

Book of Abstracts of the 71st Annual Meeting of the European Federation of Animal Science

Virtual Meeting, 1st-4th December, 2020



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EAN: 9789086863495
e-EAN: 9789086869008
ISBN: 978-90-8686-349-5
e-ISBN: 978-90-8686-900-8
DOI: 10.3920/978-90-8686-900-8

ISSN 1382-6077

First published, 2020

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The Netherlands, 2020**



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Quality of the protein from black soldier fly larvae compared to soybean protein in organic broilersM. Heuel¹, C. Sandrock², A. Mathys³, M. Gold³, C. Zurbrugg⁴, I. Gangnat¹, M. Kreuzer¹ and M. Terranova¹¹ETH Zurich, Universitätsstr. 2, 8092 Zurich, Switzerland, ²FiBL, Ackerstr. 113, 5070 Frick, Switzerland, ³ETH Zurich, Schmelbergstr. 9, 8092 Zurich, Switzerland, ⁴Eawag/Sandec, Überlandstr. 133, 8600 Dübendorf, Switzerland; christoph.sandrock@fibl.org

Insects in general and especially the larvae of the black soldier fly (BSF) are globally discussed as a possible replacement for soybean in animal nutrition. However, information about their feeding value is scarce. Therefore an experiment was carried out with organic broilers where soybean cake and oil (S) was replaced by defatted meal and fat of BSF larvae grown on two different substrates (A/B). 80 Hubbard S757 broilers were kept in pairs and fattened from day 15 to 63/64 of life with one of the five following diets: a positive control (S/S, protein meal/oil, 21% CP) complying with recommendations for this broiler type, a negative control (SS-, 18% CP), a diet with BSF meal A and fat A (AA, 17% CP), a diet with BSF meal A and BSF fat B (AB, 17% CP) or a diet with BSF meal B (BB, 17% CP, no extra fat). Diets SS-, AA, AB and BB theoretically induced a protein deficiency to determine whether the protein value of the insect material is comparable to that of soybean. One animal per pair was analysed for carcass and meat quality. The average daily gains (g) were 27.1, 20.4, 27.5, 26.4 and 19.9 for SS, SS-, AA, AB and BB (SS- and BB, $P < 0.05$ against the others). The corresponding feed efficiency (g feed/g gain) was 2.7, 3.2, 2.8, 2.9 and 3.1 (SS- and BB, $P < 0.05$ against SS). Dressing percentage was similar at ~68% in all groups. Breast meat proportion was greater ($P < 0.05$) with SS (21%) compared to all other diets (all ~18%). Insect-based diet BB enhanced ($P < 0.05$) the yellowness of skin and meat. Cooking loss differed ($P < 0.05$) between SS (14.3%) and BB (17.2%), and shear force of the meat was also highest with BB. The results indicate that BSF protein meal A has a better protein value than soybean cake as it permitted a better growth than SS- despite the same protein content. Yet, diet AA could not prevent the impairment in breast meat proportion also observed in SS-. BSF protein meal B was widely equivalent to soybean cake. In conclusion, BSF protein meal is a high quality protein source, but its protein value varies between origins.

Evaluation of the suitability of a *Tenebrio molitor* L. meal as ingredient for broiler chicken dietsD. Murawska¹, W. Sobotka², T. Bakula³, D. Witkowska⁴, M. Gesek⁵, T. Daszkiewicz⁶ and P. Matusewičius⁷¹University of Warmia and Mazury in Olsztyn, Department of Commodity Science and Animal Improvement, Oczapowski St. 5, 10-719 Olsztyn, Poland, ²University of Warmia and Mazury in Olsztyn, Department of Animal Nutrition and Feed Science, Oczapowski St. 5, 10-719 Olsztyn, Poland, ³University of Warmia and Mazury in Olsztyn, Department of Veterinary Prevention and Feed Hygiene, Oczapowski St. 13, 10-719 Olsztyn, Poland, ⁴University of Warmia and Mazury in Olsztyn, Department of Animal and Environmental Hygiene, Oczapowski St. 5, 10-719 Olsztyn, Poland, ⁵University of Warmia and Mazury in Olsztyn, Department of Pathological Anatomy, Oczapowski St. 13, 10-719 Olsztyn, Poland, ⁶University of Warmia and Mazury in Olsztyn, Department of Commodity Science and Animal Raw Material Processing, Oczapowski St. 5, 10-719 Olsztyn, Poland, ⁷Lithuanian University of Health Sciences, Department of Animal Breeding and Nutrition, Tilžės St. 18, 47181 Kaunas, Lithuania; daria.murawska@uwm.edu.pl

Nowadays, insects have gained more and more attention in Europe as an underexploited sustainable protein and nutrient source for poultry feed. The aim of this study was to compare selected growth performance effects and carcass quality characteristics in broiler chickens fed by diets with different *Tenebrio molitor* (TM) processed animal proteins (PAP) meal content. The experiment was run on a total of 800 1-day-old male Ross 308 broilers. At 1-day of age, the chickens were randomly assigned to 4 dietary treatments (10 replications per treatment, 20 birds per pen); TM-0 (0% TM- PAP control group), TM-50 (50% TM- PAP), TM-75 (75% TM- PAP), TM-100 (100% TM-PAP). The birds were raised to 42 d of age and fed *ad libitum* (Starter 1-14 d, Grower 15-35 d, Finisher 36-42 d). The results were processed statistically by one-way ANOVA. The significance of differences between means was determined by Duncan's test ($P < 0.05$). The final body weight (BW) of chicken was respectively: 3,254.0 g (TM-0), 2,741.0 g (TM-50), 2,422.0 g (TM-75), 1,405.0 (TM-100, $P \leq 0.05$). The percentage of breast muscles in the total BW decreased from 25.0% (TM-0) to 22.3% (TM-50), 19.1% (TM-75), 15.7% (TM-100, $P \leq 0.05$). In conclusion, the replacement above 50% of soybean protein of TM-PAP in the chicken's diet significantly worsens growth performance and carcass quality. Acknowledgements: This work was supported by the National Science Centre, Grant: „Development of a strategy for the use of alternative protein sources in animal nutrition enabling the development of its production on the territory of the Republic of Poland”, No Gospostateg1/ 385141/16 /NCBR /2018.

Effect of condensed tannins of sainfoin on the fatty acid profile of ewe's milk and lamb's meat

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Twenty ewe-lamb pairs were used to evaluate the effect of the condensed tannins (CT), through the inclusion of polyethylene glycol (PEG), in the diet of lactating ewes on the fatty acid (FA) profile of their milk and the meat of their suckling lambs. The feeding treatments were: fresh sainfoin (*Onobrychis viciifolia*; SF n=10) and fresh sainfoin plus PEG (SF+PEG, n=10) to bind and deactivate the CT of sainfoin. Ewes were milked weekly and milk samples were collected until the lambs reached the target slaughter weight (11 ± 0.2 kg) with an average age of 27 days. Milk and meat FA were determined by gas chromatography (expressed as % of total FA identified) and sums and ratios of FA were calculated. Regarding milk FA, the inclusion of PEG increased C18:0 and C18:2 9c,11t, and n-6:n-3 ratio during week 1 and 2 of lactation ($P<0.05$) but not thereafter. Throughout lactation, SF+PEG ewes presented higher percentage of C16:0 and lower of C18:2 n-6, C18:3 n-3, C20:5 n-3 and total polyunsaturated FA (PUFA; 6.5% vs 5.9% for SF and SF+PEG respectively; $P<0.05$) than SF ewes. Therefore, the CT from sainfoin inhibited the ruminal biohydrogenation. The effect of CT on the FA of the meat of suckling lambs was milder than the effect observed in the milk, due to the *de novo* synthesis of FA in lamb muscle. The inclusion of PEG decreased C18:3 n-3 (2.3% vs 1.7% for SF and SF+PEG respectively; $P<0.01$) and increased C18:2 9c,11t (0.58% vs 0.71% for SF and SF+PEG respectively; $P<0.01$). In conclusion, CT from sainfoin improved milk quality because it increased PUFA and decreased n-6:n-3 ratio, and to a lesser extent they improved the meat quality of suckling lamb.

Potentials of milk performance data as indicator for targeted selective treatment in Lacaune sheepK. Schwarz^{1,2}, B. Bapst³, M. Holinger², A. Steiner², I. Schleip¹ and S. Werne²¹Eberswalde University for Sustainable Development, Schicklerstrasse 5, 16225 Eberswalde, Germany, ²Research Institute of Organic Agriculture (FiBL), Ackerstr. 110, 5070 Frick, Switzerland, ³Qualitas AG, Chamerstrasse 56, 6300 Zug, Switzerland; k.schwarz94@gmx.de

Anthelmintic resistance is a major threat in farming of small ruminants worldwide. One approach to slow down the development of anthelmintic resistance is targeted selective treatment (TST), where a part of animals is left unexposed to anthelmintic treatment and thus providing refugia for susceptible parasites. Closely linked to the successful implementation of TST is the identification of animals in need of treatment. In dairy goats it has been proposed to use milk yield as TST indicator, focussing treatment on high yielding dairy goats. In dairy sheep the relation between milk performance and infection of gastrointestinal nematodes (GIN) is not yet well known. The aim of this study was therefore to investigate the general relation between milk yield and GIN infection in a Swiss Lacaune dairy sheep subpopulation and, based on this, to evaluate milk yield data as a potential TST indicator in dairy sheep. A field study was performed including 1,159 lactating Lacaune dairy ewes on 15 dairy sheep farms in Switzerland. All ewes were sampled once between August and December 2019, when they had exceeded the 70th day of lactation. For each ewe the nematode egg excretion per gram faeces (EPG) was determined and individual milk performance data was obtained closely time-related to the date of faecal sampling. Coprocultures of pooled faecal samples were conducted to determine the proportion of *Haemonchus contortus* on farm level. A linear mixed model revealed that EPG increased significantly with increasing daily milk yield ($P<0.01$), indicating high yielding ewes to be less resistant to GIN infections than low yielding ewes. The effect was most pronounced in the earlier stage of lactation, but remained within a moderate range. The other included fixed effects milk protein content, lactation day, lactation number and the proportion of *H. contortus* did not show significant relations with EPG. The results suggest the possibility of using milk yield data as TST indicator in dairy sheep. In the frame of H2020 project SMARTER no. 772787.

Antimicrobial drug use and clinical health score of udder-reared dairy calves on Swiss organic farms*R.C. Eppenstein¹, C. Schneider¹, A. Spengler¹, E. Lantinga², F. Leiber¹ and M. Walkenhorst¹**¹Research Institute of Organic Agriculture (FiBL), Animal Science, Ackerstrasse 113, 5070, Switzerland, ²Wageningen University and Research, Prof. Lantinga is retired, Droevendaalsesteeg 1, 6708 PB Wageningen, the Netherlands; rennie.eppenstein@fibl.org*

During the recent decade, cow-calf rearing systems, which allow calves to suckle milk from a dairy cow for parts or all of the rearing period are increasingly gaining public interest. To date, no epidemiological multi-herd study exists that evaluates calf health and antimicrobial use for dairy farms using cow-calf rearing systems. This study quantified incidence densities (ID) of veterinary treatment events, antimicrobial treatment incidences (TI) and clinical health scores for dairy calves reared with udder access on 14 organic dairy farms in Switzerland and Southern Germany. Antibacterial drugs were used on 31% of farms and antiparasitic drugs on 15% of farms. Overall, a median ID of 25.35 veterinary treatments per 100 calf-years, a maximum TIUDD of 40 antimicrobial daily doses and a median calf mortality risk of 3% were found. Assessments of the calves' health using clinical health scores, revealed nasal discharge (23.5%) to be the most frequent health impairment, followed by ocular discharge (22.9%) and skin conditions (19.7%). Perianal soiling was observed in 10.1% of calves. Five percent of calves qualified as severely health impaired. Compared to conventional Swiss dairy farmers who rear calves artificially, antimicrobial drug use was substantially lower. This can partly be attributed to the mind-set of organic farmers. In severe cases of calf disease, organic farmers should not be reluctant to resort to antimicrobial drugs, such as to prevent avoidable calf suffering and mortality.

Session 27**Theatre 6****Dam-reared calves: lessons from pioneer farmers for Danish dairy producers***J.O. Lehmann¹, L. Mogensen¹ and M. Vaarst²**¹Aarhus University, Department of Agroecology, Blichers Alle 20, 8830 Tjele, Denmark, ²Aarhus University, Department of Animal Science, Blichers Alle 20, 8830 Tjele, Denmark; jespero.lehmann@agro.au.dk*

In Denmark, separation of dairy calves from their dam commonly occur within the first 24 to 48 hours whereas weaning occur around either 8 weeks (conventional) or 12 weeks (organic). Consumers increasingly question the practice of early separation, and there is a growing interest among Danish dairy farmers for developing new housing and management systems that incorporate a type of dam-rearing. Danish dairy farms are mostly relatively large with high-yielding cows in capital intensive and high cost systems that sets a tight margin for the milk price, which may challenge the implementation of dam-rearing. Several farmers in northern Europe practice different forms of dam-rearing, and their choices and experience may serve as inspiration for Danish dairy farmers. So far, we have visited 9 farms in Scotland, The Netherlands and Germany that represent a variety of breeds and a herd size ranging from 30 to 130 cows as well as an average of around 5,000 kg milk delivered plus 1,300 kg drunk per calf. The 5 highest yielding herds milk cows twice per day during the dam-rearing period. Six herds combine an initial period of full-time contact with a period of part-time dam-rearing. Separation occur between 4 and 22 weeks after calving, and 6 herds separate cow and calf abruptly whereas 4 herds wean calves abruptly. One case from The Netherlands and 1 from Scotland represent particularly promising systems for Danish dairy farmers. On the Dutch farm, calves are kept in separate deep litter area for the first 120 days, and a milking robot is used to gradually reduce the amount of time that the dams gain access to this area. Weaning occurs 2 weeks after separation with both separation and weaning done gradually. This farm delivers 9,500 kg of milk to the dairy per cow per year. On the Scottish farm, calves and dams are kept full-time in the same area the first 3 months and part-time the following 3 months. Weaning occurs gradually with nose flaps one week before a gradual separation. These case studies will influence the development of different implementation strategies that later will be assessed for various impacts including production economics.

Young steers do not benefit from short term sequential grazing with lambsS. Werne¹, J. Bam², M. Holinger¹, A. Steiner¹, S. Thüer¹, M. Leubin¹ and F. Leiber¹¹Research Institute of Organic Agriculture FiBL, Livestock Sciences, Ackerstrasse 113, 5070, Switzerland, ²ICAR-National Research Centre on Yak Dirang-790101, West Kameng District, Arunachal Pradesh, India, Dirang, West Kameng District, Arunachal Pradesh, 790101, India; mirjam.holinger@fibl.org

The IFOAM – Organics International norms impose that ruminants must be grazed throughout the entire grazing season. This approach increases the exposure to pasture borne parasites and eventually increases the number of anthelmintic treatments, especially in young animals. According to the IFOAM norms, the use of synthetic allopathic veterinary drugs is allowed if preventive measures concerning pasture rotation and management have been exploited. Therefore, we examined the sequential grazing of steers and lambs as a preventive measure to control gastrointestinal nematodes in the steers indicated by weight gains and parasite egg excretion. Ten comparable pairs of steers and 5 groups of lambs were used for this study. The 5 lamb groups were assigned to 5 pairs of steers to establish the steer treatment groups. The remaining 5 pairs of steers served as control groups. Two pastures were subdivided into 15 plots. At each pasture change, the treatment steers changed their plots with the lambs, whereas the control steers only changed pasture, but not the assigned plot. The steers were 173±16 days old and had an average live weight of 171±15 kg at the start of the trial. The trial lasted for 105 days during summer 2018. The steers were weighted and sampled (faeces) at regular intervals during the 105 days and faecal egg count was determined at individual levels. Linear and generalised linear mixed effect models were applied using the software R. The model could not reveal significant differences of total body weight and daily weight gains of the steers between treatment and control. Even though gastrointestinal nematode egg excretion rose to a mean of 270±287 eggs per gram faeces in control steers compared to a mean of 140±70 eggs per gram faeces in treatment steers towards the end of the trial, no significant differences of EPG could be shown over the total trial period. We conclude that sequential grazing of steers and lambs does not improve the parasitological status of young steers. In the frame of Core Organic Cofund MIX-ENABLE.

Impact of earthworm or vermicompost supplementation under a challenging condition for broilersG. Das¹, S.M.M. Seyedalmoosavi¹, Z. Li¹, A. Troescher² and C.C. Metges¹¹Leibniz Institute for Farm Animal Biology, Institute of Nutritional Physiology, Wilhelm-Stahl-Allee 2, 18196, Dummerstorf, Germany, ²Chemovator GmbH, Industriestr. 35, 68169, Mannheim, Germany; gdas@fhn-dummerstorf.de

Earthworms (EW) have a high microbial activity in their gut, consume large amounts of particulate organic matter and excrete holorganic faecal pellets, i.e. vermicompost (VC). We investigated effects of feeding of EW or VC on performance, non-specific immune responses and gut health of broiler chicks under a challenging environmental condition. Material and methods: Starting from the first day (d) of life onwards, male Cobb-500 birds (n=480) were fed either a control diet (CON+) or CON+ supplemented with either 1% EW (on DM basis) (CON+EW) or VC (CON+VC) for 8 d (Period 1; P1). On d-8, half the birds were killed. Half the remaining birds on CON+ diet were either kept on the same diet for further 8 d (P2) or given a challenge diet (CON-) rich in non-starch polysaccharides (NSP). The birds consuming EW and VC in P1 were fed the CON- diet in P2 (i.e. CON-EW and CON-VC, respectively). On d-16, all birds were killed. Pen based average body weight (BW), feed intake (FI) and feed conversion ratio (FCR) were calculated in each P. In the end of P2, the birds were evaluated for the presence of sticky faeces (SF) attached to cloaca. Results: CON+VC improved (P<0.05) BW P1 through an elevated FI (P<0.05), but had no effect on FCR (P>0.05). CON+EW did not differ from the CON+ in terms of growth and FI (P>0.05) in P1. In P2 CON- did not affect growth relative to CON+ (P>0.05). In P2, CON-VC fed birds were still heavier than those fed on CON+. In the end of P2, 10% of CON+ birds had SF. CON- (P<0.05) increased prevalence of SF (40.5%), and VC aggravated this effect (57.9%), whereas CON-EW (18.9%) did not differ from CON+ (P>0.05). As compared with CON-, CON-EW tended to decrease (P=0.072) prevalence of SF. Birds fed on CON-EW had heavier caeca than those birds fed on CON+ (P<0.05). CON+EW tended to increase IgM in P1 (P=0.08). IgY and IgM remained unaffected by dietary treatments in either P. Conclusions: The lower incidence of SF and heavier caeca due to feeding EW may be indicative of a successful inoculation with beneficial microorganisms that might reduce anti-nutritive effects of NSP.

Functional data analysis on MY and NEFA responses of beef cows exposed to feed restrictions*L.B. Mendes, A. De La Torre, J. Pires, I. Cassar-Malek, I. Ortigues-Marty and F. Blanc**Université Clermont Auvergne, INRAE, VetAgro Sup, UMRH, Saint-Genès-Champanelle, 63122, France; luciano.mendes@inrae.fr*

Data used in this study originated from an experiment conducted with 13 primiparous Charolais cows submitted to two consecutive feed restriction (FR) periods, during which feed allowance was limited to meet 50% of NE requirements. Starting at 55 DIM, two consecutive FR of 4 d and 10 d were applied 17 d apart. Milk yield (MY) plasma metabolite concentrations, including non-esterified fatty acids (NEFA), were measured daily during FR, and every 2 to 3 d otherwise. Individual time-series for MY and NEFA were submitted to a functional data analysis (FDA) algorithm (FDA package of R statistical software). Subsequently, we extracted multiple parameters from smoothed functions which describe shape of responses to FR, including initial and final levels (Ppre, Ppost) and amplitude (T) of MY and NEFA deviations from baseline. We estimated areas between response and baseline curves during FR and the following 3 d: A1 (area between tPpre and timeT) and A2 (area between timeT and timePpost). Finally, we defined individual resilience (RFR) as the ability of cows to return to baseline at 3 d after FR. As MY changes over time, MY baseline was smoothed from raw data after excluding measurements collected during FR and the following 3 d. Smoothing time-series for NEFA was achieved for all cows, but MY smoothing was not possible for 2 cows, probably because of their relatively low MY. Comparisons of medians between 4 d and 10 d FR for Ppre and Ppost revealed significant differences (Wilcoxon test, $P \leq 0.05$) for MY (Ppre: 6.5 vs 5.7 kg/d; Ppost: 6.1 vs 4.6 kg/d) but not for NEFA (Ppre: 0.07 vs 0.07 mM; Ppost: 0.07 vs 0.08 mM). These results reflect the natural decrease of MY over time, whereas NEFA remained at basal levels before restriction. For T, we observed significant differences for NEFA (0.18 vs 0.26 mM), but not for MY (0.85 vs 0.82 kg/d), indicating that NEFA was potentially more responsive to FR than MY. The variable RFR did not differ significantly between 4 d and 10 d FR because MY and NEFA returned to baseline at 3 d after FR. This approach allows to phenotype individual variability of cow responses to FR and identify potential traits related to animal robustness. Gentore (H2020) project funded this study.

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Poster 7

Predicting longevity based on lactation curve, cell count and calving interval in organic cows*F. Moser, A. Bieber, A. Maeschli, A. Spengler Neff and F. Leiber**Research Institute of Organic Agriculture (FiBL), Department of Livestock Sciences, Ackerstrasse 113, 5070 Frick, Switzerland; florian.leiber@fibl.org*

Longevity has important impact on lifetime daily milk yields and therefore ecological and economic efficiency of dairy cows. However, actual productive lifespan of dairy cows in Europe is less than four lactations and thus far below the physiological potential. This holds also true for cows in organic systems. Besides management tools, selection criteria at the farmers' hands are needed to improve longevity on farm level. We used data of culled cows from Swiss organic dairy farms to develop prediction models for the number of lactations completed. A dataset comprising 298 cows, which had been in 1st lactation in 2009, and were culled before June 2019, served to fit 32 prediction models initially based on lactation curve parameters (LCP), somatic cell count, age at first calving, calving interval and veterinary events against the binary trait of completing minimum four lactations. The lowest tercile regarding 1st lactation milk yield was excluded in order to separate economic culling decisions from biological reasons. Full and reduced generalised linear models (GLM), generalised mixed effect models, and linear discriminant analyses, respectively with and without inclusion of veterinary events and LCP were applied; all models were based on 1st lactation as well as on 2nd lactation data. In order to rank the models, the resulting scores were applied to a dataset of 7,742 culled cows for predicting their total number of completed lactations as well as lifetime milk yield. Predictability was higher when based on 2nd-compared to 1st-lactation models, and it clearly increased if LCP were excluded. The best prediction for productive lifespan with $Rho=14\%$ was reached with a GLM model, excluding LCP. Thus, overall predictability of the best models was still poor. However, for lactation numbers above seven and lifetime yields above 50 tons the rate of cows being false classified by low scores decreased to less than 10%. We conclude that the chosen approach needs to be optimised by larger data for the model development, but might become suitable to support longevity-targeted culling decisions in low-input systems, reliably identifying the poorest percentile.

Effects of grain processing and undegradable fibre on rumen pH and fermentation of high grain dietsW.Z. Yang¹, T. Ran^{1,2}, A.M. Saleem^{1,3}, K.A. Beauchemin¹ and G. Penne⁴¹Agriculture and Agri-Food Canada, Research Centre, Lethbridge, T1J4B1, Canada, ²Faculty of Veterinary Medicine, University of Calgary, Calgary, T2N1N4, Canada, ³Department of APP, South Valley University, Qena, 83523, Egypt,⁴Department of APS, University of Saskatchewan, Saskatoon, S7N5A8, Canada; wenzhu.yang@canada.ca

Fibre is required by feedlot cattle fed high-grain diets to reduce the risk of rumen acidosis and optimise growth rate and feed efficiency. It was hypothesised that altering ruminally fermentable carbohydrate and undegradable fibre (uNDF) levels in finishing cattle diets would affect the risk of acidosis. The objective of this study was to investigate the effects of processing index (PI, weight after processing/weight before processing \times 100) of barley grain and dietary uNDF level on dry matter intake (DMI), ruminal pH and fermentation characteristics of finishing beef cattle. Six ruminally cannulated beef heifers (body weight, 715 \pm 29 kg) were used in a 6 \times 6 Latin square design with 3 PI (65, 75 and 85%; fine, medium, coarse, respectively) \times 2 uNDF levels (low and high; 4.1 vs 5.0% of DM) factorial arrangement. The heifers were fed *ad libitum* a total mixed ration consisting of 10% barley silage (low uNDF), or 5% silage and 5% straw (high uNDF), 87% dry-rolled barley grain, and 3% vitamin and mineral supplement. Data were analysed using the mixed procedure of SAS with a model that included fixed effects of PI, uNDF and interactions, and random effects of period and heifer. Sampling day and sampling time were considered as repeated measurements. An interaction of PI with uNDF occurred ($P < 0.01$) for DMI (kg/d); DMI was greater ($P < 0.05$) for high (12.7) versus low (12.1) uNDF diets with 85% PI, with no difference in DMI (average, 12.1) between low and high uNDF diets with 65 or 75% PI. There was no interaction between PI and uNDF for mean rumen pH or duration of pH < 5.8, < 5.6 and < 5.2 over a 24-h period. However, duration of pH < 5.8 (14.6 vs 13.3 h) and < 5.6 (10.8 vs 8.6 h) was reduced ($P < 0.05$) by feeding high vs low uNDF diets. The PI did not affect total rumen volatile fatty acid (VFA) concentration or molar proportions, but VFA concentration was less (172 and 162 mM; $P < 0.01$) and acetate proportion was greater (46.0 and 48.2%; $P < 0.01$) with high vs low uNDF. The propionate proportion was less ($P < 0.04$) with high (35.0%) than low uNDF (40.4%) for 75% PI, but it was not different for PI of 65 or 85%. Ratio of acetate to propionate was not impacted by PI or uNDF level. These results demonstrate that increasing dietary uNDF level is an effective strategy to improve rumen pH status in feedlot cattle, regardless of extent of grain processing. In contrast, minimising the extent of grain processing did not reduce the risk of rumen acidosis.

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Theatre 3

Requirement-oriented supply of organic broilers with riboflavin from fermentation of *Ashbya gossypii*C. Lambertz¹, J. Leopold¹, S. Ammer², B. Thesing², C. Wild³, K. Damme³ and F. Leiber⁴¹Research Institute of Organic Agriculture (FiBL), Kasselstrasse 1a, 60486 Frankfurt am Main, Germany, ²Georg-August-University, Department of Animal Sciences, Albrecht-Thaer-Weg 3, 37075 Göttingen, Germany, ³Poultry Competence Centre of the Bavarian Institute for Agriculture, Mainbernheimer Strasse 101, 97318 Kitzingen, Germany,⁴Research Institute of Organic Agriculture (FiBL), Ackerstrasse 113, 5070 Frick, Switzerland; christian.lambertz@fibl.org

The required riboflavin (vitamin B2) demand of poultry is hardly met by the native contents of grains and legumes. A supplementation is consequently necessary to avoid deficiency in this vitamin, which has detrimental effects on performance, health and welfare. In organic production riboflavin supplementation must originate from GMO-free sources. A dried product from fermentation of the yeast-like fungi *Ashbya gossypii* with a high native content of riboflavin was tested in two trials with 800 mixed-sex one-day old Ranger Gold™ chicken. Four different riboflavin concentrations were tested in each run. In the first trial, a control diet contained only native riboflavin contents without supplementation (2.9 mg riboflavin/kg), the other diets were supplemented at graded dosages up to contents of 9.2 mg/kg. In the second trial, starter feeds contained 4.0 mg and 5.6 mg riboflavin/kg, whereas contents at the later fattening stages were reduced. Body weight and feed consumption were measured weekly. Additionally, slaughter parameters were assessed (dressing, proportion of valuable cuts, abdominal fat, liver, heart and gizzard). In the first trial, the native riboflavin contents did not meet the requirements of the slow-growing broilers and resulted in deficiency symptoms. High supplementations, however, did not have positive effects on performance and slaughter parameters. Consequently, a reduction of the riboflavin supplementation particularly during the later fattening period seems to be possible to compensate higher production costs of the tested product compared to conventional vitamin production by GMO.

Riboflavin requirements in organic poultry: graded supplementation to layers and parent hensF. Leiber¹, Z. Amsler¹, M. Leubin¹, C. Baki¹, R. Eppenstein¹, C. Lambertz², V. Maurer¹ and H. Ayrle¹¹Research Institute of Organic Agriculture (FiBL), Ackerstrasse 113, 5070 Frick, Switzerland, ²Research Institute of Organic Agriculture (FiBL), Kasselstraße 1a, 60486 Frankfurt, Germany; florian.leiber@fibl.org

Added riboflavin (vitamin B2) in organic animal feeding needs to originate from GMO-free fermentation. This makes the process much more expensive compared to GMO-based riboflavin. Therefore, the level of supplementation matters from an economic point of view. Requirement definitions for B-vitamins are generally based on older empirical data and have never been defined for specific organic conditions. Two experiments (LAYERS and PARENTS) were conducted to test graded dosages of riboflavin in feeds for hens, in order to define safe lower thresholds of supplementation. The experiment LAYERS included 135 Lohmann Brown Classic laying hens. They were allocated to nine groups and supplemented with either 1.5, 3.0, or 4.5 mg riboflavin/kg fresh matter (FM) feed (L1.5, L3.0, L4.5). In PARENTS, 10 groups of 10 parent Hubbard JA 57 hens and one Hubbard S77 cockerel each were allocated to riboflavin supplementation of either 2.5 or 4.0 mg/kg FM feed (P2.5, P4.0). LAYERS lasted for 18 weeks; data for PARENTS are from 14 weeks (ongoing). Hens were fed *ad libitum* and housing conditions were according to organic standards. Realised total riboflavin concentrations in the feeds (including native riboflavin from feed components) were 5.0, 4.5, and 3.0 mg/kg FM for L4.5, L3.0, and L1.5, respectively, and 8.0 and 6.0 mg/kg FM for P4.0 and P2.5. In both experiments (18 weeks for LAYERS, 14 weeks for PARENTS), no treatment effects on feed consumption, body weight, laying performance, eggshell strength and yolk colour as well as plumage and keel bone integrity scores occurred. Symptoms of lameness were not observed at all. Riboflavin concentration in egg yolk was in the range of 0.55 to 0.65 mg/100 g yolk for all treatments in both experiments without treatment effects, except for L1.5, where it dropped to 0.4 in week 18 ($P < 0.05$). In conclusion, no clinical symptoms of riboflavin deficiency were observed in any of the treatments of both experiments. However, lower riboflavin concentrations in yolk of L1.5 indicated a lower metabolic level. This level of supplementation is therefore not recommended.

Modulation of zinc, copper and iron transporters in weaned pigs fed dietary zinc oxideD.B. Dalto¹, A.K. Novais¹, F. Guay², Y. Martel-Kennes^{2,3}, G. Talbot¹, M. Lessard¹, J.J. Matte¹ and J. Lapointe¹¹Agriculture and Agri-Food Canada, Sherbrooke R&D Centre, 2000, College street, J1G 5H9, Sherbrooke, Quebec, Canada, ²Université Laval, Département de Sciences Animales, 1506-2325, rue de L'Université, G1V 4G2, Quebec, Quebec, Canada, ³Deschambault Research Centre in Animal Science, 120, chemin du Roy, G0A 1S0, Deschambault, Quebec, Canada; jacques.matte2@canada.ca

This study evaluated the impact of dietary zinc oxide (ZnO) on the gene expression of zinc (Zn), copper (Cu), and iron (Fe) transporters in jejunum and liver of weaned pigs. From weaning (d21), 120 piglets were fed a basal post-weaning diet (without antibiotics) supplemented ($n=40$ /treatment) with 100 mg/kg (LZn), 1000 mg/kg (MZn) or 3,000 mg/kg (HZn) of ZnO until d42. Dietary Cu (130 mg/kg) and Fe (260 mg/kg) were constant throughout the experiment. Piglets were slaughtered at d21 (before treatments), d23, d35, and d42 ($n=10$ /treatment/day) for samples collection. mRNA expression of Zn, Cu, and Fe transporters were evaluated by quantitative real-time PCR. No effect of treatments ($P \geq 0.11$) was observed at d21 and d23 in jejunum and liver for any gene. For Zn-related genes, jejunum *Zip4* expression was lowest for HZn, intermediary for MZn and greatest for LZn at d35 and d42 (treatment \times age interaction; $P \leq 0.01$). In contrast, *Znt1* was greatest for HZn at d35 and d42 in jejunum and liver and did not differ between MZn and LZn, except at d35 in jejunum (LZn < MZn) (treatment \times age interaction; $P \leq 0.01$). For Cu-related genes, no treatment effect ($P \geq 0.26$) was detected for *Crt1* and *Atox1* in jejunum and liver. In both tissues, *Mt3* expression was greatest for HZn, intermediary for MZn and lowest for LZn at d35 and d42 (treatment \times age interaction; $P \leq 0.01$). A tendency for treatment \times age interaction was detected ($P=0.06$) for *Atp7a* expression in jejunum where MZn was lowest and HZn and LZn were greatest at d35. Values for *Atp7b* in liver were greatest for HZn and did not differ between MZn and LZn at d35 and d42 (treatment \times age interaction; $P=0.03$). For Fe-related genes, no treatment effect ($P \geq 0.12$) was detected for *Dmt1* in liver and *Heph*, *Fpn1* and *Tfrc* in jejunum and liver. A tendency for treatment \times age interaction ($P \geq 0.06$) was detected for *Dmt1* in jejunum where LZn was highest at d35 and HZn was lowest at d42. The expression of *Fth1* was (or tended) to be affected in jejunum and liver (treatment \times age interaction; $P \leq 0.07$) where values were highest for HZn at d35 and d42, intermediary for MZn and lowest for LZn in jejunum but MZn and LZn did not differ in liver. In conclusion, intestinal and hepatic Zn, Cu and Fe transporters were affected by dietary ZnO levels in post-weaning piglets.

Fattening pigs display weak behavioural changes due to gastric ulcerations

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Gastric ulcers and erosions in the stomach are a common health problem in fattening pigs. However, such changes can only be assessed after slaughtering. Potential behavioural indicators that allow for an early detection would be favourable. In a study with 147 male (entire and castrated) fattening pigs kept in groups of three, we conducted behavioural observations for 2 days shortly before slaughtering with an average live weight of 102 kg. We recorded body positions, feeding, drinking and social interactions. After slaughtering, stomachs were inspected for signs of erosions or ulcers. First, behavioural outcomes were modelled using linear mixed effect models with random, but without fixed effects. The residuals obtained were then analysed with linear discriminant analysis (LDA). In a second step, the prevalence of gastric ulceration was analysed using a generalised linear mixed effect model with behavioural variables as fixed effects. From 96 focal pigs, 16 (16.7%) were found to have erosions or ulcers. The LDA did not reveal satisfactory levels of correct classification. While it was possible with this approach to classify healthy pigs as healthy (93.7%), pigs with erosions or ulcers were classified only partially as sick (6.2%). By modelling the gastric ulceration score with behavioural variables, we found that affected pigs tended to lie more in contact with other pigs, to show more manipulations of pen mates and to significantly lie longer in total and feed longer on concentrate. These results indicate that there are small differences in behaviour between healthy and affected pigs. Automated behavioural observations with a higher resolution could provide more insights into how pigs show pain or discomfort due to gastric ulcerations.

Session 70**Theatre 7****Do sows have individual nest building profiles?**

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Through evolution, sows have developed the ability to build a nest before farrowing in order to shelter the piglets and increase their chance of survival. Nest building is one of the most important natural behaviours of sows and although domestic sows are kept indoors with resources to keep the piglets warm, they are still performing specific behaviour sequences related to nest building. The overall aim of this study is to explore variations in nest building profiles in sows, including repeatability over parities. Nest building behaviour was analysed from videos during the last 18 hours prior to farrowing. The data include 54 sows farrowing in individual loose housing pens with two farrowings per sow. All nest building events (rooting, pawing, arranging material, etc.) were recorded and summarised per hour in relation to the start of farrowing (defined as first piglet being born). There was a large variation between sows in total amount of nest building and in nest building profiles over time. A preliminary descriptive analysis indicates repeatable individual nest building profiles for the majority (63%) of the sows. Some of them performed more nest building during the first 9 hours and some during the last 9 hours before farrowing, while others performed only a little nest building during all 18 hours. The results thus indicate that there are different types of nest building profiles with regard to timing and amount of nest building behaviour. The nest building profiles will be thoroughly studied with trend analysis.