatial assessment can provide insights into differences in population lifestyles or behavior, such as the prevalence of antibiotics consumption in different countries.

Most commonly measured chemicals by WBE include illicit and licit drugs, pharmaceuticals and personal-care products.

This presentation summarizes the novel application of WBE in area of the public health monitoring. Latest publications of WBE provided information on exposure to chemicals such as endocrine disruptors or flame retardants. There are also theoretical prospects of measuring biomarkers of diet. Wastewater fingerprinting provides additional information about the public exposure to plasticizers and their associated health risks. In addition some studies applied the WBE approach to evaluate human exposure to pesticides in several cities across Europe.

Additional information is provided in relation to scientific activities of BIOR in area of WBE devoted to elaboration of sensitive high resolution mass spectrometric methods for determination of chemical substances in wastewater samples and the analysis of drugs residue in Latvian wastewater processing plants.

COMPLEX INVESTIGATION ABOUT Q-FEVER DISTRIBUTION AND RISK FACTORS IN DAIRY CATTLE SHEDS IN LATVIA

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Infection with Q-fever causing agent *Coxiella burnetii* is endemic in domestic ruminants in most European countries. The goal of this investigation was to estimate the prevalence of Q-fever in the territory of Latvia by assessing the presence of *C. burnetii* DNA in bulk tank milk (BTM) and pathological material in 2019 in comparison with the previous investigation carried out in 2015, as well as assessing the presence of antibodies in serum samples of aborted bovine. Further determination of the nature of the infection was done in positive serum samples by detection of serological response to Phase I or Phase II antigen.

Within the study 837 BTM samples were tested in 2019 representing 600 dairy cattle sheds from 83 regions of country using molecular biology methods. Number of pathological material samples was 536 representing 224 sheds. In total 465 sera samples of cattle were investigated for antibodies by commercial ELISA kits. Several factors were assessed in order to evaluate their impact on the prevalence of the disease in particular regions of the country – density of dairy cows and small ruminants, size of the shed etc.

From all BTM samples 161 was positive (19.19%) and were detected from 9.98 % of all tested sheds. There was a tendency that the number and proportion of positive samples correlated positively with the density of dairy cows in the area.

Of the abortion cases, 36 (6.72%) were positive in nine (3.57%) sheds and seven (11.3%) regions. Of the sera samples, 106 were positive and seven were suspicious with screening ELISA kit for Q fever antibodies in 37 sheds of 18 regions. The highest antibody prevalence (> 30%) was observed in cows aged from 7 to 8 years. From 180 bovine serum samples tested with phase specific kits, 28 were positive and 14 suspicious for Phase I, but 11 samples were positive and eight suspicious for Phase II, showing that the dominant infection type was the chronic infection.

ALIMENTARY EXPOSURE OF POLYCYCLIC AROMATIC HYDROCARBONS AND NITRATES/NITRITES IN THE REPUBLIC OF BELARUS

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Republican Unitary Enterprise «Scientific and Practical Center of Hygiene», Belarus

The study of the long-term effects of carcinogenic compounds, such as N-nitrosamines (NA) and polycyclic aromatic hydrocarbons (PAHs), on the population is an urgent task to ensure of food safety due to the high probability of their entry into with diet. Alimentary nitrates and nitrites intake is important as a precursors of endogenous N-nitrosamines formation. For hygiene assess of the levels of contamination by individual NA - N-Nitrosodiethylamine and N-Nitrosodimethylamine, the results of 147 studies of foodstuffs, including meat products, smoked meet products, smoked fish products and beer were analyzed. For hygienic assessment of PAHs (benzo(a)pyren (BR) and sum of benzo(a)pyren, benzo(a)anthracene, chrysene, benzo(b)fluoranthene (4PAHs) contamination, studies were carried out on 158 samples of food products, including smoked meat products, smoked fish products, smoked cheeses, oil and fat products and cocoa products. The analysis of the obtained results did not reveal the excess of the maximum allowable levels of NA, BR, 4PAHs in all studied samples. For nutrition exposure assessment of NA and PAHs, the consumption of food products by various population groups was studied. Studies have shown that there is no unacceptable risk when NA and PAHs are generated during the production of food products under normal conditions of consumption of these groups of food products. The value of the population carcinogenic risk due to the content of BR and 4PAHs in food at the median level indicates the possibility of an adult population from 10 to 34 and from 17 to 60 additional (to the background level) cases of malignant neoplasms, respectively. Measures aimed at reducing the level of the studied compounds in the diet are relevant and one of the elements of primary medical prevention of cancer.

MOOMINS V. HUMANS: SCIENCE FOR SUSTAINABILITY OF THE BALTIC SEA ECOSYSTEM SERVICES

Prof. Dr. Andris Andrusaitis

Acting Executive Director of BONUS EEIG, Coordinator of BANOS CSA, Finland

In autumn of 2019 passengers paging through the inflight magazine onboard the Finnair flights could come across an intriguing news item: “Moomins⁷ Saving the Sea”. More precisely, this was a promo of an international fundraiser #oursea (<https://oursea.fi/>) aiming to collect one million euros to go to John Nurminen foundation – one of the private charities supporting various investigative projects and demonstrators for restoration of the Baltic Sea. While this, of course, is an exceptionally commendable initiative, one can rightfully enquire whether saving the Baltic Sea is still an urgency as we enter the second decade of the 21st century. This despite the ambitious programme to restore the good ecological status of the Baltic marine environment by 2021 - the Baltic Sea Action Plan (BSAP) adopted by all coastal countries back in 2007 and set in action in 2010.

In this brief introduction we will analyse the achievements reached, and challenges met by BSAP with emphasis on the role of science contribution and evolving towards evidence-informed policymaking and management. Throughout the recent decade BONUS (www.bonusportal.org) – the joint Baltic sea research and development programme – co-funded by the Baltic Sea countries together with the European Union - has firmly attested its role as the major supplier of scientific knowledge for more sensible stewardship of marine ecosystem. Up to date BONUS has invested more than EUR 100 million in 64 research and innovation projects addressing the most urgent issues of sustainability of the Baltic Sea ecosystem services. Several of the BONUS projects have received important input by the fisheries scientists at BIOR, most notably BONUS INSPIRE (2014-2018) and BLUEWEBS (2017-2020).

Currently a dedicated drafting team involving experts of Latvia are preparing the input version of the strategic research and innovation agenda (SRIA) for the new geographically broadened research and innovation programme BANOS covering both the Baltic and the North Sea (www.banoscsa.org).

⁷ The Moomins are characters in a series of books and a comic strip by Finnish author Tove Jansson (1914-2001). They are a family of white, round fairy tale characters with large snouts that make them resemble hippopotamuses. 2020 marks the 75th anniversary of publishing the first Moomin book. (Wikipedia)

HISTORICAL BASELINES IN MARINE BIOINVASIONS: IMPLICATIONS FOR POLICY AND MANAGEMENT**Prof. Dr. Henn Ojaveer***Technical University of Denmark, DTU Aqua/ University of Tartu, Estonia*

The human-mediated introduction of marine non-indigenous species is a centuries- if not millennia-old phenomenon, but was only recently acknowledged as a potent driver of change in the sea. The presentation provides a synopsis of key historical milestones for marine bioinvasions, including timelines of (a) discovery and understanding of the invasion process, focusing on transfer mechanisms and outcomes, (b) methodologies used for detection and monitoring, (c) approaches to ecological impacts research, and (d) management and policy responses. Early (until the mid-1900s) marine bioinvasions were given little attention, and in a number of cases actively and routinely facilitated. Beginning in the second half of the 20th century, several conspicuous non-indigenous species outbreaks with strong environmental, economic, and public health impacts raised widespread concerns and initiated shifts in public and scientific perceptions. These high-profile invasions led to policy documents and strategies to reduce the introduction and spread of non-indigenous species, although with significant time lags and limited success and focused on only a subset of transfer mechanisms. Integrated, multi-vector management within an ecosystem-based marine management context is urgently needed to address the complex interactions of natural and human pressures that drive invasions in marine ecosystems.

SCENARIO-BASED SIMULATION OF THE GULF OF RIGA FUTURE FOOD WEB USING THE ECOPATH WITH ECOSIM MODELLING APPROACH**Ivars Putnis, Jānis Gruduls***Institute of Food safety, Animal Health and Environment "BIOR", Latvia*

The Gulf of Riga is a semi-enclosed ecosystem strongly influenced by environmental and anthropogenic pressures such as eutrophication, fisheries and invasion of non-indigenous species. The challenge of global climate change in combination with the growing needs for the exploitation of marine resources has created a high demand for ecological models that can provide information relevant for ecosystem-based management. The understanding of food web dynamics plays a key role in ecosystem-based management approach. However, the information on a complex food web dynamic process very often is insufficiently known. In this study, we prepared a mass-balanced food web simulation model for the Gulf of Riga using the Ecopath with Ecosim modelling approach. A dynamic Ecosim model was created to describe the main food web components and to analyze the effect of combined changes in a future climate, fishery, and nutrient loads. The model was forced using physical and biogeochemical variables. Model simulations were made up to 2098 including two climate change projections (RCP 4.5 and 8.5), two nutrient load schemes (BSAP, REF) and three fishing scenarios (status quo, reduction of 50% and increase 100%).

SEALS AND COASTAL FISHERY IN LATVIA: CAN WE MITIGATE SEAL IMPACT?**Inese Ozoliņa, Māris Plikšs***Institute of Food Safety, Animal Health and Environment „BIOR”, Latvia*

Seal species that are distributed in the central part of the Baltic Sea are grey seal (*Halichoerus grypus*), and ringed seal (*Pusa hispida*). The Latvian coast and central part of the Gulf of Riga is used for foraging by both species, but there are no seal haul-out sites or breeding areas. The grey seal population has almost tripled in the past 10 years, while ringed seal in the Gulf of Riga have stabilized, or have shown a slight tendency to increase.

Seal depredation has increased recently, and is now creating substantial economic consequences for coastal fisheries in Latvia. In order to evaluate the possible effects of damages to fishing gear and catch losses in the coastal zone, several studies involving fisherman’s questionnaires and individual interviews were conducted during 2016-2019. Additionally, fishermen logbook statistics have been analyzed. Our study reveals temporal and spatial trends of: 1) seal presence near fishing gear, 2) damage of fishing gear and 3) possible catch losses. This information is further used to provide mechanisms for a seal depredation compensation scheme for Latvia, which is assumed as one of the possible impact mitigation measures in the present situation.

RIVER LAMPREYS - THE FISH CONNECTING BALTIC PEOPLE**Dr. Robertas Staponkus***Klaipeda University, Lithuania*

Out of four lamprey species: European river lamprey *Lampetra fluviatilis*, European brook lamprey *Lampetra planeri*, Sea lamprey *Petromyzon marinus* and Ukrainian lamprey *Eudontomyzon mariae* present in Lithuania and Latvia, only the river lamprey *L. fluviatilis* is considered of commercial importance. However, in recent years the *L. fluviatilis* status in the Baltic Sea region by HELCOM was evaluated as near threatened. In order to prevent degradation of conservation status and sound management of the stock the study aimed to identify stock management units. We used 8 microsatellite loci to identify genetically differentiated populations. Analyses were based on distinct population in Baltic Sea tributaries from Nemunas river to the Griva river. No differentiation for microsatellite DNA loci was found among anadromous river lampreys populations in Lithuania and in western coast of Kurzeme ($p < 0,05$). Gene diversity within *L. fluviatilis* populations ranged from 0,48 to 0,52 and did not significantly differ from the expected values reflecting the favorable population status. We conclude studied populations to be panmictic and form a single management unit in the region, what as a result calls for close regional cooperation on river lamprey management and conservation.

OCCURRENCE OF ANISAKIDAE NEMATODES IN EASTERN BALTIC COD (*GADUS MORHUA*) IN EASTERN PART OF BALTIC SEE

Gunita Deksnē¹, Māra Lisovska², Beatrise Jerina¹, Ivo Šics¹, Tatjana Baranova¹, Jānis Aizups¹, Māris Plikšs¹, Ruta Medne^{1,2}

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Eastern Baltic cod stocks have substantially declined in recent years. It is due to a number of factors, one of which could be infection with Anisakidae nematodes.

A sampling of Eastern Baltic cod liver has been carried out on the board of Polish scientific vessel “Baltica” in ICES subdivisions 26 and 28 in winter and spring during on Baltic internationally trawl surveys. Size, weight and age of cod were determined and Fulton’s condition factor was calculated. The liver samples has been analyzed by visual inspection and artificial digestion method. All detected nematodes were determined to genus level after morphological characteristics. Further species identification has been done by PCR-RFLP after the size of Internal Transcribed Spacer fragments.

The overall prevalence was 40.6% (N=276) and it significantly ($p<0.05$) increased by the age of cod ranging from 0.0% in age group under one year to 100% in the oldest age group (7 years). However, there were no difference of prevalence in different sampling regions. The mean intensity has been observed 4.1 ranging from one to 113 parasites per fish. There were no correlation observed between number of parasites per fish and Fulton’s condition factor.

Most of the detected nematodes has been differentiated as *C. osculatum*. However, molecular studies are still ongoing for further species identification in doubtful cases.

This is the first comprehensive study of Anisakidae nematodes in Eastern Baltic cod. However further detailed studies are needed.

CONTRIBUTION OF THE INSTITUTE BIOR IN LONG-TERM MAINTENANCE OF SALMON AND SEA TROUT STOCKS

Santa Purvina¹, **Ruta Medne**^{1,2}, **Jānis Bajinskis**¹

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Institute BIOR is responsible for salmon and sea-trout artificial reproduction in Latvia, by farming and releasing around 1.25 millions of smolts and parr yearly in the Daugava, Gauja and Venta river basins. Artificial reproduction of salmon and sea-trout resources is implemented in accordance with the National Artificial Fish Resources Reproduction Program Guidelines. The main principle of the Guidelines is to maintain salmonid stock in long-term sustainable condition. Up-stream migrated spawners for rearing purposes are caught in the natal rivers. Fish eggs are incubated and juveniles are reared in the flow-through systems to maintain homing reflex and develop adaptation to natural conditions. For monitoring purposes all smolts and one year old parr are fin-clipped and 4000 specimens are tagged. More than 850 000 juveniles are released in smolt stage, ready for down-stream migration. According to monitoring data, artificially reared salmonids constitute largest part of upstream migrating fish: salmon - in Daugava 88%, in Gauja 86%, and in the Venta River 58%; sea trout - in Daugava 100%, but in Gauja 67%. Today, when stocked salmon amount exceeds natural salmon production as well as natural spawning potential is weak in whole Baltic Sea region, both - artificial restocking and maintenance of healthy natural population is of critical importance in a long-term perspective of the salmon and sea-trout stock conservation.

SUSTAINABLE SALMONID FISH MANAGEMENT SOLUTIONS IN LITHUANIA: TRADITIONAL STOCKING OR HABITAT RESTORATION?

Nerijus Nika

Klaipėda University, Marine Research Institute, Lithuania

The management of salmonid rivers and fish populations is crucial for long-term sustainability of target fish stocks. Fishery regulation, pollution control, artificial stocking, fishpass construction, habitat improvement and other measures are used to improve ecological status of rivers and fish stocks. During the last 25 years, Lithuania had several small-scale river restoration projects and about 20 fishpasses were installed on dams. The efficiency of applied measures often is very difficult to assess, but part of these restoration cases were not successful because of different reasons. Sea trout and salmon artificial breeding and juvenile release into rivers takes place since 1998 and is considered as a main and absolute stock improvement measure. However, again, its efficiency often is not clear, especially for sea trout. We seek to reconsider salmonid fish management practice, by switching to more long-termly sustainable solutions like river habitat restoration. One of the demonstration sites for river restoration measures is Smeltalė Stream catchment. In early 90's there was piloted first restoration project in Lithuania, when biopond system was installed to decrease existing organic pollution to the ecosystem and to increase river's self-cleaning capacity. Stream is highly regulated (72 % of total length is straitened) and recently there is significant increase in trophic state, probably due to intensive urbanization of upstream catchment. However, Smiltelė yields high density of sea trout population in its sparse productive areas, but total sea trout smolt production is low due to low total availability of suitable reproductive sections. Scientific data-based measures were applied in 2019 to increase ecological status and sea trout smolt production: biopond system recultivation and sea trout spawning and juvenile rearing habitat rehabilitation. The results of these activities and general situation with salmonid river management will be presented.

RIVER AND FISH FAUNA SPECIFIC ESTIMATION OF ECOLOGICAL FLOW IN SEVERAL SMALL HYDROELECTRIC POWER STATIONS

Jolanta Jēkabsone¹, Tatjana Koļcova¹, Kaspars Abersons², Jānis Bajinskis²

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Ecological flows (e-flow) is the quality, quantity, and timing of water flows required to maintain the components, functions, processes, and resilience of aquatic ecosystems. In Latvia indication of e-flow is a mandatory requirement for all water usage permits for operation of small HPS issued after 2006. It is set by law that estimation of e-flow for small HPS should be performed independently by Institute "BIOR" and by environmental experts yet methodology for calculations is not prescribed. So far e-flow was calculated on the basis of hydrological data and in most cases set as a half of average long-term flow rate in July and August. However it appears that in several cases e-flow for some HPS was not calculated by any expert and was set voluntarily by state official.

Aim of this research was to perform a river and fish fauna specific estimation of e-flow for three small HPS in Venta and three small HPS in Lielupe river basin district, research was performed within the Interreg project Nr. LLI-249 „ECOFLOW”. Estimation of e-flow was accomplished by using of MesoHABSIM methodology and GIS Sim-stream software. MesoHABSIM is a model that uses hydromorphological (depth, substrate, stream velocity etc.) and hydrological data and Fish Conditional Model to estimate how changes of discharge affect suitability of river reach of interest for different fish species at specific life stage.

Ecological flow estimated within this research was greater than e-flow currently specified in water use permit for all six small HPS. Greater differences were found for power plants where e-flow in permit is set voluntarily by state official.

LIVER, BLOOD AND BONE ARE THE MAJOR COMPARTMENTS FOR PERFLUOROOCCTANOIC AND PERFLUROSULFONOIC ACID DISTRIBUTION IN ADULT C57BL/6 MICE

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Perfluorinated chemicals have been used for many years due to their physicochemical properties useful for variety of applications. Due to their exceptional resistance to biological and environmental degradation these compounds have become a global environmental contaminants. The estimated long half-life in human serum with a sex differences, as well as species differences and the route and the length of exposure have raised the concern about the possible effect of these chemicals on human health.

The aim of our study was to determine the tissue distribution of perfluorooctanoic acid (PFOA) and perfluorosulfonoic acid (PFOS) in C57BL/6 mice following dietary exposure to a low dose (similar to those detected in humans and in exposed humans respectively).

Animals and treatment: Male C57BL/6 mice (6-8 weeks old) randomly divided in six groups (3 mice each) were exposed for 1, 3 and 5 days to 19 mg/kg body weight to PFOA and to 23 mg/kg body weight for PFOS by food diet using ¹⁴C-labelled PFOA and ³⁵S-labelled PFOS respectively. At the end of the feeding period the major organs were collected for determination of PFOA and PFOS content by liquid scintillation counting. The experiments were pre-approved by the Northern Stockholm Ethical Committee for Animal Experimentation.

The major compartment system for both chemicals was the liver followed by blood for PFOA and bone for PFOS. Skin and muscles were the next major compartments for both chemicals. There was no saturation with PFOS (with an exclusion of bone) while for PFOA the saturation appears to reach a plateau after 3 days of exposure.

As a conclusion we may say that both chemicals were detected in most tissues and organs examined. Our experiment mimics what is considered as one of the major routs via which humans are exposed to those compounds. It will be of a great importance to study the half-lives of these compounds in humans in relation to exposition and life style.

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IMPLEMENTATION OF THE WATER FRAMEWORK DIRECTIVE (WFD) IN THE BALTIC SEA REGION COUNTRIES

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Water is a crucial resource for humanity, generating and sustaining economic growth and prosperity. Nearly half the EU population lives in 'water-stressed' countries, where the abstraction of water from freshwater sources is too high. Recent figures show that 20% of surface water is at serious risk from pollution.

In order to protect human health, water supply, natural ecosystems and biodiversity, EU waters must achieve good ecological and chemical status. On 23 October 2000, the Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy or, in short, the EU Water Framework Directive (WFD) was adopted. It introduces a legislative approach to managing and protecting water, based not on national or political boundaries but on natural geographical and hydrological formations. Some of the key aims of the WFD are: expanding the scope of water protection to all waters, surface waters and groundwater; achieving "good status" for all waters; water management based on river basins; "combined approach" of emission limit values and quality standards; getting the citizen involved more closely. For Latvia the Daugava river basin is of transnational nature and shared not only with the EU partners as Estonia and Lithuania, but also with non-EU countries Belarus and Russia. Therefore significant mutual efforts should aim also at cooperation and inter-state relations.

PREVALENCE OF SHIGA TOXIN-PRODUCING *ESCHERICHIA COLI* IN CATTLE FARMS IN LATVIA

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Shiga toxin-producing *Escherichia coli* (STEC) are important enteric pathogens that can cause severe, sometimes bloody diarrhea, as well as hemolytic uremic syndrome (HUS). The main natural reservoir of STEC are ruminants, especially, cattle, which harbour STEC as part of their normal intestinal flora. People become infected with STEC by consumption of contaminated foods.

The aim of the study was to estimate prevalence of STEC in cattle farms in Latvia.

A total of 93 fresh combined samples of rectal feces were obtained from 471 animals from 12 dairy and beef cattle farms across the country by veterinary inspectors of Food and Veterinary Service of the Republic of Latvia in October, 2019, and delivered to the Institute of Food safety, Animal Health and Environment "BIOR" within 36 h.

For STEC detection, 25 g of each combined fecal sample was enriched in 225 mL of TSB supplemented with 16 mg/L novobiocin and 1,5g/L bile salts (mTSB+N) at 42°C for 6 h. One mL of suspension was transferred to 9 ml of fresh mTSB+N and incubated at 37°C for 20±2 h. The presence of STEC virulence factor genes *stx1*, *stx2*, *eae*, and serogroup O26, O103, O111, O145 and O157 associated genes in enrichment broth was determined with real-time PCR using primers and probes from ISO/TS 13136:2012.

Presence of STEC Shiga toxin genes *stx1* and *stx2* was detected in all 12 cattle farms. *Stx1* was detected in 44,1% (41/93) and *stx2* in 57,0% (53/93) of samples. *Stx1* or *stx2* gene was detected in 78.5% (73/93) of combined fecal samples. Intimin coding gene *eae* was detected in 68,8% (64/93) of samples. The most prevalent serogroup was O157 that was found in 66,7% (8/12) of farms in 35,5% (33/93) of combined fecal samples.

Results demonstrate that STEC virulence genes are frequently found in cattle in farms in Latvia.

NON-TARGETED SCREENING AND IDENTIFICATION OF COMPOUNDS IN PAPER FOOD CONTACT MATERIALS

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Following the recent vote of Members of European Parliament on upcoming proposal for a directive of the European Parliament and of the Council on the reduction of the impact of certain plastics products on the environment [1], there is an increased awareness regarding the replacement products of single use plastics. For single use plastics there are readily available solutions, however, there is no certainty about the overall benefit of the proposedly ecologically safer and compatible materials used for the manufacture of the replacement products.

The scope of our research is to evaluate of safety of paper straws as a replacement product. There are no guidelines present regarding the testing of paper food contact materials (FCM), hence, an approach used for FCM plastics testing was used, based on Commission Regulation 10/2011 [2], combined with an untargeted liquid chromatography – high resolution mass spectrometry (LC-HRMS) workflow.

For the use in prior workflow, databases of chemicals of concern, regulatory and non-regulatory FCM substance lists were retrieved. The corresponding compound Chemical Abstract Service Registry Numbers (CASRN) were processed through a modified chemoinformatics workflow “MS-Ready” [3] in an open-source KNIME Analytics platform to obtain the molecular descriptors used for the suspect screening search in the FCM extracts. Additionally, the obtained molecular descriptors were used to perform a toxicological profiling of potential hazardous compounds identified in the samples.

The obtained LC-HRMS data combined with a novel untargeted screening workflow enabled by Compound Discoverer 2.1. software allowed an accurate annotation of the identified compounds using the obtained FCM molecular descriptor database, online monoisotopic mass databases (ChemSpider, PubChem), publicly available curated fragmentation spectra databases (MassBank) and in-silico fragmentation matching (MetFrag, FISh).

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ALIMENTARY EXPOSURE OF POLYCYCLIC AROMATIC HYDROCARBONS IN REPUBLIC OF BELARUS

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Objectives: The greatest amount of carcinogenic polycyclic aromatic hydrocarbons (PAHs) such as benzo(a)pyrene (BP), benzo(a)anthracene (BaA), chrysene (CHR) and benzo(b)fluoranthene (BbF) enter the human body with foods. **Materials and Methods:** The content of BaA, BbF, CHR and BP in the cocoa products, fat-and-oil products, smoked meat and fish products, smoked cheeses were studied in accordance with HPLS. The assessment of alimentary exposure was carried out using the generally accepted approaches recommended by FAO/WHO and EFSA. Models for estimating the alimentary exposure for each product considered the median and 95th percentile of the content of contaminants in the studied food groups and their level of consumption. **Results:** Hygienic assessment of the results obtained didn't reveal the excess of the maximum allowable levels of the 4PAHs in all samples foods. The level of contamination of cocoa products, smoked fish and meat products, smoked cheeses of 4PAHs varied from 0,19 µg/kg to 0,33 µg/kg, from 0,60 µg/kg to 0,70 µg/kg, from 0,70 µg/kg to 0,81 µg/kg and from 0,54 µg/kg to 0,62 µg/kg respectively. The level of contamination of 4PAHs (median) was 3,72 µg/kg for fat-and-oil products, 0,75 µg/kg and 0,65 µg/kg for smoked meat and fish products, 0,58 µg/kg for smoked cheeses and cocoa products 0,26 µg/kg respectively. The 95th percentile reached 7,87 µg/kg in smoked fish products. The alimentary intake of 4PAHs was from 2,996 ng/kg body weight per day to 20,979 ng/kg body weight per day. **Conclusions:** Studies have shown that the levels of alimentary exposure of PAHs vary widely depending on the type and amount of food consumed. Therefore, in relation to these substances is necessary to carry out a risk assessment and develop measures to reduce them.

ALIMENTARY NITRATES AND NITRITES EXPOSURE IN BELARUS**Ekaterina Fedorenko¹, Sergey Sychik¹, Natalia Kolomiets²**¹ *Republican Unitary Enterprise «Scientific and Practical Center of Hygiene», Belarus,*² *Belarusian Medical Academy of Postgraduate Education, Belarus*

The nitrates content was estimated in vegetables and cheese (as food additives) as a source of these compounds. The nitrites level associated with food additives use has been measured in meat products. The alimentary exposure assessment of nitrates and nitrites among the adults based on average consumption of vegetables, cheese and meat products was carried out. There was a large variation in median concentrations of nitrate in different vegetables from 32,8 mg/kg (onion) to 1428,3 mg/kg (in leafy vegetables). The total amount of nitrates used as food additives E251 and E252 in cheese production ranged from 12,5 mg/kg (median) to 39,6 mg/kg (95 percentile). Nitrites concentration (E249 and E250) in meat products was 25 – 32,2 mg/kg. Alimentary nitrates exposure due to their content in vegetables and potatoes was 35.4 – 41.6% of ADI, the E251 and E252 food additives intake amounted to 0.001 – 0.011 mg/kg BW/day. The total dose of nitrates from the vegetables and food additives was 1.3 – 1.5 mg/kg BW/day. Nitrites intake in different exposure scenarios was 0.005 – 0.069 mg/kg BW/day, or 8.3 – 113% of ADI. Taking into account the endogenous synthesis from nitrates, the level of exposure of nitrites increases to 0.093 to 0.172 mg/kg BW/day. Alimentary nitrates and nitrites intake is important as precursors of endogenous N-nitrosamines formation. Dietary exposure to nitrate from vegetables and food additives did not exceed the current ADI in adults' population. The mean nitrites exposure from their use as a food additive was below the ADI, the highest exposure did lead to an exceedance of the ADI. The exposure to preformed nitrosamines in food should be minimized including the lowering of food additives levels.

TROUT REPRODUCTION POTENTIAL IN PAKSĪTE RIVER AND POSSIBILITIES OF ITS INCREASE

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This research is a follow-up study to a survey conducted in 2018 in the Ciecere River which suggested that reproduction of brown trout and sea trout in Ciecere River catchment occurs mostly in its tributaries. The aim of this research was to evaluate trout reproduction potential in Paksīte River which is one of the biggest tributaries of Ciecere River. Study was carried out in 10 km long part of Paksīte River above its river mouth. Study area was divided in 72 reaches with similar hydromorphological features. Suitability for trout reproduction was evaluated by use of Trout Habitat Score (THS) and overall features of river described by use of River Habitat Survey (RHS). In addition, electrofishing was performed in 6 sites.

THS value in different reaches fluctuated from 2 to 10 (in 10-point scale). Good (THS 7-8) or excellent (THS 9-10) trout reproduction potential was found in 16 and 12 reaches respectively, share of these reaches in surveyed part of Paksīte River was 23.5% and 17.4%. Most important factors reducing THS value was increase of fine sediments and decrease of stream velocity. Reaches with lower THS value were found mostly in parts of river with highest density of beaver dams. Other important feature of Paksīte River is a heavy incision of riverbed which facilitate erosion and input of fine sediments. In electrofishing presence of trout was not detected. However, bullhead *Cottus gobio* and several other species caught in this river are common satellite species for sea trout and brown trout. We hypothesize that increase of trout parr production in Paksīte River in future can be facilitated mostly by reducing of beaver population and adding of gravel in the riverbed.

Key words: Trout, THS, RHS

COMPARISON OF METHODS FOR MEASURING TROUT HABITAT SCORE IN LATVIAN RIVERS

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Trout Habitat Score (THS) is a widely used method for evaluating the condition of the sea trout population in rivers as well as determining the suitability of a stream for sea trout. It consists of six parameters – average depth; wetted width; dominant substrate; velocity; slope (if available) and shade – based on which, it is possible to roughly determine the river's potential for trout parr production. Higher THS score indicates better conditions. So far the method has not been used in Latvia.

Field research was carried out in 2018. Trout parr density data and THS scores were assessed, in total 35 sites, 24 rivers. In order to improve and verify the applicability of the method, three different methods for measuring THS were tested and compared. It was concluded that THS is applicable – THS value positively correlates with trout parr density ($p=0.003$). In the sampling sites THS values varied from 3 to 10. The highest parr density was observed in sites with THS values 10 and 8. The simplified method also correlated with trout parr density ($p=0.013$) but needs to be improved, for it is difficult to determine some parameters visually. To analyse past data, information registered in standard monitoring forms for electrofishing sites description was used and converted to THS, but there are several inconsistencies. For now the method recommended by SGBALANST will be used as the main method, but future goal is to develop an efficient, time saving method to measure the THS.

Keywords: trout parr, density, habitat, THS, methodology.

**IMPACT: STANDARDISING MOLECULAR DETECTION METHODS TO IMPROVE RISK ASSESSMENT CAPACITY FOR FOODBORNE PROTOZOAN PARASITES, USING CRYPTOSPORIDIUM IN READY-TO-EAT SALAD AS A MODEL
(PARTNERING GRANT PROJECT GRANT AGREEMENT NUMBER GP/EFSA/ENCO/2018/03 – GA03)**

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Preparation for present and future food safety risk assessment challenges is among the five strategic objectives that will enable EFSA to address its 2020 priorities. The consortium is focusing on *Cryptosporidium* as it is an important pathogen in itself and has caused outbreaks associated with fresh produce. In addition, it is also being considered as a model organism for other relevant (oo)cyst-forming protozoan parasites such as *Toxoplasma*, *Cyclospora* and *Giardia*.

The aim of this project is to increase the European-level capacity for risk assessment of foodborne protozoa of ready to eat salad leaves. This will be delivered by strengthening laboratory networks and enabling knowledge exchange and transfer through a series of planned activities. These will encompass validation and standardization of molecular detection methods to facilitate a harmonized approach for data collection for future risk assessment.

In order to achieve the overall aim of the project, the following objectives will be accomplished: review of procedures for detection of *Cryptosporidium* in fresh produce; evaluation and implementation of a standard operating procedure (SOP) for the molecular detection of *Cryptosporidium* in salad leaves; establishment and optimization of the SOP in recipient laboratories; validation of the SOP by a ring trial; promulgation and dissemination of the results.

This consortium builds on sharing of specific knowledge and specialist skills between all partners, and transfer of knowledge in some fields from more experienced partners to less experienced partners.

COPEPOD LONG-TERM DYNAMICS IN THE GULF OF RIGA: EFFECTS OF THE ABIOTIC ENVIRONMENT AND THE IMPACT ON THE PELAGIC FOOD-WEB

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Over several decades, climate and anthropogenic influences have led to significant changes in the abiotic environment of the Gulf of Riga mainly as an increase in water temperature, decrease in salinity and bottom oxygen. Zooplankton species living in the Gulf are continuously affected by changing environment which can reduce their abundance or even led to its disappearance. Copepods are important zooplankton group as they are indispensable food components of planktivorous fish, mainly herring. The tasks of the study were (1) to determine the effects of abiotic factors (temperature, salinity and oxygen) on long-term (1960-2018) dynamics of small copepods *Eurytemora affinis*, *Acartia* spp. and large copepod *Limnocalanus macrurus*; (2) to analyze the long-term (1995-2018) changes of herring condition factor and relate it to copepod biomass. In this study, we used station-based zooplankton and hydrological data that provided information about the direct in-situ environmental effects on copepod biomass. To study the response of copepod biomass on environmental factors we applied Generalized Additive Model (GAM). We detected significant changes in copepod biomass. *E.affinis* and *Acartia* spp. increased in spring, but decreased in summer. *L.macrurus* biomass changed considerably – after high biomasses in the 1980s, it nearly disappeared in 1990s and increased again during 2000s. *L.macrurus* responded positively to lower temperatures and higher oxygen concentrations. In spring, mainly warming water temperature explained the increase of small copepod biomass. In summer, salinity significantly influenced the *Acartia* spp. biomass, but the environmental impact on *E.affinis* was weak. The changes that have occurred in the copepod community are likely affecting the feeding success of herring and stock dynamics.

CO-OCCURRENCE OF FREE-LIVING PROTOZOA AND *LEGIONELLA* SPP. IN RIGA MULTI-APARTMENT HOUSE DRINKING WATER SUPPLY SYSTEMS

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Legionella pneumophila is the causative agent of Legionnaires' disease, while free-living protozoa (FLP) can harbor *Legionella* spp. as intracellular pathogens. FLP are able to create biofilms in water pipes and can protect pathogenic bacteria against high temperature, disinfectants, can serve as reservoir for bacterial population. Bacteria-protozoa interaction can enhance the antibiotic resistance and virulence of microorganisms.

The aim of this study was to investigate the co-occurrence of FLP and *Legionella* spp. in 25 Riga multi-apartment house drinking water supply systems and to identify main FLP genus.

Water samples were tested for presence of *L. pneumophila* in using standard method and for presence of free-living protozoa, isolation and cultivation in Page's Amoeba Saline Solution with Peptone Yeast extract Glucose was done. FLP were found in 25 from 49 (51.02 %) water samples, while *L. pneumophila* or *Legionella rubrilucens* were detected in 24 from 49 (48.98 %) water samples. From kitchens 36.36 % of samples were *Legionella* spp. positive and 54.55 % FLP positive, from showers 52.63 % and 50.00 %, respectively. 48.00 and 56.00 % of cold, 54.17 and 45.83 % of hot water samples were *Legionella* spp. and FLA positive, respectively. Average temperature of cold water in Riga was +17.41 °C, and of hot water +49.48 °C. Sample number with FLP and *Legionella* spp. was almost the same, but there were samples with only *Legionella* spp. (26.53 %). With microscopy free-living amoeba genus *Acanthamoeba*, *Vahlkampfia* and *Hartmanella* (*Vermamoeba*) were identified. Implementing water treatment and disinfection strategies for inactivating protozoa should also improve control opportunities for *Legionella* spp. The study will continue with more water samples.

DETECTION OF *COXIELLA BURNETII* DNA IN UNPASTEURIZED MILK SAMPLES AND MILK PRODUCTS PRODUCED IN LATVIA

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Q-fever in dairy cattle in Latvia has been investigated since 2012. Antibody positive bulk tank milk (BTM) samples in 2015 were detected in 13.2 % of dairy cow sheds. *C. burnetii* DNA positive BTM samples were detected from 10.7 % of sheds [1]. In 2019 within the project "Impact of zoonosis Q-fever on reproduction of dairy cattle and solutions for the disease control and sustainable use of animals" it was detected that 19.2 % BTM samples corresponding to 10.0 % of tested sheds were positive for *C. burnetii* DNA.

Dairy products have been tested for the presence of *C. burnetii* DNA in several countries. In Poland, 69.2 % of dairy products were positive [2]. In Spain, DNA was detected in 29.9 % of hard cheeses produced from raw sheep milk and one sample contained infectious bacteria [3]. In France, 64 % of dairy products contained DNA but not viable bacteria [4]. In the USA *C. burnetii* is the target organism to prove the effectiveness of pasteurization in recommended conditions [5, 6].

The present study was focused on unpasteurized milk samples and dairy products from the retail in Latvia. In total 63 samples from 31 producer were tested: 11 unpasteurized milk samples, 14 pasteurized milk samples, 12 yogurts, 24 other cow milk products and one pasteurized goat milk and one goat cheese. The total DNA was extracted and amplification of *C. burnetii* IS1111 was done with commercial reagent kits.

From all samples 40 (63.5 %) were positive, mainly pasteurized cow milk products and yogurts. More often positive results from industrial producers in comparison to home made products have been obtained in France and Spain, as well [4, 7]. We can conclude that effectiveness of milk pasteurization methods in processing companies and other factors in Latvia should be carefully assessed.

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CHANGES IN THE ICHTHYOFAUNA OF THE LAKE RĀZNA

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Lake Rāznas is the largest natural lake in Latvia with a water surface of 5756.4 ha, maximum depth of 17 m and an average – of 7 m. It is located in the south-eastern region of the country in the territory of Rāznas National Park (56° 19' 37" / 27° 26' 45"). Information about the fish fauna obtained from various sources of literature from 1947, "BIOR" databases on fishery statistics from 1950, as well as field research done from 1989 to 2019. In the field research fishing nets with varying mesh sizes (8 – 70 mm), a beach seine (mesh size in the codend – 5 mm) and electro-fishing equipment have been used. From 1947 to 2019, a total of 25 fish species have been identified in fisheries research at Lake Rāznas: five species (carp *Cyprinus carpio*, eel *Anguilla anguilla*, pike-perch *Sander lucioperca*, Prussian carp, and whitefish) have appeared in the lake as a result of the releases from 1925 to 2018. Self-sustaining populations have only developed for pike-perch and whitefish. Carp *Cyprinus carpio* and Prussian *Carassius gibelio* carp are thought to have no or only very low reproductive populations. The continued existence of the eel population depends on their possible releases in the future. Bullhead *Cottus gobio*, ide *Leuciscus idus* and weather loach *Misgurnus fossilis* wick were relatively rare in 1947–1958, nowadays have not been found in fishery surveys in Lake Rāznas anymore.

FISHERIES AND AQUATIC RESEARCH IN LATVIA: THE VALUE OF A SPECIAL LIBRARY**Natalja Kondratjeva***Institute of Food Safety, Animal Health and Environment "BIOR"*

The poster presents the Library of the Fish Resources Research Department of the research institute "BIOR", its mission, collections, services and recent activities.

The Library provides information support and specialized research assistance based on the identified needs of the Department's researchers. The Library collection of printed books is regularly updated with new scientific monographs. A special section of books and periodicals provides an overview of the history and development of the fisheries sector in Latvia. A significant part of the collection is made up of nonpublished documents in a variety of types and formats (scientific reports, manuscripts, informative brochures and etc.). The future work is aimed to a greater extent at digitalization of documents to ensure the long-term preservation of the institutional history and intellectual products in digital collections.

MODELLING THE VERTICAL DISTRIBUTION OF SPRAT EGGS IN THE CHANGING CONDITIONS OF THE EASTERN BALTIC

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Knowledge about the vertical distribution of pelagic fish eggs allows to calculate mean weighted ambient temperature and then to get the durations of stages of development. Combining these results with the results of ichthyoplankton surveys enables determination of mortality rates and total production of spawned eggs, which is used in the calculation of spawning stock biomass. Investigations of the vertical distribution of ichthyoplankton in the Gdansk Deep and the Gotland Basin were performed with BIOMOC multiple opening/closing net in 1996 – 2000. Pelagic eggs of Baltic sprat were floating in the wide range of depths: eighty per cent of eggs were usually distributed in the water layers of 30 – 60 m thickness. The mean depth of them was generally decreasing during the spawning season. Generalized vertical distribution of sprat eggs relative to their mean specific gravity has been made. All the calculations were bound to determine density of water and specific gravity of sprat eggs, because salinity and temperature profiles were changing with time and place considerably. A simple model for the determination of the mean depth of eggs was made taking into account only the temperature of water in the upper layer. The pattern of vertical distribution was determined in two steps: first, mean specific gravity of eggs was calculated dependently on the water temperature at 10 m depth, and second, generalized vertical distribution was plotted against real water density profile.

SOME EVIDENT PARTICULARITIES OF SPRAT – *SPRATTUS SPRATTUS BALTICUS* (SCHNEIDER) SPATIAL DISTRIBUTION OVER THE GOTLAND DEEP IN THE BALTIC SEA

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Since 1981 Latvia performs regular hydro-acoustic surveys of sprat stock in the Eastern Baltic Sea (ICES Subdivisions 26 and 28.) Oceanographic surveys are carried out simultaneously with hydro-acoustic surveys. The peculiarities of sprat distribution were analysed in relation to season, size of the stock, size of the recruitment, and some environmental conditions like severity of winter, inflows of saline waters from the North Sea, water temperature and content of oxygen in the water. The analysis showed that seasonal vertical distributional pattern is rather steady while the horizontal distribution could have differences between years although main concentrations of sprat are over big depth in cold part of the year and closer to the coast in summer-fall period. There are also differences between distribution of younger and older age groups of sprat. A hypothesis is put forward that Gotland Deep basin is the centre of distribution of sprat stock in the Baltic Sea.

THE FOOD SAFETY SYSTEM IN THE REPUBLIC OF BELARUS

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The central goal of the Belarussian food safety policy is to ensure a high level of protection of human health and consumers' interests concerning food, taking into account diversity, including traditional products, whilst ensuring the effective functioning of the internal market. The national food safety system includes legislation, organizations responsible for inspections and laboratory testing, scientific projects, risk analysis, training, stakeholder's communication. Risk analysis was implemented into the national legislation. Scientific projects cover the investigation of polybrominated substance in food, food allergens risk assessment, the method for determination of 17 dyes by high-performance liquid chromatography, assessment of viral contamination of food, health risk assessment associated with residues of veterinary drugs in animal food products. International FAO project in the field of food safety is performed. Capacity building is one of the most important element. International educational centre "On Academic" is organized. Scientific cooperation is an element of sustainable and safe national and regional food systems.

DEVELOPMENT AND VALIDATION OF A HPLC-DAD METHOD FOR QUANTIFICATION OF SYNTHETIC DYES IN VARIOUS FOOD PRODUCTS

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Currently, synthetic dyes (SD) are widely used in the food industry. However, these compounds may have carcinogenic, allergenic and terratogenic properties. Some SD are prohibited for using, for others, the maximum permissible content in the food product is established. It is completely forbidden to use synthetic dyes for baby food production, wines, juices. Because of it, the monitoring of the presence and content of synthetic dyes in food products is very important and urgent task.

The aim of this study was to develop and validate an analytical procedure for simultaneous determination of 16 synthetic dyes (SD) (i.e. E 102, E 104, E 110, E 121, E 122, E 123, E 124, E 127, E 128, E 129, E 131, E 132, E 133, E 142, E 143, E 151) in different kinds of food products. The procedure is based on the extraction of dyes from food products with an aqueous-methanol solution of ammonia followed by centrifugation, decantation, adjusting the extract pH value to 7 and subsequent quantitative determination using HPLC-DAD method. Identification of the synthetic dyes is carried out at their maximum of absorption. The quantitative limit for the synthetic dyes varies in the range of 1–5 mg/kg. The maximum expanded uncertainty of the results does not exceed 23% for each synthetic dye.

GENETIC PATTERNS OF COLISTIN RESISTANT *ESCHERICHIA COLI* IN LATVIAN LIVESTOCK AND RETAIL MEAT, 2015-2018

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Antimicrobial resistance (AMR) in pathogenic bacteria is an important problem of the modern world.

Many infections are becoming more difficult to treat due to increased resistance of the causative agents against available antibiotics and the lack of development of new antibiotics. Colistin, one of the last resort treatments for infections caused by multidrug-resistant Gram-negative pathogens is also affected by AMR. Since 2015, multiple transferrable genes conferring resistance to colistin have been discovered in bacteria isolated from food, animals and human patients.

In this study, we sampled livestock and retail meats in Latvia to assess the prevalence of colistin resistance in *Escherichia coli* – a commonly used indicator organism for AMR monitoring. Whole genome sequencing of the resistant *E. coli* isolates was performed to gain a deeper insight into mechanisms of resistance and patterns of its distribution. Both PCR and whole genome sequencing revealed presence of *mcr-1* but not any other genes that are linked with colistin resistance. Further genomic analysis allowed us to identify the plasmid that harbours *mcr-1* in most of the positive isolates. Variants of the same plasmid are present in genetically diverse isolates, indicating extensive horizontal exchange of mobile genetic elements. Strikingly, most of the positive isolates originate from a single farm throughout the study period.

DIRECT-INJECTION FOURIER-TRANSFORM ION CYCLOTRON RESONANCE MASS SPECTROMETRIC METHOD FOR ULTRA-FAST DETECTION QUANTIFICATION OF QUINOLONES IN POULTRY

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Many recent studies have shown high detection frequencies of quinolone antibiotics in poultry, as well as an increasing trend of antimicrobial resistance development. The main purpose of the research was to develop a fast and reliable analytical method for the detection of quinolones in poultry meat. In order to develop a rapid quantitative confirmation method, ion cyclotron resonance mass spectrometer was utilized. Firstly, the sample preparation procedure was simplified by reducing the procedure to extraction and freezing out steps. Secondly, the chromatographic separation step was excluded and mass spectrometric parameters were optimized. Thirdly, the method was validated by fortifying blank matrix at four levels (0.5, 1, 1.5 and 2 times the maximum residue limit (MRL) or level of interest, where no MRL was established). As a result, the overall analysis time was reduced to less than an hour. The validation study revealed that the method is capable of detection and confirmation of ten quinolone compounds in poultry above CC β levels. Finally, the developed method was applied to 19 commercially available chicken meat samples. None of the samples contained quinolones above the method's limit of quantification (LOQ). Analysis of treated chickens revealed that the developed method is suitable for determination of the ciprofloxacin and enrofloxacin content. The developed method could be one of the fastest quantitative confirmatory methods for the analysis of quinolones available so far.

BIOGENIC AMINES IN MOULD CHEESES FROM THE LATVIAN MARKET

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Nowadays blue-veined cheeses have become more popular in the market due to the increased varieties of the product, whereas the quality and safety of different mould cheeses continue to rise awareness.

Biogenic amines (BA) are low-molecular-weight nitrogenous compounds, that are mainly produced through amino acid decarboxylation, which exists in most fermented foods such as cheese, sausage, wine and fish.[1] In Europe, permitted levels for histamine (His) in fish and fish products have been established at 100-400 mg kg⁻¹, while there are not regulations set for dairy products.[2]

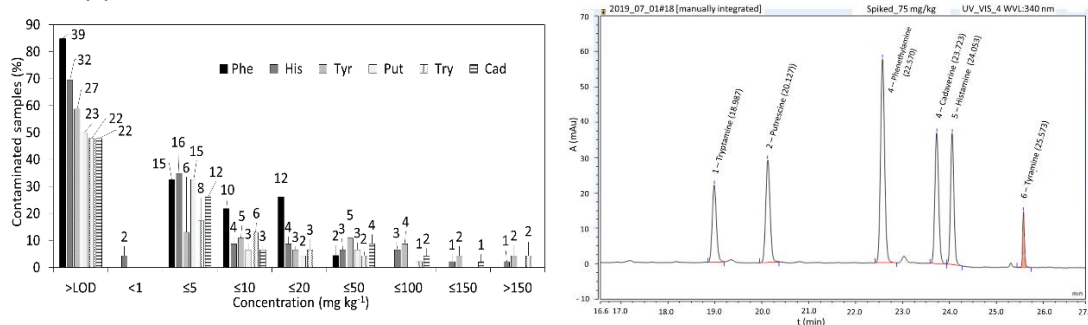


Fig. 1. Histograms of biogenic amines in 46 blue mold cheese samples from the Latvian market and a chromatogram of blank (brine-matured fresh cheese) sample spiked to 75 mg kg⁻¹.

A sensitive UHPLC-PAD method for determination of 6 BAs (Figure 1.) was optimized and applied to analyze 46 blue-veined cheese samples representative of most brands and varieties in local supermarkets in Latvia.

Tested cheese samples were positive for one to six BAs, with the individual concentrations ranging from just above the reporting level (<1 mg kg⁻¹) up to 719 mg kg⁻¹, while the total content of BAs ranged from 5.5 to 824 mg kg⁻¹. Almost a quarter (n =12) of the tested cheese samples contained under 10 mg kg⁻¹ of BAs (Figure 1.)

With respect to scientific risk assessment, high acute hazard indexes were obtained for histamine and tyramine according to the worst-case scenario based on high consumption and 95th percentile occurrence, whereas other BAs were present at insignificant levels, thus the analysed cheeses can be considered as safe for healthy adults.

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CONCENTRATION OF IMMUNOGLOBULIN CLASSES IN DAIRY COW MILK AND BLOOD IN RELATION TO COWS UDDER HEALTH AND KEEPING CONDITIONS

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Recent studies show that immunoglobulins A, G, and M contribute significantly to the maintenance of cow udder health. However, the concentration of immunoglobulins in milk during the middle stage of lactation is low therefore the question of how to promote and maintain a sufficient level and spectrum of antibodies in the udder is significant. The aim of the present study was to evaluate the dynamics of the amount of immunoglobulins A, G, M in cow milk and blood serum in relation with the keeping condition and presence of pathogens in the udder. The experimental part of the study was carried out on the dairy herd in Valmiera region. Cows were kept in a cold loose housing system, grouped and fed differently depending on productivity and lactation period. Milk and blood were sampled within two year period proportionally in housing and grazing periods from clinically healthy dairy cows. For the study were selected dairy cows in similar-age, similar milk productivity, in the middle stage of lactation.

Fresh milk samples obtained from clinically healthy udder quarters were examined for the concentration of immunoglobulins A, G, M and for the presence of udder pathogens. Blood samples were examined for the concentration of immunoglobulins A, G, M.

It was detected that keeping conditions significantly affect the concentration of immunoglobulins G, A in milk ($p < 0.001$), and the concentration of immunoglobulins A, G, M in blood ($p < 0.001$). Some pathogenic bacteria species subclinically infecting udder quarters considerably increase the values of immunoglobulins G ($p < 0.05$), A ($p < 0.001$), M ($p < 0.001$) in blood serum.

A wide variation amplitude of immunoglobulin G, A, M concentration in milk and blood in different circumstances were observed, which indicates the important role of the both: individual animal factor as well as environmental factors in the formation of udder immunological defence, which should be further investigated and explored.

APPLICATION OF HIGH-RESOLUTION MASS SPECTROMETRY FOR MULTI-MYCOTOXIN DETECTION IN TEAS MARKETED IN LATVIA

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An advanced method based on online-heart-cutting two dimensional-liquid chromatography with TOF-MS detection was used for the analysis of 70 mycotoxins in tea. The method was applied for multi-mycotoxin screening in 130 samples of different *Camellia sinensis* varieties (Pu-erh, black, and green teas), including their blends with flavourings and /or herbal or fruit. 60% (n = 75) from the total tested tea samples were free of mycotoxins. 26.8% of black tea samples and 39.5% green teas were positive for co-occurrence of one to sixteen mycotoxins from twenty compounds determined. All of the Pu-erh teas were fully contaminated with deoxynivalenol (DON) and its secondary metabolites (3-AcDON, 15-AcDON, D3G). The average Σ (DON, 3-AcDON, 15-AcDON, D3G) concentrations in Pu-erh tea samples increased by 3.8 times the levels determined in green teas (25% positive with average concentration 1,571 $\mu\text{g}/\text{kg}$) and more than 27 times increased the levels determined in black tea samples (16.9% positive for DON and metabolites, with average concentration 222 $\mu\text{g}/\text{kg}$). Ochratoxin A (OTA, ranged between 0.8-7.7 $\mu\text{g}/\text{kg}$) and its metabolite (OTB) were found in 13 to 15 samples of tested teas. Pu-erh and black teas were also determined for higher levels of aflatoxin B1 (AFB1) and the sum of AFs, which prevailed in 16% green teas and 10% black tea varieties. Emerging Alt and ATX 1 were found in 70% of Pu-erh teas at sum contents 0.14-37 $\mu\text{g}/\text{kg}$, which also contained high summary contents of ENNs.

LEVEL OF ANTIBODIES AGAINST THE AFRICAN SWINE FEVER VIRUS IN WILD BOAR HUNTED IN LATVIA

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African swine fever is a virus-induced fatal disease affecting the Suidae family. The African swine fever virus is the only representative of the genus Asfivirus. For the first time, it was detected in Latvia in June 2014 and during five years spread in nearly the whole country.

The aim of the study was to find out whether the wild boar population in Latvia is developing natural immunity to African swine fever virus. Laboratory methods were used to detect antibodies and their titre levels in wild boar blood samples, as well as the relative amount of virus in the same samples.

Analyzing the results, it is concluded that seroprevalence increases in the Latvian wild boar population, i.e., the number of hunted wild boars with antibodies against African swine fever virus is increasing. At high antibody titre ($> 1/81000$), the ASF virus is still detected. For 4 samples with a relatively high amount of virus (ASF) ($Ct < 25$) and high Ab titre ($> 1/81000$) virus isolation and additional sequencing on subtypes of genotype II is done by EURL-ASF, INIA-CISA.

From 2 wild boar samples with a relatively high amount of virus (ASF) ($Ct < 25$) and high Ab titre ($> 1/81000$), that were hunted in 2017 in the territory of Tukuma region, non-haemadsorbing (non-HAD) genotype II ASFV was isolated in EURL-ASF, INIA-CISA. Colleagues from EURL-ASF, INIA-CISA evaluated the virulence of this isolate experimentally and found a significant decrease of virulence. This isolate looks as promising vaccine strain against ASF virus.

WHOLE GENOME SEQUENCING OF *LISTERIA MONOCYTOGENES* ISOLATED FROM RUMINANTS AND FARM ENVIRONMENT IN LATVIA

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Listeria monocytogenes (*L. monocytogenes*) is a ubiquitous microorganism and it has an ability to survive in a wide range of environmental conditions. *L. monocytogenes* can cause infectious disease both in humans and animals, predominantly in farm ruminants. Most frequently *L. monocytogenes* infection may cause abortions, encephalitis, septicemia and mastitis in various animal species.

The aim of present study was to analyse the presence of *L. monocytogenes* in farm environment and compare their genetic diversity with *L. monocytogenes* isolated from clinical farm ruminant listeriosis cases by using whole genome sequencing (WGS) data.

Overall, 15% (21/140) of environment samples analysed, including silage, water, soil and faeces from healthy animals were positive for *L. monocytogenes*. In addition, 133 *L. monocytogenes* isolates were obtained from farm ruminant clinical cases, such as abortions, mastitis or encephalitis. All isolates were sequenced using Illumina Nextera XT and Illumina Miseq 600v3 sequencing protocol.

Majority of *L. monocytogenes* isolates (92.2%) belonged to serogroup IIa. Only 3.9% of *L. monocytogenes* isolates belonged to serogroups IIc and IVb. In total, 28 different sequence types (ST) were detected, indicating a high genetic diversity of *L. monocytogenes* among animal and environmental isolates. There was no association found between serogroup or ST and source of isolates. *L. monocytogenes* ST1, ST2, ST4 and ST6, belonging to the hypervirulent serogroup IVb, were detected in clinical cases of farm ruminants. In addition, *L. monocytogenes* ST4 and ST194 were detected in faeces from healthy animals and silage samples, accordingly. Genetic diversity of *L. monocytogenes* serogroup IVb found in this study highlights importance of dairy product chain as source of listeriosis.

Further studies are required to determine *L. monocytogenes* genetic patterns and different environmental conditions that promote disease of animals.

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APPLICATION OF WHOLE GENOME SEQUENCING FOR TYPING, DETECTION OF VIRULENCE GENES AND ANTIMICROBIAL RESISTANCE GENES OF *STAPHYLOCOCCUS AUREUS* ISOLATED FROM FOOD AND ENVIRONMENTAL SAMPLES

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Not only the presence of pathogenic bacteria in food is dangerous but also their resistance to antibiotics. Methicillin resistant *Staphylococcus aureus* can be detected in pig meat production chain and they are dangerous not only for consumers of pork but also for livestock farmers and slaughterhouse workers.

In present study whole genome sequencing (WGS) of 81 *S. aureus* isolates from various milk and meat products and surfaces (hands and kitchen surfaces) was done in order to determine MLST and spa type, and presence of enterotoxin coding genes and antibiotic resistance genes. The isolates were obtained from Microbial Culture Collection of the Institute preserved in the period from 2015 – 2018.

Genomic DNA was extracted from fresh bacterial cultures. Library preparation was done according to Illumina Nextera XT DNA Library Prep reagent kit protocol. MLST, cgMLST, spa type and the presence of enterotoxin and antimicrobial resistance genes was detected in assembled genomes using Ridom SeqSphere+ v5.0.

The enterotoxin coding genes were detected in 36 % of all sequenced isolates. The most common were *sea-sep* – present in 25 % of isolates. Several isolates contained more than one enterotoxin coding gene. The most common spa types were t400 (8.6 %) and t091 (7.4 %). From all used typing methods cgMLST showed the highest discriminatory power. None of the isolates contained characteristic methicillin resistance genes but several other antimicrobial resistance genes were detected – *aac-aphD*, *blaI*, *blaR*, *blaZ*, *dfrA*, *forB*, *ImrP*, *mprF* and *sdrM*. Several isolates contained more than one such gene.

While gaining valuable insights into the genetic diversity of *S. aureus* isolates, it was also concluded that our whole genome sequencing techniques should be optimized for this particular pathogen and validated with other methods.

ASSESSMENT OF FISH FACTORY MICROFLORA USING 16S RRNA SEQUENCING

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In Latvia, several companies produce canned fish products that have to be sterile. They need to be assessed for the presence of histamine as well. Several mesophilic enterobacteria and psychrotrophic bacteria can increase histamine content by production of histidine decarboxylase. Microbiological quality control methods can be very time and resource demanding. Thus, fish processing sector as well as other fields of food production demand fast methods to assess the microflora within the production chain. This study explores the applicability of 16S rRNA metataxonomic sequencing to such analysis.

Within the study 16S rRNA gene amplicon sequencing was done of surface samples from a typical fish producing factory in Latvia. Samples were processed according to following methods: ISO 6579-1: 2017, ISO 11290-1:2017 and an in-house method for the detection of *Salmonella* spp., *Listeria* spp. and *Staphylococcus aureus*, respectively. DNA was extracted after pre-enrichment. 16S V3-V4 amplicons were sequenced with Miseq platform of Illumina. With microbiological methods *Listeria* spp. were detected on three and *S. aureus* on two surfaces. *Salmonella* spp. were not isolated. According to sequencing results *Listeria* spp. were found on one surface, *S. aureus* – on two surfaces, and *Salmonella enterica* on one surface. *Pseudomonas* spp. were detected in almost all factory areas. Other frequently detected potentially pathogenic bacteria include *Bacillus cereus*, *Aeromonas* spp., *Vibrio* spp., *Shewanella* spp., *Clostridium* spp. and *E. coli*. From histidine decarboxylase producers *Klebsiella pneumoniae* were detected on three surfaces and *Morganella morganii* on one surface. Dominating bacteria were members of fish-related microflora: *Macrococcus caseolyticus*, *Exiguobacterium*, *Vagococcus fluvialis*.

APPLICATION OF ACOUSTIC METHOD FOR BALTIC SPRAT STOCK ASSESSMENT**Fausts Švecovs, Alla Vingovatova, Guntars Strods***Institute of Food Safety, Animal Health and Environment "BIOR"*

Acoustic surveys are used in stock assessments within the ICES community and almost all as relative indices of fish abundance. The Baltic Sea acoustic surveys started in 1972 and since then carried out annually as International surveys in May and October. The first step of acoustic survey is determination of average SA (scattering coefficient) by ICES rectangles.

On the next stage of studies abundance (in number) and biomass of species (sprat and herring) are calculated through the specific formulas.

The data obtained from trawl catches during the acoustic survey allow to evaluate amount of sprat and herring by age groups in the investigated area. The most important purpose is adequate estimation of sprat recruitment (age group 1).

The results of acoustic survey are used in the ICES Working Groups to predict sprat catches (Total Available Catch) for the period of 1-2 years. Our calculations showed that differences between the predicted values of sprat stock size and the actual ones are not significant and can be explained by objective circumstances.

RELIABLE LC-MS/MS DETERMINATION OF DANSYL CHLORIDE DERIVATIZED GLYPHOSATE, AMPA AND GLUFOSINATE

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In the past decade, glyphosate, its degradation product aminomethylphosphonic acid (AMPA) and some related pesticides, including glufosinate, have been particularly studied due to concerns over their globally wide and intensive use. Applications of such pesticides have resulted in frequent detection and maximum residue limit exceedances in food of plant origin, as well as detection in food of animal origin. Due to the chemical properties of some pesticides (high polarity, low solubility in organic solvents, strong acidity, complex formation, poor electrospray ionization), special methods are usually required to ensure reliable determination.

In this study we report, for the first time to the best of our knowledge, a LC-MS/MS based determination of dansyl chloride (5-(dimethylamino)naphthalene-1-sulfonyl chloride) derivatised glyphosate, AMPA and glufosinate. Large excesses of needed reagents and byproducts thereof may interfere with detection of desired analytes and contaminate analytical columns and mass spectrometers [1]. The present method has been developed to prevent this.

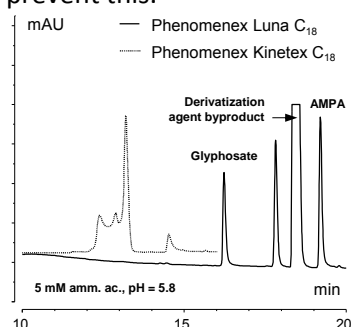


Fig. 1. Separation of analytes from byproducts on different octadecyl bonded silica phases.

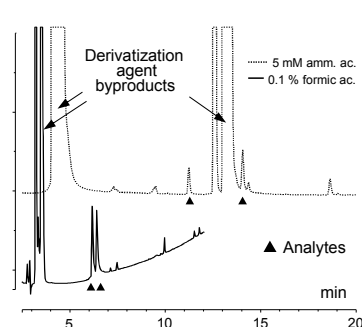


Fig. 2. Separation of analytes from byproducts with different mobile phase additives.

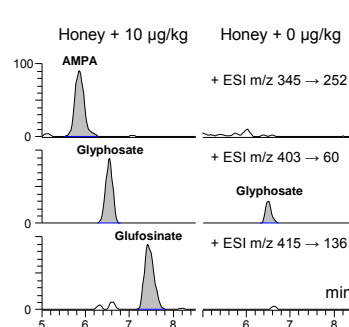


Fig. 3. Detection of analytes in a honey sample and the sample spiked with 10 µg/kg.

Honeybees are known to prefer drinking from agricultural and urban runoff, therefore pesticides such as glyphosate may occur in honey [2]. The present method was applied to samples of honey. The LOQ was 10 µg/kg. Linearity was achieved ($R^2 > 0.99$) both with and without use of internal standards. Matrix effect in the LC-MS/MS stage was estimated $< 5\%$.

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DETERMINATION OF MOLD CONTAMINATION AND MALDI-TOF MS BASED IDENTIFICATION OF FUNGI IN COMMERCIAL TEAS

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Tea is widely consumed beverage and can be source of chemical and microbial contamination due to mycotoxin producing fungi (e.g. *Aspergillus*, *Penicillium*, *Fusarium* spp., etc.), which may occur during pre-harvest and post-harvest periods.

This study reports microbial safety studies of tea and herbal teas marketed in Latvia. A total of 164 tea samples (e.g., 66 black, 43 green, 20 Pu-erh, 7 Oolong, and 31 herbal teas) purchased from local stores. The samples tested for enumeration of fungi (LVS ISO 21527-2:2008), water activity, whereas fungi species identified by MALDI-TOF.

Only 13% (n = 21) of tested teas showed no contents of fungal contamination. Tea safety limitations of total fungi content $\leq 10^5$ cfu/g are recommended by Tea and Herbal Infusions Europe (THIE) and American Herbal Product Association (AHPA), which were not overreached in analyzed teas. In addition, the Regulations of the Cabinet of Ministers, No.461 have set requirements of total fungi content $\leq 5 \times 10^2$ cfu/g. Comparing to these regulations, 28% (n = 46) of samples overreached the limit. Herbal teas had the highest average fungi count in samples of 5.9×10^3 cfu/g.

MALDI-TOF library (2015) allowed to identify 17 different fungi genera with 32 species. *Aspergillus*, *Penicillium* spp. genera were prevailing in samples. *Aspergillus niger* was identified in 66% samples (108), *A. glaucus* in 55% (91), *Penicillium chrysogenum* 11% (19), *Fusarium incarnatum* 5% (8).

As we compared standards existing for tea by THIE and AHPA, we revealed that in Latvia regulations fixed stricter requirements for fungi. Major important fungi were identified by MALDI-TOF library and most of them were potential mycotoxin producers that need more attention to evaluate hazards to human health.

ECOLOGICAL STOICHIOMETRY OF DROSOPHILA MELANOGASTER UNDER CONDITIONS OF PREDATION RISK INTRODUCED VIA MECHANICAL STRESS AND SPIDER ODORS

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The presence of predators has a complex impact on the phenotypic development of prey. Predation risk is sensed by different modalities of prey individuals and may cause different behavioral, morphological and physiological reactions. In this study, we tested whether exposure to predator odors and mechanical stress mimicking the presence of predatory insects during the larval phase of development has a similar effect on body mass and body elemental composition of adult fruit flies *Drosophila melanogaster*. Body mass of male and female individuals decreased in fruit flies affected by spider odors, while mechanical stress did not influence body mass of flies. Although predator odors did not affect body carbon concentration, mechanical stress significantly decreased body carbon in females. Mechanical stress had no significant effect on the body nitrogen of fruit flies. In contrast, predator odor stress significantly increased body nitrogen in male and female individuals. The carbon-to-nitrogen ratio decreased in fruit flies in the predator stress group, while the carbon-to-nitrogen ratio did not change in flies in the mechanical stress group compared to the control group. The results of this study show that responses to mechanical stress and predator odor induced stress were found to be considerable. However, the directions of these responses were significantly different suggesting that elevated predator risk associated changes in body mass and ecological stoichiometry may be affected by different signal modalities in the perception of predator threat. These results are important to improve the general stress paradigm (GSP) and to better predict the flow of energy and such chemical elements as carbon and nitrogen between organisms and their physical environment in communities and ecosystems.

ANIMAL CARCASSES CAUSES OF DEATH ANALYSIS IN LATVIA 2019

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Scientific Institute BIOR is the National references laboratory in Latvia, which provides animal carcasses post mortal investigation. There are included state-funded and commercial examinations, and also forensic veterinary medicine investigation. Aim of research is the analysis of animal carcasses causes of death in Latvia. Full pathologanatomical investigation of animal carcasses per year was not summarized and published in Latvia. The results show the current problems of the veterinary sector in the country. Totally, there were performed 122 animal carcasses necropsies in the Scientific Institute BIOR in 2019, which include 45 forensic examinations and 76 pathologanatomical investigations. Forensic examinations mostly were conducted for companion animals (56%), but they also included aqua culture animals (33%), wild animals (9%) and farm animals (2%). Pathologanatomical investigations were performed for 21 different animal species. Necropsy with pathologanatomical investigation was used for all 122 animal carcasses in research for the final cause of death detection, however, for some cases additional histological, bacteriological, serological, virological and molecularbiological testing were carried out. The results help to better recognize the current epidemiological situation of animal diseases for different animal species. Moreover, these data describe animal death associated with problems in management program, environment, housing and care, as well as accident, violent or iatrogenic death.

MONTMORILLONITE-ANTHOCYANIN COMPOSITES AS SENSORS FOR MONITORING FOOD QUALITY

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In the European Union (EU) significant amount of food is wasted due to the lack of customers' understanding of the difference between 'best before' and 'use by' dates on food labels. In total, 4,7 million tonnes of food are wasted in the EU households every year, equivalent to 92 kilos per person. This problem could be solved by using montmorillonite-anthocyanin composites as smart sensors attached to the food surface or incorporated into food packaging. Sensors change colour from red to blue depending on pH level changes in food and packaging environment caused by bacterial growth. Coulometric pH sensors provide consumers with real time information about food quality during storage and transportation reducing avoidable food waste. As sensors are made from natural resources, clay minerals and pigments from berries, they are non-toxic, biodegradable and could be certified for food contact. Also, they are reusable and colour stable in various conditions. At this point smart packaging sensors have been tested in a laboratory but involving new partners and stakeholders in future experiments could allow us to expand our research into real environments with various food products.

TOWARDS A NOVEL, DATA BASED ASSESSMENT OF FISHING MORTALITY RATE OF RIVER LAMPREY *LAMPETRA FLUVIATILIS* IN RIVERS OF WESTERN REGIONS OF LATVIA

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River lamprey is one of the most important target species in Latvian inland waters fishery. Its status of a local delicacy ensures a high marked demand and increasing interest by the industry. Latvian inland fisheries data collection system provides detailed information on the catch size but efficiency of fishing gears is largely unknown. Aim of this research was to gather information of river lamprey fishing mortality rate which is crucially needed for sustainable management of exploitation of this species in the future. Research was performed by using mark-recapture method and telephone interviews of fishermen. Fishermen who participated in reporting the recapture data did so voluntarily. Most lampreys returned in the rivers, where they were released, but ~9% of tagged lampreys emigrated to other rivers. In total, recapture of 734 (24.5%) of tagged lampreys was reported. However seasonal variation of recaptured lampreys (delayed recapture) allows estimating that fishing efficiency and potential fishing mortality exceeds 40%. For more accurate estimation of a fishing mortality rate more precise information of the recapture of tagged lampreys is needed and the release of tagged lamprey in the sea should be considered. Many of the fishermen report that the biggest hindrance to noticing recaptured lampreys is the large number of lampreys caught in fishing gear. Interviews indicated that interest in the effort to search for tagged lampreys would increase if more information was provided before survey, and if a reward was offered for returned tags.

Keywords: River lamprey, *Lampetra fluviatilis*, fishing pressure, mark-recapture

SPATIAL AND TEMPORAL PATTERNS IN THE DEMERSAL FISH COMMUNITIES IN LATVIAN WATERS

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Fish monitoring in the Baltic Sea has been carried out by the surrounding countries since the 1960s. However, variations in fishing gear, seasons and vessel types made comparative analysis of these data difficult, giving rise to a need for internationally coordinated surveys. A new coordinated trawl survey program (Baltic International Trawl Surveys – BITS) using standardized methods was established in 2001. The main aim of this program is to monitor the spatial distribution and abundance of two target species, cod and flounder. Although data on other, less numerous fish species are also collected in BITS surveys, they have not yet been analyzed on the community and/or ecosystem levels in Latvian waters. In this study, we analyze the entire body of data collected in Latvian BITS surveys from 2006–2019 to identify the spatial and temporal patterns of demersal fish communities and to understand how these patterns are affected by various environmental and anthropogenic factors.

DEVELOPMENT OF NEW INNOVATIVE READY-TO-USE FISH PRODUCTS

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As the pace of life grows, the question of ready meals has become more and more topical. Such fish as rainbow trout (*Oncorhynchus mykiss* Walbaum), Baltic cod (*Gadus morhua callarias* L.) and mackerel (*Scomber scomber* L.) are common in the Baltic region, either as a part of aquafarming or catch. They are a good source of protein, ω -3 fatty acids, various vitamins and minerals. However, these fish are mainly used in the Latvian diet as smoked fish.

The aim of the project was to develop the technological process and solutions for an innovative, ready-to-cook (convenience food) fish fillet (whole muscle) products of different price categories with high added and nutritional value for daily consumption of fish available in Latvia.

Experiments were carried out at the Department of Food Technology, Latvia University of Life Sciences and Technologies. Four types of fish portion products with sauces have been developed: sterilized , pasteurized, fresh in MAP packaging and frozen fish products with shelf life from 20 days to 1 year. Quality changes of during storage (5 ± 2 °C temperature for sterilized, pasteurized and fresh MAP samples, -20 ± 2 °C for frozen samples) were characterized by such parameters as sensory evaluation, moisture content, water activity, pH, colour and microbiological parameters. Shelf life of the developed products depends on the heat treatment regime, storage conditions and packaging solutions.

Keywords: cod, trout, mackerel, fish fillet, ready-to-cook fish products

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NEW DEFINITION OF FOOD SAFETY – A FUTURE CHALLENGE

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Food safety traditionally focuses on harmful elements, microorganisms and viruses in food that can cause an immediate or near-term undesirable effect on health, and so constitutes the main focus of food safety authorities. However, the definition within society is expanding; consumers believe that it does not only refer to food that will not cause immediate damage but food also must be safe regarding long-term effects on health. The growing change in the definition of food safety and the expected outcome of safe food is an increasing challenge for food safety authorities that calls for necessary readjustments in how it is viewed and discussed.

“Food safety” in this concept includes favourable nutritional content: closer to a “natural” product, fewer ingredients, less processing, decreasing artificial food additives, a high nutritional value obtained by thoughtful execution of each production step. Therefore, “food safety” becomes merged with the definitions of quality, health and possibly flavour. A preventative medicine approach to chronic diseases, towards a healthy lifestyle, requires the consumption of safe and healthy food, an approach advised by medical personnel and authorities for also reducing the costs to both individuals and the public welfare system. As individuals play a more active role in healthcare and become aware of food choices for long-term benefits, the new criteria of safe food recognized by the public needs to be implemented by food safety and health professionals.

The production of Bliss Gelato further addresses other considerations for food safety related to retaining the flavour as it is presented in nature. Berries are grown without pesticides, they are picked close to the point of manufacture, and picked closest to their ripe condition. Transportation is short, ensuring a berry with fewer microorganisms. The close vicinity to the berry farm and good networking ensures the ripest berries with the best health outcome and flavour. The added benefit of pesticide-free berries ensures that fruit is delivered in its cleanest form. These measures collectively provide the healthiest and tastiest berry flavoured Bliss Gelato products.

Society expects a specific flavour and so “Food safety” may be extended to retaining the flavour for a taste experience from nature. This requires the best growth conditions, picking fruit at the right time and using fresh fruit. “Food safety” traditionally focused on reducing the microorganisms, now includes consideration of food quality for health, and needs consideration to also retain the best flavour – quality, health, flavour.

RECOVERY OF PHOSPHATE IONS FROM AQUEOUS SOLUTIONS BY MODIFIED PEAT**Artis Robalds***Institute of Food Safety, Animal Health and Environment "BIOR", Latvia*

Peat is a natural material that can be used in the treatment of wastewater, however, its ability to bind phosphate ions is relatively low. To increase adsorption capacity of adsorbents, they can be modified by chemical and/or physical methods. In the present work, high-moor peat modified with iron compounds was used as a biosorbent for the recovery of phosphate ions from aqueous solutions. Peat was selected as a cheap and easily available material with a large specific surface area and pore volume. A series of laboratory-scale batch experiments were conducted to study the effect of initial phosphate concentration, temperature, ionic strength, pH and contact time. It was found that sorption capacity decreased with the increase of solution pH and the sorption process was relatively rapid – 63 % of phosphate ions were adsorbed in the first 15 minutes. Pseudo-first order and pseudo-second order kinetic models were used to evaluate the kinetic data. In addition, high uptake values were observed, especially in the concentration range typical for wastewaters. The maximum adsorption capacity of modified peat increased from 9.64 mg P/g to 11.10 mg P/g, when the temperature was changed from 2 °C to 40 °C. Slight influence of ionic strength on phosphate uptake was also observed. Results suggest that iron modified peat can be used as an effective adsorbent to remove phosphate ions from aqueous solutions.

Keywords: adsorbents, biosorption, peat, phosphates, wastewater

SALMONELLA ENTERICA IN ESTONIAN MEAT CHAIN

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Salmonella enterica represents a considerable public concern worldwide, with farm animals often recognised as their reservoir. Salmonellosis remains the second most commonly reported gastrointestinal infection in humans after campylobacteriosis, and is an important cause of foodborne outbreaks in European Union.

In 2019 altogether 154 human salmonellosis cases (11.7 per 100,000) were reported, which is significant decrease compare to year 2018 when 323 salmonellosis cases were registered in Estonia by the Estonian Health Board.

In this presentation an overview of the occurrence and serovar diversity of *Salmonella* over the 6-year period using data from different stages of meat production chain in Estonia, is presented.

In total, 36 different *Salmonella enterica* subsp. *enterica* serovars were detected from samples taken during official monitoring and own-check control programs of enterprises. The majority of the serovars were obtained from samples taken from farms and processing plants and retail. Almost sixty percent of the isolates originated from pigs or products made thereof followed by poultry (17%) and cattle (12%).

During the years 2013 – 2018 the prevailing *Salmonella* serovars isolated from food production chain were *S. Derby*, *S. Typhimurium* monophasic variant 1,4,[5],12:i:-, *S. Typhimurium* and *S. Infantis* with the proportions of 30%, 16%, 11% and 9%, respectively. The same serovars were also most represented in humans, with the difference that *S. Typhimurium* was isolated secondarily. Similarly, to many other countries, the prevalence on monophasic *S. Typhimurium* has been emerged during last years both in food chain and among human population.

S. Derby proved to be predominant serovar and was most frequently isolated from pigs' faecal samples followed by samples of pig carcasses and pork. Almost two third of *S. Derby* isolates were originated from samples of primary production stage or abattoirs.

S. Typhimurium isolates were mainly prevailed in cattle and poultry farm samples and raw pork products.

The fourth predominant serovar *S. Infantis* occurred in raw products of poultry or pork origin. Two serovars, *S. Mbandaka* and *S. Lexington*, were initially found in oil plant feed samples and then at the following stages during the subsequent years.

In 2013, *S. Agona* and *S. Choleraesuis* var Kunzendorf were relatively highly represented in samples taken from pigs' farms, but their occurrence was decreased in the coming years.

Taking into account the findings, it can be concluded that the epidemiological significance of monophasic *S. Typhimurium* strains has increased considerably in recent years. The incidence of salmonellosis caused by this serovar ranked third in 2017 after *S. Enteritidis* and *S. Typhimurium*. This serovar prevails among non-thermally processed pig meat products, indicating that products of pig origin may be a potential source of human infections. The antimicrobial resistance pattern among food chain isolates was characteristic to those, which predominates within several European countries. Regardless of the genetic similarity among some human and pig strains, isolates from human infections cannot be directly linked to specific sources through macro-restriction analyses without additional epidemiological investigation and typing studies based on whole genome sequencing.

However, these results indicate the essential need to include the routine and modern typing studies in surveillance programs in Estonia.

HAS CLIMATE CHANGE AFFECTED FEEDING AND BODY CONDITION OF BALTIC COD *GADUS MORHUA L.* IN THE GOTLAND BASIN OR THE BALTIC SEA?

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Cod in the Baltic Sea live in an estuarine environment whose variable and from North Sea inflow dependent salinity and oxygen conditions impose physiological stresses on cod stock. The body condition of cod during recent decade has significantly decreased with implication for reproduction potential, growth and also fisheries. Change in fish condition might provide insight on fish general health over time and influence on natural mortality. Our field data indicate that a decrease in the body condition of cod during last decades coinciding with the period of development of stagnation processes in the Baltic Sea. Ecosystem changes in the Baltic driven by North Sea water inflow irregularity and increased eutrophication have resulted extension of hypoxia area. This consequently influenced the feeding opportunities and availability of food resources. As a result, the body condition has decreased. However, in the eastern Baltic coastal areas that are not affected by hypoxia decrease of condition is not observed.

Here we analyzing oceanographic, cod abundance, feeding data and main pelagic and demersal food item dynamic over recent 40 years in the eastern Baltic. Our hypothesis is that long term dynamic of Baltic cod condition is mainly determined by changes in oceanography and availability of benthic food in the diet of cod.

THE ROLE OF VARIABLE INSECT FAUNA ON ZONOTIC AND EXOTIC ANIMAL DISEASE TRANSMISSION AND DYNAMICS IN LATVIA

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Mosquitoes, mites and ticks are vectors that can carry disease from one infected person (or animal) to another and from place to place. Global climate change and large-scale environmental changes have led to increase of regular outbreaks or clusters of local cases of dengue, West Nile and chikungunya viruses.

The aim of the study is to determine the incidence of local and invasive insects and tick species in Latvia as the potential vectors for pathogens that are harmful to the human and animal health.

Our study was based on cross-sectional design for vector distribution and abundance assessments. Mosquito and tick samples were collected from April till October with different techniques. Mosquitos were collected in 195 and ticks in 122 different sampling sites in Latvia. Vector-borne diseases were tested using validated molecular biology methods.

Overall, 31 mosquito and 3 tick species were collected. Invasive tick species *Dermacentor reticulatus* were detected in 49 monitoring places in Latvia. Within two years 36 *D. reticulatus*, 132 *Ixodes spp.* and 104 *Culicidae* samples were tested for different pathogens. In the samples, pathogens such as *Dirofilaria*, *Francisella*-like endosymbionts, *panFlavi* viruses, Tick borne encephalitis, *Anaplasma phagocytophilum*, *Borellia spp.*, Spotted fever group *Rickettsia* and *Babesia spp.* were found. Two potentially for human dangerous *Babesia spp.* were detected – *B. microti* and *B. venatorum*.

Summarizing literature and the results of our study, we conclude that in Latvia, all collected tick species and almost all mosquito species can be vectors for different infection diseases. Further studies are required to clarify research priorities in prevention and control of vector-borne diseases in Latvia.

OCCURRENCE AND DIVERSITY OF *LEGIONELLA SP.* IN DRINKING WATER SUPPLY SYSTEMS IN LATVIA

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Legionellae are ubiquitous bacteria in natural and man-made aquatic systems that can be transmitted to humans through inhalation or aspiration of contaminated water and aerosols. Free-living protozoa (FLP) are considered as a vector and reservoir for bacterial population and serves as additional protection for pathogenic bacteria against high temperatures and disinfectants. In addition, non – renovated water supply systems and low hot water temperature may be contributing factors for spread of *Legionella*. Different guidelines and control measures have been recommended to control proliferation of *Legionella* in man-made water systems, however they have not been introduced in Latvia.

Overall 1904 samples from taps and showerheads were collected from 375 apartment buildings and 40 hotels in Latvia. Isolation and identification of *Legionella pneumophila* was carried out according to ISO 11731. Genotyping was conducted according to the standard Sequence-Based typing method of the EWGLI using 7 genes. Isolation and cultivation of FLP was performed using previously described protocols. Identification of FLP was performed by microscopy and 18S Ribosomal DNA PCR and sequencing protocol for *Acanthamoeba*.

At least once *L.pneumophila* was observed in 210 of 375 (56%) apartment buildings and in 26 of 40 (65%) hotels. The highest occurrence was observed in hot water samples, where 52% of samples tested positive. In 76% of cases hot water temperature did not exceed 50°C at the point of water consumption. Three different *Legionella* species were identified during the study: *L.pneumophila*, *L.rubrilucens* and *L.anisa*. Most prominent *L.pneumophila* serogroup was sg 3, isolated in 57% of all cases and 26 different sequence types were found, including four new sequence types. However, at the same building, more than two different types were not detected.

Occurrence of FLP was statistically higher in *Legionella* positive samples with FLP present in all *Legionella* positive samples.

Most frequently observed FLP genus were *Acanthamoeba*, *Vermamoeba* and *Valkampfia*.

Conclusions: Better understanding of molecular diversity and occurrence associated factors would provide a basis for more targeted intervention measures.



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