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WAGENINGEN UR (WAGENINGEN UNIVERSITY AND
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Effects of the compulsory indoor confinement of organic layer poultry: a dust storm!

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Summary

In August 2005 an order was issued in the Netherlands for free range poultry to be kept indoors to prevent the introduction of avian influenza. The Animal Sciences Group of Wageningen UR (Wageningen University and Research Centre) conducted a telephone survey at the start of this indoor confinement regime to establish its effects on the wellbeing of laying hens and to chart the economic consequences for the poultry keepers. The survey revealed that, according to the poultry keepers, the impact on the wellbeing of the birds was not serious, thanks to the introduction of enrichment material such as extra litter and extra feeding. And the economic consequences were confined to an increase in the amount of work associated with the special enrichment measures. To obtain a more objective picture of the consequences of the indoor confinement order, the researchers visited 37 organic layer poultry farms during November and December. Despite the rules having been relaxed, these farms were still keeping their laying hens indoors. During each visit various parameters were scored, including: strain and age of hens, dimensions and equipment of the sheds, method of ventilation, general appearance of the hens, plumage, mortality and use of enrichment material. In addition, a quantitative measurement of dust was made in the sheds.

Like the first study, this follow-up study also showed that compulsory indoor confinement had not led to any serious wellbeing problems. Admittedly, the condition of the laying hens' plumage often left something to be desired, but this depended to a very large extent on the strain of hens and their age. It was not possible to say to what extent the protracted indoor confinement of the hens was responsible for the mediocre condition of their plumage, since no control observations were made on farms where indoor confinement was not imposed. Serious feather pecking was observed occasionally, but did not lead to cannibalism. No correlation could be found between the outward appearance of the laying hens and the use of enrichment materials such as straw bales, etc. As this was an observational study, it is quite possible that the use of enrichment material was frequently prompted by the existing behaviour and general condition of the animals, as a result of which farms with few such problems had less need to take extra measures. Thus, it was not possible to determine the effect of the enrichment measures on the wellbeing of the animals in this way. In general, it emerged that poultry keepers often paid extra attention to their flocks at the start of the compulsory confinement period, providing extra litter or feed as enrichment, but gradually cut back on these extra measures.

The study revealed that most farms were still using laying hens whose beaks had been tipped. It is not clear to what extent the absence of major feather pecking problems can be attributed to this. Further research is needed into the impact on feather pecking of the introduction (on 1 March 2006) of a prohibition on beak-tipping in organic poultry keeping, notably when animals are compulsorily confined indoors.

Particularly striking were the high dust levels measured in the sheds (average 4.5 mg/m³). It was clear that the amount of dust in the sheds was directly related to the density of the laying hens and the strain of hen. The latter may be because a placid strain of hen is less prone to scratching and scraping and thus generates less dust. In particular, sheds with a "volière" (tiered aviary)¹ system tended to have high dust concentrations (6.9 mg/m³). Previous

¹ The "volière system" is a multi-tiered aviary system – in this system the hens are kept in loose flock sheds with raised perches or platforms.

researchers have reported that a dust concentration above 3.7 mg/m^3 is bad for animal health. In summary, it can be stated that the harmful effects associated with indoor confinement can be mitigated by giving animals more enrichment. However, this present study is unable to pronounce on the effectiveness of the individual enrichment measures. It was clear that the dust levels in the sheds where laying hens are confined are too high and that this is related, inter alia, to the system employed in the sheds.

Introduction

Since the introduction in the autumn of 2005 of an order to keep poultry confined indoors in order to prevent the spreading of avian influenza by migratory birds, the ASG (Animal Sciences Group) has been studying the effects of this order on poultry and the consequences for the farms affected.

Our initial survey at the start of this period, to ascertain the effects of indoor confinement on the animals' wellbeing and health, was a telephone survey of organic poultry keepers. It revealed that although animal wellbeing was affected there were no serious problems thanks to the use of enrichment measures (extra straw, extra feeding). No further research was done into the effectiveness of the measures taken by the poultry keepers.

By virtue of its nature (a survey) the initial research gave a subjective picture. In the follow-up study we wanted to examine, via objective measurement, the level of wellbeing of the birds, and to ascertain whether there was a demonstrable connection between particular wellbeing-improvement measures and the actual wellbeing of the animals. With the relaxation of the indoor confinement order we had hoped that some farms would allow their hens outside again. This was not the case, and thus the study is simply a comparison of measures within a group of farms that had all kept their hens confined indoors.

As the poultry keepers themselves indicated that the use of enrichment materials had resulted in more dust being generated in the sheds, this study focuses strongly on that particular aspect.

Objectives:

- To chart the effects of compulsory indoor confinement on the wellbeing of laying hens that had previously had access to the outdoors.
- To analyse enrichment measures and examine their impact on the wellbeing of the laying hens.
- To investigate possible adverse effects of the enrichment material (e.g. extra dust through use of extra straw).

Approach:

Organic poultry keepers were sent the report of our initial study, accompanied by a letter announcing the second part of the study.

The 63 poultry keepers who had observed the indoor confinement order since 22 August and had participated in the surveys were selected to take part in the follow-up study.

After this, between 17-11-2005 and 14-12-2005 as many farms as possible were contacted by telephone and were visited shortly thereafter. All farms were visited by the same researcher. During the visit various parameters were noted for each flock of hens, including age and strain. The shed dimensions and the systems of birdkeeping employed in the sheds were also described. The shed climate was given a score on a scale between 1 and 4 (1: stuffy; 4: fresh). The amount of litter was given a score on a scale between 0 (none) and 10 (a lot). In addition, a quantitative dust measurement was made using a mobile dust meter (MicroDust, type Pro 880nm, number: 238877). The method of ventilation (natural and/or mechanical) was noted.

A plumage score for each flock was given at the farm, and photographs of groups of hens were taken so that the plumage could later be scored objectively in Lelystad (with thanks to Maaikje Fillerup). Plumages were scored on a scale between 1 and 4, and the percentage of animals with each plumage score was estimated (Wahlstrom et al 2004). In contrast to the method described by Wahlstrom et al., we did not judge the individual parts of the hen for plumage, but simply the overall plumage. The scale was as follows: Score 1: 25% feathered, score 2: 50% feathered, score 3: 75% feathered; score 4: 100% feathered (Annex A shows some examples). If all the animals in the flock (100%) scored 4 the flock would score 400 points; if all the animals in the flock scored 1 the flock would score 100 points. In addition, an overall impression for "general appearance" in the flock was recorded, on a scale of 1 to 10, with 1 being poor and 10 being excellent. Attention was paid to aspects such as the outward appearance of the laying hens, liveliness, alertness and colour of comb. In addition, the percentage of birds with obvious injuries was noted. Mortality was noted on the basis of the figures given by the poultry keeper for the past month and week. During the visit the mortality figure for the previous day was noted. From these figures the mortality per week per flock of 3000 birds was calculated. In the case of flocks smaller than 3000 birds this mortality figure is extrapolated.

The data were entered in an Excel worksheet and the connection between diverse parameters was analysed using the Genstat® programme (with thanks to Johan van Riel, Statistical Division, Veehouderij BV, Wageningen UR).

Results

General findings

Of the 63 farms that took part in the initial survey 50 were approached to see whether they would be willing to take part in a follow-up study. Seven of these said they did not want to be visited, because of a hygiene/infection risk; 2 temporarily had no hens due to a changeover between laying cycles; 2 had allowed their birds outside again; 1 was willing to take part but later dropped out due to the illness of the poultry keeper; and 1 did not want to take part because the birds looked too bad. So the final response was 37 of the 50 farms (74%).

On these 37 farms a total of 93 flocks were investigated, containing in total 214 195 laying hens, with an average flock size of 2 303 birds (flock sizes varied from 30 birds to 70 000 birds). In the Netherlands approximately 550 000 organic laying hens were being kept in 2005, therefore this survey covered about 40% of the sector. Officially the maximum permitted flock size in organic poultry keeping is 3 000 birds.

Table 1 shows the strains of birds on the farms visited and the numbers in each strain. At this moment the three leading breeds, in terms of numbers, are: Hy-line Brown, Lohman Silvernick and Bovans Goldline

Table 1. Strains of laying hens and total numbers on the farms investigated.

Strain of laying hens	Numbers
Bovans Goldline	40400
Dekalb Amberlink	7550
Miscellaneous	325
Hy-line Brown	60990
Hy-line Silver	9000
Isa Brown	15980
Isa Plenair	11000
Lohman Brown	15425
Lohman Silvernick	53525

The mean age of the hens was 51 weeks (varying between 21 and 80 weeks). In 49 of the 93 flocks there were also cocks in the flock. The number of cocks per flock varied between 1 and 60, and the number of hens per cock varied between 7 and 1900. At the time of the study beak tipping of organic layer poultry was still permitted. In 26 flocks the beaks had been left untouched (36815 laying hens), in 64 they had been tipped (169480 laying hens) and on one farm with three flocks (7900 laying hens) the beaks had been trimmed, the poultry keeper

claiming that when he bought them he had been unable to obtain any laying hens that had not been beak-trimmed.

The mean number of hens kept per square metre of shed was 6.9 (the SKAL² guideline is a maximum of 6 laying hens per m²), ranging between 1.9 and 12.9.

Farms which have more than 6 laying hens per m² of shed floor have created more space by installing raised perches ("volière" system), so that they are still able to comply with the SKAL guidelines. Of the flocks investigated, 40 had a covered free-range area ("winter-garden"). Approximately one third of the flocks (n=26) were kept in a "volière" (tiered aviary) system. The mean number of hens per cubic metre was 2.2 in such systems, varying between 1.3 and 3.7. The mean density in flocks not kept in a "volière" (tiered aviary) system was 1.8 birds per cubic metre (varying between 0.9 and 3.7). For 34 flocks natural ventilation was used (density of laying hens: 1.8 per m³), for 35 a combination of natural and mechanical ventilation (density of laying hens: 1.8 per m³) and for 24 only mechanical ventilation was used (density of laying hens 2.2 per m³).

The light level in the sheds was quantified as a percentage of the daylight outside and averaged 55% over all flocks, varying between 30 and 95 %. Some sheds had no natural daylight and used only artificial light. Many farms ensured a subdued light level (lower than 50% daylight), inter alia by using red lamps (21 of the 93 flocks), which, according to the poultry keepers, helps to keep feather pecking under control.

From the scores regarding the amount of litter used it was clear that at the time of the visits a strikingly high number of farms were not using any litter (38 flocks). In these farms the birds frequently walked on the dried droppings. The other farms which did have litter on the floor mainly used straw, frequently added in the form of whole straw bales. The dust measurements in the sheds showed the average dust concentration in flocks without litter to be 4.7 mg/m³. However, no significant correlation could be demonstrated between the presence of litter and the average quantity of dust in the sheds. For 88 flocks a dust measurement was made. This showed the average dust concentration to be 4.5 mg/m³, ranging from 1.9 to 9.6 mg/m³. Fig. 1 shows the relationship between dust level and density of the confined laying hens. For a number of flocks no dust measurements were made (shown in Fig. 1 as 0). As the graph shows, there is a clear correlation between the density of the number of hens and the dust level in the shed. This correlation appears to be stronger for white hens than for brown hens. Higher densities of hens are mainly seen in farms that have installed a full "volière" (tiered aviary) system in the sheds, which causes a significant increase in the amount of dust in the shed (Table 1). These sheds often use mechanical ventilation. The correlation between the amount of dust in the shed and the method of ventilation indicates that the highest dust values occur in those sheds where mechanical ventilation is used (Table 2).

² SKAL is the inspection body for inspection and certification of organic production in the Netherlands.

Table 1. Effect of the "volière" (tiered aviary) system on the density of laying hens and dust measurements in the shed¹⁾

"volière" (tiered aviary) system	Number of flocks	Dust in mg/m ³	Hens/m ³
No	63	4.3 ± 0.2	1.8
Half	14	3.7 ± 0.3	2.0
Full	11	6.9 ± 0.3 ²⁾	2.6

1) On some farms no dust measurements were made.

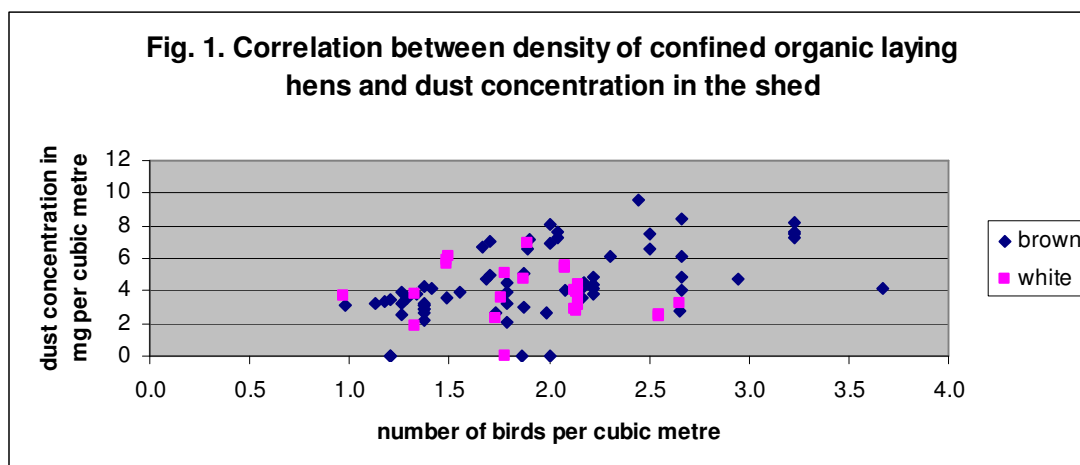
2) Mean dust levels ± SEM. P< 0.001 as compared to flocks not kept in the "volière" (tiered aviary) system (Kruskall Wallis test).

Table 2. Correlation between ventilation method and dust concentrations in the sheds¹⁾

Ventilation method	Number of flocks	Dust in mg/m ³	Hens/m ³
Mechanical only	24	5.45 ± 0.35 ²⁾	2.2
Mechanical + Natural	31	4.16 ± 0.26	1.8
Natural	33	4.23 ± 0.31	1.8

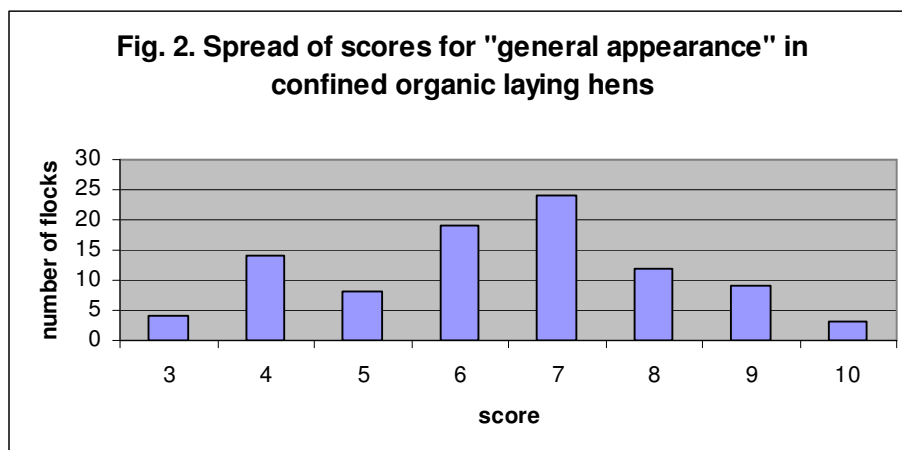
1) On some farms no dust measurements were made.

2) Mean dust levels ± SEM. P< 0.001 in respect of flocks with purely natural ventilation (Kruskall Wallis test).



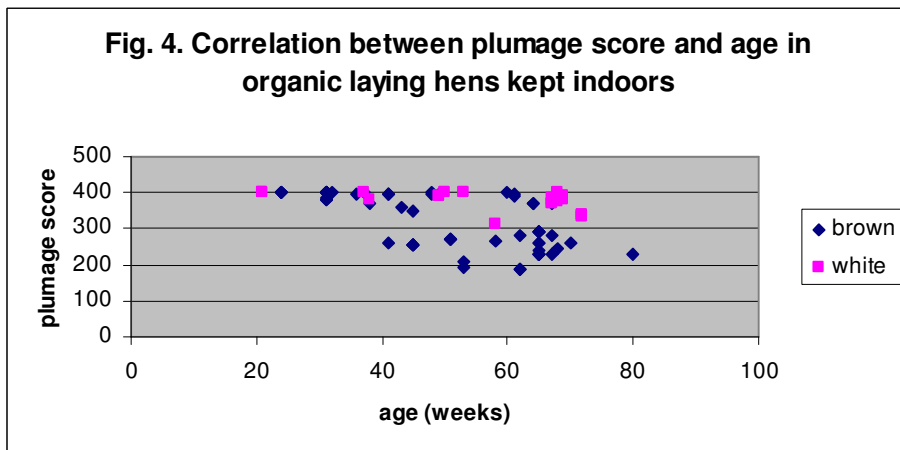
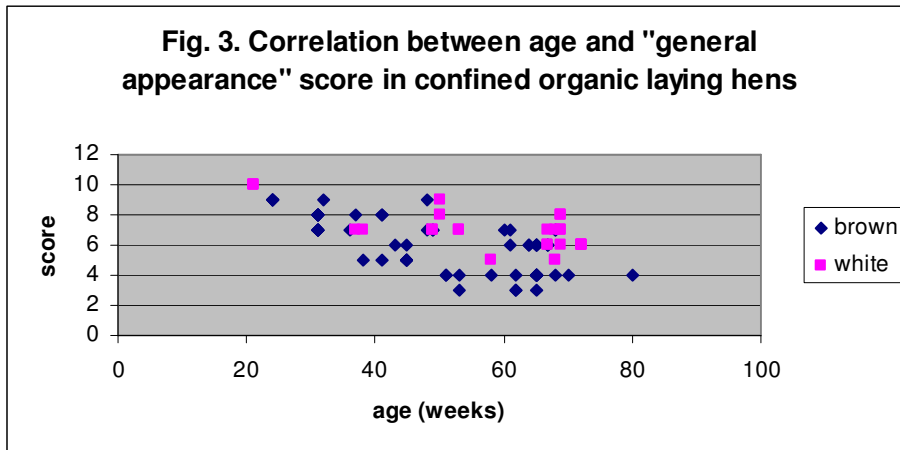
The mean shed climate score was 2.8, with no sheds obtaining the lowest score of 1 (poor) and 14 sheds (10 farms) the highest score of 4.

An overall impression for the "general appearance" of each flock was recorded, on a scale of 1 to 10. 26 scored "unsatisfactory" (<6; 28%) and 67 scored "satisfactory". The mean score for all flocks was 6.4, with scores ranging from 3 to 10 (see Fig. 2).



As there was a feeling that the impression concerning "general appearance" was related to the age of the birds, this was analysed more closely. Fig. 3 shows a clear correlation between the "general appearance" score and age. For example, laying hens that scored 10 were only 21 weeks old, while laying hens that were 80 weeks old scored only 4. The graph distinguishes between the white and brown hens. It is clear that the white hens' scores remained higher with age than those of the brown hens. A lot of attention was paid to the birds' plumage. Plumages were scored in the shed itself and were later scored again on the basis of photos that were taken. As there was a good correlation between the plumage scores at the farm and the plumage scores assigned subsequently on the basis of photos (correlation 0.85), we have chosen to give the results of the farm visit scores in the description that follows. In 29 (31%) of the 93 flocks assessed the condition of the plumage was mediocre (score of less than 300 points). Fig. 4 shows the plumage score in relation to the age and strain of the laying hens. Here again it is clear that the plumage becomes poorer with age, more rapidly in the case of brown hens than white hens (see also the examples in Annex A).

In 12 flocks (9 farms) birds with wounds were observed. In 3 flocks wounds were observed in 1-2% of the hens, in 6 flocks in 5%, and in 3 flocks in 10%.



One parameter used to measure the wellbeing of the laying hens was mortality. This was calculated on the basis of the number of hens dying per week per flock of 3000 laying hens (in the case of smaller flocks the mortality figure was extrapolated). The mean mortality rate was 6.4, ranging from 0 to 36 birds.

During the visit the poultry keepers were asked whether feather pecking was a problem. Six said it was a big problem, but that it had not yet led to cannibalism. In a number of these farms feather pecking had been a problem even before the compulsory confinement of the birds indoors, but confinement had aggravated the problem. Although many farms had put a lot of enrichment material into the shed when the indoor confinement was first introduced, many farms had stopped doing it, without noticing any subsequent escalation in feather pecking. A number of poultry keepers said they had stopped scattering corn more frequently precisely because it tended to cause more unrest. And one poultry keeper also said that a lot of direct sunlight encouraged pecking behaviour. The hens start by pecking at particles of dust in a ray of sunlight and then move on to pecking each other. They also jostle for a sunny spot on the perch. One poultry keeper stated that reducing the light level had substantially reduced pecking and mortality. Other measures used by poultry keepers to reduce feather pecking involved giving the birds feed with more structure, and one farm added salt to the drinking water.

Effect of measures to promote wellbeing

After our initial telephone survey of organic poultry keepers we reported that a variety of enrichment measures had been introduced. During the farm visits in November/December 2005 we looked into this aspect more closely, also asking which of these enrichment measures had already been in use before the imposition of the indoor confinement order. As mentioned earlier, many poultry keepers had already cut back on the intensive use of enrichment materials, as they had gained the impression that cutting back did not lead to any escalation in feather pecking.

Using statistical analyses (Genstat®) we investigated the extent to which the introduction of new measures in a flock affected the quality of the plumage, taking into account the age of the birds. It is not evident from the results that using an enrichment measure is associated with better plumage. Indeed, it seems to be the case that flocks where no measures were introduced had a better appearance than the flocks that had been given extra straw. As mentioned earlier, the quality of the plumage deteriorates with age.

A breakdown of plumage condition by breed of hen, with a further breakdown being made in the brown group between hens that had had their beaks tipped and those that had not, yielded no evidence that the introduction of measures to promote wellbeing led to better plumage. The trend, in fact, seems to be that flocks where such measures were introduced had worse plumage than flocks where nothing was done. This analysis too showed that the plumage of white hens stays in better condition with age than that of brown hens.

Genstat® was also used to investigate the extent to which the measures taken had led to increased dust levels in the sheds, and how this correlated with the number of hens per cubic metre. Once again, it is striking that there is no clearly demonstrable difference between flocks where measures were taken and the amount of dust in the sheds. What is clear, however, is that in flocks of beak-tipped brown hens there is a correlation between the amount of dust and the increase in stocking density of the birds. This phenomenon is not observed with brown hens that have not been beak-tipped, or with white hens. Here again, there was no demonstrable correlation with measures taken to promote wellbeing. The above observations may be explained by the fact that farms where there was already a need to do something (because of the behaviour and appearance of the hens), would be likely to take such measures in order to prevent any exacerbation of the existing situation, whereas farms that had no such problems would not necessarily feel the need to take any extra measures.

Discussion

When the order to keep poultry indoors was issued in August 2005, many organic layer poultry keepers took various measures to prevent feather pecking. As the period of compulsory confinement lengthened, various poultry keepers cut back on these enrichment measures, which were often labour-intensive, and noted that feather pecking in the sheds did not get any worse. This development made it difficult for us to achieve the original goal of our study, namely to analyse the effectiveness of enrichment measures. Generally speaking, our farm visits in December 2005 showed that the level of wellbeing of confined hens seemed to be acceptable. However, it was noticeable that plumage condition in many flocks left something to be desired. The most important factors affecting the condition of the laying hens were the strain of hen and age. It was not possible to draw conclusions as to how much of a role the protracted confinement played in this, as no comparison was made with non-confined flocks.

In the case of feather pecking the beak plays an important role, and for this reason in non-organic poultry farming the beak is trimmed at an early age (T. Fiks, column Biofoon, 2005). Although beak-trimming is prohibited in organic poultry keeping, the majority of the flocks in this study had had their beaks tipped (removal of just the horny tip). As from 1 March 2006 beak-tipping too is due to be prohibited in the organic poultry sector. The question is what effect this will have on feather pecking behaviour in laying hens, notably when they are confined indoors. Recently, however, a lot of attention has been paid in the organic sector to the prevention of feather pecking, with great improvements having been achieved through correct rearing and the choice of the right strains of hens.

It should also be borne in mind that large flocks of laying hens are already accustomed to spending the bulk of the day indoors anyway, and that full-time indoor confinement should not directly induce new feather-pecking behaviour. Nevertheless, most poultry keepers did say during the farm visits that feather pecking behaviour had got worse after the introduction of compulsory indoor confinement, but had not led to serious cannibalism.

The point that did attract attention, however, was the fact that air quality, measured on the basis of dust concentrations, often left something to be desired. Not allowing the hens to spend time outdoors means that they are exposed 24 hours a day to an environment in which significant quantities of dust circulate. Total dust levels above 5 mg are regarded by experts in this field as high (Ir. A. Aarnink, personal communication). According to earlier research by Takai et al, the mean total dust concentration in poultry sheds was 3.6 mg/m³. The mean total dust concentration that we measured was 4.5 mg, ranging between 1.9 and 9.6 mg. Wathes et al have indicated that for the sake of animal health the quantity of dust in livestock sheds should be lower than 3.4 mg/m³. In the flocks that we investigated, only 30% met this requirement. It emerged that two important factors affecting the quantity of dust were the density of stocking the hens ("volière" (tiered aviary) system) and the strain of hen. Sheds holding brown hens had more dust than sheds holding white hens. One explanation for this could be the calmer behaviour of particular strains of hens. The use of extra straw or straw bales did not appear to be directly related to higher dust concentrations. There are probably other sources of dust in the sheds apart from the straw (flakes of skin, droppings, feed remains, etc.), and ventilation also plays a role.

Poultry keepers themselves stated that there were relatively large amounts of dust in the sheds. A correlation with humidity was also observed: the drier the air, the greater the amount of dust. And perhaps the time of year at which we visited the farms also played a part.

Analysis of the data gathered during the farm visits did not demonstrate any correlation between the birds' "general appearance" or plumage and the extra measures introduced to prevent feather pecking. The plumage on farms that had introduced lots of measures was in fact often worse than on those farms had done very little. Of course, one explanation for this could be that farms where there was already a need to do something to prevent feather pecking would be the ones most likely to take such measures in order to prevent any exacerbation of the situation.

In conclusion, we can state that even our study involving farm visits failed to reveal any adverse effects of compulsory indoor confinement on the wellbeing of organic laying hens. The study did not clarify to what extent this can be attributed to the introduction of extra enrichment measures. It may be that extra enrichment measures are needed in the immediate aftermath of the introduction of compulsory indoor confinement but can then be abandoned after the birds have become acclimatised. However, the study did demonstrate that the atmospheric climate to which the confined birds are exposed needs improvement, important factors being the system used in the shed ("volière" (tiered aviary) system), the behaviour of the laying hens and the method of ventilation.

Conclusions and recommendations

When compulsory indoor confinement is imposed the negative consequences for the laying hens can be mitigated by the use of extra enrichment material such as straw bales and extra feed.

It is not clear to what extent the absence of major feather pecking problems can be attributed to the fact that most organic laying hens at present have their beaks tipped. Further research is needed to investigate what impact the introduction of a beak-tipping ban (1 March 2006) in organic poultry farming will have on the incidence of feather pecking.

In 30% of the flocks the appearance of the plumage left something to be desired. Although both age and strain of hen are important factors here, it is not clear whether long-term indoor confinement also plays a part. Paying more attention to the condition of the plumage would do the image of the organic sector good.

In light of the fact that the compulsory indoor confinement of free range laying hens may become a recurring, twice-yearly exercise (depending on vaccination policy), attention should be paid to the choice of the strain of laying hens and the choice of the shed system.

The level of dust in sheds in which laying hens are compulsorily confined is too high and is linked to the strain of hen and the shed system employed. Further research is needed to examine how these dust levels can be brought back to acceptable proportions. In addition, poultry keepers and their employees should be informed about the damage that the dust can do to their lungs and should take measures to minimise this by wearing dust masks.

The organic legislation on housing livestock must set limits both on densities per square metre and densities per cubic metre. In particular, a shed equipped with a "volière" (tiered aviary) system gives the outsider a picture of an over-full shed that does not sit well with the organic image.

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Annex A. Examples of plumage scores.



Fig. 1. The plumages of these laying hens (Hy-line Brown; 24 weeks old) scored 4. As all the birds had this score, this flock scored 400 points. The score subsequently given based on the photos taken was also 400.



Fig. 2. The plumages of these laying hens (HY-line brown; 65 weeks old) mainly scored between 2 and 3. The total number of points for this flock as assessed in the shed during the farm visit was 230. The score subsequently given based on the objective assessment of the photos was 280.



Fig. 3. The plumages of this flock (HY-line brown: 62 weeks old) scored between 1 and 3 in the shed, giving the flock a total score of 185. The birds with very poor plumage could not be seen on the photos that were taken, and the score assessed on the basis of the photos was 305.



Fig. 4. A flock of Silver Nick laying hens (68 weeks old) with a total plumage score of 400 points.



Fig. 5. A flock of Bovans Goldline (68 weeks old), given a total score of 245 points in the shed and a score of 290 points based on assessment of this photo.



Fig. 6. Small flock of laying hens (total 35 birds), comprising a variety of strains, and of unknown age. The total plumage score in the shed, and again after studying the photos, was 400 points.