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Summaries

Dr. Falko Kaufmann

Helminth infections in laying hens kept in alternative production systems in Germany – Prevalence, worm burden and genetic resistance

Dissertation, Georg-August-Universität Göttingen, 2011

Summary:

The aim of this study was to investigate the spectrum and intensity of helminth infections, as well as to estimate seasonal effects on the prevalence and burden of helminths in organic free range layers in Germany. Furthermore, resistance of six common commercial laying hen strains to an experimental *Ascaridia galli* infection was compared. In a next step genetic parameters of resistance to a natural mixed infection under field condition were estimated for two commercial breeds.

The experiments were conducted between 2007 and 2010 at the Department of Animal Sciences and on a commercial laying hen farm.

For the first trail laying hens from organic free range farms were collected between 2007 and 2010. The hens were sacrified and the gastrointestinal tracts were examined for the presence and intensity of helminth infections with standard methods. Hens slaughtered from October to March were included in winter data, whereas hens slaughtered from April to September were included in summer data sets. Almost all hens harboured at least one worm of one helminth species. Average worm burden per hen was 218.4 worms. The most prevalent species were the nematodes *Heterakis gallinarum* (98 %) followed by *Ascaridia galli* (88 %) and *Capillaria* spp. (75.3 %), whereas the overall prevalence of the cestodes was 24.9 %. Total worm burden was significantly higher during the summer season when compared with animals slaughtered during winter season. Risk of being infected with any of the nematodes was higher in summer than in winter. Probability of infection with any of the tapeworm species was higher in the summer than in winter.

For the second experiment six genotypes of commonly used commercial laying hens, namely Lohmann Brown (LB), Lohman Silver (LSi), Lohmann LSL classic (LSL), Lohmann Tradition (LT), Tetra SL (TETRA) and ISA Brown (ISA), were compared for their ability to resist an experimental *Ascaridia galli* infection. Laying performance, feed intake, change in the integument and faecal egg counts were determined during the experiment. The hens were infected at the beginning of laying period and slaughtered 105 d after infection i.e., at an age of 35 weeks, to determine their worm counts. Significant differences in average worm counts of the genotypes were quantified. LSL hens had the highest (25.8) and LT hens had the lowest (12.9) worms per hen. Although worm burden of LSL hens did not differ than those of TETRA and ISA, they had higher worm burdens than LSi, LT and LB hens. ISA hens also had higher worm burdens when compared with LT and LB hens. LSL and ISA hens had higher number of larva than LSi, TETRA, LT and LB hens. No large differences were observed among the genotypes for the performance parameters.

For the third trail, groups of Lohmann Brown (LB) and Lohmann Selected Leghorn (LSL) hens were reared under helminth-free conditions and kept afterwards together in a free range system. Mortality rate,

body weight development, laying performance and faecal egg counts (FEC) were recorded during a 12 month laying period. At the end of the laying period, 246 LSL and 197 LB hens were necropsied and worms counted following standard methods. LB hens showed a significantly higher average number of adult *H. gallinarum*, *Capillaria spp.* and tapeworms when compared with LSL animals. In total, LB had a significantly higher worm burden than LSL. The estimated heritabilities for total worm burden were on moderate in LSL and high in LB.

It can be concluded that the vast majority of hens in organic production systems is infected with a broad spectrum of helminths. However, within- and between-breed variation and heritability estimates reported in this study suggest, that it is possible to select for helminth resistance in both breeds based on worm counts. Such an approach should be considered sustainable as an explicit genetic progress for resistance against each single nematode species can be achieved from short to long terms. This may be of importance for chickens kept in alternative and organic farming systems.

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Dr. Susanna Käppeli

Keel bone deformities in Swiss laying hens: Prevalence and influence factor´s
(Brustbeinveränderungen bei Schweizer Legehennen: Prävalenz und Einflussfaktoren)

Dissertation, Zentrum für tiergerechte Haltung in Zollikofen and University Bern, 2011

Summary:

The research of Susanna Käppeli was made at the Centre for proper housing in Zollikofen and the Veterinary Faculty of the University of Bern under Professor Michael Stoffel and consists of three publications on keel bone deformities in Swiss laying hens.

The first paper is an epidemiological slaughterhouse study on the incidence of keel bone deformities in Swiss laying hens and was submitted to the journal British Poultry Science and accepted for publication. Several studies have shown that keel bone deformities are a common problem in laying hens. In addition to weak bones due to osteoporosis, especially the housing of the hens in alternative systems with perches are made responsible. In Switzerland, since 1991, hens have to be kept in systems with perches and also in the EU from 2013 on, only systems with perches will be allowed. Therefore, studies on such systems are specifically interesting. However, until now, no studies on keel bone deformities in Switzerland have been made. The aim of our study was therefore to record the incidence of keel bone deformities in Swiss laying hens and to identify possible causative factors in this problem.

Over a period of 14 months, hens from 39 different flocks of commercial laying hens were investigated in two different slaughterhouses. A hundred randomly selected animals were palpated on the slaughter line after defeathering. The keel bone status was classified into four grades: Grade 4 = normal keel bone, grade 3 = slightly deformed keel bone, grade 2 = moderately deformed keel bone and grade 1 = severely deformed keel bone. Information on the flocks was collected by telephone interview with the farmer: Housing type (floor pen or aviary and aviary type), perch type, outdoor access, label, hybrid, age and herd size. On average, 25.4% of the animals had moderate or severely deformed keel bones. Including the slight deformities, 55% of the animals were affected. There were large differences between the flocks: In the most affected herd, 48% of the animals had moderately and severely deformed keel bones, while in the herd with the least affected animals, only 6% of the animals showed such changes. Hens kept in aviaries had significantly more deformities of the keel bone (total deformities $F_{1,37} = 4.26$, $P = 0.046$,

moderate and severe deformities $F_{1,37} = 4.85$, $P = 0.034$) than hens in floor pens. In aviaries, differences between manufacturers were found, while for the perch materials, we found no significant differences. This study shows that keel bone deformities are also a common problem in Switzerland. Previous studies (Scholz 2008, Fleming 2004) showed that moderate and severe deformities almost always involve fractures. These are associated with pain and therefore a relevant animal welfare problem in modern farming, which affects a very large number of animals. The large differences in prevalence between farms and between manufacturers suggest that the housing is an important factor. The study design was not suitable to make concrete advices for improvements in system building, because too many factors we could not investigate (eg management) influenced the results.

The second publication is an experimental study on the effect of different perch materials, genetic factors and a vitamin D metabolite on the incidence of keel bone deformities. The paper was submitted to the journal Poultry Science, and is accepted for publication. Based on the results and limitations of our first study, the target of the experimental investigation was to find out more about the factors influencing these deformities. 4000 day old chicks were reared in a barn with 8 aviary compartments. There were 2000 Lohman Brown (LB) and 2000 Lohman Brown female parent stock animal (LBPS) used to investigate the influence of genetics. One half of the compartments had a standard vitamin D3 rearing feed with 2000 IU of synthetic vitamin D3, the other compartments had the same diet, but half of the vitamin D3 was replaced by Hy • D ® (25-hydroxycholecalciferol), an active metabolite of vitamin D3. Another factor was the perch material, where plastic and metal perches were compared. From the age of 18 weeks, the hens were kept in a barn with 24 floor pen compartments with the same factors as in the rearing period. Every 6 weeks, the keel bone of 10 animals per compartment was examied with the same palpation method used in the first study. During the rearing up to the age of 18 weeks, practically no changes were found. With the onset of laying at the age of 20 weeks, the deformities rose continuously. The age factor was highly significant. Until the last palpation with the age of 62 weeks, moderate and severe deformities increased up to 43.8%. The difference between LB and LBPS animals was large. LBPS had significantly less total, moderate and severe deformities ($P < 0.0001$) than LB hens. We could not find a significant difference in terms of deformities on the keel bone, when Hy • D ® was fed. Plastic perches resulted in significantly less moderate and severe keel bone deformities. As in the slaughterhouse study, the prevalence of keel bone deformities was high. With the assumption that moderate and severe deformities are fractures, this clearly represents a welfare problem, because fractures are associated with pain. The most important factors in our study were genetics and perches. Breeding programs for hens with stronger bones might be a way to reduce the prevalence of keel bone deformities in laying hens in the future. The prevention of injuries, for example when choosing perch material, should also be considered when developing new systems for laying hens. In contrast, supplementation of feed with Hy • D ® was not suitable to prevent keel bone deformities. It is possible that today's poultry feed already contains enough vitamin D3 and with Hy • D ® no further benefits can be provided.

The third study is closely connected with the experimental study. It is accepted for publication in the journal ‚Archiv für Geflügelkunde'. We investigated the influence of Hy • D ® compared with synthetic vitamin D3 on the blood parameters of total calcium, phosphate and 25(OH)D3. We wanted to find out, if feeding Hy • D alters these blood parameters. Four thousand one-day LSL chicks were kept in eight compartments and divided into two treatment groups with the different feed as factors. In four compartments, the feed was a commercial starter and pullet feed with 2800 IU of synthetic vitamin D3 in the starter feed, and 2000 IU of synthetic vitamin D3 in pullet feed. In the other four compartments, the chicks had the same commercial feed, but was half of the synthetic vitamin D3 was replaced by Hy • D ®. At 18 weeks, the hens were transferred into the laying barn. The control diet groups were given a laying feed with 3000 IU of synthetic vitamin D3. In the treatment groups, half of the vitamin D3 was again replaced with Hy • D ®. At the age of 11, 18 and 34 weeks, ten hens per pen were taken to collect blood samples and the blood was analized on total serum calcium, total inorganic phosphate and serum 25(OH)D3. There was no difference in total calcium in any of the three ages between the diets. With the onset of lay, the calcium levels rose significantly from 3 mmol / L in all food groups at week 18 to 8.32 mmol / L in the control diet group and 8.66 mmol / L in the Hy • D ® feed groups at week 34. At weeks 11 and 34, the phosphate levels in the control diet group was significantly higher than in the Hy • D ® groups. The Hy • D ® group had significantly higher 25 (OH) D3 levels in all three studies. In summary,

through our study we can say that by feeding Hy • D ®, serum 25 (OH) D3 and the serum phosphate is significantly affected. But we can not say whether the bone strenght is also affected or not. This would have to be investigated in further studies.

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Katharina Graunke

Behaviour and use of protection of outdoor-wintered beef cattle in Sweden

Diploma-Thesis, Swedish University of Agricultural Sciences in Skara and TU München, 2008

Little is known about the correlation between weather and the use of natural or artificial protection by cattle and about the influence of weather on the cattle's behaviour. The aim of this study was to investigate the behaviour of cattle (*Bos taurus*) kept outdoors during winter time and to study the effect of weather, available protection and experience on the behaviour.

The study was carried out in the southwest of Sweden on a pasture of 12 ha with a herd of 78-85 adult beef cattle head and up to 50 calves. Protection was available by coniferous forest which was situated both on and around the pasture dividing it into four protection categories: in forest, near protection – leeward, near protection – windward, no protection. From December 2006 till March 2007 ten cows and ten heifers of Black Angus and Black Angus-Charolais-crossbreeds were observed as focal animals during a total of 240 hours. Each animal was followed 12 times each one hour at a time. Recordings were made with instantaneous sampling at 4-minute intervals (body position, general behaviour, protection category, number of animals in a two-cow-length-radius (5 m) around the focal animal) and continuously for social behaviour. Four hours of observations were carried out each day and these observation times were adjusted to the altitude of the sun. Temperature, wind speed and solar radiation were measured simultaneously in the animals' surrounding and at an exposed spot of the pasture. These variables were combined to a single measure called Wind Chill Temperature (WCT). Precipitation was noted by the observer. All collected data was analysed with a Poisson-regression model-link function, logistic regression model-link functions, the Friedman two-way analysis of variance by ranks, the Wilcoxon signed ranks test and the Sign test. The coefficients of the regression models estimate the mean difference per unit of the belonging variable and are given as factors with a 95 %-confidence interval (CI).

The animals were lying more in the mornings than in the afternoons. The cows and heifers were feeding more in the afternoons. Social behaviours were of aggressive nature for about ¾ of the recordings. Aggressive social behaviours were shown 21.9 percentage points more often while feeding from the feedracks and silage bales on the ground than while not feeding.

During the four months of observations the cows and heifers were in the forest in 12.4 %, near protection in 10.4 % and without protection in 77.2 % of the recordings. In total, there were no significant differences in the number of recordings when the cows and heifers were lying without protection compared to lying in the forest. If the proportionate percentages of lying per protection category were compared, the cows and heifers were lying significantly more in the forest compared with lying without any protection ($Z = -3.16$, $p = 0.002$). The comparison of the proportionate percentages of resting (i.e., ruminating or showing no activity while lying or standing) in the forest and resting with no protection showed significant differences with the animals resting proportionately more in the forest than unprotected ($Z = -3.72$, $p < 0.001$).

During precipitation, i.e., rain, snow and hail, the cows and heifers frequented the forest 2.71 times more often than when there was no precipitation (factor: 2.71, CI: 1.19-6.20, $p = 0.018$). However, in only 17.0 % of the observation hours the animals were in the forest during precipitation. Still, in 75.0 % of the observation hours the WCT in the animals' surrounding was at least 2.0 °C higher than at the exposed

spot of the pasture. The mean temperature was 1.8 °C higher ($Z = -13.34$, $p < 0.001$) and the mean wind speed 1.7 m/sec lower ($Z = -14.28$, $p < 0.001$) in the focal animals surrounding than at the exposed spot of the pasture.

Lying, feeding and ruminating were all influenced by WCT differently and depending if it rained, snowed, and hailed or not. The higher the WCT the more the animals were lying (factor: 1.19/°C, CI: 1.14-1.25, $p < 0.001$), the less they were feeding (factor: 0.92/°C, CI: 0.89-0.95, $p < 0.001$) and the more they were ruminating (factor: 1.07/°C, CI: 1.03-1.10, $p < 0.001$) when there was no precipitation. During precipitation they behaved the other way around and they were lying the less (factor: 0.90/°C, CI: 0.87-0.93, $p < 0.001$), feeding the more (factor: 1.05/°C, CI: 1.03-1.08, $p < 0.001$) and they were ruminating the less (factor: 0.96/°C, CI: 0.94-0.98, $p < 0.001$) the higher the WCT was.

Social behaviours were influenced by WCT, precipitation and precipitation at different WCT as well. When there was no precipitation, social behaviours in total (factor: 0.93/°C, CI: 0.91-0.95, $p < 0.001$) and aggressive behaviours (factor: 0.92/°C, CI: 0.90-0.94, $p < 0.001$) were less likely to be shown the higher the WCT was, whereas during precipitation the probability to show social behaviours in total (factor: 1.03/°C, CI: 1.02-1.05, $p < 0.001$) and aggressive behaviours (factor: 1.03/°C, CI: 1.01-1.05, $p < 0,001$) was the bigger the lower the WCT was.

The number of other cattle within a two-cow-lengths-radius around the focal animal was influenced by WCT and wind speed but not significantly by precipitation. At lower WCT (factor: 0.98/°C, CI: 0.97-0.99, $p < 0.001$) and higher wind speeds (factor: 1.08/m/sec, CI: 1.03-1.14, $p = 0.002$) there were more animals around the focal animal than at higher WCT and lower wind speeds. Furthermore, in the forest the cows and heifers had 1.45-times fewer conspecifics close to them than without any protection (factor: 1.13/protection category, CI: 1.05-1.23, $p = 0.002$).

The heifers and cows had found similar microclimates, but to do so the heifers tended to frequent the forest more than twice as often as the cows (factor: 0.43, CI: 0.18-1.01, $p = 0.053$). In total the heifers were also lying more than twice as often as the cows (factor: 0.45, CI: 0.21-0.95, $p = 0.037$).

The results indicate that the animals adapted to the circumstances and behaved differently according to the weather and degree of protection. The cows and heifers were able to find warmer microclimates even without having to frequent protecting objects. The circumstances around feeding like in this study two to three times per week mainly from feedracks hold a considerable stress potential especially at lower temperatures. However, to have conspecifics for protection during cold temperatures and high wind speeds is important for cattle both when no other protection is available and when there is other protection. Experience seems to play a central role for cattle when protecting themselves from weather and for their ability to find suitable microclimates. The results indicate that the heifers did not have the same skills to find similar microclimates outside the forest as the cows. Further research on this topic has to be done in order to learn more about the relations between the different factors, which affect free-ranging cattle.

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