

## RESEARCH INTO REDUCING ENDOTOXIN EMISSIONS

# Of particles and poultry

**People living near poultry farms often suffer from respiratory problems. Dust and endotoxins in the barn ventilation air are to blame for this. The ideal solution has yet to be found, but letting chickens take their dust baths in a separate ‘bathroom’ could help.**

TEXT RENÉ DIDDE PHOTO MARCEL BEKKEN INFOGRAPHIC WUR/PETRA SIEBELINK

People living near livestock farms have an above-average risk of pulmonary conditions. If they have prior respiratory problems then they get more symptoms and need more medication. This is particularly the case for residents living near poultry farms. There is also a link between reduced lung function and the number of livestock farms in the area, and between the level of ammonia in the air and impaired lung function. These findings come from a three-year study of the health of residents living close to intensive livestock farms in the Peel region, on the border of Brabant and Limburg. The research report, which was published last

summer, had good news too. Local residents suffered less than average from allergic asthma and no evidence was found for an increased incidence of zoonoses (infectious diseases that are transmitted from animals to humans).

The research was commissioned by the ministries of Health and Economic Affairs and was carried out by Utrecht University, Wageningen University & Research, the National Institute for Public Health and the Environment (RIVM) and the Netherlands Institute for Health Services Research (NIVEL). The study was one of the largest of its kind in the world. The scientists examined patient records of 110,000 patients, surveyed

14,000 people and conducted medical examinations of 2500 people.

Endotoxins played a role in all the conditions where an effect was found. Endotoxins are fragments of the cell walls of dead bacteria, and are found for instance in manure and animal skin flakes. ‘Endotoxins cause shortness of breath, and chronic exposure leads to a decline in lung function,’ says Nico Ogink, a researcher in livestock and the environment at Wageningen Livestock Research (see box).

### BRIEF FEVER

Endotoxins stick to larger dust particles in particular. As a result they spread and can





**‘We need innovative ideas’**

Barn full of free-range chickens.

reach people living up to about one kilometre from the barn. In high concentrations, they trigger a brief reaction with fever. In lower concentrations, they are a factor in respiratory conditions such as chronic bronchitis and non-allergic asthma. The lungs of the livestock farmers themselves are also affected by the dust and endotoxins. ‘We already know this from research on working conditions from the 1990s. Livestock farmers are still taking huge risks with their own health given the poor quality of the air in the barns. Poultry farmers would be well advised to wear protective equipment such as dust masks in the barn,’ thinks Ogink. The chickens themselves may also

have reduced lung function. ‘We’ve never actually investigated that properly. The birds have a short turnaround time and there is a lot of noise in the data with health problems from other sources such as pathogenic viruses in the barn air and bacteria in the manure.’

Pigs, goats and cows also produce dust with endotoxins, but not nearly to the same extent as poultry. That is because chickens are more active than other farm animals.

#### **TAKING A DUST BATH**

The endotoxins end up around and in the homes of local residents because they are blown out of the barn along with the dust in

the ventilation air. The quantities involved are considerable in modern-day large-scale housing systems. Chickens produce a great deal of heat, and each hen needs three cubic metres of fresh air per hour. A standard modern barn can easily contain 40,000 laying hens, so that means 120,000 cubic metres of ventilation air is being blasted out of the barn every hour, taking dust and endotoxins with it.

On top of that, the individual space for laying hens has increased to almost A3 paper size rather than A4 since 2012. ‘That makes it easier for a chicken to take a dust bath and forage in the litter with its feet,’ says Ogink. He was the co-supervisor for a >

PhD project completed this autumn by Albert Winkel on dust emissions from different kinds of barn. To the surprise of the Wageningen PhD candidate, he found that the modern aviary housing system, where the chickens range freely during the day and can roost at night, produced dust concentrations including endotoxins that were up to 15 times higher than for the old battery cages.

This puts the poultry sector in a dilemma: improving animal welfare leads to increased dust emissions. Winkel describes some new ideas for barn designs that could combat the dust problem at the source. Farmers are already making the layer of litter thinner in order to reduce the dust problem, but a more fundamental approach would be to move the litter. Laying hens would then eat, drink, sleep and lay eggs in a large aviary barn without any litter and take the dust baths they love so much in a separate ‘dust bathroom’. The advantage of this is that the ventilation air in the large hall would then be virtually free of dust while customized measures can be taken in the dust bathrooms.

Another option is one that is already being used for broiler chickens, in which the air is ionized with electrons. This makes the dust to stick to the ceiling. ‘The disadvantage is that it only traps the fine particles, and only half of them. It’s less effective for the larger particles that carry the endotoxins,’ says Ogink. Another, more expensive technique is to spray rapeseed oil on the litter. ‘The oil causes the dust to stick together and form larger particles, so that it is less likely to swirl up. But that approach requires a lot of cleaning as the oil also gets into the pipework.’

Up to 70 percent of the dust can be extracted from the air using what are known as ‘end-of-pipe’ measures, just before the ventilation air leaves the barn. But that

does nothing to improve the air inside the barn: the farmer and chickens are no better off.

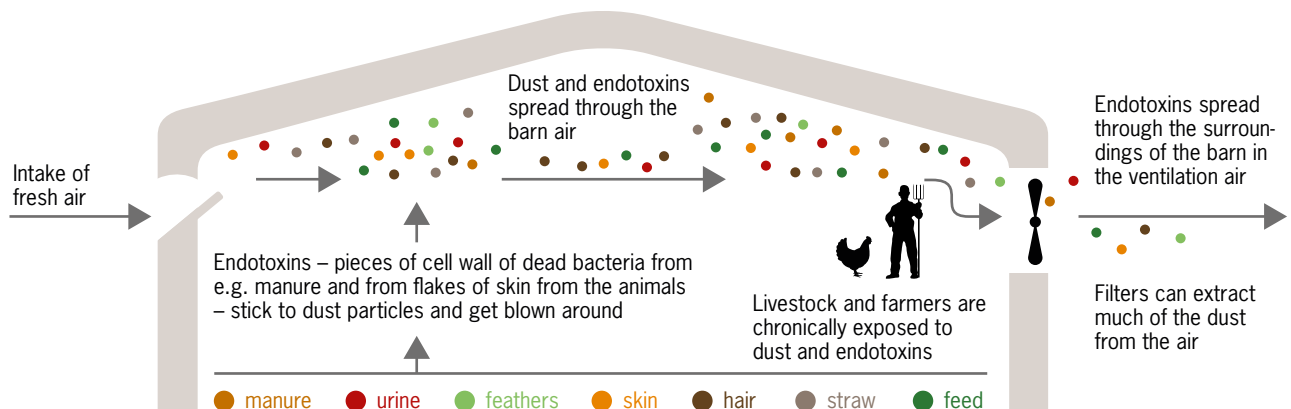
Free range systems do not offer the perfect solution either. As Ogink explains, ‘The point is that even when chickens can go outside, they prefer to spend a lot of time indoors and take their dust baths there.’

### COMPETITION IN THE EGG MARKET

Farmers also think something needs to be done. ‘The Dutch Federation of Agriculture and Horticulture (LTO) believes it is important to improve the climate in the barn. Concentrations of dust in the air, including endotoxins, are far too high. Better air quality would be good for poultry farmers themselves, their chickens and the surrounding area, but the measures do need to be affordable,’ says Hugo Bens. He is on the LTO board with the environment for poultry farming in his portfolio and is himself a poultry farmer in Haps (Brabant). The egg sector is an international market where competitiveness depends on tenths of a cent per egg. Bens points out that about half the poultry

**‘Measures to improve air quality must be affordable’**

## ENDOTOXINS IN A BARN



## ‘The solutions have to be accepted by society’

farms have taken measures. Farmers are increasingly being required to take action as a condition for permit renewals. ‘Poultry farmers are making sure the layer of litter is thinner, which helps reduce dust emissions,’ he says. They are also taking end-of-pipe measures, for example in the heat exchangers that warm up incoming fresh air using the heat from the outgoing ventilation air. ‘The dust gets deposited on special strips, reducing emissions into the environment.’ Ammonia is also deposited onto the strips.

The Wageningen research has shown Bens that all of this is still not enough to reduce dust emissions to acceptable levels. What is more, only half of the farmers are taking steps so far. ‘We are talking to Wageningen and other parties about the barn of the future. We need innovative ideas.’

### SAFE LIMIT

Various studies are already being conducted to achieve this. For example, Wageningen Livestock Research is currently testing different housing systems to figure out what delivers the best performance. There is also

research planned on the safe limit for endotoxins as set by the Health Council of the Netherlands.

Furthermore, Wageningen University & Research and Utrecht University have been commissioned by the Ministry of Infrastructure and the Environment to follow up on the large-scale health study by investigating exactly which poultry farms are responsible for the respiratory problems. ‘We are trying to find out for example whether the presence of pig farms in the vicinity of poultry farms has a cumulative effect on public health,’ says Ogink. ‘We are also trying to develop an assessment framework for endotoxins so that we can see whether the endotoxin levels in the locality of these farms remain below the safe limit. Such an assessment instrument could help when evaluating permit applications.’

### ONE HEALTH

The research into the reduction of fine particles and endotoxins at the source falls within Wageningen’s strategic research theme ‘A Global One Health’. ‘In it, we

study the complex interactions between health, genetics and animal physiology, housing systems and management by farmers,’ explains Annemarie Rebel, head of Animal Health and Welfare at Wageningen Livestock Research. ‘These are all cogs that are interconnected. We can no longer work on single-issue solutions without considering whether they lead to problems elsewhere.’

As an example, research is also being carried out on the feed given to chickens and the effect that has on gut flora and the production of manure. ‘Making a group of chickens more robust by improving their feed means they need fewer antibiotics and may well produce fewer endotoxins,’ says Rebel.

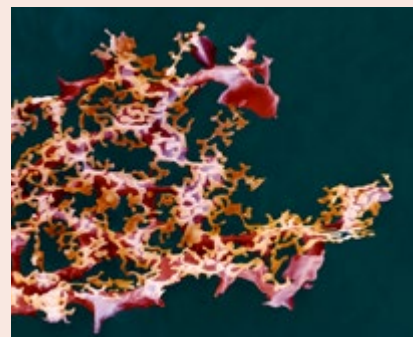
The studies involve not just agricultural scientists but also researchers in the medical sciences, economists and social scientists, who investigate the interpretation and perception of the research among farmers and local residents. ‘After all, the solutions do have to be accepted by society.’ ■

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### A DRY COUGH

Endotoxins are fragments of the cell walls of dead bacteria, found in the feed, manure or skin of farm animals. They adhere to dust particles in the barn, particularly the larger particles, although they sometimes stick to fine particles too (defined as particles smaller than a hundredth of a millimetre). If a livestock farmer or local resident inhales endotoxins, this can cause symptoms such as shortness of breath or a dry cough. This is followed several hours later by flu-like symptoms: tightness in the chest, headaches and painful joints.

The symptoms disappear when exposure ends, for example during a holiday, but the cycle is repeated when the person is exposed to endotoxins again. Chronic exposure leads to a clear decline in the lung function. This can make the lungs susceptible to infections, which in turn can lead to pulmonary conditions.



Electron microscope record of E. Coli endotoxins.

PHOTO: ANP