Feather eating and crop filling in laying hens

Federfressen und Kropffüllung bei Legehennen

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Introduction

Recent studies have suggested a role of feather eating in the development of feather pecking in laying hens (McKeeagan and Savory, 1999, 2001). The relevance of feather eating for the laying hen is not known so far. The digestibility of protein of raw feathers is very low (McCASLAND and Richardson 1966). Therefore, feather eating may not contribute substantially to protein supply of laying hens. The function of feathers may influence the function of the gastrointestinal tract by their structural components. It has been shown that insoluble fiber increases the volume and motility of the gastrointestinal tract (HETLAND et al., 2004). We hypothesized that feathers may have a similar effect as insoluble fiber. It has been found that increased fiber contents improved the feather cover of laying hens due to less feather pecking (WAHLSTRÖM et al., 1998). This raises the question whether feathers may substitute fiber in hens fed conventional low fiber diets in order to improve the functionality of the gastrointestinal tract.

Pelleted feeding and food restriction, which are known as risk factors for feather pecking (EL-LETHEY et al., 2000; NEAL, 1956), were used hypothetically to stimulate feather eating. Both, feeding pelleted diets and restricted feeding regimes lead to an intake of a high amount of feed within a short period of time (BESSEI et al., 1999). As the feed is stored in the crop, these feeding methods increase crop size temporarily. It was assumed that feathers accelerate the passage of the digesta, and thus leads to a rapid reduction of the crop contents.

Since crop filling in laying hens can be easily scored by palpation, we investigated in the present study the relationship between feather eating, crop filling, feeding conditions and genetic line.

Materials and Methods

General

The present study comprised three experiments with a total of 144 hens. We used Rhode Island Red hens of a strain which has been divergently selected for high (HFP) and low (LFP) pulling at a bunch of feathers (BESSEI et al., 1999).

In each experiment 24 HFP birds and 24 LFP birds were randomly selected. These hens were from the same hatch. Birds, which were reared in a deep litter system, were transferred to individual cages, measuring 43 x 43 x 45 cm (l x w x h), at 21 weeks of age in experiment 1, at 28 weeks of age in experiment 2 and 36 weeks of age in experiment 3. The feeder was placed at the front and a nipple drinker at the back of the cage. The distance between the cages was 10 cm. The cages were kept in a ventilated windowless room with constant temperature (20°C). Lights were on from 4:00 h until 18:00 h.

Half of the birds of each line received pelleted feed and the other half mash. After one week of adaptation to the experimental situation ad libitum food consumption of pelleted and mash fed birds, respectively, was measured daily for one week. These data were used for feed restriction, which was adjusted to 90% of the ad libitum consumption. The pellets were made of the same diet as the mash.

We tested the response of each bird to the presentation of downy feathers (~ 4-5 cm long), plucked from dead birds of the same genetic line. Ten feathers were put into a transparent plastic lid (10 x 8 cm), which was fixed next to the food once every day in the morning (9:00 h) over a period of one week in the test phase. The control phase was one week without access to feathers. The treatment was applied to half of the birds during the first experimental week and to the other half during the second week to eliminate a potential effect of the sequence on the results.

Feed consumption was recorded every morning over 24 hours (8:00 h - 9:00 h). The number of feathers pulled out of the plastic lid and found on the cage floors, in the feed troughs and in the drop pans was counted three times a day (8:00 h, 12:30 h, 17:30 h). The number of feathers eaten was calculated by the number of 10 presented feathers minus the sum of the counted feathers. The drop pans were cleaned every day (8:00 h - 9:00 h) after counting the feathers at 8:00 h.

Crop size was scored by palpation at 8:00 h, 12:30 h and 17:30 h using scores respectively approximate diameters as follows: 0 = empty crop-1 cm; 1 = 1-2 cm; 2 = 2-3 cm; 3 = 3-4 cm; 4 = 4-5 cm; 5 = > 5 cm. In experiment 3, crop size was not scored at 8:00 h. Body weight was recorded at the beginning of each experiment and at the end of the test and control phase.

Statistical Analysis

Data were analysed by multivariate analysis of variance by the general linear models procedures of SPSS (8.0) statistical software including the factors line (HFP/LFP), feeding regime (restricted, ad libitum), feed structure (mash, pellet) and age (21, 28 and 36 weeks of age) of the birds.

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Age of the birds was tested as a fixed variable in the analysis, but no age by treatment interactions were noted so the data were pooled. Significant differences were determined by Student’s t-test. Differences were considered significant at $P < 0.05$, unless otherwise stated.

Repeated measurement analysis of variance was used to compare characteristics in the test phase to the control phase.

Since none of the interactions between the factors showed significant effects, only the result of the factors were presented.

**Results**

The overall mean of feather eating was 4 out of 10 presented feathers. Most of the feathers, 80% in HFP birds and 69% in LFP birds, were eaten between 9:00 h - 12:30 h when “fresh” feathers were offered (Figure 1). Over a period of 23 hours (9:00 h to 8:00 h the next morning) a significant higher number of eaten feathers was found in HFP birds than in LFP birds. No differences in feed structure and no differences in feeding regime were found for the number of feathers eaten over a period of 23 hours (Table 1).

There was a general tendency for an empty crop at 8:00 h and an increasing crop size from 8:00 h to 12:30 h and to 17:30 h in all treatments and over the control and test phase (Table 1). In the test phase crop size was significantly larger in HFP birds than in LFP birds at 17:30 h, while crop size was not affected by line in the control phase. At all points in time crop size was larger in pellet fed than in mash fed birds in the test and control phase. The same was true for restrictively fed birds than ad libitum fed birds, but contrary to the crop size at 8:00 h.

No effect from line (HFP/LFP) or feed structure (pellet/mash) was found on food consumption (as percentage of live weight). Restrictively fed birds showed lower food consumption than ad libitum fed birds in the test and control phase.

![Figure 1. Mean number of feathers eaten (and SD) at three different times of day in LFP and HFP birds, restrictively and ad libitum fed birds and in pelleted and mash fed birds. Data are overall means across ages.](image_url)

![Graphical representation of mean feather eating](graph_url)

<table>
<thead>
<tr>
<th>treatment</th>
<th>Test phase with access to feathers</th>
<th>Control phase</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eaten feathers (n)</td>
<td>crop 8:00h</td>
<td>crop 12:30h</td>
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<tr>
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<td>pellet</td>
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Values within columns assigned to line, feed structure (f. structure) and feeding regime (f. regime) with different superscripts differ significantly ($P < 0.05$).

1 Data are overall means across ages. BW = body weight; HFP = high feather pecking birds; LFP = low feather pecking birds; ad. lib. = ad libitum feeding; restr. = restrictive feeding.

Figure 1. Mean number of feathers eaten (and SD) at three different times of day in LFP and HFP birds, restrictively and ad libitum fed birds and in pelleted and mash fed birds. Data are overall means across ages. Durchschnittliche Anzahl gefressener Federn (und Stabw.) zu drei unterschiedlichen Tageszeiten bei LFP und HFP, restriktiv und ad libitum, mit Pellet und Mehlfütterung.
Crop size was significantly larger in the test phase compared to the control phase at 8:00 h \((P < 0.012)\) and at 17:30 h \((P < 0.001)\). Food consumption was significantly lower in the test compared to the control phase \((P < 0.002)\), while no difference in body weight was found.

**Discussion**

Assuming that feather pecking and feather eating are closely related, it was expected that HFP birds, pellet fed birds and restrictively fed birds show more feather eating. The results showed, however, that only HFP birds showed significantly more feather eating. This is in agreement with the results of McKeegan and Savory (2001) where feather peckers manipulated, picked up, and ate feathers significantly more frequently than non-peckers.

The HFP birds of the present experiment had been selected for pecking at a bunch of feathers for four generations. The effect of electronic recording of pecks or pulls at a bunch of feathers has been discussed controversially. Bessei et al. (1999) reported a high positive phenotypic correlation between visually observed vigorous feather pecking towards pen mates in the home pen and automatically recorded bunch pulling \((r = 0.82\) in HFP birds). The correlations were based on group means and not on individual data. In other studies, however, using the same device of automatic recording, an inverse relationship was found between Van Hierden et al. (2000) reported that a line, which was known for high feather pecking under group keeping conditions, showed less bunch pecking, and similar results have been reported from White Leghorn lines which had been selected for high and low feather pecking by visual observations (Kjaer, personal communication). Rodenburg and Koene (2003) found that a high feather pecking line pecked less at a bunch of feathers as compared to a low feather pecking line. But severe feather pecking in the home pen and pecking at a bunch of feathers by socially tested birds when pooled data of both lines were used, corresponded. The inconsistent results show, that in some cases the bunch of feathers may be considered as feathers and in other cases just as foraging material. The high rate of feather eating in HFP birds in the present experiment demonstrated that HFP birds are attracted by feathers as “food”.

It is generally acknowledged that pelleted feeding (El-Lethby et al. 2000) and feed restriction (Neal, 1956) increase the risk of feather pecking. This effect has been explained by reduced time spent feeding (Savory and Mann, 1997). In the present experiment neither pellet feeding nor restricted feeding increased feather eating. This may be due to the fact that in the present study the birds were housed in individual cages, and the amount and the speed of feed intake was less pronounced compared to commercial group housing conditions. It is generally known that chickens increase the speed of feed intake when kept under restricted feeding regimes and the whole daily ration is eaten within a short time. In addition, the fact that restrictively fed birds did not eat significantly more feathers in the present study, it is unlikely that birds ate feathers because they were hungry.

In previous experiments (Bessei et al., 1999) HFP birds fed on pellets showed significantly more vigorous feather pulling than LFP birds when tested with a bunch of feathers. In addition they showed a more pronounced peak in feed intake in the evening as compared to mash fed birds while no such effect was noticed in LFP birds. Aerni et al. (2000) reported that birds fed on pellets showed higher rates of feather pecking than mash fed birds. The effect of the feed structure was significant on slatted floor but not in a deep litter compartment. The effect of pellets and slatted floor on feather pecking was explained by a lack of foraging material. With regard to the present findings it can also be assumed that on slatted floor feathers may have been plucked and eaten so as to replace crude fiber supply from litter. The fact that in the present study neither pellet feeding nor restricted feeding increased feather eating indicates that feather pecking does not lead to feather eating under all circumstances.

Indeed crop size increased in all groups during time of day and reached highest volumes in the evening. Similar results have been reported by Savory (1985). HFP birds ate significantly more feathers than LFP birds and crop size was significantly larger in HFP birds at 17:30 in the test phase. Assuming that feathers were grinded in the gizzard, food was stored in the crop and this resulted in larger crops in HFP birds. Hetland et al. (2002) supposed that structural components may increase grinding efficiency of the gizzard and cause a satiety sensation. Additionally, results of Preston et al. (2000) showed that feed utilisation was improved in birds with a high gizzard weight. These findings may also be a possible explanation for reduced feed intake in the test phase compared to the control phase, while body weight was constant in the present study. That would mean feed conversion efficiency was increased in the test phase.

In conclusion, this study showed that genotype (HFP and LFP birds) has an effect on feather eating, which resulted in larger crop size.

**Acknowledgment**

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**Summary**

Recent studies have underlined the role of feather eating in the development of feather pecking in laying hens. We investigated self selection of feathers by laying hens, in response to different feed structure (pellet, mash) and feeding regime (ad libitum, restricted). Since both factors result in modification of feed intake patterns, crop size was scored. 72 adult laying hens each of a high (HFP) and a low feather pecking line (LFP) were used. They were assigned to a randomised factorial design in the test and control phase: Factor A line (HFP birds, LFP birds), factor B feed structure (pellets, mash), factor C feeding regime (ad libitum, restricted) and factor D (21, 28 and 36 weeks of age). 10 feathers were offered to the hens every morning in the test phase. The number of feathers eaten was counted three times a day. Crop size was scored by palpation at the same time in the test and control phase. Feed consumption and body weight were recorded. In the present experiment HFP birds showed significantly more feather eating. Contrary to our hypothesis neither pellet feeding nor restricted feeding increased feather eating. There was correspondence in all treatments in the increase of dilatation of crop size over the day. In the test phase crop size was significantly larger in HFP birds than in LFP birds in the evening. In conclusion, this study showed that genotype has an effect on feather eating and crop size.

**Key words**

Laying hens, feather eating, crop size, feather pecking
Zusammenfassung

Federfressen und Kropffüllung bei Legehennen


Mit zunehmender Tageszeit und über alle Behandlungen hinweg hat sich eine Zunahme der Kropfgröße gezeigt. Der Kropf war bei starken Federpickern am Abend signifikant größer.

Zusammenfassend kann man feststellen, dass die genetische Linie einen signifikanten Einfluss auf die Anzahl der gefressenen Federn und auf die Kropfgröße hat.

Stichworte

Legehennen, Federfressen, Kropfgröße, Federpicker

References


KJAER, J., 2004: personal communication


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