

SUMMARIES OF PRESENTATIONS AT THE

PARALLEL SESSION OF THE SECTION B

BIOECONOMY AND INNOVATIONS

BIOECONOMY DEVELOPMENT IN LITHUANIA: TENDENCIES AND DRIVERS

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The questions investigated by the authors cover definition and coverage of bioeconomy, Lithuanian bioeconomy profile and development tendencies, drivers of Lithuanian bioeconomy strategy as well as the goals and objectives of Lithuanian bioeconomy development. The research is based on various research methods such as general scientific abstraction, analysis and synthesis, content analysis, statistical data analysis, questionnaires, interviews, case studies and others. The data for empirical research was collected from Eurostat, Lithuanian Official Statistics Portal and Joint Research Centre of European Commission.

Bioeconomy covers biomass production sectors, fully bio-based transformation and partly bio-based transformation sectors. In 2014, bioeconomy turnover of the EU-28 states totalled about EUR 2.2 trillion. Bioeconomy accounts about 9 percent of the entire EU economy. In terms of bioeconomy turnover per person, Ireland, Finland and Denmark were leaders in 2014. In Lithuania bioeconomy turnover per person was lower than the EU-28 average. In 2015, more than two thirds of turnover in Lithuanian bioeconomy was generated in the food sector, and slightly more than a fourth – in the forest biomass-based sector, where turnover of manufacture of bio-based textiles, apparel and leather as well as bio-based chemicals and pharmaceuticals was a bit more than a tenth. 17.6 percent of persons were employed in bioeconomy in Lithuania in 2015. Location quotient revealed that considering gross value added the concentration of Lithuania both in biomass production and fully bio-based transformation sector compared to the entire EU was 2.4 in 2014. Lithuania was among the leading EU countries in terms of bioeconomy growth in all subsectors of biomass production and fully bio-based manufacturing between 2010 and 2014. This country ranks first in terms of growth of the paper industry, fourth – in terms of growth of agriculture, food and beverage, and wood (except for the production of furniture) sectors and fifth – in terms of the growth of forestry and logging and fishery subsectors.

There are global, European and national drivers of Lithuanian bioeconomy strategy. Among the global drivers are depletion of natural resources, increasing population, increasing environmental pressures, and climate change. The main European drivers are common EU bioeconomy policy, strategy and action plan; assurance of biomass availability and sustainability and efficient biomass value chain; strengthening markets and competitiveness of the bioeconomy subsectors; necessity of close cooperation among all stakeholders – politicians, business people, scientists and the public; need of the development of new technologies and processes, especially industrial biotechnology. The bioeconomy development in Lithuania has been regulated and promoted through certain sectoral policies: agriculture, forestry, fisheries, energy, environment (including waste management), scientific research, innovation and biotechnology development, etc. In the future, the cross-sectoral links and interactions in the Lithuanian bioeconomy will increase for a number of reasons: increased demand for biomass not only in the traditional fields of manufacturing; need to increase the production of higher value added bio-products, i.e. to generate higher value applying cascading principle; transition towards circular economy; development and implementation of new innovations increasing multidisciplinary and cross-sectoral R&D. Goals and objectives of Lithuanian bioeconomy development should be directed to pursuing sustainable and strategically oriented development of bioeconomy, increasing the efficiency and sustainability of biomass production, processing and use of bio-waste; increasing the demand and consumption of bio-products.

Keywords: bioeconomy, profile, strategy, drivers.

THE PATH TO BALANCED RURAL DEVELOPMENT IN THE VISEGRAD AND NORDIC-BALTIC COUNTRIES OF THE EUROPEAN UNION

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The paradigm of sustainable development as an economic and political concept has dominated research and policy agenda for more than two decades but still it poses challenges for assessment of development sustainability degree of countries or regions. In an effort to address the issue of sustainability measurement, our study proposes an original methodology to assess the distance between actual multidimensional development of rural areas and its sustainability equilibrium (state of equally balanced dimensions).

The aim of this study is: to assess the level of rural development based on the combined dimensions (economic, social and ecological) of its sustainability; to find the development level distance from sustainability equilibrium, and to identify this distance changes over time in EU states with focus on Visegrad countries, and Nordic and Baltic countries. The fundamental question is whether rural areas in these countries have been approaching or getting closer to their 'perfect' sustainability that incorporates economic, social and environmental performance.

The research uses the World Bank, OECD and Eurostat data for the 2000-2013 period. All four Visegrad group countries (Czech Republic, Hungary, Poland, Slovakia) represent Central European states and EU 2004 enlargement members while six of eight Nordic and Baltic states belonging to the EU include three old (Denmark, Finland, Sweden) and three new (Estonia, Latvia, Lithuania) members. The research methods comprise: factor analysis to build single indicators for each sustainability dimension (sub-indexes) and then to aggregate them into the composite indicator providing overall measure of sustainable development; the distance analysis based on 3D Cartesian coordinate system to find the distance of actual development point (described by the values of three sub-indexes) to sustainability equilibrium point (described by an average of these sub-indexes) – the shorter this distance, the more balanced (sustainable) is rural development in a particular country; time-series analysis of these distances to identify their changes over time.

The findings are as follows: Based on composite indicators, Swedish and Finnish rural areas were (2000-2013) on the highest level of development, opposite to Polish areas being the second least developed in the EU-28. Generally, rural development was higher in Nordic and Baltic countries but in 2013 much closer to its balanced state were Visegrad rural areas (with Hungary and Poland on top position) than these in Nordic-Baltic region (with the most unbalanced development in Latvia and Estonia). On average, during 2000-2013, the highest degree of rural development sustainability occurred in Hungary (EU-28 leader), Czech Republic and Poland while the lowest – in Latvia (last position in EU-28), Estonia and Sweden. Development patterns appear to be different – from high and sustainable development in Finland through high but unsustainable in Sweden to low but sustainable in Poland. From 2000 to 2013, the progress in rural sustainability took place only in Poland, Finland and Denmark whereas the reverse trend was evident for Czech Republic. Our results suggest that synergy between high level of development and its high sustainability degree may exist without making trade-offs between the three sustainability dimensions. How this balance can be achieved depends on various factors that need further research.

Keywords: sustainability, development, rural areas, Visegrad group, Nordic-Baltic countries.

RESILIENT FARMING SYSTEMS AND FARMERS MARKET DIFFERENTIATION.

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The presentation are based on the Lithuanian case study carried out as a part of the international research project “Rethinking the links between farm modernization, rural development and resilience in a world of increasing demands and finite resources” (RETHINK). This research project funded through RURAGRI is an ERA-NET supported by the European Commission under the 7th Framework Programme and national funding agencies in 14 countries.

The EU common agriculture policy (CAP) support is mostly focused on the technological modernization of farms, linked with production intensification, and weakly focused on the farms prosperity and resilience. As a result farmers are only a slightly motivated to produce added value and high quality food products, to use short food supply chains addressing constantly changing consumer needs, or to pay much attention on issues related to climate change. The farms modernization is not linked with innovations and sustainability, prosperity and resilience. The modernization consists largely of using improved seeds, modern farm machinery such as tractors, harvesters, threshers, etc., chemical fertilizers and pesticides in an optimal combination with water. The theoretical fundamentals formed up to this day are unusable for creation of CAP and national policy measures and agriculture farms management opportunities. For this reason the analysis of CAP and national policy impact on prosperity and resilience of Lithuanian farms and agriculture companies should be defined and justified.

The aim of research is to identify the impact of EU CAP and national policy on farmers farms resilience and rural prosperity. The research is based on the positive research paradigm, case study, content and descriptive analysis, empirical study methods, logical and systematical reasoning, graphic presentation other methods.

The Lithuanian case study was determining farmers’ behaviour and causal factors in decision-making. The research based on the positive research paradigm, case study, content and descriptive analysis, empirical study methods, logical and systematical reasoning, graphic presentation, abstracts and other methods. The present is examining the impact of political factors on prosperity and resilience on farmers farms. The political factors have the highest impact for prosperity of the farms in Lithuania (as compared to the technical – entrepreneurial, ethical - social factors, and intangible values).

The support from the EU is not fully in line with the current concept of farms’ modernization and agricultural innovation. The EU CAP and national policy on influence on the competitiveness of the agricultural sector is more strengthening than weakening. The research results show the main elements that farmers believe should be included in the new concept of rural prosperity, as well as the main strategies adopted to reach prosperity divided into the five sub dimensions: development of the rural social infrastructure and implementation of information technologies; strong self-governance, social awareness and partnership; high culture of life and communication; rural employment and job creation in rural areas, population welfare; economic and social viability, ecology and environmental security of the countryside.

Keywords: *Comman agriculture policy, farms resilience, farmers market, rural prosperity.*

MODERN LIVESTOCK POLICY IN NORWAY

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More than 90 percent of the agricultural area in Norway is used for animal feed and large forest and mountain areas are used for grazing. About 70 percent of market income in agriculture originates from livestock, and headage payments make up 30 percent of the direct payments. Livestock is important in Norwegian agricultural policy. In this paper we will present some elements of the agricultural policy related to livestock.

In an early phase the main objective of the livestock policy was to improve productivity and contribute to increased competitiveness. Increased production and lower relative food prices were important for securing enough food for the poor. Improved food safety was a goal as combating animal diseases and improving the hygienic standard in handling of animal products could prevent human diseases. Since the Second World War, a main objective was to become self-sufficient in products which Norway had natural conditions for producing. Income parity between farmers and other groups was a main goal, at least until the early 1990s. With a few exemptions, such as pelts from fur bearing animals, export has not been a goal for Norwegian agriculture, especially after the WTO agreement was implemented in 1994.

Much of the present livestock policy is related to food safety and animal welfare. The EU legislation in these fields, is implemented in Norwegian law. In some cases Norway has (or is about to) implemented stronger animal welfare regulations than the EU. For instance, it is likely that fur farming will be banned. Norway has been and still is free of several animal diseases and has an eradicating policy, stamping out specific diseases, such as virulent footrot in sheep and chronic wasting disease in wild reindeer, when detected. Antimicrobial resistance is a serious concern, and a reason for keeping the use of antibiotics at a low level in agriculture and fish farming.

In recent years there has been increased focus on public goods and bads from agriculture. On the positive side are landscape values, and effects of agriculture on rural activities and settlement. Livestock grazing is regarded as important for maintaining landscape values and supported. On the negative side are pollution of air and waterways and emission of greenhouse gasses (GHGs). The government is working on stronger regulation of manure management, which might have strong effects on agriculture in some areas if implemented. Emission of GHGs from agriculture has attracted attention recently with ongoing work to acquire more information on actual emission of GHGs from ruminants, effects of various measures to reduce emissions, and on developing effective policy measures. Another topic is possible negative effects of red meat consumption on human health. Clearly, there are conflicting goals regarding livestock and livestock policy.

Keywords: food safety, Norway, public goods and bads, food security, livestock policy.

THE LIVONIAN PUBLIC WELFARE AND ECONOMIC SOCIETY – ONE OF THE OLDEST OF ITS KIND IN EUROPE

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In the territory of Livonia, monasteries, but also the Jesuit College established in Tartu (1585) played the major role in the field of education during the early modern period. Gustav II Adolf, the King of Sweden, founded a university in Tartu in 1632. The University operated until 1710 when Swedish rule ended in Livonia. Under Russian rule, local progressively minded citizens in Estonia, Livonia and Courland recognised the need for non-Russian high schools and scientific organizations. One of the most important organisations was the Livonian Public Welfare and Economic Society (*Livländische Gemeinnützige und Ökonomische Sozietät*) founded in Riga in 1792 (moved to Tartu in 1813). The Society developed cooperative relationships between political and cultural powers, including research scientists in the area of agriculture, whereas the membership comprised enlightened estate owners, representatives of local power, prominent scientists, etc. On the initiative of G. F. Parrot, the Society's first secretary (who later became the first Rector of the Imperial University of Dorpat in 1802), the society was moved to Tartu in 1813 (after Napoleon's invasion of Russia), and operated here until liquidation in 1940. The major research activities supported by the Society dealt land improvement, animal husbandry and breeding, forestry, cartography, political and peasant reforms, etc. The society became a bridgehead in integrating economy, education and culture of this time, initiating projects beneficial to the public welfare in the area of agriculture, industry, trade, traffic and finance and promoting and generating cooperative networks between different societies across Livonia. The Society published a yearbook „*Oekonomisches Repertorium...*“ (1808 – 1915, and issued a magazine „*Baltische Wochenschrift*“ (1863 – 1915). It had 13 full members (*ordentliche Mitglieder*) at a time, including the president, vice president and treasurer. Between 1792 and 1918, the Society had a total of 115 full members and 13 presidents. Honorary members (*Ehrenmitglieder*) of the Society comprised the largest group, and there were some correspondent members.

Since 1918, after the Baltic States had entered independent statehood, was initiated development of agricultural scientific experimental stations at the universities, counselling services for farmers. The Nordic Association of Agricultural Scientists was founded in 1918 and respective national organisations were established as well. For example, the Estonian Agricultural Academic Society was founded in 1920. The Society was liquidated in 1940 along with its sister organisations in the Baltics. The Academic Agricultural Society was re-established in 1989, followed by similar organisations in the Baltic countries. Today, Estonia, Latvia and Lithuania are members of NJF that is celebrating its 100th anniversary this year.

Keywords: Livonia, Society, Nordic Association of Agricultural Scientists, Baltic countries

SENSOR TECHNOLOGY TO DETECT TICK-BORNE FEVER IN SHEEP ON RANGE PASTURE?

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More than two million sheep graze on unimproved, rough grazing lands during the summer months each year in Norway. Free ranging sheep are perceived to experience high level of animal welfare through their opportunity to perform natural behaviour. These benefits are however compromised when sheep experience predator attacks, disease and accidents. Ensuring animal health and welfare in farming systems gets increased attention, and new policies and legislations are implemented. Extensive farming systems provides particular challenges, as daily attention of animals is not feasible on range pastures. About 125 000 sheep (6-7%) are lost on such pastures every year. Being able to monitor farm animals on range pastures is increasingly important and implementing available technology for this purpose should be exploited.

Tick-borne fever (TBF) is a disease considered to be a major challenge in sheep farming during the grazing season along the coast of south-western Norway. It is caused by the bacterium *Anaplasma phagocytophilum* (*A.ph*) and transmitted by the tick *Ixodes ricinus*. TBF is characterised by high fever, inclusion of the *A. ph*. bacterium in neutrophils and severe neutropenia. Clinical signs of TBF is ofte observed within 14 days of infection, starting with an abrupt rise in rectal temperature (often above 41o C), a period of fever of one to two weeks and occasionally coughing, reduced appetite and dullness. TBF is seldom fatal but secondary infections may cause direct loss, but indirect losses like reduced weight gain.

Implementation of sensor technology in rangeland sheep farming can monitor physiological parameters, such as body temperature (T). Integrating such sensors in a GPS tracking system may contribute to detect, locate and treat sick animals, as well as improve our knowledge of animal health in time and space in rangeland farming systems. There are also possibilities of that such monitoring systems can alert abnormal behaviour i.e. predator attack.

The overall aim of this project is to develop a system for automatic real-time monitoring of physiological indicators of farm animals to ensure and improve individual health and welfare and productivity. The objective of the work presented here is to evaluate if a temperature sensor can be used for early detection of Tick-borne fever (TBF).

In 2016, temperature sensors (Star Oddi, Iceland) were implanted in the abdomen of 20 lambs in a one sheep flock in a TBF risk area and in 20 lambs from one flock in a non-TBF risk area in Norway. The sensors were programmed to log temperature every 10 minutes, and were implanted in lambs in early June and collected in early September to retrieve data. Temperature data were obtained from 13 temperature loggers from lambs in the TBF risk are and 14 loggers in the non-TBF risk area. The telemetry system (Telespor, Norway) was used on all lambs, and provided accelerometer information and real-time positioning data that was used for continuous surveillance on range pasture. All animals were monitored twice a day for approximately one month period after turned out on tick infested pastures. Number and magnitude of fever was calculated for each lamb. Preliminary results from this study will be presented at the conference.

Keywords: sheep, sensor technology, temperature, tick-borne fever, rangeland.

CAN THE ALERTNESS OF ICELANDIC LEADERSHEEP HELP TO PROTECT SHEEP FLOCKS AGAINST PREDATORS?

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Icelandic leadersheep, a unique sub-breed of the North European short-tailed Iceland breed, are known for their strongly inherited alertness and urge to lead their flock. They have been known through centuries for their outstanding behavioural abilities and intelligence and have not been selected for production traits like other Icelandic sheep. The behavioural traits of these sheep have attracted attention; particularly their alertness and the possibility that this could play a role in protecting sheep flocks against predator attacks. Norwegian scientists have shown breed differences in sheep mortality at summer pastures due to predators. A joint Icelandic/Norwegian project was initiated to test the hypothesis that the presence of Icelandic leadersheep affects flock behaviour when exposed to a predator model. An experiment was carried out on Hestur Sheep Experimental Farm in W- Iceland during two days in November 2016 using a total of 66 ewes divided into 11 groups. Six of the groups consisted of one Icelandic leadersheep and five Icelandic sheep (LSG), the remaining five groups consisted of six Icelandic sheep (ISG). The predator model tests took place within a fenced, rectangular pasture of 50m x 25m adjacent to a sheep house. All 11 groups were exposed to the same three treatments: human-, dog- and drone test, after a 10 minutes habituation period. The order of the treatments was randomized and there was a minimum 5 minutes interval between each test. All tests were video recorded. The behaviour observations recorded were; eat, stand walk, run and „other“. Recordings were made every 5 seconds during a two-minute period before and after test period, as well as every 5 seconds in 5*30second periods during each of the human, dog and drone treatment. Statistical analyses were conducted using the GLIMMIX procedure in SAS. There was a significant difference in behaviour between the groups with LSG compared to ISG. The LSG spent significantly more time eating than the ISG groups for all tests, especially in the period after each test was finished, and it hence seems the LSG recover more quickly after a predator test. Including an Icelandic leadersheep into the flock affects behaviour. This should be further elaborated in commercial settings in order to understand the impact and relevance of including this genetic trait in sheep farming.

Keywords: sheep, behaviour, predators, Icelandic leadersheep, predator model.

COSTS AND BENEFITS OF PIG FEED SALMONELLA CONTROL PROGRAMME IN FINLAND

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Feeding stuffs and their quality play a significant role in the pork supply chain. Feed can be an important route for introduction of pathogens, such as Salmonella, into pigs. Hygienic management of feed is therefore important for animal health and food safety. Finland has adopted a stringent policy to control for Salmonella in animal feed. However, the economic rationale of the policy has not been analysed.

Our aim was to determine the cost and benefits of pig feed Salmonella control programme in Finland. Two options were compared: a) current pig feed salmonella control and b) an alternative where fewer preventive measures were taken and interventions upon detection of Salmonella in feed were more limited than in under the current control policy.

A Monte Carlo simulation model was developed to determine the costs incurred due to preventive measures and due to measures taken to eradicate Salmonella. The data were collected through surveys conducted among feed and livestock sector operators. The model was parametrised to represent current situation and an alternative scenario.

At present, the costs for prevention of Salmonella contaminations in pig feeds were estimated at €1.8-€3.0 million per year. The costs due to feed contamination and the resulting Salmonella infections in pigs and humans were estimated on average at three (0.7-8.7) million euros annually. Thus, the total costs of the current control programme were around to €5 million per year.

In an alternative situation where there was no control of feed-borne Salmonella, prevalence in pig feeding stuffs were higher. This would result in an increase in Salmonella infections in pigs to up to 12 per cent. According to a reduced control scenario, considerable increase in Salmonella prevalence in the Finnish pig feed could increase Salmonella contaminations in fattening pigs and human infections to 55-fold. When measures to eliminate Salmonella from feed were not carried out, the costs due to preventive actions against Salmonella were estimated at €1.1-€1.8 million per year. Additionally, the costs due to eradication of feed-borne Salmonella from pig farms, consequential measures at slaughterhouses and the health costs to humans could rise to approximately €32.5 million. The results suggest that the present Salmonella controls, including the preventive actions, are cost-effective and generate benefits to the society.

Keywords: Salmonella, feedstuff, risk management, cost-benefit analysis.

EFFECTS OF MONOCULTURES OF *E. CAUDATUM* AND *M. ELSDENII* INOCULATION ON *IN VITRO* FERMENTATION, METHANE PRODUCTION AND PREVENTION OF SUB-ACUTE RUMINAL ACIDOSIS

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The Intensive feeding with high concentrate levels, highly fermentable forages, and insufficient dietary coarse fiber can lead to the observation of various disorders related to digestion and metabolism by increasing ruminal acid production and lowering pH than optimum leading to sub-acute ruminal acidosis (SARA). The objective of present study was to find out the possibilities to reduce the chances of sub-acute ruminal acidosis (SARA) *in vitro* using separate and mixed monocultures of each of rumen protozoa (*Entodinium caudatum*) and bacteria (*Megasphaera elsdenii*, ATCC 17753).

The monocultures were included to two substrates i.e. wheat (30 g/L) and maize (30 g/L) as T1 (control: no addition), T2 (2 ml *E. Caudatum*, 5.5x10⁴/ml), T3 (2 ml *M. Elsdenii*, 10⁷ cfu/ml), and T4 (1 ml each of *E. Caudatum* and *M. Elsdenii*) and fermentation- and gas production parameters were recorded during 24 h of incubation. The rumen fluid was collected from two rumen cannulated holstein heifers (450 ± 20 kg live weight) offered alfalfa hay as the sole diet. The collected rumen fluid was subject to defaunation and isolated protozoa were frozen for future use. During incubations, buffered defaunated rumen fluid, and protozoa as well as bacteria monocultures were added to the substrate in the fermentation bottles. The generated data were analyzed according to General Linear Model with Repeated Measures statement using SPSS.

The maize significantly reduced (P<0.001) the concentrations of total volatile fatty acids (VFA) as well as individual VFA, lactate, NH₃ and methane and total gas production. The concentrations of total VFA, lactate as well as general fermentation parameters did not alter (P>0.05) by the microorganism used. However, a combination of *M. elsdenii* monoculture and maize (grain × microorganism interaction) reduced (P<0.040) the methane concentration in the total gas and propionate production (P<0.006). It is concluded that a combination of maize and *M. elsdenii*, ATCC 17753 monoculture may be used to set off additional acid load in the rumen environment *in vitro*, thus controlling SARA. Additionally, it may reduce methane production, however, the *in vitro* results may be used with caution while generalizing for *in vivo* conditions.

Keywords: acidosis, monocultures, gas production technique, methane production, volatile fatty acids.

TRITICALE, BARLEY AND WHEAT AS A RAW MATERIAL OF WHOLE-CROP SILAGE

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Whole-crop silage from small-grain cereals is one option to decrease costs of the cattle farms. One harvest produces practically the same dry matter (DM) yield than 2 – 3 harvests in grass silage production. The low digestibility is often mentioned limiting the use of whole-crop silage for dairy cows feeding. However, cereal species and varieties can have wide variation in feed quality and by mixing grass silage and whole-crop silage suitable feed can be prepared for both dairy and beef cattle.

Spring triticale is fairly new crop in Finland and it is cultivated only for a raw material of whole-crop silage. The aim of this study was to compare yield and nutritional quality of some varieties of triticale, barley and wheat as a raw material of whole-crop silage. The results shown here are from 2017 experiment, but the aim is to repeat the experiment during 2018-19. Furthermore, we have conducted a feeding experiment to examine the performance of beef bulls offered diets based on different whole-crop silage alternatives, but those results are not introduced here.

Soil type in 2017 experiment at Luke Ruukki Research Station (64°44'N, 25°15'E) was sandy loam. Two varieties of triticale (Nagano, Nilex), two varieties of barley (Kaarle, Trekker) and one variety of wheat (Helmi) were used in a plot experiment. Artificial NPK fertiliser was applied so that N-level was 90 kg N/ha. We wanted also study establishing new ley during growing whole-crop silage, so there was option to decrease seed and fertilizer amount by 30% (normal/decreased). The experimental design was a split-plot with four replicates. The experiment was drilled at the end of May. Crops were harvested at the early dough stage using Haldrup-plot harvester. Feed quality analyses were done with NIR from dried crop samples.

At normal fertilizer/seed level DM yields were about 9500 kg DM/ha with the exception of Nagano, which yielded 10 200 kg DM/ha. Decreased fertilizer/seed level produced 10 – 15% lower DM yields. Trekker had the highest D-value (digestible organic matter in DM) (655 g/kg DM), Kaarle the second highest (625 g/kg DM) and D-value of other crops was below 600 g/kg DM. Crude protein varied between 80 – 90 g/kg DM. Water-soluble carbohydrate content was the lowest in barleys (about 100 g/kg DM) and the highest in triticales (about 200 g/kg DM).

Success of establishing new ley can be evaluated during coming grass yields. Probably, there will not be a big difference between normal and decreased fertilizer/seed level, because the crops were not lodged at all in the autumn of 2017. However, this method can be as an insurance against lodging and it cost here about 1500 kg DM/ha.

Results of one year and one soil type suggest that triticale varieties can produce a bit higher whole-crop silage yields than the other crops, but feed digestibility can be the best in well-chosen barley varieties.

Keywords: digestibility, crude protein, feed, ley, lodging.

DENITRIFICATION BIOREACTORS – A METHOD FOR REDUCING NITRATE FROM TILE DRAINAGE WATER

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Artificial drainage is a common agricultural practice in Lithuania. In this country, the total drained land area occupies 47% of the total land area and 87% of the agricultural land area. It is well known that tile drainage systems serve as transport pathways of contaminants directly from agricultural land to streams. When entering drains, water leaches nutrients (mostly inorganic forms of nitrogen), and the increased nutrient inflow into surface water bodies leads to their eutrophication. As a new technology, woodchip denitrification bioreactors for tile drainage are being investigated for practical edge-of-field nitrate (NO₃) removal. This technology is based on routing tile drainage water through the bioreactors, where nitrate is used by bacteria to oxidize carbon while reducing NO₃ to nitrogen gas. The rate of transformations of nitrates into gaseous forms depends on biological activity, inflow water temperature, pH, dissolved oxygen amount, flow velocity and hydraulic retention time.

Therefore, to test the technology three pilot-scale bioreactors (1 m³ each) under field conditions were installed at Aleksandras Stulginskis University, Lithuania. The bioreactors were filled with mixed woodchips along with two types of additives (10% v/v) – activated carbon and flax-seed cake. The prevailing particle diameter of the woodchips varied from 1.5 to 3.0 cm. The bioreactors were fed nitrate during the study period at concentrations ranging from 4.0 to 29.1 mg N L⁻¹. Nitrate-nitrogen removal efficiency and rate along with the measurements of other water parameters at the inlet and outlet of each bioreactor were conducted with irregular time intervals.

The study has shown that the average nitrate removal efficiency in bioreactor with no additives was 44% and in bioreactor with activated carbon additive - 48%. In bioreactor with the flax-seed cake additive 45% of nitrogen load was removed. During the cold seasonal period, when water temperature at the inlet varied between +2.1⁰C and +12.2⁰C, the average removal efficiency of 32%, 36% and 34% was observed in bioreactor with no additives and in bioreactors with activated carbon and flax-seed cake additives, respectively. The tests also revealed that woodchip media are capable of achieving higher NO₃-N removal rates due to higher flow rates. Higher NO₃-N removal rates for shorter retention times are governed by NO₃-N removal reaction kinetics. This highlights the importance of better optimization and proper evaluation of the effects of hydraulic retention time when designing denitrifying woodchip bioreactors.

Keywords: denitrification bioreactors, agricultural drainage, nitrate removal.

MATHEMATICAL MODELLING OF THE ENERGY BALANCE FOR THE TREATMENT OF SOLID BIOMASS FUEL BY COMPRESSING

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The aim of the presented research is the implementation of a mathematical model for analyse and planning of the production of solid biomass fuel by compressing. The mathematical model reflects the current experimental state of the art of effectiveness for fuel compressing machines. The process of making briquettes is considered to be fairly energy-intensive. Nevertheless, if we compare the energy expenditures to the heating value of the fuel, then it is less than 10%, even when converted into primary energy. The experiments that were conducted by the authors illustrate that the actual energy expenditure is significantly smaller. The main expenditure comes from moving the working parts of the device. The energy that is needed for making of the briquette is insignificant. The residual bulk-material from agricultural and forest industry has low bulk density which consequently causes several management problems. However, it is beneficial to produce fuel with homogeneous properties using pressure processing. Unfortunately, the raw material does not correspond well to the pressure from the briquette machine, yet, the management can be substantially improved with adding wood to the mixtures.

Keywords: compressing, fuel, pressure, density, volume.

DYNAMIC MODELLING OF YEAR-ROUND BIOENERGY DELIVERY OF SHORT ROTATION COPPICE WILLOW

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Short rotation coppice willow is an energy crop grown on agricultural land with a typical 4 to 5 year replant rotation. The conventional system for harvesting is cut and chip followed by direct delivery to a heat or combined heat and power plant. The biomass can also potentially be used to produce liquid or gaseous biofuels. In order to optimise the bioenergy supply system, however, on demand delivery of raw bioenergy material on a year-round basis is required. Harvesting short rotation coppice willow is only done wintertime when the ground is frozen and the bioenergy crop is defoliated. In addition, direct-chipped biomaterial is not suitable for storage due to high water content. Stored material in piles or silos can potentially self-combust.

The objective of this study is to evaluate a system for year-round delivery of short rotation coppice willow where whole stems are cut and stored in piles. Unchipped stems stored outside will dry safely with time down to a storable water content. The biomass can then be chipped on site and transported on demand to a power or fuel conversion plant.

To evaluate the system discrete event modelling of the harvesting together with implementation of a natural drying dynamic model was used. Transport of machines and chipped biomass was simulated using network analysis in the road network, existing fields and a processing plant in Uppsala, Sweden. The model used 10-year historical hourly weather data to model natural drying of harvested stems and to calculate trafficability.

The system for year round delivery of short rotation coppice willow could deliver biomass an all months over the year except in April when the dry stems were out while the newly harvested stems had not reached safe storage water content. The harvest cost was about 40 € per tonne dry matter. Field trafficability, yield and harvest productivity were important factors.

Keywords: modelling, bioenergy, short rotation coppice willow.

PILOT SCALE CONTINUOUS THERMAL HYDROLYSIS OF ORGANIC WASTES FOR INCREASED BIOGAS PRODUCTION

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Thermal hydrolysis is an established method of pre-treating organic wastes prior to anaerobic digestion or as an intermediate step between two anaerobic digesters. The process can be likened to pressure cooking, where material is subjected to high temperatures (usually 100-200°C) and respective pressures for a certain period of time (usually <1 hour). For many full-scale and, to the best of our knowledge, all pilot and laboratory-scale applications, the equipment used usually operates in batch mode due to technical difficulties of adding and removing material to a pressurised continuous process. The advantages of a continuous (or semi-continuous) process at full-scale over a batch process include a smaller footprint and lower operational costs. At pilot or laboratory-scale, batch thermal hydrolysis reactors suffer from problems of slow heating and cooling times which leads to poor definition of true treatment times. This work describes the development and operation of a pilot scale (treatment volume of 1.02 litres) thermal hydrolysis system that operates semi continuously. By using a high electrical heating power of 7.2 kW and a high heating surface to volume ratio, the system can treat materials for periods of just a few minutes. The system has been tested using the liquid fraction of cattle manure and biogas batch tests have shown that methane yields were increased by up to 40.5% at four days digestion, but the improvement was less pronounced at longer digestion times, with 12% increased methane yield after thirty two days.

Keywords: biogas, pre-treatment, thermal hydrolysis.

TRANSPORT FUELS VIA BLACK LIQUOR GASIFICATION - AN ANALYSIS OF CLIMATE IMPACT WITH LIFE-CYCLE ASSESSMENT METHODOLOGY

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Fuel crops are considered, according to several studies, to reduce greenhouse gas (GHG) emissions by 50-80% compared with fossil fuels. But what happens if the raw material comes from forest raw materials instead? The opinions here differ greatly, which led to a political discussion of forest fuel as a raw material: can you bind large amounts of carbon? or do they lead to a disaster with greatly increased GHG emissions compared to fossil fuels?

The aim of the project was to develop an approximate method that provides sufficiently accurate values for GHG emissions in the production of the transport fuels from black liquor, also when the biogenic carbon flows in the incoming forest raw material are included, using life-cycle assessment (LCA) methodology.

In order to achieve this, the carbon balance with carbon binding in growing forests and land has been studied for a Norway spruce forest in southern Sweden, which is felled after a 100-year rotation cycle. To get a landscape perspective, 100 such rotation cycles have been superposed in 100 different stages of development.

The wood is used for production of pulp and paper. In this production, there is a lignin residue, black liquor. This black liquor can be used as a raw material in a fuel synthesis where DME (dimethyl ether) and FTD (Fischer-Tropsch diesel) is produced, which can be used as transport fuels.

The carbon climate impact has been studied with two types of LCA methodology, so-called attributional life-cycle assessment (ALCA) and consequential life-cycle assessment (CLCA). The ALCA calculates a future integrated paper, pulp and transport fuel production system, while the CLCA evaluates the environmental consequences of changing an existing paper pulp mill to also produce transport fuel.

Further, the analysis has been carried out for different starting points of calculation: a) start with a grown forest; b) start with a forest in the middle of several rotation periods in a landscape; and c) start with land without vegetation.

The results for the ALCA show that the reduction of GHG compared to fossil fuels are: a) 23% for DME, 37% for FTD; b) 107% for DME, 104% for FTD (a small net binding of carbon for the case which usually applies in practice); and c) 190% for DME and 170% for FTD (a significant net binding of carbon). If you ignore biogenic carbon and possible binding of soil carbon, the corresponding values will be 93% for both DME and FTD.

Conclusions are that the produced fuels comply with the EU-directive of 60% reduction of GHG for bio-fuels, forests have a significant potential for binding of carbon, and the results are highly dependent on the assumptions assumed in the forest raw material production system.

Keywords: life-cycle assessment, fuels, black liquor gasification, fuel synthesis, forest.

MECHATRONICS APPLICATIONS IN THE AGRICULTURAL WORLD

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Nowadays, food security is one of the most compelling challenges worldwide. For this, more precise consideration, understanding, and planning of the future of agricultural engineering and Biosystems are needed not only nationally, but also internationally. This involves new strategies, methods of food production and the supply chain. One of the ways to increase production, quality and to reduce waste and losses and perform different operations, timely and correctly is the use of new technologies and updated machines. In addition to these, Mechatronics is one of the most key and updated domain, which is a kind of interdisciplinary knowledge with many job opportunities. Applications of this science in agricultural engineering and Biosystems could modernize both mechanized and non-mechanized systems, which can lead to improve the production systems and accelerate the processes. Furthermore, implementation of Mechatronics makes agriculture more attractive to the younger generations than just funds. Before this, an advanced knowledge and critical understanding of the essential requirements such as the linked sciences, applications, and challenges, are needed. Thus, this presentation aims to introduce modern technologies and understanding of the domain, the importance, applications and challenges associated with Mechatronics in the agricultural world and the related chains. This makes the future of agriculture more attractive, specific and interesting than before.

Keywords: development, mechanization, mechatronics, new technologies, precision farming.

THE DEVELOPMENT OF ERGONOMIC LIVESTOCK TECHNOLOGY IN OPTIMAL CONDITIONS FOR LIGHT INDUSTRIAL COMPANIES

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Livestock farming has, over the years, developed from the source of livelihood of agrarian society into a modern science. Feeding livestock and ways of keeping it has attracted a lot of attention from various stakeholders. Today, we have reached a level that allows for the production of animal products with rather little effort and low cost, however, it is still a long way to go to perfection. Continuously advanced technology and newly introduced materials require further research and integration into efficient livestock production. In today's society, it is no longer enough to provide the animals with just a simple shelter and sufficient quantity of food- we need to go deeper into small things, every detail needs attention. Modern livestock buildings technology using even the fast and accurate technology to evaluate it uses a computer technology or intelligent system to make a comprehensive assessment, work processes, environmental impact assessment, optimal temperature, humidity, air flow, atmosphere air gas condensation, fodder containing correct nutrients, etc., ensure rapid growth of the animal's well-being environment. When creating the ideal conditions, it should be kept in mind that all costs will be repaid in the long run, the application of high-end technologies may not be sustainable. The key might be in cheap and easy solutions, such as the design of lightweight buildings, which allows a person to easily control all indoor climate parameters, assessment of work processes and work technologies designates.

Keywords: livestock breeding, work process, microclimate, workflow, precision farming.

DAIRY COW LONGEVITY IN VOLUNTARY MILKING SYSTEM

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In modern dairy farming the main emphasis is put on the modernization of different processes, such as feeding, milking, herd monitoring and microclimate control. In last decade European dairy farmers recognized the positive aspects of voluntary (automated) milking systems (VMS). One of main benefits of VMS in dairy farms in the long run is standardized milking procedure that improves the milk quality and, after adaptation period, milk productivity. The cows that are included in VMS milking groups' needs to meet certain standards. The most important trait for VMS cows is the quality of udder – teats need to be straight and optimally placed in the middle of each quarter. As cows are getting older, the quality of teats and udder decreases and the milking in VMS is getting impossible and cows are removed from group or from herd that leads to significantly reduced longevity. The decrease of lifespan in each farm is connected with significant financial losses that could be avoided by the stronger selection process for VMS. The aim our study was to find out the effect of different factors on the longevity of cows milked in VMS.

The study was carried out in Latvia University of Life Sciences and Technologies (LLU) research and study farm “Vecauce”. In farm there are 2 different milking systems – VMS (DeLaval) and milking parlour (herringbone DeLaval). Cows in VMS are fed with the partially mixed ration and they have unlimited access to fodder stations where they can receive preprogramed amount of fodder. In the VMS group in each given time are included 100 Holstein Black and White (HBW) dairy cows. For study purposes we used Data about 114 HBW dairy cows that were included in VMS group from year 2013 to 2018. From Latvian “Agriculture Data Centre” we collected data about cow lifespan traits, milk productivity and body conformation trait linear evaluation results.

The average analysed cow lifespan was 1824.2 ± 52.05 (approximately 5 years) days in which was obtained 30017.9 ± 1280.25 kg milk, and in one life day – 16.1 ± 0.35 kg milk. The conformation trait linear evaluation scores for teat length, front and rear teat placement, central ligament and udder depth traits significantly worse ($p < 0.05$) were in the third lactation. The udder depth linear evaluation score in the first lactation showed significant impact on the lifetime milk productivity traits – cows with the optimal evaluation score (5 points) of udder depth characterized with significantly lower lifespan and lifetime milk productivity (accordingly 1795.4 ± 55.62 days and 29995.6 ± 1411.13 kg milk), but with the highest life day milk productivity (16.09 ± 0.38 kg). As the VMS group in “Vecauce” farm were completed with the consideration of the rear teat position, the results obtained in first lactation did not show any impact on longevity traits on the other hand, the cows that characterized with optimal rear teat position evaluation scores (5 points) in third lactation had significantly longer lifespan (2145.6 ± 83.16 days) and higher lifetime and life day productivity (accordingly 38336.3 ± 2110.46 kg and 17.6 ± 0.47 kg milk).

Keywords: udder conformation, lifespan, live weight.

AUTOMATIC TECHNOLOGY TRENDS IN ESTONIA DAIRY FARMS

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The first ideas about fully automated milking process were generated in the mid-seventies and focused on technical improvement of milking system. Topics included in the program of specialist conferences, like Automatic milking – a better understanding confirm that current problems concerning automatic milking system (AMS) cover socio-economic aspects, farm and milking system hygiene, animal health, milk quality and abnormal milk, welfare, grazing, farm and herd management. All of the mentioned problems and the other ones are the field of detailed research works and assessments to develop knowledge about automatic milking as an integrated system in the dairy farm

The present work places focus on cow motivation to visit the milking unit. AMS in Estonian dairy farms were tested and 3 cow traffic situations were analyzed for effects in cow behavior, effective use of the barn, and milking capacity.

The ideology of the automatic milking system allows each animal to operate around the clock according to its needs. From the point of view of production, however, complete freedom is not feasible, because the goal is still the production of milk, not the keeping of animals today and in the near future. Experience shows that some animals, however, should be milked driven. However, it does not suit the purpose of automatic milk production, the work of a man on a board should be minimized. The motivation to feeds is the main drive of the cows to visit milking station. Therefore, a computer controlled cattle control system, which also includes traffic control, is in use. Along with the technical differences in AMS, the organization of animal movement is important on board.

Keywords: automatic milking, cow motivation, behavior, capacity.

DEVELOPMENT TREND OF APPLES SORTING MACHINES IN THE WORLD

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Apple is one of the most popular fruits worldwide with an annual production of over 80 million metric tons. According to the FAO, China, the US, and the European Union are the top three producers of apple in the world, respectively. "An apple a day keeps the doctor away" is a common saying, which describes the impressive health benefits of apple in human life. However, there are good enough reasons to sustain apple trade and production. For this, the appropriate chain supply of this fruit is essential. Nowadays, apples sorting machines are important as same as the chain supply in international trade market. In this regards, the development trend of apples sorting machines in the world, including past, present and future will be presented. The presentation talks about the key issues covering the global apple production, the top ten producers of apple, the importance of sorting machines in the supply chain, history and the previous sorting systems, and recent technology. Finally, technical specifications, types of sorting machines, important parameters, famous and infamous manufacturers of sorting machines worldwide, the future aspects and other relevant practical matters will be presented.

Keywords: apple production, chain supply, new technologies, sorting machines, manufacturers.

SAFE RECYCLING OF HORSE MANURE FOR AGRICULTURAL PURPOSES

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Huge amounts of horse manure is either burnt or illegally deposited. Treated correctly it is a good source for plant nutrition and valuable as a soil improvement or for other horticultural uses. To ensure a safe return to agriculture, aspects such as residues of unwanted compounds should be considered. For instance, there is not much knowledge about the fate of pharmaceutical residues in horse manure.

The main aim of the project was to develop a method for analysing several pharmaceutical compounds in a single sample and to study how selected pharmaceuticals decompose in manure using different biological methods. Another objective was to map customer interest in possible peat substitutes made of local resources, e.g horse manure.

Commonly used equine medicines were selected for the study. In total, 70 samples of horse manure and horse manure compost were analysed.

The Ultra Performance Liquid Chromatography - tandem mass spektrometer (UPLC MS/MS) was used to develop the analysing method.

Manure from treated horses and horse manure with additions of controlled amounts of medicines were composted outdoors in a windrow consisting of horse manure and freshly cut grass. In a pot trial, earthworms were added to some of the manure from the treated horses to study the effect of worm action on the biodegradation of pharmaceutical residues.

A survey on use and preferences of soil and fertilizer products was conducted among 100 garden centre customers.

The analysing method was found capable of analysing all four active ingredients at the same time.

Contents of pharmaceutical residues in horse manure were highest 1-2 days after treatment, with some variation between substances. After this peak, residue contents in manure decreased rapidly.

Degradation of the added medicines was slow in the composting trials. In the compost windrow, the contents of medicines decreased gradually throughout a 60-day period, with slightly different degradation curves for the various substances. Three of the tested active ingredients were still detectable in the compost after 60 days. The earthworm trials need be improved and repeated, as many worms also died in the untreated horse manure pots.

The customer survey showed that there is a certain interest for peat-free, locally produced soil and fertiliser products. Approximately half of the respondents replied that they are willing to pay as much as 20 % more for such products.

The project provided a basis for the further development of horse manure as a pharmaceutical residue-free product. Manure from treated horses should be kept apart from other manure for the first 1-3 days after medical treatment. Strategies for the management of such manure should be developed so that this resource can be used safely in plant production.

Keywords: horse manure, veterenary medicines, decomposition.

CHARACTERIZATION OF MARGINAL AGRICULTURAL FIELDS IN SWEDEN - AREAS, SHAPES, LOCATIONS, TRANSPORT DISTANCES AND TIME DEMAND FOR MACHINE OPERATIONS

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In Sweden, thousands of hectares of agricultural land are not being actively used for agricultural production. Of the total agricultural land area of 2.57 million hectares in 2017, 0.16 million hectares were fallow land. Hundreds of thousands of hectares of ley are also underutilized or cultivated at low intensity. In 2008, the excess cultivation area of this crop was estimated to be 0.2-0.3 million hectares. Bearing in mind the ongoing rationalization and closure of small farms, the current total acreage of such 'marginal' land may be as high as half a million hectares.

The demand for renewable biomass fuels for the production of heat, electricity and vehicle fuels is expected to increase. Therefore, instead of fallow or fields being abandoned and overgrown with brushwood, an alternative for 'marginal' land is the cultivation of dedicated energy crops such as poplar, short-rotation coppice willow and perennial energy grasses. The overall aim of this project is to compile a decision basis for farmers on how to improve the profitability of such fields.

In the project, marginal fields were characterized in four municipalities (Svalöv, Ronneby, Vingåker, Skellefteå) in Sweden with regard to field size, field shape, distance to farm, location (in flat land or non-flat land areas and in areas with respect to level of standard yields). Furthermore, field work was simulated for different field sizes and field shapes in order to compare the time demand for machine operations in 'marginal' fields and in 'normal' fields. For this, a dynamic simulation model was developed to simulate the driving pattern of machines on a minute/second time scale level, taking in-field preparation and finishing up times into account, as well as operational speed in rows/passes and delays due to turnings, acceleration, stochastic stoppages, etc.

Preliminary results showed that there are large differences within Sweden. For example, what is considered as a 'less fertile' and 'small' field in one part of the country may be considered as a 'fertile' and 'large' field in another part. Nevertheless, the average field area for fallow and extensive ley culture usually is in the range 1-2 ha, which is smaller than for e.g. cereal crops. Marginal fields often have a more irregular shape, and they are often more distant, but this is also dependent on region and type of landscape. The simulations of field operations showed that field area and field shape have significant impacts on time demand, and hence machinery costs. For example, it was shown that the time demand rises steeply for fields smaller than about 1.5 ha as a result of more time, relatively seen, spent on e.g. turnings. Later in the project, the economic profitability of cultivating various conventional as well as bioenergy and industrial crops on marginal agricultural land will be calculated and compared.

Keywords: marginal field, characterization, simulation, machinery.

REMOVAL OF AMMONIUM IONS BY USING ZEOLITIC WASTES

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In this research the sorption capacity of ammonium ions was investigated by using zeolitic waste FCC catalyst. By using XRD analysis it was determined that main mineral is zeolite Y which consist of this zeolitic waste. It was used as an adsorbent for petroleum refining during catalytic cracking, and after a certain time it contaminates and becomes a waste. This waste in Lithuania can make up to 200 tons per year. For ammonium removal two types of zeolitic materials were investigated. The first type was used untreated and the second one was activated by integrating in 15 % H₂O₂ aqueous solution. In our previous works it was determined that the zeolite sorption capability increased (about 1.75 times after 48h) after treatment with a hydrogen peroxide solution, but it wasn't investigated the ammonium ion removal. The initial solution for ammonium ion removal were made by using NH₄Cl solution. Initial concentrations were 1mg/l. The experiment were carry out under dynamic conditions. Sorption durations were from 12 until 72 hours. The initial results show that this type of zeolitics waste are suitable for ammonium sorption from water solutions.

Keywords: zeolites, zeolitic waste, ammonium uptake.

INSECTS – A POTENTIAL PROTEIN SOURCE FOR FEED OR FOOD

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The insects are considered to be an opportunity to create new business in rural areas and in the food sector and to improve protein self-sufficiency. Close to 2000 insect species have been identified edible. Although globally 2 billion persons consume insects as food, in Europe they are used in small quantities. In Finland, the use of insects as food was allowed in 2017. Because insects are a novel line of production, there is little experience on how to organize insect rearing.

The aim of this paper is to analyse the potential of insect rearing in Finland. Our analysis is based on literature analysis, data collected from a farm rearing house crickets in Finland and calculations prepared based on the data during a development project Entolab.

According to the literature, insects have the potential to produce protein efficiently. They consume less water and feed per kilogram of biomass they gain, than traditional farmed animals. However, insects have often been reared with chicken feed for instance. In order to foster the environmental argument, it would be important to find novel sources of feed for insects. These would preferably sources which are currently not used as food or feed, such as biomass or sidestreams which are currently of low value. However, little is known which feedstuffs are best-suited for insect rearing.

Another factor that is critical for the success of insect rearing is the ability to increase the use of automation. Because insect rearing is still fairly labour-intensive, novel solutions are needed to automatize especially daily management routines such as feed supply.

Foods placed on the market in Europe must be safe, and food safety is a priority. Insect food manufacturers must meet the hygiene standards (HACCP, safety, hygiene, traceability). To ensure both product safety and insects requires good hygiene practices. For example, the sanitation of breeding grounds and platforms is an essential part of biosecurity. Ensuring safe feed is an integral part of food safety.

Economically, majority of production costs in insect rearing are either fixed costs, or due to feeding or labour use. The results, as well as currently limited scale of production and high costs of production suggest that currently insects are better suited for food use than for feed use. Food use allows innovative approaches to develop business and to supply high-premium insect products to the markets. However, as the production efficiency is improved and production volumes increased in the coming years, also feed use can become economically viable option.

Keywords: edible insects, feed, profitability, production system.

THE HORTICULTURE HERITAGE OF THE SWEDISH STATE RAILWAY - A BASIS FOR A GREENER ENVIRONMENT IN PUBLIC TRANSPORTATION

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The garden organization of the Swedish State Railways (SJ) started in 1862 about six years after the foundation of the State Railways. A “director of the railway gardens” was employed in order to organize parks and plantations at the railway stations and restore the wounds the new transportation method gave to nature in Sweden. The plantings were aesthetic and for utility. Most plants were delivered from the main nurseries of SJ. Tests of suitable plant species were conducted in order to find suitable, hardy plants. In the mid 1900s about 500 000 plants were delivered annually. Hedges were planted along the railway lines to protect from snow drift, wind and keeping away livestock from the tracks. 1862-1960 five garden directors influenced the plantations in an ambitious vision of spreading horticulture to remote places and thus enlighten the Swedish population. In 1961 the last employed director had left his employment and an external consultant was brought in until the closing of the garden organization in 1973. The reduction of the gardening organization during the 1950s and onwards reflected an increasing focus on rational handling of people and goods. The railway stations were no longer the places for meetings and gathering but the travelers were stimulated to rapidly pass by on their journey. This époque reflect the transition from enlightenment and supplying harmonious travelling experiences to becoming a supplier of time efficient transportation. Our research is the yet most thorough archive inventory. Unfortunately, the archives of SJ were weeded thoroughly before they were turned over to the National Archives. Most of the material has been lost, among which hundreds of detailed drawings of flower beds, parks and ornaments. The fragments are few and give only glimpses of the gardening activities performed by SJ during more than a hundred years. However, the archives gives us a good basis for using the horticultural heritage to make the modern railway stations greener and more attractive for the travelers of today. We look for Nordic-Baltic partners for an international project on design of railway environments for improved attractiveness and in the long run increased railway transport.

Keywords: landscape planning, horticulture, public transportation.

CREDIT SUPPORT FOR AGRICULTURAL LAND PURCHASE IN POLAND - EVOLUTION AND PERFORMANCE

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The aim of the presentation is to examine the characteristics and evolution of the credit support for agricultural land purchase in Poland and to assess its outcomes after 23 years of operating with special focus on changes in farm structure. The examined period covers years 1994-2016. Descriptive statistics was applied for analyses of empirical data.

In Poland, the preferential credits for agricultural land purchase were introduced at the beginning of the nineties of XX century. They were part of the credit support system for restructuring and modernisation of the Polish agriculture that started in 1994. The state agency was established for running the system. Credits are granted by commercial banks at their own risk. Credits are allowed under credit lines that differ with respect to aims, scopes, terms. In 1994-2016 preferential credits for land purchase were granted under six credit lines. Three of them were in operations during the entire period. Credit terms were advantageous for borrowers. Till 2015 the interest rate on credits under four credit lines was calculated as one-fourth of the central bank rediscount rate, next as 67 per cent of WIBOR 3M. In the case of one credit line, the borrowers paid 50 per cent of interest rate charged by bank.

Preferential credits for agricultural land purchase got farmers' attention. Under two credit lines designed for land purchase only, banks provided about 141,000 credits of total nominal value estimated at PLN 10 billion (ca \$3 bn). Assuming the same number of credits for land purchase granted under other lines, the total number and value of such credits increased twofold. The numbers indicate that 14% of the Polish farms were beneficiaries. Author estimates that 1.8 million ha of agricultural land (ca 10% of agricultural land area in Poland in 1994) changed the owner during the examined period. These numbers do not reflect the full demand for preferential credits as the value of subsidies was limited. Subsidised agricultural land purchase influenced the farm structure by area. The average per farm area of agricultural land increased from 6.7 ha in 1994 to 10.3 ha in 2016. The share of agricultural land bought with the credit support in market agricultural land turnover in examined period, estimated by Author at 45%, illustrates the role of this support for improvement of farm structure. But negative outcomes appeared too. As credits encouraged the demand for agricultural land, they contributed to sharp increase in agricultural land price. The nominal price of arable land in 2016 was 16 times higher than in 1994.

To sum up, the credit support for purchase of agricultural land is well organised. The credit terms stability deserves appreciation. Data analysis indicates the important role of preferential credits in encouraging the agricultural land turnover. The support contributed to the improvement of farm structure. In the examined period, average farm area increased by 50%.

Keywords: land purchase, farm structure, credit support.

ENTREPRENEURIAL INTENTION AMONG STUDENTS OF BALTIC REGION

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Many countries are dealing the problem of weak participation of young people in labour market. Many researchers propose development of entrepreneurship as one of measures for solving this problem. The growth of entrepreneurial activities will help in reducing the unemployment rate. But it is not enough to have the ideas and wishes to start new business. There are needed also knowledge; financial, legal and mental opportunities. Attitude towards entrepreneurship can be based on personality traits and demographic characteristics, economical and social environment etc. Investigation on students' intention in this research was made using data received during implementation the GUESSS project in year 2016. There were involved students from Higher Education Institutions in 50 countries around the world who provided answers to wide range questionnaire. The objective of this research study is to explore the entrepreneurial intention among students from higher learning institution. Authors of this research concentrated only on few of these questions concerning intentions of respondents to run their own business (self-perception towards entrepreneurship, the entrepreneurial background of parents). There were used data collected in following countries of the Baltic region: Denmark, Norway, Poland, Sweden, Estonia, Finland, Lithuania, and Latvia.

Descriptive statistics, Kruskal-Wallis test (K-W) and Tukey Contrasts were used to compare independent groups. Data were analyzed using R software.

It would seem that students from Latvia and Poland have a stronger desire for a transition towards entrepreneurship than students from other countries. The weakest ambition indicated Swedish students. The Danish and Finnish students scored the influence of the entrepreneurial background of parents the highest, and Swedish students the lowest. The research found out that there were statistical significant differences between countries and gender ($p < 0,01$).

Keywords: students, entrepreneurship, own business, Baltic region, cross-national comparison.

SUMMARIES OF POSTERS

OF THE SECTION B

BIOECONOMY AND INNOVATIONS

BIOMASS OF SOFTWOOD AND HARDWOOD TREES GROWING ON AFORESTATED FARM OR DEGRADED LANDS FOR BLENDED FUEL PELLETS PRODUCTION

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Production of biomass fuel pellets has significantly increased over the last decade and involves international trade of ten million tones annually. To cover the needs in biomass feedstock, fuel pellet producer appear to draw in competition with other biomass consumers.

The main aim of this investigation is comparison of the fuel characteristics of wood, including stem wood and non-debarked wood, widely used for industrial production of fuel granules from the following species: pine (*Pinus sylvestris*), aspen (*Populus Tremula L.*), with the ones of wood species considered today as a alternative raw material for granulation: lodgepole pine (*Pinus contorta*) and plantation poplar species (*Populus spp.*) and willow (*Salix spp.*) growing on aforestated farm lands or degraded lands. Fuel characteristics including elemental composition, ash content and calorific values of stem wood and bark of above mentioned trees species, were evaluated. The ash content in non-debarked wood biomass in dependence of bark portion in mixture was evaluated using regression equations.

The behaviour of the investigated biomass at thermal oxidation conditions, modelling combustion process, was evaluated using TG, DTG, DTA methods in air atmosphere. The effect of softwood/hardwood ratio in the composition of sawdust mix on the energy consumption for granulation, standard mechanical characteristics of the pellets obtained were investigated. Laboratory scale pilot flat die pellet mill KAHL-1475 was used for granulation. The one batch (300 g) gasifier of original construction (1.2 kW) equipped with gas analyser Testo and water cooled jacket was used for measuring of heat released rate and emissions at different stages of pellets combustion.

All investigated fuel characteristics of the stem wood and bark of *Populus Tremula L.*, *Populus spp.* and *Salix spp.* are significantly worse than corresponding characteristics of *Pinus contorta* and *Pinus sylvestris*. The main disadvantage of the investigated hardwood species is high ash content as for stem wood, as especially for bark, that significantly lowers the calorific value of the biomass.

For all types of wood biomass the optimal portion of hardwood and softwood was find to produce the pellets which meet the requirements of EU standards for fuel pellets.

Keywords: pine, willow, lodgepole pine, poplar, stem wood, bark, mixed fuel pellets.

IS SLAUGHTER AT A MOBILE ABATTOIR BENEFICIAL FOR MEAT QUALITY?

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The objective of this project was to compare animal welfare and meat quality at mobile vs. large scale stationary slaughter. Handling at slaughter exposes the animals to welfare risks and can be very stressful. In addition to reducing animal welfare, stress associated with slaughter may impair meat quality. The effects of mobile slaughter on animal welfare and meat quality have so far not been studied to a large extent.

One small-scale mobile and one conventional stationary abattoir were studied. At the mobile plant, the animals were taken from the farm facilities to an inspection pen, from which the animals were driven along a short driveway to the stun box. The plant was housed in two trucks, parked on farm. Animals slaughtered at the stationary abattoir were transported up to 250 km on road, and about one third of them were kept in overnight lairage before slaughter. A total of 283 and 281 animals were included at the mobile and the stationary plant, respectively. At the stationary plant, the carcasses were electrically stimulated. The mobile plant used pelvic suspension and the stationary plant Achilles suspension. The observations included animal handling and animal behaviour in the driveway to the stun box and in the stun box, blood chemistry at bleeding (cortisol, glucose, lactate), carcass conformation and fat grading (EUROP scale), marbling and meat quality attributes (pH, weight loss at thawing and cooking, colour, Warner-Bratzler shear force, compressive load and modulus) after seven days of hanging.

There was no clear association between final pH of the meat and the animals' emotional expression at the start of driving or with the way to drive the animals. Ultimate meat pH differed between the slaughter plants; carcasses slaughtered at the mobile plant had a higher pH, which could be due to the fact that electrical stimulation was not used. The percentage of animals with a final pH above 5.8 at cutting was 14.8% at the mobile plant and 7.7% at the stationary one. At both plants, cooking loss decreased with increasing fat class and with increasing marbling. Shear force and compressive load were higher at the stationary plant, where compressive load was highest in cows and bulls; otherwise the differences between different animal categories were small. At the mobile plant, animals regarded as hesitant prior to being driven had higher, and animals considered as nervous even higher, compressive loads. Both compressive load and shear force were slightly higher in animals staying overnight at the stationary plant.

This project shows that calm animals when driving to the stun box begins, an appropriate layout of the slaughterhouse premises, driveways and equipment and correct handling of the animals during driving, stunning and bleeding are essential to achieve low stress levels and a high meat quality. There are conditions for good animal welfare and meat quality in both mobile and stationary slaughter of cattle. Based on the project, it cannot be concluded that animal welfare or meat quality is generally better with one or the other way of slaughtering.

Keywords: mobile slaughter, stationary slaughter, animal welfare, meat quality.

EFFECTS OF FOUNDRY SAND ADDITION ON TRAFFICABILITY, YIELD AND CO₂ EMISSION FROM A CULTIVATED PEAT SOIL

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Peatlands store a large share of the world's soil organic carbon and are widespread in Northern and Central European countries. Drainage is a precondition for traditional agricultural production on organic soils. Drainage increase peat mineralization and changes the physical and chemical soil quality. Only a few decades after initial drainage, agricultural systems on drained organic soils start experiencing a high risk of crop failure. Decreased hydraulic conductivities lead to decreased infiltration, ponding, and finally to abandonment as drainage will not be effective anymore. Another problem is the low trafficability.

The aim of this experiment is to investigate if the addition of foundry sand to the top soil will improve the trafficability and how it will affect the yield and CO₂ emission. In the Swedish part of the EU-funded PEATWISE project, a field experiment (randomized block design, 3x3) was set up at a former cultivated, but now abandoned, fen peat located at Bålinge Mossar (60.03N, 17.43E). We compare trafficability, yield, oxygen concentration in the soil and CO₂ emission from plots sown with Timothy (*Phleum pratense*) treated with 0 cm, 2.5 cm or 5 cm foundry sand. The sand was applied in the autumn of 2015 and mixed in the top 10 cm of the soil. CO₂ emissions were measured with automatic chambers (ADC BioScientific, UK) taking 12 measurements per day in frames where we removed the vegetation.

The trafficability was slightly higher for the plots with sand addition 2016 but the opposite was found 2017 despite that you can feel that the stability has increased just by walking on the plots. The yield 2017 was highest from the plots with 5 cm sand (11.6 t d.m. / ha), lowest from plots with 2.5 cm sand (8.8 t d.m./ha) and the control yielded 10.3 t d.m./ha.

The CO₂ emission during the autumn of 2015 (15/9-1/11) was highest from the plots without sand addition (3.4 μmol m⁻²s⁻¹) and lowest from the plots where 5 cm sand was added (1.4 μmol m⁻²s⁻¹). The emission from plots with the 2.5 cm treatment was 1.8 μmol m⁻²s⁻¹. During 2016 (4/5 – 27/9), the emissions were lowest from the plots treated with 5 cm foundry sand (4.26 μmol m⁻²s⁻¹), and highest from the plots with 2.5 cm sand (6.10 μmol m⁻²s⁻¹). The untreated plot had an average CO₂ emission of 5.09 μmol m⁻²s⁻¹. The 5 cm plots had lowest emission 2017 as well, emitting an average of 4.53 μmol CO₂ m⁻²s⁻¹ whereas the 2.5 cm treatment emitted 4.87 μmol CO₂ m⁻²s⁻¹ and the 0 cm treatment 5.92 μmol CO₂ m⁻²s⁻¹.

The addition of foundry sand changes the properties (physical and chemical) of the soil which reduce the CO₂ emission and increase the yield.

Keywords: CO₂ emission, peat soil, foundry sand.

ESSENCE AND PECULIARITIES OF MONITORING OF SOCIO-ECONOMIC AND SPATIAL DEVELOPMENT OF THE REGION

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The article has revealed the essence of monitoring the socio-economic and spatial development of the region. The study has concluded that it is necessary to methodically differentiate spatial monitoring and “classical” monitoring of social and economic development. Besides, indicators of monitoring of spatial development of the region have been given and the order of their estimation has been described on the example of regions of the South of Russia. An assessment of the model of spatial organization of territories has shown that the most even distribution of economic power and impulses of economic development are noted in the Stavropol Territory. The economy of this region develops on a network principle, unlike other regions of the South of Russia, although it has a similar specialization and comparable conditions for the resource potential. The paper concludes that the implementation of monitoring of socio-economic and spatial development of the regions should be indivisible elements of the tools of the regional management system, aimed at timely identification of the existing differentiation of the territories in order to further smooth it. The application of methods of spatial analysis makes it possible to identify such important parameters of the development of the region as the level of centralization, narrowing, fragmentation of economic space. The analysis of spatial development allows reducing the asymmetry in the development of the regions of Russia through the application of complex targeted regional development programs, the activities of which are built individually for each typological group of regions, depending on the level of spatial development.

Keywords: region, monitoring, spatial development, socio-economic development, narrowing, economic space.

WHEAT YIELD AND ENERGY PRODUCED BY IT

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Wheat is an important crop in the world. The main direction of using wheat is grain for food production due to flour baking properties and high calorific value of grain. New solutions are being sought for obtaining higher yields by limiting harmful organisms and using chemical compounds, however, it can be obtained by carrying out elementary agrotechnical measures, like appropriate soil tillage method and crop rotation.

The aim of the research is to confirm that, by choosing soil tillage method and forecrop, it is possible not only to get higher winter wheat grain and straw yield, but the total energetic gain from harvest also increases. The paper was based on one season data (2016/2017) from two factorial trial with two soil tillage treatments and three crop rotations, which was started in 2009. In this study, the first factor was soil tillage method (minimum and traditional) and the second – three winter wheat forecrops (winter wheat, oilseed rape, faba bean). Totally six variants in four replications were investigated. Winter wheat variety ‘Zentos’ was sown in Cambic Calcisol (Bathruptic, Episiltic, Protostagnic). Yield was harvested at GS 92 using direct combining, and recalculated at 100% purity and 14% moisture. Straw yield was calculated from grain: straw ratio after sample-sheets’ analysis. Gross calorific value (MJ kg⁻¹) was obtained using bomb calorimeter according to the method LVS EN ISO 18125:2017, for an average sample of each variant of grain and straw, in total 12 samples. Calorific value of dry matter yield was calculated to obtain energetic gain per hectare. Research is financed by National Research Programme AgroBioRes, Project Soil.

The results showed that soil tillage method ($p < 0.01$) and forecrop ($p < 0.001$) had a significant impact on winter wheat grain and straw yield, and on energy yield gained from grain and straw. The highest grain yield was obtained when wheat was grown after faba bean (8.06 t ha⁻¹) and oilseed rape (7.08 t ha⁻¹), but the lowest – in repeated wheat sowings (6.38 t ha⁻¹). The highest straw yield also was obtained when faba bean was forecrop (10.36 t ha⁻¹). Calculated grain: straw ratio was on average 1: 1.29. When investigating the gross calorific values of each grain sample, the difference between established values had been noticed. Wheat gross calorific value was 18.2 MJ kg⁻¹ when it was grown after faba bean, but value was lower by 0.7 MJ kg⁻¹ when it was grown in repeated wheat sowings. The gross calorific value of straw had an opposite result – the lower value was noted growing wheat after bean (17.8 MJ kg⁻¹), but that in repeated wheat sowings was 18.3 MJ kg⁻¹. The energy gained from grain (on average 110.5 GJ ha⁻¹) and straw (on average 144.4 GJ ha⁻¹) was the highest when forecrop was faba bean, but the lowest in repeated winter wheat sowings. In this study, higher grain and straw yields and energy yields were obtained in variants with minimum soil tillage ($p < 0.01$).

It is possible to increase the productivity of winter wheat by choosing the forecrop and soil tillage method.

Keywords: winter wheat, forecrop, soil tillage, yield, energy gain.

RESULTS OF TESTS OF LABORATORY INSTALLATION OF MICROHPP

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The article considers quantitative and qualitative assessments of water and energy resources, which uses a certain system of indicators, including the topographic, hydrological and energy features of the river or basin.

The technical potential was estimated by the gross hydroelectric resources of the river flow to be accounted for, reduced by the amount of losses of hydraulic energy. Preliminary design and a prototype of microHPP was developed with the propeller and hydroturbine and a laboratory facility. The for carrying out research tests. Laboratory installation for conducting research tests of microHPP consisted of a 1-reservoir, 2-a pump, 3-a valve, 4- the micro HPP itself, 5 and 6-pressure gauges and, 7 and 8-hoses, 9-a control panel and control. A capacity of reservoir 1.5 m³. The installation uses a KM 100-80-160-C9HL4 pump with a capacity of 100 m³ and a pressure of 32 m. The pressure gauges serve to determine the head. Experimental investigations were carried out under pressures 2, 3, 4 m. The frequency of rotation of turbines in the experiments varied from 250 to 2500 min⁻¹.

The rated power of 1 kW, laid down in the technical design assignment, is achieved with water flow (0,03 ... 0,035) m³/s and a water pressure of 4 m. At the same time, the turbine rotation speed was (1520 ... 1580) min⁻¹. During the test period, the nodes and units of microHPP worked stably in accordance with their functional purpose. In general, bench tests of microHPP showed a sufficiently high performance.

Keywords: microHPP, water and energy resource, hydropower resources.

CHALLENGE OF THE PROBIOTICS ON GROWTH PERFORMANCE AND INTESTINAL HEALTH IN PIGLETS

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Due to the World concerns of antibiotic abuse, there is an increased interest to improve health and reduce antibiotics usage in pig farming by alternatives. Probiotics induce alterations to the intestinal microbiota, improve mucosal immunity and enhance gut tissue integrity, therefore stabilization of the intestinal microbiota is an essential precondition key for intestinal health and growth in pigs. The aim of our study was to find out the effects of the mixture of probiotics on growth performance and intestinal health in piglets.

Two weeks old piglets (n=22, Duroc × Landrace) were allocated in two groups: basal diet (C group) and basal diet + mixture of probiotics added to the drinking water (P group). During the experiment (6 weeks) offered and refused feed, as well as piglets were weighed to calculate average daily gain, daily feed intake and feed conversion ratio. At the end of experiment, piglets (four from each group) were slaughtered. Fecal samples and samples of digestive content (n=36) were used for enumeration of *E.coli*, *Enterobacteriaceae* and *Lactobacillus* spp. Tissue samples of *jejunum* were dehydrated and embedded in paraffin wax, sectioned and stained with haematoxylin and eosin for histomorphological measurements and immunohistochemistry.

In this study, oral administration of mixture of probiotics had no significant difference ($p>0.05$) on weight gain, average daily gain ($353 \pm 15 \text{ g d}^{-1}$ vs. $369 \pm 27 \text{ g d}^{-1}$) average daily feed intake ($620 \pm 88 \text{ g d}^{-1}$ vs. $580 \pm 82 \text{ g d}^{-1}$) and feed conversion ratio (1.80 ± 0.09 vs. 1.68 ± 0.15) compared group P to group C. After three weeks of experiment, the challenge of probiotics decreased the count of *Enterobacteriaceae* ($p<0.05$, $1.73 \pm 0.38 \text{ lg cfu g}^{-1}$ vs. $3.37 \pm 0.47 \text{ lg cfu g}^{-1}$) and the count of *E.coli* ($p>0.05$, $1.66 \pm 0.38 \text{ lg cfu g}^{-1}$ vs. $2.91 \pm 0.29 \text{ lg cfu g}^{-1}$) in the faeces. After six weeks of experiment, probiotics increased the count of *Lactobacillus* spp. ($p<0.05$, $7.75 \pm 0.24 \text{ lg cfu g}^{-1}$ vs. $6.27 \pm 0.82 \text{ lg cfu g}^{-1}$) and decreased the count of *E.coli*, *Enterobacteriaceae* ($p>0.05$) in *jejunum*. Compared group P to group C, probiotics had no significant difference ($p>0.05$) on villus height ($358.71 \pm 7.47 \mu\text{m}$ vs. $360.70 \pm 13.77 \mu\text{m}$), crypt depth ($244.16 \pm 6.79 \mu\text{m}$ vs. $231.42 \pm 11.24 \mu\text{m}$) and the ratio of villus height to crypt depth (1.61 ± 0.06 vs. 1.71 ± 0.08) in *jejunum*.

Treatments had the opposite effect on mucosal Treg (Foxp3 positive cells) in jejunum – significantly increased was in probiotic group compared to control.

This study demonstrates that mixture of probiotics supplied via drinking water had no affect on growth performance, but significantly improved gut microbial balance - increased count of *Lactobacillus* spp. and decreased count of *Enterobacteriaceae* in piglets. Probiotics had no significant influence on the alterations in morphology of small intestine in piglets.

Keywords: histomorphology, gut microbiota, Foxp3.

Acknowledgement. Research was supported by the National research programme AgroBioRes 2014.10-4/VPP-7/5.

CONTROL OF TRANSIENT PROCESSES IN MILKING MACHINES

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Currently, there are a wide variety of technologies of machine milking. But all the milking machines have a strong mechanical effect on the udder of cows. Because of this, there are a number of negative factors that reduce the quantity and quality of milk. Analysis of the construction of teatcups and vacuum pumps shows that when the milking machine is operated, sudden transients occur in the interstitial chamber of the teatcup. The rapid transition processes greatly inhibit the reflex milk output. This leads to a decrease in productivity of cows and increases the incidence of mastitis. The best way to manage the transition in a teatcup is the use of control devices. This method is implemented through the use of various types of valves. Developers of milking equipment are the task of creating an electric pulsator with the regulatory regime. This mode should provide a more continuous transition from quantum of sucking up on the compression stroke. Also, this mode must be able to be used in installations of individual milking or milking robots. Most of the development created to regulate the duration of transient processes, solve the existing problem only partially. Therefore, they are not issued by the industry. The article describes a review of the methods of improving the design of teatcup to manage the transition process in misenai camera teatcup. The management of the transition will enable us to live in milking machines from existing deficiencies in the milking.

Keywords: milking machine, teatcup, pulsator, liner, pulsation chamber.

WOOL QUALITY OF NORWEGIAN WHITE SPÆL SHEEP BREED

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The Norwegian White Spæl Sheep are characterised by their fluke-shaped and tapered short tail, dual-coated wool and the ability to thrive under harsh environmental conditions. The income in Norwegian sheep farming comes from lamb meat, wool and pelts. Today, wool is of minor economic importance, commonly accounting for less than 10% of the income. However, the interest of wool as a sustainable and local fibre is increasing. Wool quality traits of the Norwegian White spæl breed has been reported to be declining; i.e. an increase in medulated fibres and in kemp. To address this challenge, there has been developed and incorporated 1) wool quality assessment tutorials for farmers and breeders, 2) included heritability estimates of wool fleece weight and quality class in index calculations, and 3) conducted OFDA analysis of wool from breeding rams for three consecutive years. The work was initiated by the research-project *KRUS - Enhancing local wool value chains in Norway* (NFR 244618/E50) and has been carried out by NIBIO, the Norwegian Sheep Breeders Association (NSG), Animalia and Norilia.

Wool quality assessment tutorials for farmers and breeders are available as a.pdf and video for free download from NSG webpage (nsg.no). A 'wool evaluation kit' with a magnifier is available for purchase, also from NSG. Implementing index estimates was made possible when including fleece weigh and fleece classification from all sheared lambs at slaughter into the Norwegian National Sheep Recording system. Further, OFDA analysis were conducted on wool from breeding rams collected autumn 2015, 2016 and 2017. The wool samples were analysed using the optical FD analyser (OFDA100; BSC Electronics Pty Ltd, Western Australia, Australia). OFDA analysis is conducted to describe wool quality traits, development of quality traits over time and also development of quality traits at different age of breeding rams. Preliminary results from this study will be presented at the conference.

Keywords: sheep, wool quality, Norwegian white spæl, dual felt, double-coat.

IVERMECTIN RESISTANCE OF HORSE DIGESTIVE STRONGYLES

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Lately, much has been said about ivermectin resistance to digestive horse strongilide infections. Often, the owners of the horses choose the animal to do deworming, without sending first the coprogram to the laboratory for the test. Misidentifying antihelmetic and inappropriate doses result in the strongilide ivermectin resistance.

Our goal was to investigate whether the ivermectin resistance was observed in horses in Latvia. The tasks were as follows: collecting faecal samples, examining them, calculating the quantity of an invasion, identifying resistance. The study was launched in March 2018.

In the study, we used 23 horses from the age of five, different sexes and types of use (sport, hobby etc). Horses were from different districts of Latvia (Jelgava, Riga, Jekabpils, Aizkraukle region). All animals were clinically healthy - rectal temperature, respiration rate, heart rate, condition of the animal were determined. 23 horses were examined for coprology specimens. Samples were obtained from each horse rectal, faeces put into sterile plastic bags, each individually identified (animal identification number, age, gender), and transported in a cold box at plus 4° C to the laboratory for investigation. Samples were examined at the Laboratory of Veterinary Medicine at the Parasitology Laboratory using the flotation method. The egg number is set per gram of faeces after McMaster. (D. Keidane, 2006).

Depending on the results obtained and the volume of the invasion, all positive horses were given an ivermectin-containing paste. The dose is adapted to the individual weight of each horse. Repeated faecal samples were taken after 14 days. Samples were examined by flotation method, and the number of eggs re-diagnosed per gram of faeces after McMaster.

We can conclude that in the samples, before deworming with ivermectin-containing paste, the number of strongilidae eggs varied from 100 to 800 eggs per gram of faeces. Collection and investigation of faecal samples are still going on.

Keywords: horses, ivermectin, resistance, strongyles.

TECHNOLOGY DEVELOPMENT OF PROTEIN-FAT EMULSION AND ITS USE IN FOOD PRODUCTION

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In today's market, the production of high-quality, cost-effective, competitive products is impossible without the use of advanced technologies and innovative solutions. The objective of this research work is scientific testing of methods related to the development of innovative technology of protein-fat emulsion with a higher stability than its analogs. The use of the developed protein-fat emulsion in the production of food stuff enables to create a finished product with optimal functional and technological properties. Scientific researchers are presented on the example of emulsified sausage goods. When developing the technology of protein-fat emulsion, the following raw materials were used: high-oleic sunflower oil, an aqueous solution of animal protein product "Kat-gel 95". The emulsion was obtained using a device for cavitation disintegration of liquid food media and water "Hielscher Ultrasound Technology UP" according to the developed modes. During the series of scientific experiments the following research methods were used: analytical, organoleptic, measuring, calculation. The conducted researches allowed to recommend the replacement from 15 to 20% of meat raw materials on the received emulsion in a formulation of sausage goods. The absence of pork fat in the sausage goods, as well as the replacement of meat raw materials in the composition of the product with the developed protein-fat emulsion, contributed to the improvement of the quality characteristics of the finished product, increasing the stability of sausages during storage, improving organoleptic properties, reducing the caloric content of meat products; reducing the risk of defects associated with the emergence of bouillon - fat drips. Further increase in the level of protein-fat emulsion leads to a slight increase in the structural and mechanical properties of sample minced meat systems and economically impractical. All the samples of boiled meat products are characterized by a lack of bouillon - fat drips and are resistant in storage.

Keywords: emulsion, emulsion stability, technology, composition, raw meat.

THE CHANGES OF MILK PRODUCTIVITY AND QUALITY OF LATVIAN LOCAL BREED DAIRY COWS

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With the farm modernization and increasing cow milk productivity farmers are usually preferring specialized dairy breeds (usually Holstein Black and White (HBW) breed). Although HBW cows are highly productive, but they have not built the resistance to different local environmental conditions. On the other hand the native breed cows are bred in the region for hundreds of years and are more resistant to negative environmental effects, they characterizes with stronger health, better longevity and higher milk composition indicators. Despite the positive aspects of local breed cows, because of their lower milk yield there is small number of animals in the population of native breeds in the dairy herds in European Union states. With that in consideration there is a need to emphasize the positive traits of local breed cows and therefore maintain the dairy breed biodiversity. In Latvia there are 2 dairy cow native breed – Latvian Blue (LZ) and Latvian Brown (LBGR). Cows are located mainly in small farms (1 – 5 cows per farm), with the exception of Latvia University of Life Sciences and Technologies (LLU) research and study farm “Vecauce” where are located 30 LBGR cows.

For analysis of genetic resources cow milk productivity and quality, we collected data from 25 LZ cows and 25 LBGR cows that were included in VPP AgroBioRes 3 LIVESTOCK project and concluded at least one productive lactation. Analysed cows were located in different farms and had different environmental conditions. For study purposes were collected data about cow daily milk productivity (from monthly recordings), milk productivity, reproduction traits and live weight in 1st and 3rd lactation. Data were collected from Latvian “Agricultural Data Centre” data base.

Analysed group cows in the first milk recording control (from day 7 to 38 after calving) characterized with in average 19.09 ± 0.64 kg daily milk yield and milk fat $4.48 \pm 0.13\%$ and $3.25 \pm 0.06\%$ protein content. If studied closer, milk fat content significantly ($p < 0.05$) higher was in LBGR breed group (accordingly $4.70 \pm 0.19\%$ and $4.26 \pm 0.18\%$), but the protein content in milk was similar in both analysed groups – 3.24 ± 0.09 for LBGR and 3.27 ± 0.07 for LZ breed cows. At the end of lactation the difference of milk fat and protein content in milk increases. At the 10th time of recording (day 278 to 318 after first calving) the difference between milk composition traits increased. In LBGR cow milk there was $5.06 \pm 0.17\%$ fat and $3.97 \pm 0.13\%$ protein, but for LZ breed cows that was significantly lower ($p < 0.05$), accordingly $4.43 \pm 0.20\%$ of fat and $3.68 \pm 0.07\%$ of protein. In the context of milk quality we analysed the amount of somatic cells in milk. As cows were kept in different housing systems with different health and hygiene protocols, the somatic cell count (SCC) differed not only between both analysed breeds, but also between different milk samples. At the beginning of first lactation significantly higher SCC was for LBGR breed cows (176.1 ± 57.53 thousands in 1 mL^{-1} milk), but in LZ cow milk there was 105.6 ± 20.53 thousands SCC in 1 mL^{-1} milk.

Keywords: milk composition, somatic cell count, milk yield.

IMPACT OF THE FLOUR OF JERUSALEM ARTICHOKE ON PRODUCTION OF METHANE AND CARBON DIOXIDE AND WEIGHT GAIN IN CALVES'

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The aim of this research was to measure the amount of methane (CH₄) and carbon dioxide (CO₂) in calves' rumen and compare the obtained results between the control group and the experimental group which received the additional supplement of the prebiotic inulin in a dosage which showed the best results in our previous experiment and also compare the live weight gain between the groups.

The research was conducted in the dairy cow farm in Latvia. Ten clinically healthy randomly selected Holstein Friesian (*Bos Taurus L.*) crossbred calves of average age 33±6 days were used in the research. Calves were split into 2 groups: 5 calves in the control group (CoG), 5 were supplemented with 12 g of flour of Jerusalem artichoke (*Helianthus tuberosus L.*) per calf, containing 6 g of prebiotic inulin (Pre12). The prebiotic was added to barley flour once a day in the morning. The length of the experiment was 56 days. CH₄ and CO₂ were measured by using cavity ring down spectroscopy device Picarro G2508. The weight measurements and samples from calves' rumens were evaluated three times during the research – on the 1st, 28th and 56th day of the research. Samples were obtained by puncturing the calf rumen with 16G needle and were collected into 20ml syringes. The site of puncturing was the upper left flank where visually was noticed the accumulation of gases. After collection of gases 10 ml of this gas was injected into gas analyzer and measured 180 seconds.

The data of initial and daily live weight gain were normally distributed ($p > 0.05$), and there was homogeneity of variances ($p > 0.05$). Independent-samples T test showed that the weight gain during the whole research was more to the Pre12 calves (65.8 ± 6.57) than CoG calves (36.8 ± 7.98), a statistically significant difference of 29.00 (95% CI, 18.33 to 39.66), $t(8) = -6.272$, $p < 0.001$. Also the daily weight gain was more to the Pre12 calves (1.2 ± 0.12) than CoG calves (0.7 ± 0.14), a statistically significant difference of 0.518 (95% CI, 0.325 to 0.710), $t(8) = -6.209$, $p < 0.001$. The data of CO₂ and CH₄ were not normally distributed ($p > 0.05$), and Mann-Whitney U test showed that there was no difference of mean amount of CH₄ in calves' rumen between CoG and Pre12 as well as there was no difference of mean amount of CO₂ in calves' rumen between CoG and Pre12 ($p > 0.05$). Also, Kruskal–Wallis H test showed that there was no difference of mean amount of CH₄ and CO₂ in calves' rumen between different days of the experiment ($p > 0.05$). The main results showed that the prebiotic inulin at dosage 6g per calf added to barley flour once a day can promote the more rapid weight gain in calves and it does not influence the mean amount of CH₄ and CO₂ in calves' rumen.

Keywords: inulin, calves, CH₄, CO₂, weight gain.

CORRELATION BETWEEN DAIRY COWS' RUMINATION ACTIVITY, PRODUCTIVITY INDICES AND HEALTH

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In recent years, the precision farming technologies are increasingly used in livestock feeding and health management. The aim of the study was to investigate correlation between “HeaTime Pro System” registered daily rumination times and cows’ average milk yield, number of lactations, milk fat, somatic cell count and health status. The experiment was conducted within the State Research Project (AgroBioRes) VP29 in one dairy herd with 362 milking cows where rumination sensor is installed. In the fresh cows’ group the individual rumination times of cows were gathered daily at 24:00 seven days before and after milk sampling (M) day and were calculated the average rumination activity (R15), then it was compared with the rumination activity on M day (RM). The rumination data of 92 cows during the first 120 days of lactation were divided into groups and were compared: productivity - above 40 litres/day and below 20 litres/day; milk fat below 3.1% and above 5% in the first 40 days of lactation; somatic cell count (SCC) above 1 million and mycoplasmosis infected animals. The statistical data analyses were performed on Excel and SPSS17 platform.

Results. The average R15 and RM did not differ significantly. In the high yield group, productivity was significantly ($p < 0.05$) higher than in low yield group, but RM in these groups did not differed significantly ($p > 0.05$). Cows infected by mycoplasmosis had insignificantly lower R15 than the high productive cows. In cows with milk fat below 3.1%, R15 was the highest - 632 ± 37 min/day, and it was significantly higher than cows with milk fat above 5% - 568 ± 22 min/day; these cows have a risk of subacute rumen acidosis (SARA) and ketosis, respectively. In cows of the third and fourth lactation, R15 was significantly ($p < 0.05$) higher than in the first and second lactation. The lowest R15 was found in cows with low productivity, high SCC and with milk fat above 5%. There was found a moderate correlation between all 92 cows’ R15 and milk yield ($r = 0.43$), R15 and milk fat % ($r = -0.46$), but in cows with milk fat above 5% there was a strong correlation ($r = -0.75$).

Conclusions. Changes in average 15 days’ rumination time in context with milk yield and milk fat % can be used for recognition of cows with metabolic disorders - ketosis and SARA. In this investigation, cows with different milk fat %, lactation number and SCC had a significant difference ($p < 0.05$) rumination activity in 15 days period.

Keywords: cow, rumination, milk fat, productivity.

THE RESULTS OF STUDIES OF THE CLEANING DEGREE OF AN ELECTROSTATIC AIR CLEANER

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An electrostatic air cleaner is a highly efficient means for air clearing which allows blocking the dust, tiny particles and bacteria. However, the cost of such devices is quite high; for example, the increase of degree of cleaning by 6 percent raises relative value of almost in 3 times. As a result, it restrains their distribution in agriculture. The solution to this problem is possible to upgrade the design of the electrostatic air cleaner, which consists in science-based choosing the area of a collecting electrode.

The standard research methods were used for the experiment: the method of multifactorial experiment, statistical analysis, determination of the adequacy of the experimental data. The measuring equipment, which completed certification in the Russian Federation, was used such instruments as ammeter, kilovoltmeter and precision balance. There have been studied several collecting electrodes in the form of tubes with different inner surface such that its area corresponds to the analytical values: a smooth surface, a corrugated surface, an undulated surface, a complex surface with interleaving niches and crowns (like cuts in firearms).

As a result of experimental studies, it is found the dependence of the degree of cleaning of the electrostatic air cleaner η on the speed of the particles movement to the collecting electrode v and supply air w at a constant square area of the collecting electrode. The maximum degree of air cleaning from bacterial pathogens varies from 60 to 99 percent with a collecting electrode surface area 5 m².

Firstly, electrostatic air cleaners must be used in the microclimate systems of maternity buildings, preventative clinics, areas for young-stock breeding and poultry, on the stations of artificial insemination and in buildings for the collection of milk. The use of air cleaning installations in conjunction with recirculation allows reducing gas content in the room, where animals are kept, in 6 times; the number of pathogenic bacteria (coliform bacillus, staphylococcus) is reduced in 10 times; amount of consumed electric power is reduced to maintain the microclimate in 2 times; a young stock loss is decreased from 40 percent to 5 percent.

Keywords: collecting electrode, electrostatic precipitator, ecology.

ELECTROPHYSICAL WAYS TO REDUCE POTATO LOSSES

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Modern techniques of potato tubers storage have a number of economic, technical, and technological disadvantages and they don't ensure high product safety - potato losses run up to 70 percent per storage season. It is expected that losses can be cut by applying electrophysical methods of potato tubers treatment before storing. Thus the effects of electrophysical treatment methods on the potato safety during its storage are considered in this article.

During the experimental studies potato tubers were exposed to electromagnetic direct-current field, electromagnetic alternating current field, ionization, microwave field. In the design of the experiment standard research methods such as a multifactorial experiment method, a statistical analysis, and an adequacy test were used. The equipment used in the research: equipment for magnetic potato treatment, a microwave field generator, a generator of air ions, DC and AC voltage sources, and auxiliary instruments certificated and licensed in the Russian Federation.

The experimental machine for electromagnetic treatment of potato tubers was designed according to standard parameters of electric network: 220 V and frequency 50 Hz. When the machine is connected to AC, magnetic induction in the treatment area is 0.35 mT. When using AC-to-DC conversion, voltage value remained constant and was equal to 220 V.

As a result of the experimental studies it has been found that untreated potatoes had mass loss of 39 percent. Mass loss of potatoes treated with microwave field was over 50 percent. Potatoes exposed to aeroionization lost 23 percent of their mass. At a magnetic treatment dose of 6-8 mT•s mass loss of potatoes does not exceed 20 percent, but when a dose of magnetic treatment is greater or less than the specified ranges, mass loss of potatoes exceeds 40 percent reaching 75 percent. Hence it has been demonstrated that the method of electromagnetic treatment within specific ranges is the most economical one.

It is anticipated that magnetic fields influence the potato cells, as the result of the effects, potato tubers either lock in moisture, starch and other substances, or lose them quickly due to inner-structure destruction. According to the results of the experiments, electromagnetic potato tubers treatment at a dose of 6-8 mT•s has been recognized as the most effective option.

Keywords: potato, aero-ions, microwave field, magnetic field.

CHEMICAL AND MICROBIOLOGICAL QUALITY OF *TENEBRIO MOLITOR* AND THEIR POTENTIAL FEED

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The use of insects in feed and food is becoming more and more desirable, in order to improve the sustainability of food production. The future economic importance of insects may also be significant. Microbiological and chemical risks have been mapped for insect rearing and processing and the most significant risks have already been identified. However, more research is needed. Insect production must also take into account ethical and animal welfare aspects.

The microbiological and chemical contaminants in insect feeds and foods are influenced by the insect species, production method, feeds for insects, growth phase, and insect processing methods. The most significant of these factors is feed.

Insects and their feeds have been studied in Finland e.g. in “Insects in food chain”- and “ScenoProt”-projects. In this poster presentation, results of microbiological and chemical analyses of *Tenebrio molitor* larvae are shown. In present project, “Safe and sustainable feed for insects from domestic side streams of bio-economy” (HyväRehu), the comparison of feeds containing vegetable sidestreams as part of insect feed were designed and the microbiological quality was assessed before and after the four week growth period of larvae. Feeds studied in the HyväRehu-project were designed in the light of previous research and knowledge and they will be introduced in this poster. Usually the main component of the feed for *T. molitor* larvae is grain together with protein rich feedstuff. Added yeast has previously been discovered to speed up the growth of *T. molitor*. Investigated feeds were designed on the basis of substituting soya bean, that is commonly used as an ingredient of feed, and some of the grain with domestic side streams of bio-economy to increase the sustainability and productivity and ensuring the safety of *T. molitor* breeding. Best suitable side streams for this purpose are year-round well available, profitable, dried and microbiologically safe materials. Potato protein, barley feed, mash feed, fishmeal, pressed turnip rape, pea meal, faba bean and carrot were chosen to be used as feed ingredients aiming to test feeds that would meet the nutrition requirements of the *T. molitor* larvae and produce good growth with low mortality. As a conclusion, more research is needed for the control of microbiological quality of *T. molitor*.

Keywords: *Tenebrio molitor*, insect production, safety, nutrients.

CONFLICTS IN BALTIC FISHERIES

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The Baltic Sea is the youngest and one of the smallest seas on Earth. It is characterized by a lack of tides and the epicontinental character. Marine environment of the Baltic Sea is significantly influenced by various anthropogenic factors such as overfishing and anthropogenic eutrophication. These factors are known to interact between each other as well.

The large research studies on the Baltic Sea fisheries realized by the authors at the Faculty of Economics and the Faculty of Food Sciences and Fisheries at the West Pomeranian University of Technology in Szczecin. There were used methods of induction in order to draw general conclusions from individual observations and synthesis with deduction for achievement of output of the known and already proven general theorems. The elaboration is mainly based on the European legislation, regulating the fishery in the Baltic Sea, Eurostat materials and data gained from STECF–Scientific, Technical and Economic Committee for Fisheries as well as the report of the Commission for the EP and the Council.

The deteriorating biological conditions in the Baltic Sea, a small epicontinental sea, due to overexploitation of fish stocks has led to a decline in the condition of fish stocks, both quantitatively (reduction of shoals) and qualitatively (size of the specimens and their condition). Overexploitation of fish stocks particularly concerns the most valuable species (e.g., cod and salmon) as well as the species that they feed on (e.g., herring and sprat). The growing competition in the exploitation of Baltic fish stocks has resulted in conflicts between different types of fisheries: small scale, marine, and recreational fisheries. Coastal zones experience intense conflicts, in which case, the most disadvantaged is the small-scale fisheries operating in a short distance from the harbors. However, catches for the industrial purposes are a probable cause of deterioration of the Baltic cod stocks. According to our review, the present condition of Baltic fisheries is far from the desired state described as sustainable fishery.

Keywords: Baltic Sea, responsible fishery, sustainable fisheries, small-scale fisheries, marine fisheries, recreational fisheries.

HOW FOUR TYPICAL SWEDISH PRODUCTION SYSTEMS FOR LAMBS AFFECT SENSORY ATTRIBUTES OF THE MEAT

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The aim of this study was to evaluate the effect of the four most typical production systems for Swedish lamb on sensory attributes of meat including appearance, texture, taste and flavour using an analytical panel.

In total, 32 crossbred intact ram lambs (Dorset x Fine Wool; 75:25) were included in the study. Groups of 8 animals each were assigned to one of four production models for weaned intact male lambs. Group 1 on indoor feeding was fed a total mixed ration consisting of grass and clover silage *ad libitum* and a constant amount of 0.8 kg concentrate per lamb and day, Group 2 and 3 on cultivated pasture with or without 0.3 kg concentrate per lamb and day, respectively, and Group 4 grazed a semi-natural pasture. Further, all lambs were weighed each week. At slaughter, carcass weight, conformation and fatness as well as pH and temperature after 24 hours were recorded. After six days ageing *M. longissimus dorsi* were sampled and immediately frozen and stored at -20°C until analyses. The samples were thawed and cooked using the *sous vide* method to an internal temperature of 65.5±1.2°C. The samples were chilled overnight and then cut in 5 mm slices. Samples were held at 70°C for 10 minutes before served. Sensory analysis was performed by a trained panel with six assessors. The sensory data was analysed by two-way ANOVA, with production system as fixed and assessors as random factors. Differences were considered significant when P<0.05.

Regarding the sensory attribute 'resistance to cutting', Group 3 was scored lower compared to Groups 2 and 4. There were also a strong tendency ($p=0.051$) for Group 4 being scored higher than the other groups for the attribute 'hay odour'. The indication that the meat from lambs grazing semi natural pasture may be related to the lower growth rate and higher age at slaughter for this group and would be of interest to investigate further. Regardless of the differences in growth rate and final pH after 24 hours there were no differences for the sensory attributes. According to these results it could be valid to speculate about individual differences between animals rather than differences due to the different production systems. Normally, growth rate and pH value of the meat are considered as tools to predict sensory attributes, such as tenderness, in this study there were no clear relationships.

The results from this study indicate that the four different production models, covering the Swedish lamb production, did not affect ultimate pH or colour of lamb carcasses. Sensory meat attributes affected were 'hay odour' and 'resistance to cutting'. With this in mind, it seems that the different production systems, besides having an effect on production and carcass descriptors, did not influence eating quality including tenderness and flavour which are of the most important once from a consumer perspective. Furthermore, this study found that the variation between animals was higher than between the different rearing systems.

Keywords: live weight gain, pH-value, temperature, sensory attributes, texture, colour.

SELECTED METHODS OF FORMATION DESIRABLE PHENOTYPE OF DIFFERENT SHEEP BREEDS

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Modern trends in the development of sheep breeding suggest an increase in the importance of meat characteristics of animals with the fullest possible preservation of wool productivity indicators, which is particularly in demand when organizing lamb production, combined with the application of remote aerospace methods for assessing pasture fertility.

The study of the relationship between morpho-biochemical blood indices and resistance to the live weight of young animals obtained from intra- and inter-linear selection of parents and the correlation analysis of the economically useful signs of mothers with their daughters made it possible to establish the degree of the prepotent influence of one mothers' sign on the manifestation of a similar trait in offspring.

The Caucasian breed ewes of the desirable line have the greatest heritability of wool fineness (21.1-22.3 μm), so as the Jalghin merino ewes of the fine line - (18.1-20.5 μm). The shearing of the washed wool was better inherited by the Caucasian breed animals of the desired line and its interlinear selection with the thick-wool line, as well as the Jalghin merino ewes of the strong line. The latter were characterized by the greatest degree of heritability of the live mass, as well as interlinear ewes when combined with long-wool and thick-wool lines.

At the age of 4 months, young ewes had the highest repeatability rates and did not have significant differences between linear and interlinear variants of breeding. With increasing age, the level of repeatability factors in all groups was reduced to values of 0.41 to 0.61. At the same time, it should be noted that the young ewes of the Caucasian variety with interlinear breeding had the living mass feature characterized by greater stability than the linear one.

The experimental groups of sheep Caucasian and Jalghin merino were grown in pasture areas with an index NDVI (Normalized Difference Vegetation Index) of at least 0.55 ± 0.03 , established by the results of remote assessment of pastures using unmanned aerial vehicles (UAVs).

The research was carried out with the financial support of the Ministry of Education and Science of Russia under the Agreement No. 14.613.21.0081 with the Ministry of Education and Science of Russia from November 22, 2017, the unique identifier: RFMEFI61317X0081.

Keywords: sheep, animal line, correlation, heritability, repeatability.

GENETIC CAUSES OF BIRTH OF IMPAIRED CALVES AND REPRODUCTION DYSFUNCTION OF A DAIRY HERD

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Modern genotypes of dairy cattle created using the Holstein breed are characterized by improved performance of the ex-terrier relative to the milk-type expression in the animal and increased by 25-50% compared to the initial mother breeds by the milk production parameters, annual yield of the best cows in commodity farms can often reach 7,5-9,0 thousand kg of milk. However, the uncontrolled use of improved bulls can often lead to disruption of the process of reproduction of the herd and the birth of weakened and unviable calves.

Analysis of the causes of the disruption of the normal reproduction process in the dairy herd of black-and-white cattle, which got by crossing with bulls of the Holstein breed, showed that the cause of the birth of a weakened youngster with signs of deformity (internal organ dystopia, aplasia and limb hypoplasia, absence of lumbar vertebrae, eye pathology, anal atresia) and clinical signs of a disorder of the function of the gastrointestinal tract (diarrhea, rejection of feed, lethargy, oppression), dehydration (dryness and loss of skin elasticity, apadenie eyeball), thickening of the joints was the use of the selection of parental pairs of bull-producer with a genetic anomaly HH1C. In this case, the genetic analysis of the broodstock for 12 types of haplotypes associated with impaired fertility and 31 types of monogenic diseases showed that only 6.9% of the breeding stock caused the appearance of genetic anomalies of CVM and BLAD.

In the system of growing young cattle, the animals were grazed in the farm cultural pastures with the index NDVI (Normalized Difference Vegetation Index) in the range of 0.55 ... 0.65, on the average, 0.60 ± 0.02 , established according to the results of remote assessment of pasture areas with the use of unmanned aerial vehicles (UAVs).

The research was carried out with the financial support of the Ministry of Education and Science of Russia under the Agreement No. 14.613.21.0081 with the Ministry of Education and Science of Russia from November 22, 2017, the unique identifier: RFMEFI61317X0081.

Keywords: genetic anomalies, pasture stock raising, dairy cattle.

MAINTAINING THE STABILITY OF MILK-YIELD PARAMETERS AND MILK QUALITY IN HIGH PRODUCTION MILK CATTLE

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In the conditions of industrial milk production the stability of production processes and the steady supply of raw milk to processing enterprises are of particular importance. In the climatic conditions of the North Caucasus in summer the air temperature often rises to +35 ... + 45 ° C and causes the development of heat stress in animals, violation of physiological metabolic processes, decrease in feed intake, increased water consumption, changes in milk productivity and milk quality.

Monitoring of the chemical composition of milk conducted in the six top dairy herds of the Stavropol Territory with a total livestock 4586 cows with an average daily milk production about 25-35 kg showed that, along with a drop in milk yields, decrease in the amount of fat and protein in milk 3.61-8.68% and 1.88-7.65% respectively took place during the abnormally high summer air temperature. The feed analysis demonstrated that the content of exchange energy in dry basis was 9.4 MG / kg, fibre - 19.7%, and the protein was a bit reduced - 14.8%. It has been established that the addition of concentrated feeds to the daily allowance providing 680 g of crude protein promoted an increase in the protein content in dry basis to 16.6%, resulting in increased fat content in milk to 3.60-3.72%, and the protein to 3.21-3.42%. At the same time, the maximum air temperature was still quite high within +34-37 ° C.

A linear affiliation analysis of highly productive cows that are more resistant to the abnormally high temperature factors has shown that the daughters of the bulls of the leading lines in the Holstein breed (Wis Back Eidial 1013415, Reflection Sovering 198998 and Montvich Chifshtein 95679) with a milk productivity more than 11,500 kg and fat and protein 3.87% and 3.23%, respectively, and the age of the first calving about 720 days, are characterized by positive breeding progress in the herd.

Keywords: milk quality, protein, dairy herds.

MEAT AND INTERIOR FEATURES OF EWES OBTAINED FROM PARENTS OF DIFFERENT AGE

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In this article the meat productivity of offspring received from reciprocal selection of parental pairs of 1.5 and 3.5 years age of the Soviet merino breed sheep. It was found that, on average, the ewes obtained from the uneven-aged selection on the slaughter mass exceeded the ewes received from the even-age selection by 6.2% ($P < 0.05$), on the slaughter yield this superiority was 1.5 abs. percent. It was also found that the ewes obtained from the lambed ewes of 3,5 years age and the rams of 1,5 years age exceeded the herdmates of other variants of selection for slaughter mass from 4.3% ($P > 0.05$) to 14.9 ($P < 0.05$) and slaughter output - from 0.6 to 2.3 abs. percent. The coefficient of meat in the ewes from the uneven-aged selection was on the average higher by 0.27 units. The first class of cuts was the most in Group II animals (94.2%), which exceeded the herdmates of Groups I, III and IV by this indicator - by 1.8, 0.2 and 0.7%. The first sort of cuts was greatest in animals obtained from lambed ewes of 3.5 years age and rams of 1.5 years age (94.2%), which exceeded the herdmates from 0.2 to 1.8%. The ewes from the uneven-age selection exceeded herdmates from the even-age selection in the length of the small intestine and the average index was 27.8 m, which is higher by 0.5 m, or by 1.8%. The results of the research showed that in terms of meat and interior characteristics, the offspring received from the parents of uneven-age selection are superior to those obtained from the even-age selection parents.

The experimental groups of fine-wool merino sheep were kept in pasture areas with index NDVI (Normalized Difference Vegetation Index) in the range 0.50 ... 0.65, on the average 0.58 ± 0.03 , established by the results of remote assessment of pasture areas using unmanned aerial vehicles (UAVs).

Keywords: sheep, reciprocal selection, Jalghinsky merino ewes, unmanned aerial vehicles.

Acknowledgement. The research was carried out with the financial support of the Ministry of Education and Science of Russia under the Agreement No. 14.613.21.0081 with the Ministry of Education and Science of Russia from November 22, 2017, the unique identifier: RFMEFI61317X0081.

THE USE OF UNMANNED AERIAL VEHICLES IN THE MONITORING OF AGRICULTURAL LAND IN THE STAVROPOL TERRITORY

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Modern technologies allow remote monitoring of the quality of agricultural land using unmanned aerial photography. This process is less expensive, more mobile and more efficient and provides accurate and detailed information on the required object. The use of high-resolution cameras from 5 cm / pixel allows you to quickly examine large arrays of fields. The organization of monitoring is most effective when there is a service of geoanalytical data (space images) and in this case, monitoring is carried out from the problem areas.

Monitoring of agricultural lands in the Stavropol Territory with the help of UAV showed that the processes of land degradation tend to increase and solving this problem is one of the top priorities in land management. Negative processes develop both on arable land and on natural forage lands due to an increase in anthropogenic load. Since a large plowing of the territory and uncontrolled grazing of agricultural animals contribute to the development of various types of land degradation.

The timely identification of new foci of erosion processes and their development helps to solve the problem of agricultural land degradation, which is achieved through the use of remote technologies. Inventory of land using UAV is much more accurate and productive than current methods of bypassing the field on the contour or drawing on satellite data. Therefore, this work and the scheme for identifying degraded lands with the help of UAV can be the main document for working out the methodology and developing working projects to eliminate local causes of agricultural land degradation.

Keywords: land monitoring, unmanned aerial vehicles.

Acknowledgement. The research was carried out with the financial support of the Ministry of Education and Science of Russia under the Agreement No. 14.613.21.0081 with the Ministry of Education and Science of Russia from November 22, 2017, the unique identifier: RFMEFI61317X0081

INCREASE OF PASTORALISM EFFICIENCY WITH APPLICATION OF AEROSPACE MONITORING

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Pastoralism makes it possible to provide at least 70% of the animals' need for digestible protein, while the efficiency of production processes increases proportionally with the extension of the pasture period from 7-8 to 9-10 months, which is typical for the North Caucasus, Transcaucasia and Central Asia. At the same time, due to the unstable dynamics of climatic conditions in recent years, the methods of distance assessment of pasture fertility, based on the use of aerospace monitoring acquire special significance.

The development of the effectiveness of the use of various unmanned aerial vehicles (UAVs) for the remote evaluation of production processes in pastoralism has shown that the most optimal is the use of the complex, including unmanned aircraft of multi rotor type of small and medium range with takeoff weight from 5 to 50 kg, range of action from 5 to 75 km with a wireless channel for controlling and transmitting video and thermal information. The optimum flight height of a UAV is 40-100 m, with a wind speed of up to 7 m/s. Behavioural responses of pasture animals (fattening cattle, sheep) did not statistically significantly change during monitoring using UAV, so the difference in the time spent on feeding behaviour in the animals of the experimental groups was observed in the range of 0.06%. Decoding of NDVI-snapshots allows to identify areas with insufficient vegetation of pasture plants and to evaluate their nutritional properties (dry matter content, nitrogen concentration), which allows rationally planning the use of pasture areas.

Keywords: pasture, pasture animals, unmanned aerial vehicles.

Acknowledgement. The work is carried out within the framework of a research project, a unique project identifier is RFMEFI61317X0081.

THE ASSESSMENT OF THE FUNCTIONING OF PHOTOVOLTAIC INSTALLATION UNDER SMALL HOUSEHOLD CONDITIONS

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The aim of the study was to present the mechanism of operation and to assess technically and economically a typical household photovoltaic installation. The study included the data on the construction of the PV installation panels and the aspects connected with the profitability of the investment. The energy consumption and production from the existing photovoltaic installations was analysed and the project was assessed as well. The polycrystalline panels, the monocrystalline panels and the CdTe panel were selected for the analysis. The value of the savings was calculated on the basis of the energy production from the photovoltaic installation multiplied by the average energy cost and the coefficient for the prosumers in the settlement with the distribution system operator. The discussed photovoltaic installation used the photovoltaic polycrystalline panels which allowed for the achievement of the most beneficial yield-price relationship under Polish conditions. The economic analysis determined a degree of the covered energy demands in the discussed case. It amounted to 29.44% per year and allowed for the obtainment of the savings at the level of over PLN 1200 per year.

Keywords: photovoltaic installation, energy production, energy consumption, renewable energy sources.

THE DEVELOPMENT OF THE INTERFACE SOLUTION FOR THE ACQUISITION OF INFORMATION FROM THE OBD SYSTEM OF THE VEHICLE

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The intensive development of the automotive industry has been observed over the past decades. The prices of cars have become more affordable for the average consumer, resulting in the increase in the number of the vehicles. This is connected with the increased exhaust emission which has an adverse impact on the environment. The proper standards whose role was to minimise the harmful effects of the vehicle on the environment were placed on the car manufactures. The on-board diagnosis systems have been developed for the permanent monitoring of the vehicles. The OBD system is one of them. The aim of the study was to develop the interface with the use of simulation tools for the acquisition of information from the OBD system for the engine simulation of the vehicle in-service within the currently applicable WLTP test. The diagrams of the performed simulation of the operation of the vehicle within the WLTP test with the use of the Scilab Xcos environment and the results achieved from the applied interface were presented in the design part. The mathematical relations were used to build a simulation model of the operation of the vehicle within the WLTP test which faithfully reproduces the real operating processes. The development of the simulation for the acquisition of the data on the current operating parameters of the engine allows for the creation of the programming solutions at the initial stages without the necessity for the operation of the programme with the real OBD system integrated in the vehicle.

Keywords: OBD, WLTP, diagnosis.

THE METHODOLOGY OF PREDICTIVE CALCULATIONS OF BREAKTHROUGH WAVE IN HYDRODYNAMIC ACCIDENTS OF STORAGE DAMS

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Currently, more than 280 reservoirs of various types and purposes are operated on the territory of Kazakhstan. Safety problems at the facilities of the hydraulic engineering complex have particular importance, not only associated with the flooding of the territory, but also with water and energy supply.

The purpose of this work is to calculate the storage dams in the case of hydraulic accidents.

Based on the results of full-scale leveling surveys, predicted calculations of the breakthrough of the storage dams of Bartogai, Kapchagai and Kurtinsky hydrounits have been made.

Methodical recommendations developed in the laboratory of bridge hydraulics and hydrology of the department for the exploration and design of railways of the scientific research institute of transport construction include the determination of costs in the dam section during its destruction, as well as in the passages located in the up and down streams of the storage dam, taking into account the transformation of the breakthrough wave or release in transit.

The work uses recommendations and GOSTs, the rules of operation of storage dams of hydroelectric complexes and other methodological documents devoted to the safety of dams and hydraulic structures.

To perform predictive calculations of the breakthrough of water dams in the downstream of the hydrounit, a level-theodolite survey was performed at a distance of 7-8 km from the dam site.

The remaining transversals were taken from space images using GIS technologies.

Hydraulic calculations determined the parameters of the breakthrough wave when the dam of the Kapshagaysky, Bartogai and Kurtinsk reservoirs was destroyed: the height of the crest of the breakthrough wave; the speed of breakthrough wave, as well as the water level mark, the speed of breakthrough wave and the time of the wave passage through the planned sections with the establishment of possible flooding zones in the hydrodynamic accident.

Keywords: storage dams, earth dam, hydrodynamic accident, breakthrough of dam, consumption of breakthrough wave.