FOOT PAD HEALTH: relevant for performance and poultry welfare

In poultry farming, the occurrence of foot pad dermatitis is first described as 'bumblefoot' in the early 1960s. Poultry feet were not used at that time and of little economic value. This changed in the 1980s, when the first feet exports were made from the USA to Asia and subsequently foot pad dermatitis (FPD) was also systematically documented.

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FPD is an inflammatory skin change of the foot pads – depending on the severity – in connection with a destruction of the upper skin layer and the formation of ulcers. FPD is painful for the animal, the animals are reluctant to stand up and have an unsteady gait. Animals that do not stand also do not eat, in addition, the pain and inflammation also reduce appetite, which has negative effects on performance.

Foot pad health is increasingly a focus of animal welfare and is also reflected in the payment systems, with deductions for poor foot pad scores already being applied in some cases.

Practical data on the occurrence of FPD is difficult to collect. Figures from Denmark cite the occurrence of severe cases of FPD for 60% of broilers slaughtered in 2002, with monitoring and derived measures reducing the number to around 10% in 2012.

The economic losses can be immense for affected farms. De Jong et al. (2014) kept Ross 308 broilers on systematically soaked litter to induce FPD. On day 36, about 99% of these animals showed severe changes, while only 2% of the control animals kept on dry litter showed severe FPD. In the study, the occurrence of FPD was also associated with significant performance losses (Table 1).

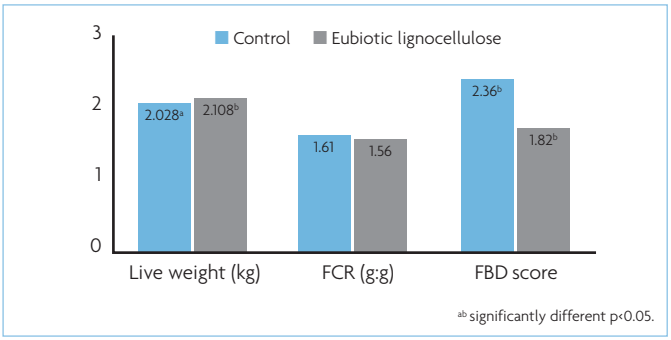
End weight, feed conversion ratio (FCR) and feed intake of the FPD animals were significantly impaired compared to the control animals, which reduced the gross margin by 40%. Animal welfare, performance and economics therefore provide good reasons to address the issue in order to identify influences and find possible solutions.

Parameter	Control	Induced FPD	P-value
End weight day 37 (g)	2,090	1,948	<0.01
Feed conversion ratio (g:g)	1.61	1.68	<0.05
Feed intake (g)	3.331	3.199	<0.01
Gross margin (€*)	0.2212	0.1320	-

*Gross margin per chicken housed =[gross income - (chicken cost + feed cost + total variable expenses)]

Table 1. Performance data and economic evaluation in broilers with induced FPD (de Jong et al. 2014).

Fig. 1. Live weight and FPD score of broilers with and without supplementation of eubiotic lignocellulose at day 35. FPD score: 0 = (no lesions) to 4 = deep lesions; (Liebl et al. 2019).



Main influencing factor: bedding moisture

Bedding moisture is the dominant factor for foot pad health. FPD is a contact dermatitis, the expression and severity of which is very closely related to the moisture of the litter or litter-excrement mixture.

The problem of 'wet litter' is actually multifactorial influenced in herds, with weather/environment, relative humidity, ventilation/heating, housing system, drinking trough, feeding, herd management, litter type/management and health status as influencing factors and also exerting interactions.

According to Kamphues et. al (2011), litter moisture is a result of input and output of water. Moist excrements are not always associated with diarrhoea but can also be due to a higher urine volume.

The dry matter (DM) content in freshly deposited excrement varies in broilers, turkeys and laying hens by 18-20%.

Towards the end of fattening, broilers show almost linear correlations between the DM content of the litter-excrement mixture and the FPD, whereby notable negative footpad findings usually occur at a moisture content of more than 35%, with additive effect of moisture and time.

The close correlation with the end of fattening can be explained by a higher animal density and the higher feed and water intake, which means that more excrement is excreted per unit of time.

At the same time, a larger proportion of the litter surface is 'covered' by the animals, i.e. supplied fresh air hits the animals but not the litter surface to remove the water.

Importance of feeding

Feeding and water intake influence the dry matter of the excrement. Water intake alone is subject to strong fluctuations.

Turkeys react to an increase in temperature from 24° to 35°C with a reduction in feed intake and a simultaneous increase in water intake (216 vs. 337 mL/d), as a result of which the DM of the excrement drops from 22 to 12%.

In broilers, the rule of thumb is that at temperatures above 20°C, water consumption increases by 6% for every 1°C increase in temperature, with feed intake decreasing by 1.2% – both of which favour the occurrence of wet litter.

In the area of feeding, the influencing factors and thus also the 'possibilities for intervention' are manifold. Nutrient surpluses are eliminated by poultry via urine, i.e. surpluses of protein (nitrogen), Na, Cl, Mg or K also reduce the DM of the excrement.

Various additives such as probiotics and phytogenic additives or essential oils are used in poultry.

They are intended to intervene in the complex area of 'gut health', for 'support' or 'prevention' by, for example, reducing pathogenic bacteria, promoting desirable micro-organisms, strengthening the gut barrier, anti-oxidative or anti-inflammatory effects.

Other additives, including enzymes (such as phytases), can improve nutrient availability and thus reduce nutrient excesses.

Carbohydrates and fibre in the context of wet litter

For a long time, 'fibre' was regarded as an anti-nutritive factor in poultry feed. In the meantime, however, as with other monogastric species, it is undisputed that a targeted fibre supply can have positive effects on

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intestinal health and ultimately on the performance of the animals. For poultry, a differentiation between soluble and insoluble fibre is important.

High viscosity of the digesta is a factor that can be causative for wet litter. It slows gastric emptying, which has a negative effect on feed intake, and reduces the rate of digestion and the digestibility of nutrients.

The prolonged transit time of intestinal contents allows for proliferation of pathogenic bacteria such as E. coli and C. perfringens, which can negatively affect gut health. High viscosity is closely related to the intake of non-starch polysaccharides (NSP), especially soluble NSP, which can be found in high proportions in feed for poultry, for example, in wheat and soybean meal.

The consideration of 'fibre' in connection with litter moisture goes beyond the influence on viscosity. Fibre can positively influence the passage rate, in conjunction with a reduction in the proliferation of pathogenic bacteria. If fibre is fermented in the caecum, there is a positive influence on the microbiota due to the short-chain fatty acids produced.

In particular butyric acid has a positive effect on the reabsorption of water, which in turn counteracts the occurrence of wet litter. Soluble fibre can be fermented, but this partly already happens in the small intestine and the desired effects in the caecum are reduced or do not occur.

Supplementation with an eubiotic lignocellulose (OptiCell; insoluble but, unlike standard lignocellulose, partially fermentable) can have a positive effect here. As an insoluble fibre source, it supports an optimal passage rate.

The small particles (on average 80-120µm) ensure that the lignocellulose reaches the caecum, where it can then be partially fermented.

Youssef and Kamphues (2018) put the extent of fermentability of this eubiotic lignocellulose in vitro at 23-28%. In vivo, the addition of eubiotic lignocellulose increased the levels of lactic and butyric acids in the caecum content of broilers fed a diet based on wheat and soybean extraction meal.

This effect was attenuated in a maize-based diet, indicating positive effects of supplementation with eubiotic lignocellulose in diets with high levels of soluble NSP.

In a wheat-based broiler diet, supplementation with eubiotic lignocellulose improved liveweight, FCR and the occurrence of foot pad dermatitis at the end of the trial (Fig. 1).

Eubiotic lignocellulose is produced from untreated fresh wood. With a total dietary fibre content (TDF) of 97% in dry matter, it is a standardised fibre concentrate that can be used effectively with small amounts in the diet (broiler 0.8%). Unlike other fibre carriers, the addition of eubiotic lignocellulose also reduces the risk of mycotoxins.

Lignocellulose – also effective as a bedding material

The positive properties of lignocellulose can also be used in the form of a special poultry litter material (SoftCell). It has a high water binding capacity, based on a large surface area of the particles, obtained by very fine grinding.

This lignocellulose dries quickly in the barn and the bedding surface and foot pads remain permanently dry and do not stick together.

The material is soft and does not pose a risk of injury to the foot pads. The high water-binding capacity reduces the application rate – little or no additional spreading is required.

In growing turkeys, Youssef (2011) found a significant improvement in foot pad health when lignocellulose was used over wood shavings and chopped straw during a four-week trial period (Table 2).

This difference was seen both in dry (without water added to the litter) and wet condition (animals kept for eight hours per day on litter whose DM was adjusted to 27% by adding water).

The use of lignocellulose bedding can also improve foot pad quality in broilers (Fig. 2).

In a 37-day fattening trial, the performance data of the groups kept on litter, wood shavings or lignocellulose were comparable, but the severity of foot pad injuries was significantly reduced with lignocellulose.

Material	Lignocellulose	Wood shavings	Chopped straw
Dry	0.64[a]	1.29[b]	2.07[b]
Wet*	3.64[c]	5.14[d]	4.64[d]

[abcd] significant different p<0.05 *Wet litter experimentally adjusted by adding water to 27% DM

Table 2. Results of the macroscopic foot pad evaluation in turkeys on different litter materials (foot pad score: 0 = no change to -7 = 50% of the foot pad necrotic; Youssef 2011).

Conclusion

Moist litter is the main cause of foot pad changes in fattening poultry, whereby the causes are manifold. Since negative changes in the foot pads result in high economic losses, it is worth taking measures to investigate the causes and to clarify possibilities for remedial action.

In addition to other factors, feeding can also be the cause of wet litter or support other causes.

In addition to optimising the diet and avoiding nutrient surpluses, the fibre supply of the animals is of importance.

Supplementation with an eubiotic lignocellulose can optimise performance and, due to the positive effect on passage rate and intestinal health, also improve foot pad health. Bedding is also important when it comes to the wet litter problem.

Specific lignocellulose bedding has advantages compared to other bedding materials and allows for both a significant reduction in foot pad lesions and an overall improved walking ability of the animals. ■

References are available from the author on request

Fig. 2. Foot pad assessments for broilers on different bedding materials (Simon 2011).