

Clay minerals to fight footpad lesions

FOOTPAD LESIONS IN POULTRY ARE AN INDICATION OF ANIMAL WELFARE STANDARDS. THIS IS BECAUSE FOOTPAD BURNS OFTEN INDICATE THAT THE ANIMALS ARE NOT PROPER HOUSED AND FED.

ARNO VAN DER AA EXPLAINS HOW CLAY MINERALS IN THE DIET CAN HELP PREVENTING THESE PAINFUL FOOT CONDITIONS.



Arno van der Aa studied Animal Science at Wageningen University and Research Centre in the Netherlands. Currently he is employed as Technical Manager at Orffa Additives and as such responsible for dossier build up, technical support and trial coordination for feed additives.
Contact: aa@orffa.com

In June 2007 EU Directive 2007-43-EC became effective and implementation is due on 30th June, 2010. The implementation of welfare measurements for broilers in this recently approved legislation has put the importance of prevention of footpad lesions once more in a new perspective. However, it took experts a long time to decide if footpad lesions has to be part of this Directive and it was finally decided not to include footpad lesions as an effective parameter in the Directive. At the same time it was noted that at the evaluation of this Directive in 2012 this parameter would be discussed again. Concurrently, the discussion also continues on a national level. In the Netherlands for example, footpad lesions were still planned to be taken up by the national implementation of the EU Directive 2007-43-EC. This would mean that the incidence of footpad lesions would become a tool to define the density of birds a poultry farmer is allowed to keep, which has direct influence on the economical results. Just before governmental approval in July 2008, footpad lesions were (again) left out of the Dutch regulation. But, the government agreed with the poultry industry to investigate possibilities for monitoring and adjusting footpad lesions. This indicates again the importance of footpad lesions but also the difficulty for governments to effectively include this parameter in their legislation. In some countries footpad lesions have already had a direct effect on farmer's income. Sweden already started in

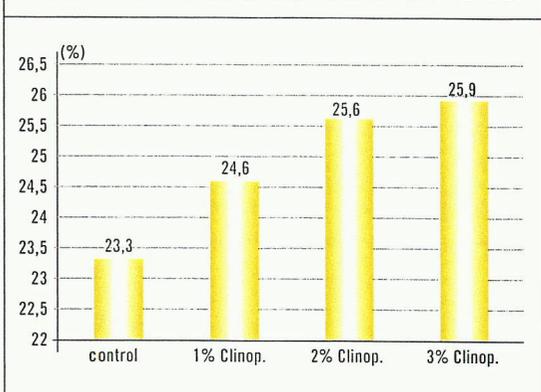
1994 with the "broiler foot health programme". In Denmark footpad lesions are measured in the slaughterhouse and farmers are put under veterinarian supervision and given penalties when incidence and severity of footpad lesions are too high. It is very likely that more countries will soon follow this kind of practice, or that retail and/or ngo's become driving forces to fulfill consumer's demands. For the benefit of the poultry industry, a pro-active approach seems advisable.

MULTIPLE FACTORS

But what are we talking about exactly? Footpad lesions are a multifactorial disorder and are affected by internal and external factors. Internal factors of influence can be categorised as sex, breed, age, pressure, daily growth and animal health. External factors include water supply, litter type, litter height, top dressing of litter, climate, season, light, bird density, faeces distribution and last but certainly not least, feed composition (Veldkamp

TABLE 1 - EXPERIMENTAL SETUP				
Treatment	Additive	Starter	Grower	Finisher
1	Control	-	-	-
2	Clinoptilolite	0.5%	1.0%	1.5%
<i>A negative control group against a treatment with Clinoptilolite (AmmoMIN, Orffa Additives) added to the diet. The procental addition of Clinoptilolite is a dilution of the diet.</i>				

FIGURE 1 - DRY MATTER CONTENT OF MANURE AT DIFFERENT INCLUSION RATES OF CLINOPTILOLITE IN THE BROILER DIET



2007). Within this article especially the effect of feed measurements, but more particularly the use of clinoptilolite (clay minerals) will be discussed.

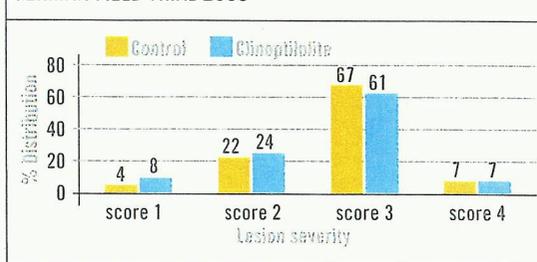
FEED AND LITTER MANAGEMENT

There are several ways to manage litter quality and footpad lesions with feed strategies. The levels of sodium and potassium in the feed may affect water uptake and thereby lead to wet litter problems. Some feed ingredients, like soy and tapioca, have high potassium levels and thereby also high levels of certain feed ingredients that may affect litter quality. High levels of crude protein are also known to have a negative effect on litter quality. High protein levels cause high levels of uric acid formed in the liver and excreted by kidneys. Thereby it stimulates water uptake and wet droppings. To prevent footpad lesions, the inclusion levels of biotin may be of importance. Biotin improves the formation and development of the upper skin. Earlier reports have shown that biotin deficiencies increase footpad lesions (Mayne, 2005). Litter quality is an important parameter regarding the incidence and severity of footpad lesions. Moisture content is important, since wet litter is known to influence the occurrence of footpad lesions in broilers and turkeys (Mayne, 2005). But especially the combination of wet litter combined with nitrogen components like ammonia is irritating for footpads. The combination of wet litter and high ammonia can affect the footpad, which results in colourisation of the skin, and ultimately ulcerations. Damaged footpads give free way for fungi or bacteria to cause secondary infections, which may even lead to condemnations of the carcass (Ekstrand *et al*, 1997). Broilers affected by footpad lesions will experience pain and therefore reduced mobility, leading to lower feed intake and growth.

CLAY MINERALS AND LITTER QUALITY

Clinoptilolites are specially selected clay minerals, known for their typical structure which enables the clay

FIGURE 2 - EFFECT OF CLINOPTILOLITE ON LESION SEVERITY, GERMAN FIELD TRIAL 2005



mineral to bind ammonia (Suchy *et al*, 2006). As a result gut health is improved, since ammonia is toxic to the gut wall. As an additional effect, a reduction of footpad lesions may be expected because ammonia bound to clinoptilolite causes less irritation to the footpads.

In 2001 the binding of ammonia by clinoptilolite was tested in piglets by the University of Ghent, Belgium. They found that 32% of total ammonia was bound in faeces of piglets fed diets that contained clinoptilolite, compared to only 1% with bounded ammonia in the control treatment. Results from several trials have shown that inclusion of clinoptilolite in the diet reduces water excretion and thus improves litter quality. As a result of ammonia binding in the gut, technical performance is also improved. In the following sections different trials are discussed.

BALANCE TRIAL IN BELGIUM

In 2005 a trial was performed at CLO-DVV (Melle, Belgium) to measure the bio-efficacy of clinoptilolites in three different dosages. The trial was setup as a balance trial with male Ross-308 broilers according to the EU Reference method (Bourdillon *et al*, 1990). Three different dosages of clinoptilolite (1%, 2% and 3% on top of addition) were compared with a negative control group. There was a 7 days adaption period (day 14-21 days of age) and the trial lasted from 21 to 24 days. For every treatment 6 replicates of 4 male broilers were used. Feed and nutrient intake, water excretion, dry matter of excretion, total excretion, fat digestibility and Nitrogen-retention were measured.

The dry matter content of the manure was significantly increased; see the results shown in *Figure 1*. Water excretion (H_2O /feed intake) decreases with the inclusion of clinoptilolite. Further results showed that the addition up to 2% of clinoptilolite in the ration had no effect on the feed intake, energy value of the diet, or Nitrogen retention. Meaning that dilution of the diet up to 2% is possible, while keeping the same performance. This is explained by improved fat digestibility and improved usage of protein sources. Using a dilution strategy including clinoptilolite can be a successful tool to lower feeding costs.

FIELD TRIALS IN GERMANY

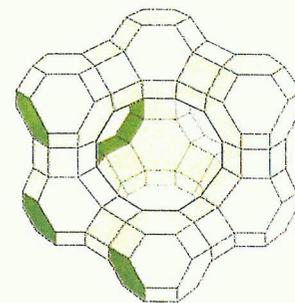
In 2003 a field trial was performed in Germany on a farm with two identical stables containing 26,500 birds each. The effects of additional clinoptilolites were determined, using on top of addition of 0.5%, 1.0% and 1.5% in starter, grower and finisher diets respectively. Litter quality improved numerically at days 14, 21 and 28 with 0.5 (scale 1 to 6). The trial was repeated in 2005 with an addition of 1.0% clinoptilolites in all phases. Litter quality improved numerically by 0.67 on average at day 9, 21 and 28 (scale 1 to 6). Footpad lesions were scored in 994 birds, on scale 1 (no lesions) to 4 (severe lesions). Results are given in *Figure 2*. Scores tended to be positively influenced by the clinoptilolite versus control diets: score 1 (8.4% vs 4.2%), score 2 (24.0% vs 22.0%), score 3 (60.8% vs 66.8%) and score 4 (6.9% vs 7.0%). In both trials economic results improved, by 23% and 41% respectively. Interestingly, both trials resulted in an improvement in losses at the slaughterhouse.

RESEARCH TRIAL IN THE NETHERLANDS

To improve litter quality and reduce footpad lesions prevalence and severity, a trial was performed in 2007 at Provimi Research Station "De Viersprong" in Velddriel, The Netherlands. In this trial the effects of clinoptilolite (AmmoMIN, Orffa Additives BV) on top of addition in the diet were measured. The feed composition was formulated in such a way that wet litter was expected, this to see clear effects on litter quality and footpad lesions. Birds were fed a control diet or a diet with an addition

of 0.5%, 1.0% and 1.5% clinoptilolite in starter, grower and finisher diets respectively. This means that clinoptilolite replaces other ingredients, leading to a nutritional dilution. Both treatments contained 120 male birds divided over 6 replicates. Results of this trial are shown in *Table 2*. Birds fed clinoptilolite tended to grow faster (+54 grams) from day 0 to 35, although not significant. No differences were found in Corrected Feed Conversion. These results show that at least similar results on performance can be obtained, with a tendency to higher growth, even with a dilution of the diets by adding clinoptilolites. This can be explained by the binding of ammonia in the gut. The dilution of the diet with clinoptilolite may reduce the costs price of the formulation. Litter scores were measured weekly on a scale from 1 (dry) to 5 (wet). From day 21 onwards, litter scores improved numerically for birds fed clinoptilolite.

Footpad lesions were scored from 1 (no lesions) to 4 (severe lesions) per bird at days 28 and 35. According to trial protocol, fresh wood shavings were added to cages when litter scores became too high (> 4). Adding clinoptilolite to broiler diets numerically improved average footpad lesions, from 1.7 to 1.5 at day 28 and from 1.3 to 1.1 at day 35 for control and clinoptilolite diets respectively. It should be noted that even four out of six replicates of the control group required extra wood shavings compared to only two clinoptilolite replicates. Also these extra wood shavings were required a later stage. Extra addition of wood shaving is known to reduce the severity of footpad lesions. In practice, extra addition of wood shavings is not common; therefore, the effects on footpad lesions may even be higher. Experiences from other trials teach us that dry matter of the faeces may increase due to clinoptilolite addition.



Clinoptilolites are specially selected clay minerals, known for their typical structure which enables the clay mineral to bind ammonia

TABLE 2 – EFFECTS OF CLINOPTILOLITE ON LITTER QUALITY AND FOOTPAD LESIONS

	Control	Clinoptilolite
Growth (0-35d) gr	2116	2170
Feed intake (0-35d) gr	3457	3611
Corrected FCR (0-35d)	1.621	1.629
Litter score		
Day 7	1	1
Day 14	2	2
Day 21	2.8	2.3
Day 27	3.5	3
Day 31	4	3.5
Day 35	4.3	4
Footpad lesion scores*		
Day 28	1.7	1.5
Day 35	1.3	1.1
<i>!Corrected FCR (0-35d.)</i>		
<i>FCR corrected to 2132 grams at day 35, -0.01 for each additional 25 grams of body weight.</i>		
<i>*0= No lesions, no discoloration or scars. 1= Mild lesions, parts of the footpad is discoloured to light brown 2= Larger or multiple tumours, discoloration of the foot pad to dark brown 3= Severe lesions; deep lesions, ulcers, and scabs</i>		

DILUTED DIETS VERSUS ISONUTRITIOUS DIET

In 2008 a second trial was performed at Provimi Research Station "De Viersprong in Velddriel, The Netherlands. In this trial a comparison was made between diets diluted with clay minerals versus isonutritious diets in which clay minerals were taken up. In both treatments strategy was 0.5% clinoptilolite (AmmoMIN) addition or inclusion in starter diets, 1.0% clinoptilolite in grower diets and 1.5% clinoptilolite in finisher diets. In the first case we speak of "on top off addition" or dilution of the diet. In the second case clay minerals are calculated within the diets, and diets are reformulated to obtain an isonutritious diet. All treatments contained 120 male birds divided over 6 replicates.

Results of this trial are shown in table 3. There was a tendency to lower mortality in clinoptilolite treatments (4.4% in control versus 3.3% and 2.5% for respectively diluted and isonutritious diets). There was a tendency to higher growth when clinoptilolite was used in diluted

TABLE 3 - EFFECTS OF CLINOPTILOLITE ON LITTER QUALITY AND FOOTPAD LESIONS

	Control	Diluted diet / "on top of"	Reformulated diet / isonutrient	LSD
No. of birds, (replicates)	120 (6)	120 (6)	120 (6)	-
Mortality (%)	4.2	3.3	2.5	-
Gain (0-35 days), g	2169 ^a	2212 ^{ab}	2268 ^a	74
Feed Intake (0-35 days), g	3487 ^a	3551 ^{ab}	3639 ^a	121
FCR (0-35 days)	1.608	1.599	1.605	0.030
FCR corrected (0-35 days) ¹	1.608	1.568	1.565	0.044
Footpad lesion score				
Day 28	0.7 ^a	0.5 ^a	0.4 ^a	-
Day 35	1.1 ^a	0.8 ^{ab}	0.6 ^b	-

¹Corrected FCR (0-35 days)
FCR corrected to 2212 grams at day 35, -0.01 for each additional 25 grams of body weight.

feeds (+43 grams), whereas growth in isonutritious diets growth was significantly improved (+99 grams). In both treatments corrected feed conversion ratios show a high tendency to improvement of more than 4 points (> 2.6% improvement). Diets diluted with clinoptilolites showed a high tendency to improved footpad burn scores both on 28 and 35 days. Whereas isonutritious diets with clinoptilolites showed even better, significant improvements in footpad burn scores. This trial confirms that there is a tendency to better production performance and reduction

of footpad lesions in broilers when clinoptilolites are used to dilute the diet. This type of strategy will additionally lower feed costs. In addition, when clinoptilolites are used in isonutritious diets, both on production as well as footpad burns, significant results can be obtained. This indicates even more the positive effects of clinoptilolites for use in broiler chicken diets.

CONCLUSIONS

It seems footpad lesions in the poultry industry are becoming increasingly important. Not only does one have to keep in mind that animal welfare is important for the image of the poultry meat industry, footpad lesions can also impact performance due to low mobility of the birds. It will also become increasingly important in terms of legislation, although in many countries so far, practical implication seems to be at a bottleneck. Inclusion of clinoptilolite in broiler diets has several advantages. First of all it can be used as an assurance to prevent wet litter and reduce severity of footpad lesions. As a side effect, also less carcass rejections seem to occur. Secondly, it is a cost price reducing measurement, while performance will be equal or may even improve, in case the product is used to dilute the diet. <

References are available on request



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Orffa Additives BV • Vierlinghstraat 51 • 4251 LC Werkendam • t: (+31) 0183 / 44 77 66 • f: (+31) 0183 / 44 12 10 • E-mail: info@orffa.com www.orffa.com