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Influence of farm factors on the occurrence of feather pecking in organic reared hens and their predictability for feather pecking in the laying period

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ABSTRACT

Feather pecking is one of the most obvious welfare problems in laying hens. It is seen in all types of housing systems. Although banned in some countries, beak trimming is generally used to reduce the damage caused by this behaviour. In organic farming, where beak trimming is prohibited, the animals are being kept in a less intensive way than in conventional farming in order to improve their welfare. However, feather pecking is also seen in organic laying hens. Generally, rearing circumstances play an important role in the development of this behaviour. Therefore, rearing flocks were monitored for feather pecking and the relations between rearing factors and feather pecking at a young and at an adult age were analysed. Also the correlation between feather pecking during the rearing period and feather pecking during adult life was studied. Twenty-eight commercial flocks of rearing hens were monitored. These flocks split into 51 flocks of laying hens. Flocks were scored for signs of feather damage during rearing at the ages of 7, 12, and 16 weeks and on the laying farms at 30 weeks. On the rearing as well as the laying farm, data were collected on the housing system. Logistic regression was used to analyse our data. Feather damage was seen in 13 out of 24 (54%) of rearing flocks. Logistic regression showed that a higher number of pullets being kept per square meter in the first 4 weeks of life were associated with feather damage during the rearing period (Chi square = 8.49, df = 1, $p = 0.004$). Moreover, the combination of not having litter at the age of 1–4 weeks and the absence of daylight at the age of 7–17 weeks was a significant predictor of feather damage during the laying period (Chi square = 13.89, df = 4, $p = 0.008$). In 71% of the cases that pullets did not show feather pecking damage during rearing, they did not show feather pecking damage in the laying period either. When flocks of pullets did show feather damage, in 90% of the cases they did so during adult life. These results lead to suggestions on how to improve the rearing conditions of laying hens and increase their welfare not only during rearing but also during later life. Although the observations were done on organic farms, the results can be applied for other non-cage systems too.

1. Introduction

Feather pecking in laying hens and pullets is a behavioural disorder that is associated with reduced welfare in both actor (Vestergaard et al., 1993; El-Lethey et al., 2000) and victim (Gentle and Hunter, 1990). Feather pecking can be defined as grasping and firmly pulling of feathers of another bird, which may be followed by eating it (Savory, 1995). More recently different forms of feather pecking are defined, such as 'gentle' and 'severe'. The definition of Savory (1995) corresponds to the definition of severe feather pecking. It has been observed in all

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commercial housing systems, also in non-cage systems that are designed to offer better opportunities to perform specific behavioural patterns and improve welfare, such as organic systems. Correlations have been described with genetic factors (Fröhlich, 1991; Kjaer and Soerensen, 1997; Kjaer et al., 2001; Buitenhuis et al., 2002; Jensen et al., 2005), housing conditions during the laying period (Hughes and Duncan, 1972; Simonsen et al., 1980; El-Lethey et al., 2000; Green et al., 2000; Sedlačková et al., 2004; van Krimpen et al., 2005), housing conditions during the rearing period (Blokhuis and van der Haar, 1989, 1992; Noergaard-Nielsen et al., 1993; Huber-Eicher and Wechsler, 1998; Johnsen et al., 1998; Gunnarsson et al., 1999; Huber-Eicher and Audigé, 1999; Zeltner et al., 2000; Huber-Eicher and Sebö, 2001; Nicol et al., 2001; Keppler et al., 2003; van de Weerd and Elson, 2006) and even factors during brooding (Riedstra and Groothuis, 2004). In order to reduce the problems caused by feather pecking, laying hens are beak trimmed, which can be regarded as a welfare problem in itself (Hughes and Gentle, 1995). At the same time, housing systems, for example within the context of organic farming, have been developed in which laying hens should have less behavioural restrictions and are therefore expected to perform less disturbed behaviour like feather pecking. In organic farming, mutilations such as beak trimming, are prohibited (Regulation (EEC) No 2092/91). However, feather pecking is still one of the most obvious welfare problems in organic farming. Bestman and Wagenaar (2003) described that some degree of feather pecking was seen in 71% of organic layer flocks of 50 weeks and older. They also described that the degree of feather pecking in flocks was less when more hens used the outdoor run, the age at purchase of the pullets was lower and when there were more cockerels in the flocks. However, many farmers reported that at arrival on the farm, sometimes, young hens already feather pecked and that it was very hard or even impossible to change this behaviour. Already in the 1980s it was shown experimentally that rearing conditions influenced feather pecking both during rearing as well as during lay, even when the conditions during the laying period were improved, compared to the rearing period (Blokhuis and van der Haar, 1989, 1992; Johnsen et al., 1998; Noergaard-Nielsen et al., 1993; Jensen et al., 2006). In this study concerning organic poultry farms, the following questions were addressed: (1) what percentage of flocks of rearing hens show feather pecking damage, (2) which factors during rearing are associated with feather pecking damage during rearing, (3) which factors during rearing are associated with feather pecking damage in the laying period and finally and (4) what is the correlation between feather pecking damage during the rearing period and feather pecking damage during the laying period? These questions were studied by collecting data from commercial organic rearing flocks and after the pullets had moved to organic laying farms.

2. Animals, materials and methods

In the Netherlands rearing farmers are contracted by the hatcheries. In collaboration with the three hatcheries that together produce more than 90% of the organic laying hen pullets, observations were carried out on 10 rearing farms in the period September 2003 till January 2005. Twenty-eight flocks of initially total 322,000 pullets were monitored. The rearing farms were visited when the pullets were 7, 12 and 16 weeks of age. The pullets were scored for feather pecking damage by an observer walking through the flock using a manual counting device. A total of 100 birds were observed and the ones with feather pecking damage on the back and tail area were counted and a percentage of feather pecked birds was calculated. Feather damage was initially defined as de-feathered spots on the back and tail area, corresponding to the usual type of scoring of adult laying hens. However, after scoring the first four flocks this way, no such de-feathered spots were observed but there were spots with some individual feathers missing. Thus damage was more subtle than what we expected at the beginning of the observations. The first four flocks were not included in our analyses. From that moment onwards feather damage was defined as damaged or missing of feathers on the back and tail area. A flock of rearing hens was being categorized as feather pecked when at least in one of the three observation weeks at least 6% of the pullets showed signs of feather damage. Thus, when a flock was categorized as being feather pecked at the age of 7 weeks, but recovered, it continued to be categorized as being feather pecked. This was done so, because in one flock feather pecking damage was seen at 7 and 12 weeks of age in more than 25% of the pullets while no such damage was seen in none of the pullets of this flock at 16 weeks of age. It did not feel sensible to categorize this flock as 'non-feather pecking'. At the rearing farms, data were also collected about the breed of animals, the housing system, climate, management procedures and mortality (see Table 1). These data were collected by asking the farmer or using the farm records, except for the estimates on light intensity and ammonia concentration, which were done by the researcher using her own senses of vision and smell. The animals were all moved to the laying farms at the age of 17 weeks. When the birds were 30 weeks old, the laying farm was visited and again data were collected about the animals, housing system, management procedures and mortality. Feather damage was scored by counting those hens with feathers damaged or missing on the back and tail area in a sample of 100 animals. This scoring was again done by walking through the flock with a manual counting device. A flock of laying hens was categorized as being feather pecked if at least 6% of the hens showed signs of feather pecking damage. All data were put in an Excel database.

2.1. Statistical analysis

Logistic regression (SPSS 15. 0 for Windows) was used to predict the probability of the flocks being in the pecking or in the non-pecking category, while taking into account the different variables concerning animals, housing, management procedures and mortality. Rearing variables that could influence feather damage during rearing, were selected on the omnibus test (SPSS 15.0), number of missing cases and the level of prediction by the dependent

Table 1
General information about the rearing flocks. .

Factor	Feather pecking ($n = 13$)	Non-feather pecking ($n = 11$)
Group size in weeks 1–6	11.500 (1600–50,000)	6.300 (750–18,000)
Density in weeks 1–4 (pullets/m^2)	34 (18–53)	21 (15–37)
% of flocks on litter in weeks 1–4	40%	71%
Density in weeks 5–6 (pullets/m^2)	25 (8–33)	18 (13–37)
% of flocks have litter available in weeks 5–6	80%	93%
Perches in weeks 1–6	41% of the flocks have perches	62% of the flocks have perches
If available: mean perch length (cm/animal)	4 (2.3–7)	2 (0.35–7)
% of flocks receiving scattered grain in weeks 1–6	16%	29%
If receiving scattered grain: amount (gram/pullet/day)	3 (1–5.5)	2.4 (0.07–3)
% of flocks with sufficient or much[a] daylight in weeks 1–6	15%	36%
% of flocks free of blood mites in weeks 1–6	100%	75%
Group size in weeks 7–17	4500 (1600–9500)	5.700 (750–12,750)
Density in weeks 7–17 (pullets/m^2)	9.9 (6–24)	10.5 (7.3–15)
% of flocks on litter in weeks 7–17	100%	100%
% of flocks receiving scattered grain in weeks 7–17	40%	86%
If receiving scattered grain: amount (gram/pullet/day)	3.0 (1–7.6)	3.5 (0.5–12)
Perches in weeks 7–17 (cm/animal)	6 (2.3–10)	7 (0–9)
% of flocks with sufficient or much[a] daylight in weeks 7–17	35%	21%
Age in weeks at first provision of range area	12 (5–28)	11 (7–22)
Percentage of hens seen outside at 16 weeks	25 (5–45)	24 (1–45)

[a] The amount of daylight was estimated by the observer.

variable. Logistic regression was used in order to predict to what degree and in what combination the selected variables contributed to the occurrence of feather damage during the rearing period. The same steps were made for rearing variables that could influence feather damage during the laying period. Finally, the association between feather damage during the rearing period and during the laying period was calculated using Cramer's V (SPSS 15.0).

3. Results

Because of missing data, the different questions, as described in Section 1, had to be addressed using variable numbers of flocks to be included in the statistic procedures. The age categories for the different factors, as used in the analysis (see Tables 1–3), are based on the moments at which important management routines took place and not because of mathematical reasons. One such management routine is restricting the pullets on the elevated slatted floor during the first weeks of life. On these floors feed and drink facilities are available. If pullets were allowed to leave these slatted floors before the age of 4 weeks, they were not able to jump high enough to reach feed and water again. During such a spatial restriction pullets most of the time have no litter available. Another management routine is removing a part of the flock at the age of 7 weeks because from then on, according to the national organic regulation, the density should be lower than for pullets younger than 7 weeks. Therefore, changes in density and the presence of litter are likely to change at the ages of 4 and 7 weeks.

3.1. Rearing factors related to feather damage during the rearing period

Feather pecking damage was seen in 13 out of the 24 (54%) flocks. Of those 13 flocks with feather pecking damage, in 3 flocks it was seen at all ages, in 1 flock it was seen both at 7 and 12 weeks, in 4 flocks it was seen at both 12 and 16 weeks of age and in 5 flocks it was seen only at 16 weeks. Table 1 gives a summary of the characteristics of the 24 flocks, categorized in feather pecking and non-feather pecking flocks.

We used Omnibus tests of the model coefficients, the percentage correct prediction and the number of non-missing values of a variable to select the rearing variables related to feather damage during rearing (see Table 2): group size in weeks 1–6, pullet density in weeks 1–4, pullet density in weeks 5–6, floor cover in weeks 1–4 and type of housing (aviary or floor) in weeks 7–17. Logistic regression without backward exclusion (likelihood ratio) showed that out of these variables, pullet density in weeks 1–4 was the most important in predicting feather damage (Chi square = 8.49, df = 1, $p = 0.004$), which meant that high pullet density during the first 4 weeks of life was in 78.3% of the cases predictive for the presence of feather damage

Table 2
Rearing variables related to feather damage during rearing.

Variable	Missing cases	Cases	% original	% correct predicted	Omnibus-p
Group size weeks 1–6	4	24	54.2	62.5	0.107
Pullet density weeks 1–4	4	24	54.2	79.2	0.002
Pullet density weeks 5–6	5	23	52.2	65.2	0.118
% of flocks on litter in weeks 1–4	4	24	54.2	70.8	0.042
Aviary or floor housing weeks 7–17	4	24	54.2	70.8	0.007

Table 3
Rearing variables related to feather damage during the laying period.

Variable	Missing cases	Cases	% original	% correct	Omnibus-*p*
Pullet density weeks 1–4	6	45	51.1	57.8	0.032
% of flocks on litter in weeks 1–4	6	45	51.1	64.4	0.045
Air ammonia weeks 1–6	6	45	51.1	71.1	0.020
Daylight weeks 7–17	6	45	51.1	68.9	0.005

during the rearing period. However, it should be mentioned that in the low density groups more often litter was available than in the high density groups.

3.2. Rearing factors related to feather damage during the laying period

We used Omnibus tests of the model coefficients, the percentage correct prediction and the number of non-missing values of a variable to select the rearing variables that influence feather damage during the laying period (see Table 3): pullet density in weeks 1–4, floor cover in weeks 1–4, the amount of daylight in weeks 1–6 and 7–17 and finally the amount of air ammonia in weeks 1–6. Logistic regression showed that out of these variables the combination of floor cover in weeks 1–4 and the amount of daylight in weeks 7–17 was a significant predictor of feather damage during the laying period (Chi square = 13.89, df = 4, $p = 0.008$). This meant that the presence of litter during the first 4 weeks of life and the absence of daylight during weeks 7–17 were the best predictors for the presence of feather damage during the laying period (71.1% correct). However, again it should be mentioned that during the first 4 weeks of life flocks without litter often had a higher pullet density than flocks with litter.

3.3. Consistency of feather damage during rearing and feather damage during laying

At 17 weeks of age the pullets moved from the rearing farms to the laying farms. Some of them were split in such a way that pullets of one rearing flock were distributed to up to four different laying farms. Therefore, we could use more records for calculating the consistency of feather damage between rearing and laying period as for calculating the frequency of feather damage in rearing flocks. In total we could use 41 records (see Table 4). The overall percentage for correct predictions concerning feather damage during the laying period was $\{(15 + 18)/41\} \times 100 = 80.5$. The likelihood of feather damage during adult life when hens showed feather damage during rearing was 90%.

Table 4
Association between feather damage during the rearing period and during the laying period (strength of association using Cramer's $V = 0.623$, $p = 0.000$).

	Feather damage in weeks 1–16			
	No	Yes	Total	Percentage correct
Feather damage during lay				
No	15	6	21	71.4
Yes	2	18	20	90.0
Total	17	24	41	

4. Discussion

4.1. Number of rearing flocks with feather damage

We found that in 54% of the flocks of organic rearing hens some degree of damage caused by feather pecking was present. This percentage is between the 77% and 38% found by respectively Swiss researchers (Huber-Eicher and Sebö, 2001) and Swiss farmers who were asked whether their pullets did feather peck (Huber-Eicher, 1999) both studies were done in non-cage systems. Huber-Eicher and Sebö (2001) wrote that the amount of feather pecking is concealed during rearing when only judged by feather damages. Therefore, both the 54% and the 38% might be an underestimation of the prevalence of feather pecking in pullets. Because feather pecking is related to reduced welfare, preventive measures should be taken.

4.2. Factors related to feather damage during the rearing period

We found that a high density of pullets per square meter during the first 4 weeks of life, was a risk factor for feather pecking damage during the rearing period. However, it should be mentioned that in this study it is difficult to say to what degree pullet density and litter availability are really independent from each other. More feather pecking in case of higher pullet density has been described by others as well. Hansen and Braastad (1994) found in their experiment that pullets reared at a density of 13 pullets per square meter had worse plumage condition at 6 weeks of age and throughout the laying period than pullets reared at a density of 6.5 pullets per square meter. Keppler et al. (2003) experimentally compared rearing densities of 7 and 10 pullets per square meter and found more feather pecking (and cannibalism) in their high density groups. Huber-Eicher and Audigé (1999) studied commercial rearing flocks and found much more feather pecking in flocks with 10 pullets or more per square meter than in flocks with lower densities. Savory et al. (1999) found a combined effect of density and group size. The densities in their experiments ranged from 13 to 54 pullets per square meter. However, their groups consisted of respectively 10 and 20 pullets. This makes it difficult to compare their results to our results. Moreover, the pullet densities in our study, even in the flocks without feather damage (see Table 1), were most of the times higher than in the 'high

density groups' of most studies mentioned above. There should be other factors contributing to the development of feather pecking than density alone. There are at least three mechanisms possible of why high stocking density might lead to feather pecking. Firstly, pullets for several reasons peck at several life and lifeless 'parts' of their environment. Reasons for this could be found in the context of foraging, dust bathing or social exploration. When the environment consists of relatively more conspecifics than other 'substrates', relatively more pecking behaviour can be directed at these conspecifics. This pecking at other pullets can change from pecking to pulling and the result is more feather pecking in case of higher density. Secondly, a higher density might lead to stress, because there might be more competition about resources such as space and feed, there might be more agitation and there might be less space for performing certain behaviours. This stress might lead to the development of feather pecking. Thirdly, the mechanism of social transmission might play a more prominent role in higher densities than in lower densities. If a pullet develops for whatever reason feather pecking, in a higher density there might be more conspecifics copying this behaviour.

4.3. Rearing factors related to feather damage during the laying period

The absence of litter during the age of weeks 1–4 as well as the absence of daylight during the age of weeks 7–17, was related to feather damage in later life. However, it should be mentioned that in our study in flocks without litter the pullet density was often higher than in flocks with litter. This means that we cannot see absence of litter completely independent of pullet density. The effect of absence of litter during early life on feather pecking during later life was also found by others (Blokhuis and Arkes, 1984; Blokhuis and van der Haar, 1989; Johnsen et al., 1998; Huber-Eicher and Sebö, 2001). The most well-known mechanism of why the absence of litter may lead to feather pecking is redirected foraging or dust bathing behaviour. If there is no suitable substrate for foraging or dust bathing behaviour, the pullets may redirect their pecking (which is part of both foraging and dust bathing behaviours) at their conspecifics. If the pecking changes into pulling, then feather pecking has developed. Concerning the effect of daylight on feather pecking, it should be mentioned again that the amount of daylight was not really 'measured' but estimated by the observer. Thus we should regard this somehow subjective result carefully. However, there are hardly any relevant references available on the relation between daylight and feather pecking. Jensen et al. (2006) found an effect of dark brooders compared to heating lights on feather pecking. However, their 'light treatment', which led to more feather pecking, took place at a younger age than 'the daylight treatment' in our study. Kjaer and Soerensen (2002) did not find an effect of light intensity during rearing on feather pecking during later age. Therefore, we dare not to draw strong conclusions from our results concerning daylight, nor can we compare them with the results of other experiments.

4.4. Consistency of feather damage during rearing and feather damage during laying

We found a high likelihood (90%) of feather damage during adult life when the hens already showed feather damage during rearing. A lifelong effect of early feather pecking has also been found by others (Blokhuis and van der Haar, 1989, 1992; Johnsen et al., 1998; Noergaard-Nielsen et al., 1993; Jensen et al., 2006). This means that improving the rearing conditions is of crucial importance. This is even the case when damage at a young age looks as subtle as it did in the study of Huber-Eicher and Sebö (2001) and in our study. We did not find any featherless spots on our pullets, but in the worst cases only white down feathers as a sign that the cover feather had gone. There might be several explanations for why feather pecking at a young age looks differently. First is that because of the young age in pullets, not so much time has passed for feather pecking damage to develop, when compared to laying hens of 30 weeks old. Second is that pullets moult their feathers three times during rearing, so eventual damage will be recovered by this natural process. Third is that small pullets might be less able to put enough effort on really pulling out feathers.

Although our study was done in organic systems, the results are applicable to other non-cage systems. Because in such other systems also density can be reduced and litter given to young chicks.

5. Conclusion

Risk factors for feather damage are a higher number of pullets being kept per square meter during 1–4 weeks of age, the absence of litter during 1–4 weeks of age and the absence of daylight during 7–17 weeks of age. Furthermore, early feather damage predicts feather damage during the laying period.

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