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Aeration of droppings/litter in broiler production – a total evaluation

Through system conditioning of the droppings/litter mix, the ammonia concentrations and emissions in trampoline shed were less than in a reference shed system. This was confirmed through investigations from [1].

An increased dry matter in the droppings/litter mix resulted in a reduction in microbial activities which lead to the release of ammonia from nitrogen compounds. On the other hand, substantially more dust was produced by the system aeration procedure.

Despite better weight gain and slaughter performances, the high investment requirements and the added variable costs involved led to poorer economic viability for this shed system.

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Within the framework of an EU part project on "Development of the countryside" with support from the state of Lower Saxony and in co-operation with the Agricultural Investigation and Research Association (LUFA) in Oldenburg, the influence of continuous aeration of droppings/litter mix in broiler houses regarding emissions, feeding and slaughter performances and economic performance in comparison to conventional on-floor shed was investigated.

Material and methods

For the execution of this research project a new broiler facility was built at Werlte/Emsland District comprising two constructionally-identical buildings. A floor aeration system was fitted in one building whilst the other was used in a conventional way as a reference system. The facility went into operation in September 1997.

Both buildings (80 m • 12 m) were solidly constructed with identical bird area of 960 m^2. The buildings were erected parallel to one another at 15 m spacing and linked with a common antechamber. The concept of droppings/litter aeration is based on the installation of a second floor of metal mesh 40 cm above the asphalt basic flooring. On top of this is stretched a permeable woven plastic material which carries the litter and the birds. The air between the two floors is continuously drawn out of the building with the help of six fans with a total capacity of 9,800 m^3/h fitted on the longitudinal sides of the building.

Via a temperature-insulated canal fitted at 150 cm above the birds the exhaust air is brought back into the building. Because of the resultant degree of pressure the air flows through the litter and material into the area under the trampoline floor (*fig. 1*).

Via rollers at the gable end of the building the perforated woven material is mechanically rolled-up at the end of a feeding cycle. While the birds are collected the droppings/litter mix falls onto a laterally-positioned conveyor belt and is then transported directly out of the building and loaded onto transport vehicles.

During the entire trial period, all-in all-out or split system was used for the birds. Per m^2 were housed 25 day-old ROSS chicks which gave 24,000 chickens per cycle and building. In the summer cycles (cycles 4 and 5) the stocking rate was reduced and 22,000 day-old chickens per building housed. After

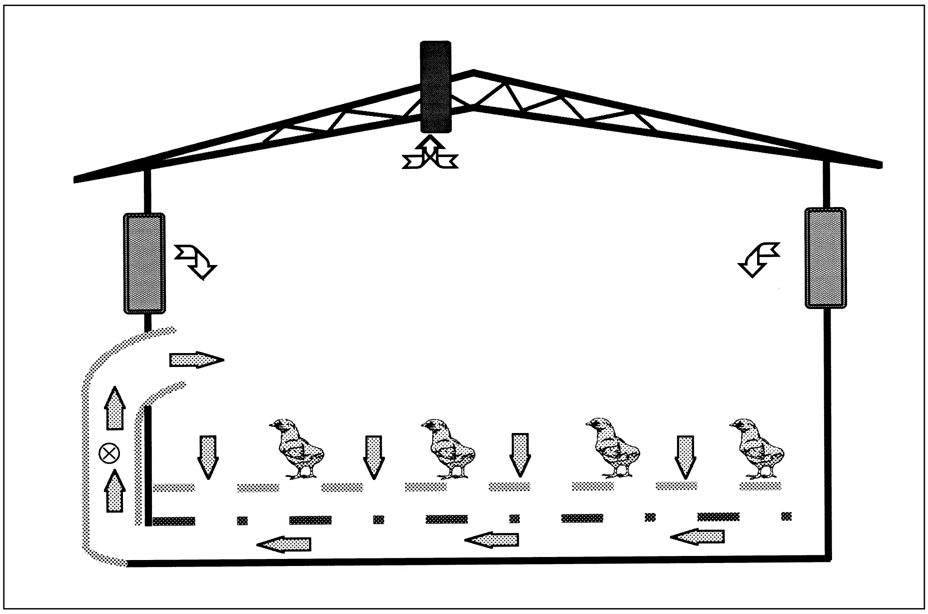

Fig. 1: Scheme of the litter ventilation system

about 32 feeding days, 25% of the birds with a target weight of 1,450 g were shipped out. The remaining birds were further fed until the 40th feeding day and finally shipped out at a target weight of 2,000 g. The housing and shipping-out operations were carried out for both sheds on the same day. After shipping-out the reference shed was mucked out. Both sheds were cleaned with a high pressure cleaner and finally disinfected. Before each new batch of chicks the sheds were littered with wheat straw (1 kg straw/m^2 floor area).

Both houses were ventilated with a underpressure system. Six fans in the roof ridge and four on the gables draw out exhaust air. Maximum total capacity of the fans in both houses was 9 m^3/bird and hour. Inlet air came into the buildings through adjustable side inlet elements.

Results

The results showed that litter aeration let to a reduced ammonia concentration in the shed interior atmosphere and a clear reduction in ammonia emissions. In a summer cycle (14.7.1998 to 23.8.1999) an average ammonia concentration of 6.1 mg/m^3 exhaust air as well as an ammonia emission of 1.1g/bird •day (from the recorded period from the 8th to 39th feeding day) were determined in the reference shed. The emission values in the trampoline shed during the same period comprised ammonia concentrations of 4.3 mg/m^3 with 0.7 g/bird•day. The average ammonia concentration in exhaust air in the cycle from 21.10.1998 to 30.11.1998 (winter cycle) was 3.8 mg/m^3 in the reference shed and 2.9 mg/m^3 in the trampoline shed. In the reference shed, an average ammonia emission of 0.41 g/bird•day and in the trampoline shed of 0.21 g/bird•day was determined. In both cycles the ammonia emissions from the trampoline shed was below that of the reference one by 57.1% and 65.2% respectively.

In all the investigated feeding cycles (9) the exhaust air from the reference shed proved to produce a slightly higher concentration of odour substances than the trampoline shed. In the last feeding week in all cycles the smell concentration in the reference shed exhaust air averaged 785 GE/m^3, that in the exhaust air of the trampoline shed 574 GE/m^3. Thus, there was 36.8% less smell substance concentration in the trampoline shed compared with the reference shed.

Compared with the reference shed, the building with trampoline flooring had a higher measured concentration of suspended dust. In the last three feeding weeks of cycles 8 and 9 there was an average suspended dust concentration of 29,284 µg/m^3 recorded in the air of the trampoline shed, compared with 10,362 µg/m^3 in the reference shed. Over the total feeding period the suspended dust concentration was higher in the trampoline shed.

During the last feeding week in the trampoline shed the average dry matter content of the litter was 67.7% and 50.5% in the reference shed. The pH values in the litter were 6.8 (trampoline) and 7.9 (reference). Organic matter proportion of litter in the trampoline shed was 43.7% and for the reference shed 33.7%. The proportion of uric acid in the litter amounted to 65.4 mg/g fresh material in the trampoline shed and 15.3 mg/g in the reference shed. Thus, in comparison to the reference shed, the trampoline shed had four times the amount of uric acid. The C/N ratio in litter lay higher in the trampoline shed with 10.2 compared with 8.9 in the reference shed. The total bacteria count in the reference shed litter, taking the averages of the last feeding week in all cycles, was four times higher than that found in the trampoline shed. The total bacteria count per g of fresh matter was 1.2•108 and 2.5•107 in the reference and trampoline stalls respectively.

In all nine trial cycles no significant difference in broiler liveweight on the 40th feeding day was found. However, with 1,988 g, the birds in the trampoline shed were an average 27 g heavier than those in the reference shed. Neither was any significant difference evident with the slaughterweights of the birds from both systems. Once again, however, the slaughterweight of the trampoline stall birds, taking the average of all feeding cycles, was, at 1,401 g, 35 g heavier than the reference birds. Investment costs for the buildings and equipment equalled 21 DM per feeding place with the trampoline shed. The extra costs compared with conventional buildings of 10.15 DM per feeding place were caused by the droppings/litter aeration system and the automatic mucking-out.The application of recirculated air ventilation for the litter aeration in the trampoline shed resulted in 3 pf/bird and cycle higher electricity costs compared with the reference system. Heating costs were also higher in the trampoline shed by 1.3 pf/bird and feeding cycle. Added to this is the fact that the inter-cycle cleaning and refurbishing work in the trampoline system took more time than in the reference shed, with the related increase in costs. This meant that despite a higher income of 3.06 pf/bird (through the higher slaughterweight/bird) from the trampoline system, the higher variable costs meant that the latter earned notably less gross margin in comparison with the reference system.

Literature

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