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The poultry industry is struggling more and more with livestock disease. Often this can be traced back to microbial pathogens and ammonia in the litter. The addition of highly porous biochar can serve to reduce toxic ammonia pollution in the coops and regulate the moisture level of the litter. The biting coop odour and foot pad dermatitis in the poultry can be prevented within just a few days. If biochar is included in the feed, toxins can be deactivated already in the digestive system. The intestinal flora is positively activated, and the vitality of the animals improves rapidly and markedly.

Industrial poultry farming places extremely high demands on hygiene of the coops, of the air in the coops and of the feed, as well as of waste and faecal matter. High animal densities increase the pathogen pressure as the immune response of stressed animals is weakened, with the result that more pathogens are excreted. The smaller the area in which the animals are kept, the more the microbial environment in the coop is dominated by microbes that live off the animal itself and its excretions. This produces a significant risk of spreading germs, which is exacerbated by poor coop and feeding hygiene.
If, in addition, the poultry is treated with anti-infection and antibacterial agents, this creates an environment that selects pathogens that are resistant to the drugs being used. Because these events depend on the quantity of pathogens (pathogen pressure), it is all the more important to control the coop environment in a timely manner so that pathogen pressure is reduced.
Due to the loose housing of poultry, animals in coop systems inevitably live in constant contact with their excrement. The extremely nutrient-rich and humid faeces create ideal conditions for the multiplication of pathogenic microorganisms. Added to this, the microbial decomposition of the excrement leads to significant emissions of ammonia. The pungent-smelling gas is harmful to the animals because it irritates the mucous membranes, attacks the lungs, weakens the immune system and even accumulates in the blood. Besides the effect on animal welfare, animal performance also deteriorates seriously. Last but not least, ammonia emissions are environmentally harmful. Via nitrogen return in rain, they produce highly climate-damaging emissions of nitrous oxide, soil acidification and eutrophication of water bodies.
The use of biochar as a feed additive and as litter can significantly minimize the problems described both with regard to animal health and in terms of environmental performance.

Instructions for the use of biochar in litter

Biochar has a very high water holding capacity and can absorb up to 5 times its own weight of water. Biochar adsorbs very efficiently both organic molecules such as amino acids, fatty acids, proteins and urea and also mineral compounds such as ammonium, ammonia and nitrate. Used in litter, biochar locks in moisture and organic and inorganic nitrogen compounds. The nitrogen adsorption and the continuous drying of the litter deprive the microbial pathogens of their nutrient base and reduce toxic emissions of ammonia. After just a few days, a significant reduction in coop odour can already be noticed.

With the lowering of the moisture content and ammonia contamination the risk of footpad diseases decreases. Existing infections begin to heal. Animals' resistance increases, with a positive effect on their vitality, egg production and final body weight.

Biochar's high adsorption capacity makes it possible to reduce the use of lime in the litter, thereby reducing the pH of the litter and manure, which in turn reduces ammonia emissions.

Footpad diseases

Turkeys and broilers frequently suffer from leg weakness syndrome, which last but not least is economically disastrous. To this should be added footpad inflammation, known as footpad dermatitis (pododermatitis). The causes of these inflammation reactions are multifactorial, but the main causes are high levels of ammonia (NH3) and overly damp litter. Particularly important in this respect are the structure and hardness of the litter, both of which are improved by the use of biochar. The effects of footpad diseases include pain, reduced physical activity, reduced feed and water intake, growth depression, feather pecking/cannibalism, reduced carcass quality and increased mortality.

Application of biochar

The biochar should, depending on the type of litter, be mixed 5-10 vol % with the usual litter. The char is first moistened in order to prevent dust formation. Ideally it is applied in the form of lactic acid biochar bokashi. When using straw pellets as litter, the char is best added already at the pelleting stage.

If silage is used as litter, the char can already be added at the ensiling stage. In this way, dust formation can be avoided entirely, and the low pH of the silage kills off pathogens. Mixed into silage, the char is bound very well and no longer rubs off onto the animals' feet. This is particularly important in egg farms, since coal can rub off from the hens' feet onto the eggs.

Use of biochar in feed

In addition to its use as a litter additive, biochar, and in particular biochar bokashi, is also used as a feed supplement. Biochar promotes digestion, improves feed efficiency, and thus in particular energy absorption via the feed. Toxins such as dioxin, glyphosate, mycotoxins, pesticides and PAHs are efficiently bound by the biochar, thereby obviating any adverse effects on the digestive system and intestinal flora. The health, activity and balance of the animals will also be improved, as will meat and egg production. With animals' immune systems stabilized, the risk of infection from pathogenic micro-organisms decreases.

The huge economic impact of diarrhoeal diseases in poultry is well-known. The causes of these diseases are often of an infectious nature and are caused by, among others, E. coli, clostridia, coccidia and mycobacteria. Of particular importance are salmonella and campylobacter germs; while rarely causing disease in poultry, they can do so in humans. Non-infectious causes of disease are in particular poor feed quality and biocide contamination of the feed, as when herbicides are used to siccate feed grain or to treat weeds during the growing of GMO corn or soy feed. The consequences are an increased susceptibility to disease, growth depression, infertility and digestive disorders.

Numerous factors are responsible for the stabilization of the intestinal milieu. Of particular importance here are the stabilization of the intestinal barrier and the functionality of the liver. Numerous bacteria such as lactobacilli and enterococci, but also non-pathogenic yeasts play an indispensable role here. Feeding biochar and biochar bokashi can stimulate the activity of these desired microorganisms in the digestive system. The benefit of the biochar lies therefore not least in its ability to relieve in particular the liver-intestinal circuit.

The charging of the biochar with specific lactobacilli to direct the symbiosis in the gastro-intestinal tract of farm animals can further potentiate the effect of the biochar. Biochar bokashis produced as ready-made feed on the basis of a fermented biochar, wheat bran and herbs are an important feed supplement for maintaining and enhancing performance in animal production.

According to studies by Van (2006), the addition of up to 0.6% biochar in the feed improves growth in young animals by an average of 17%. Similar results are confirmed by Kana (2010) and Ruttanvut (2009) for ducks and broilers. No systematic scientific studies of long-term effects exist as yet.

It is recommended to mix 0.4% – 0.6% biochar to the usual feed. With laying hens the feed supplement should be sus-

pended for 2-3 days every 10-15 days. Biochar bokashis, such as Carbon-Feed from Swiss Biochar, should be added 2% – 3%% to the usual feed. If biochar is already used in the feed, the amount of biochar in the litter can be reduced accordingly.

Using biochar to improving manure quality

The above-mentioned effects of biochar for storing moisture and nutrients also mean that the poultry manure is better degraded microbiologically. Carbon and nitrogen losses are significantly reduced and with them the emission of greenhouse gases (Steiner 2010). The fertilizer quality of the poultry manure increases strongly as a result of the biochar and the odour pollution can be reduced significantly, which increases the marketing potential of poultry manure.
If biochar is used neither in the litter nor in the feed, it is advisable to sprinkle it in a ratio of 10 vol % on the manure belt. If the poultry manure is used for energy production in biogas units, the addition of biochar both increases the methane yield and improves the fertilizing quality of the digestate. Poultry manure can also be directly pyrolyzed to produce biochar and energy.

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