Europ.Poult.Sci., **84.** 2020, ISSN 1612-9199, © Verlag Eugen Ulmer, Stuttgart. DOI: 10.1399/eps.2020.314

Proceedings of the Annual Meeting of the German Branch of the World's Poultry Science Association, Dummerstorf and Rostock, Germany, March 10 – 11, 2020

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The 2020 Annual Meeting of the German Branch of the World's Poultry Science Association (Deutsche Vereinigung für Geflügelwissenschaft e.V.) was held in Dummerstorf and Rostock. Both locations were kindly hosted by Prof. Dr. Klaus Wimmers and his team from the Leibniz Institute for Farm Animal Biology (FBN). In all, 53 participants from science, practice, industry and administration visited the lecture meeting at the University of Rostock. The topics presented showed a cross-section of current fields of action in the poultry sector:

- Phosphorus homeostasis and molecular mechanisms
- Resistance and tolerance to nematode infections
- Impact of the perinatal phase on the phenotype
- ESBL and AmpC colonization of broilers
- Exhaust air treatment in poultry farming
- Potential of partly defatted larvae meal

Along the lectures, a couple of young researches used the possibility of poster presentations. Topics ranged from corticosterone in feathers to alternative flooring systems for broilers. The annual meeting is intended to exchange new findings in poultry research and to deepen the network in Germany and beyond. To this end, the event offered extensive time for discussion between research and practice, with mutual inspiration. The proceedings of the annual meeting provide an abstract collection of oral and poster presentations.

Key words

behaviour, emission, nutrition, health, hygiene

Acknowledgement

We wish to thank the members of the organizing committee.

Our special thanks are directed to the sponsors Boeringer Ingelheim, MSD Tiergesundheit and Zoetis.

Europ.Poult.Sci., 84. 2020, ISSN 1612-9199, © Verlag Eugen Ulmer, Stuttgart. DOI: 10.1399/eps.2020.314

Abstracts of oral and poster presentations

Towards improved phosphorus efficiency in poultry species

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Phosphorus is an essential element for life and, therefore, an indispensable component of fertilizers and animal feed. It plays an important role in bone formation (hydroxyapatite), energy metabolism (ATP), cell signal transduction, as a component of cell membranes (phosphoproteins, phospholipids), blood buffering and in all processes involving nucleic acids (DNA, RNA). However, phosphorus is a finite resource and its inefficient use can have severe environmental effects (CAMPBELL et al., 2017). In poultry research, the understanding of the phosphorus homeostasis is of great importance, i.e. the maintenance of a phosphorus equilibrium state by endogenous regulatory processes to balance absorption (gastrointestinal tract), utilization (skeleton and oviduct) and excretion (kidneys). Knowledge on the molecular mechanisms to improve bioavailability, digestibility and thus the utilization of phosphorus from plant sources would not only reduce the phosphorus levels required in feed, but may also reduce phosphorus levels in poultry litter and finally emissions. Recent studies in Japanese quail have pointed to genetic factors, which are thought to explain a significant amount of the variation in phosphorus utilization (BECK et al., 2016). Gene expression profiles of quail siblings discordant for phosphorus utilization suggested a link between improved phosphorus utilization and mitochondrial energy metabolism, accelerated cell proliferation of enterocytes, and gut integrity (OSTER et al., 2020). However, results suggest that phosphorus utilization might not be fully independent from traits like calcium utilization and feed efficiency of quail. In assessing indicators of the efficient use of phosphorus, further research on host factors such as endogenous phosphatases, and the turnover and proliferation of intestinal cells could provide approaches to establish consistent mechanisms of improved phosphorus utilization efficiency in poultry species. Moreover, there is a demand to develop sustainable feeding regimes of poultry species, in which feed ingredients are analyzed for their potential contribution to meeting poultry phosphorus requirements and minimizing phosphorus emissions from farms.

Key words

closed nutrient cycles; dietary phosphorus supplementation; mineral homeostasis; plant-derived available phosphorus

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Does a dual-purpose genotype differ from meat- and layer-type genotypes in terms of response to experimental nematode infections?

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We investigated whether a dual-purpose genotype (Lohmann Dual, LD) differs from the conventional, high-performing broiler- and layer-type chickens in terms of resistance and tolerance to mixed-nematode infections including *Ascaridia galli* and *Heterakis gallinarum*, the two common ascarids parasitizing the chicken host. In experiment 1 (E1), cocks of Ross-308 (R), Lohmann Brown Plus (LB) and LD, and in E2 hens of LB and LD genotypes were compared following experimental infections. Orally induced infections occurred with 500 and 1,000 eggs of the ascarids per bird in E1 and in E2, respectively. In E1, infections reduced feed intake in all genotypes, but growth was impaired only in R, indicating a lower tolerance to the infections in this genotype. Overall, *A. galli* burden was higher in R than in LB, whereas LD did not differ from R or LB. Susceptibility to re-infection with *H. gallinarum* was higher in LB than in both LD and R. In E2, infections reduced feed intake and increased feed conversion rate in both genotypes. Infections impaired laying performance in LB immediately after infections while it was much later in LD hens. The delayed impairment in performance of LD hens was associated with a strong increase in egg weight of this genotype over time, which was not the case with LB genotype. Burdens of the first generation worms were not different between the two genotypes, whereas susceptibility to naturally occurring re-infections was higher in LB than in LD hens. Our data collectively suggest that tolerance to nematode infections is associated with host performance level in a way: the higher host performance, the lower tolerance to mixed nematode infections. Resistance to the mixed-nematode infections is more complex and depends on both host genotype and the worm species involved. The complete study summarized in this abstract can be found in Stehr et al. (2019a, b).

Key words

ascarids; avian host; dual purpose chicken; egg quality; growth rate; host performance; multi-species infection; resistance; susceptibility; tolerance

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The importance of the prenatal and early postnatal environment for the behavioural and physiological development of chicken

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The perinatal phase, comprising the pre- and postnatal period, is a sensitive phase during which the environment can have a long-lasting impact on the individual phenotype. The long-term effects might be explained by epigenetic mechanisms, which are also involved in the transmission of experiences during (early) life to subsequent generations (GOERLICH et al., 2012). It is thus no surprise that a number of studies investigate how stressors during the perinatal phase affect the development of behaviour and physiology. To measure effects of stressors on an individual, several (non-invasive) techniques have been developed. Quantification of steroid hormones, for example, is meanwhile possible in eggs, faeces, and feathers, providing promising alternatives to blood samples. Several validated behavioural tests are available to describe individual phenotypes, in the lab and on farm. Further useful techniques include thermal imaging and (prenatal) heart rate measurements (GOERLICH-JANSSON et al., 2019). Nevertheless, potential welfare issues due to early life experiences remain unexplored.

In birds, the egg and its components (e.g. steroid hormones), and incubation conditions (e.g. light, noise) affect the development of the embryo. After hatching, the young chick is influenced by its physical and social environment, and nutrition. In the poultry industry, embryos and chicks are exposed to a variety of potential stressors during the perinatal phase. Management of parental stocks and maternal stress may affect egg composition, leading to prenatal effects on the chick's future phenotype. Incubation conditions often do not resemble natural conditions (e.g. incubation of eggs in complete darkness), potentially resulting in abnormal behaviour (FIJN et al., 2020). Processing and transport of chicks, or nowadays of hatching eggs, may lead to stress and long-term consequences thereof. A sustainable and animal welfare friendly management of poultry should thus ideally take into account knowledge on (grand)parental stocks, egg characteristics, prenatal and early life circumstances of a chick.

Acknowledgements

Rebecca E. Nordquist, Gerrit van der Linde (Heering Holland), Bas Rodenburg.

Key words

adaptive capacity; animal welfare; digital egg monitoring; endocrinology; faecal hormone metabolites; infrared thermography; maternal effects; phenotypic plasticity; stress coping; transgenerational effects

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Larvae meal of the black soldier fly (*Hermetia illucens*) as a potential protein source for broilers

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Currently, alternative protein sources such as processed insect meals are in special focus of animal nutrition to replace imported feed proteins such as soybean meal (SBM). As a part of the multidisciplinary project "sustainability

transitions", this research evaluated the potential of partly defatted *Hermetia illucens* larvae meal (HIM) in broiler diets with complete substitution of SBM in combined growth and N-balance studies.

Studies were examined based on diet acceptance, zootechnical performance, whole body analysis, precaecal digestibility, and protein quality validation in accordance with current applications of the "Goettingen approach". The experiments were divided into starter and grower period. As animals, male broilers (Ross 308) were used. The control diet was based on wheat, corn and SBM. In all experimental diets SBM was completely substituted by HIM, but fortified with crystalline amino acids (AA) both on a basic level of supplementation (equal to the control diet) or an extended level according to current ideal AA ratio recommendations (WECKE and LIEBERT, 2013). In addition, in the growth study one diet in which the level of the first limiting AA was reduced to 80% of the recommendation was tested.

N-balance studies confirmed that at a basic level of AA supplementation, the dietary protein quality was significantly depressed, but the extended level of AA supplementation significantly improved protein quality parameters ($p < 0.05$).

In the growth study, at least comparable or even improved weight gain, feed intake and feed conversion rate were consistently recorded for the HIM group with adjusted AA levels. Furthermore, first results indicate a high precaecal digestibility of crude protein in HIM-based broiler diets.

From a nutritional-physiological point of view, HIM is suitable to substitute a large part of SBM-based protein in broiler diets if an adequate AA supply is maintained. High inclusion rates of insect meal are not limited by acceptability and combining ability.

Key words

alternative protein sources; black soldier fly; broiler nutrition; chicken; growth performance; insect meal; N-balance study; protein quality

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Intraindividual variation of corticosterone in different feather types of layer pullets

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Recent studies indicate that feather corticosterone measurements may be suitable to assess and evaluate animal welfare in poultry as the hormone is secreted into the circulatory system and detectable in the feathers when birds coped with adverse husbandry conditions and stress. However, there are still uncertainties regarding the exact procedure and duration of the deposition of corticosterone into the feather matrix, the methodology of extraction and analysis and species-specific reference values, which may be crucial when interpreting examination results.

Thus, the aim of the current study was to determine the variation of feather corticosterone concentrations between different feather types of one layer pullet.

Based on BORTOLOTTI et al. (2008) a validated protocol adapted to pullets and laying hens (HÄFFELIN et al., 2019) was applied to examine three tail feathers (rectrices), the fourth alula and the fifth primary feather of both wings, and a pool of five interscapular feathers (N = 8 samples) of a pullet (Lohman Brown, 19 weeks of age). All feathers were fully grown and undamaged.

The average corticosterone concentration was 104.7 ± 49.38 pg/mg (mean ± SD) and 93.6 pg/mg (median) over all samples (N = 8), respectively. The coefficient of variation was 13.0% in tail feathers (n = 3), 7.7% in the primaries (n = 2), and 5.0% in the alula feathers (n = 2). Highest concentrations were measured in tail feathers and lowest in alula feathers, respectively.

The differences in corticosterone concentration and deposition may be explained by the different growth rates of the feather types, which lead to the conclusion that feather type-specific reference values are needed when assessing and evaluating animal welfare based on corticosterone deposition in feathers.

Key words

animal welfare; behaviour; domestic chicken; glucocorticoid; HPA axis; indicator; laying hens; stress; wellbeing

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Evaluation of the effect of a partially perforated flooring system on the behaviour in broilers

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Broilers are mainly kept in one-dimensional housing environments on litter. Due to limited resources and costs for bedding materials, alternative flooring designs gain interest. The main disadvantage of no–litter flooring is the lack of bedding material, which is necessary to promote the broilers' natural behaviour. Among the benefits, environmental enrichment and especially elevated areas positively influence broilers' behaviour. The study evaluates the effect of a partially (50%) perforated flooring system on broiler behaviour as an indicator for animal welfare. In the area of feed and water supply an elevated perforated area was installed, accessible by perforated ramps. The remaining area as well as the control barn was equipped with wood shavings (600 g m^{-2}). In a fattening period of 32 days, the Avoidance Distance test (ADT) and the Novel Object test (NOT) according to WELFARE QUALITY (2009) were carried out weekly with 500 Ross 308 broilers per barn (final density: 39 kg m^{-2}). On day 7 ($F(1)=6.67$, $P = 0.017$), 21 ($F(1)=9.74$, $P = 0.005$), and 28 ($F(1)=12.82$, $P = 0.002$), more animals of the experimental barn approached the observer during the ADT compared to the control barn. This observation could also be made during the NOT on day

14 ($F(1)=6.14$, $P = 0.015$), 21 ($F(1)=34.64$, $P < 0.001$), and 28 ($F(1)=38.68$, $P < 0.001$) with more animals around the object in the experimental barn. These data reflect a pronounced explorative rather than fear-related behaviour of broilers kept on the new flooring system compared to the conventional litter flooring. Owing to the different floor types and the elevated area, the partially perforated flooring system contributes to an environmental enrichment. The increased complexity and multidimensionality reduced the fear response and thus, contributes to an increase in animal welfare.

Key words

animal science; animal welfare; animal behaviour; broiler production; broiler housing; broiler behaviour; flooring design

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Development and testing of an image-based system for the automatic detection of plumage damage in flocks of laying hens

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The condition of the plumage is one important indicator for animal welfare in laying hens (e.g.: KEPPLER et al., 2017; ML NDS., 2017). It is used to draw conclusions on housing and management conditions. Early recognition of feather pecking allows prompt application of emergency procedures such as enrichment. Thus, regular evaluation of the plumage can help to avoid a progressive feather pecking event. A variety of scoring schemes are currently used for the assessment of laying hen welfare indicators. The time-consuming procedure impairs the comprehensive and continuously evaluation of plumage during whole husbandry period. An automated measurement system facilitates an objective and timesaving procedure. The aim of the project was the development and testing of an image-based system for the automatic detection of plumage damage in laying hens as part of the German cooperative project 'AutoWohl'. A prototype was developed to detect plumage damage in brown hens, which can be used as a warning system for feather pecking in a flock. The system contains a near-infrared-sensitive camera in addition to a three-dimensional camera, which is necessary to differentiate between hens and background. It calculates the part of damaged surface (missing cover feathers or featherless areas) in relation to common plumage (defined whole plumage area). Results show that the automatic system was able to detect plumage damage in flocks of brown laying hens. However, establishment in practice needs further development. Evaluation of the white hen plumage requires the integration of additional technology for the differentiation between intact and damaged plumage areas. In initial investigations thermal imaging technology turned out to be very promising. Thermal technology can also be supportive for early plumage damage detection of featherless areas of the back which are covered by the wings but show a reduced heat-isolation.

Key words

damage; feather-pecking; image-based; laying hens; plumage

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Investigation of exploration behaviour and neophobia in the domestic fowl

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The relationship between fear and exploration behaviour determines the adaptability of an animal. To investigate the range of adaptation in chicken, standardized tests allow to phenotype specific behaviours related to fear and exploration in different genetics. The Novel Object test (NOT) was run according to the Welfare Quality® Assessment Protocol for Poultry (broilers, laying hens) and analyzed in-pen by the experimenter and, additionally, by the program EthoVision® XT (Noldus Information Technology GmbH, Wageningen, Netherlands). The NOT was run with the local breeds Belgian Malines (n = 25) and French Bresse Gauloise (n = 24). After a habituation to the experimenter of 5 min, an unknown object was placed on the floor next to a group of chickens. For a total of 2 minutes, the number of animals that undercut the distance of one animal length to the object was documented, in four consecutive repetitions. Based on both evaluation methods, in-pen and tracking system, more Malines than Bresse Gauloise undercut the determined distance to the novel object (both $p \leq 0.001$). These findings indicate low fear and high explorative behaviours of Malines compared to their conspecifics Bresse Gauloise. Comparing the time of measurement, the number of Malines, which undercut the distance decreased from the first two measurements to the last one, continually ($p \leq 0.001$). On the contrary, the number of Bresse Gauloise did not vary between repetitions ($p = 0.119$). These results indicate an increasing habituation of Malines and a constant behavioural response or rather a lack of habituation of Bresse Gauloise when test time progresses. The results of the NOT show a different level of fear and exploration and thus adaptation of the compared breeds. Different coping strategies might be present in different chicken genotypes which should be favored in breeding programs to promote animal welfare.

Key words

adaptability; animal welfare; chicken; exploration; fear; habituation; novel object test