MEASURING PECKING OF A BUNCH OF FEATHERS IN INDIVIDUALLY HOUSED HENS: FIRST RESULTS OF GENETIC STUDIES AND FEEDING RELATED REACTIONS

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Introduction

Studies on the genetic basis of feather pecking have shown that there is sufficient genetic variation within layer strains which theoretically can be used for genetic selection (Bessei, 1984a,b; 1985; 1995; Keeling and Wilhelmson, 1995; Kjaer, 1995a; Craig and Muir, 1993). The application of behavioural traits in practical poultry breeding, however, is hampered by problems of recording and standardising the selection traits (Faure, 1981; Bessei, 1985). This holds also true for feather pecking. Since this behaviour usually occurs in short bouts, which are not very frequent and unpredictable in time, it is extremely time consuming to collect reliable data, especially when large numbers of birds have to be observed. Therefore attempts have been made to measure feather pecking automatically and under standardised conditions.

The first attempt of automatic measuring of the feather pecking activity in individually caged laying hens has been reported by Bessei (1984a). The methodology was based on observations of Cuthbertson (1980) and own unpublished experience, that chicken show high interest in, and pecked at, feathers which are presented to them by an observer. The pattern of pecking and the posture of the birds while pecking was similar to those of pecking of the feathers of their pen mates. In the following the development of the technique and results from various experiments will be reported.

Measuring pecking of a bunch of feathers as an all-or-none trait

The first experiments have been carried out by a simple computer-supported measuring device. The keels of a bunch of feathers were fitted in a metal tube and fixed on a thin piece of resilient steel so that pecking at and pulling of the feathers produced oscillation. This oscillation was recorded by a microphone and transferred into all-or-none counts. Differentiation between vigorous feather pulling (VFP) and gentle feather pecking (GFP) was not possible.

Heritability estimates of the visually recorded feather pecking during rearing and the automatically recorded pecking in the individually housed layers were of similar magnitude (.20 and .18), but both, the genetic and phenotypic correlation between the different traits was almost zero (table 1).

One of the potential causes for the lacking correlation may be the fact that there was no differentiation between different types of feather pecking behaviour. Kjaer (1995b) observed GFP and VFP separately in floor reared hens different types of feather pecking behaviour. This equipment may be the fact that there was no differentiation between vigorous feather pulling (VFP) and gentle feather pecking (GFP) automatically and under standardised conditions.

A thinner and therefore more "sensitive" resilient holder of the feather bunch was used, and the oscillations resulting from pulling or pecking were recorded by strain gauges. Special software (Visual Designer) was used which allowed to distinguish between pecking and pulling activities as distinct types of behaviour. This equipment was used in an experiment with a total of 420 pedigreed chickens of a Rhode Island layer strain. The chicks were selected from families which had shown extremely high or low pecking rates as recorded in a previous experiment. They were received at day-old and assigned to 21 groups of 20 individuals each, 11 groups of the low pecking and 10 groups of the high pecking line. The groups were kept in deep litter pens from 1 day-old to 26 weeks of age. Behavioural observations were made visually from 21 to 26 weeks of age. Thereafter the birds were transferred into individual cages, and GFP and VFP were recorded by the above mentioned device separately. The mean values of the high and low pecking lines (HPL and LPL) were significantly different for visually observed VFP and both, GFP and VFP of the bunch of feathers. The means for visually observed GFP did not differ significantly among lines (table 2).

The Spearman rank correlation coefficients for all traits are shown in table 3. The correlation between visually and automatically recorded pecking activities was generally lower within the low pecking line. Visually observed and automatically recorded VFP was highly correlated (r = .82) in the high pecking line. The correlation coefficients between GFP and VFP were generally of positive direction.

<table>
<thead>
<tr>
<th>Traits</th>
<th>FPvis</th>
<th>BPvis</th>
<th>FPaut</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPvis</td>
<td>.20</td>
<td>.08</td>
<td>-.04</td>
</tr>
<tr>
<td>BPvis</td>
<td>.25</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>FPaut</td>
<td>.18</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Heritabilities and genetic correlation of visually observed feather pecking (FPvis), being pecked (BPvis) and automatically recorded pecking towards a bunch of feathers (FPaut) in a tinted layer strain (Bessei, 1984b)

Table 2: Mean frequencies of visually observed gentle and vigorous feather pecking (GFVis;VFVis), automatically recorded gentle and vigorous feather pecking (GFPaut;VPaut) of a bunch of feathers in two lines selected for high and low feather pecking (HPL, LPL) in a previous experiment

<table>
<thead>
<tr>
<th>Lines</th>
<th>GFVis</th>
<th>VFVis</th>
<th>GFPaut</th>
<th>VPaut</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPL</td>
<td>.335</td>
<td>1.124</td>
<td>4.065</td>
<td>6.816</td>
</tr>
<tr>
<td>LPL</td>
<td>.326</td>
<td>.876</td>
<td>2.138</td>
<td>3.924</td>
</tr>
<tr>
<td>Significance</td>
<td>n.s.</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

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Feeding pellets to laying hens and turkeys has proved to stimulate feather pecking and cannibalism (Jensen et al., 1963). The increase of feather pecking in response to pelleted feeding was thought to be the result of a compensatory effect to the reduced feed pecking activity. The mean values of feeding activity and feather pecking seem to support this hypothesis. The circadian rhythms of feed related pecking and feather pecking of the HPL showed the same results. In the pellets fed HPL there was only a small peak of FA in the morning while both, VFP and GFP activities were high at that time. When mash was fed, there were high peaks in FA in the morning and the evening. VFP remained at a low level throughout the day while GFP showed a high peak in the morning.

The circadian pattern of FA in the LPL was similar on both feed types. The level of VFP and GFP in this line was very low and now clear circadian rhythm was developed.

The inverse relationship between feed intake and feed-related pecking indicates that feed intake per time unit was higher in the pellet fed birds in the morning. It can be assumed that the birds were satiated within short time, either by the filling of the crop or by activation of physiological satiation mechanisms in the hypothalamus. The motivation for pecking may persist under these conditions and pecking activity may be redirected to the feathers of group mates or to the feather bunches. Redirection of feed pecking to feather pecking has been reported by various authors. Huber-Eicher and Wechsler (1997) could demonstrate that deep litter (straw) distracted the pecking activity from the feathers to the litter. Similarly Blokhuis and van der Haar (1992) found that pecking activity of the litter reduced pecking of the feathers.

The hypotheses of feather pecking as redirected feed pecking does not apply in the comparison of the HPL and LPL lines, which differed in their feather pecking activities but not in their feed pecking activity. HPL hens did not respond to pelleted feed by increased GFP as did the LPL hens.

### Response to high fibre and high sand diets

Bulk feed requires more feed pecking activity and may reduce feather pecking in concurrence with the compensation theory. In two experiments the pecking towards the feather bunches was recorded in LPL and HPL hens fed isocaloric and isonitrogenic diets containing different levels of fibre or ash through the inclusion of 10 % of oat shells or sand respectively (table 5). Both treatments increased the feed intake as compared to the control feed (tables 6 and 7). Both, VFP and GFP were increased in response to the inclusion of sand but level of significance was reached in the HPL hens only. The energy requirement of the individual hens as calculated on the basis of body weight, egg output and body weight gain (Emmans et al. 1975) showed that there was an overconsumption of 18.7 and 27.8 % resp. in the sand treatment of the HPL and LPL. The inclusion of oat shells produced similar but not significant effects in feed intake and overconsumption of energy. The energy intake in the control group was lower than estimated. There was also a considerable increase in feather pecking activity of the HPL birds which received the oat shell diet, but the differences were not significant in this case.
Table 5: Nutrient composition of the experimental diets; the figures in brackets represent the results of chemical analysis (after Bley, 1998)

* without sand

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Sand</th>
<th>Oat shells</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>15.8 (15.8)</td>
<td>15.8 (16.5)</td>
<td>15.8 (16.1)</td>
</tr>
<tr>
<td>ME</td>
<td>10.2 (10.1)</td>
<td>10.2 (10.4)</td>
<td>10.2 (10.1)</td>
</tr>
<tr>
<td>CF</td>
<td>7.8 (5.6)</td>
<td>7.3 (4.3)</td>
<td>7.3 (10.9)</td>
</tr>
<tr>
<td>Ash</td>
<td>12.6 (13.9)</td>
<td>12.6* (23.2)</td>
<td>12.4 (14.7)</td>
</tr>
<tr>
<td>Fat</td>
<td>3.9 (4.1)</td>
<td>11.1 (11.0)</td>
<td>11.1 (11.5)</td>
</tr>
</tbody>
</table>

Figure 1: Ciradian rhythms of feeding activity (FA) in seconds per hour, VFP and GFP of HPL and LPL hens in response to mash and pelleted feed (after Zeeb, 1998)

Table 6: Feed intake and pecking at a feather dummy of laying hens of a high (HPL) and low (LPL) feather pecking line in response to the inclusion of the 10 % oat shells

<table>
<thead>
<tr>
<th>Feed intake (g/day)</th>
<th>Vigorous pulling (n/day)</th>
<th>Gentle pecking (n/day)</th>
<th>Energy intake in % of estimated requi.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPL Oat shells</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>133</td>
<td>247 a</td>
<td>128 a</td>
</tr>
<tr>
<td></td>
<td>129</td>
<td>179 a</td>
<td>78 a</td>
</tr>
<tr>
<td>LPL Oat shells</td>
<td>154</td>
<td>38 a</td>
<td>11 a</td>
</tr>
<tr>
<td>Control</td>
<td>131</td>
<td>62 a</td>
<td>29 a</td>
</tr>
<tr>
<td>Group means</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oat shell Control</td>
<td>142</td>
<td>152 A</td>
<td>75 A</td>
</tr>
<tr>
<td>HPL</td>
<td>131</td>
<td>213 x</td>
<td>103 x</td>
</tr>
<tr>
<td>LPL</td>
<td>142</td>
<td>213 x</td>
<td>103 x</td>
</tr>
<tr>
<td>Overall Means</td>
<td>136</td>
<td>139</td>
<td>65</td>
</tr>
</tbody>
</table>
If we assume that higher feed intake increases the need for feed pecking, and that bulky feed such as finely ground oat shells further increase the feed related pecking activity, it may be expected according to the above mentioned compensation theory, that feather pecking is reduced under such feeding conditions. The present results show that bulky feed - in contrast to the expectation - increased the tendency of pecking towards the feathers.

It has been demonstrated in various experiments that the inclusion of oats which contains high amounts of fibre reduces the incidence of mortality through cannibalism (Seemann, 1982) and/or improves the quality of the feathers. Present results show that bulky feed - in contrast to the above mentioned compensation theory, that feather pecking activity, is an adequate theory. The inclusion of sand and oat shells have been found in the LPL. The inclusion of 10% of oat shells or similar results while no such compensation could be found in the LPL. The inclusion of 10% of oat shells or sand to an iso-caloric and isonitrogenic diet produced a considerable increase in feed consumption and over-consumption of energy. Although feed pecking activity was not recorded in this experiment it was obvious that higher feed intake and the bulkiness of the oat shell diets increased necessarily the feed pecking activity in comparison with the control diet. Nevertheless the feather pecking activity of the HPL birds was increased considerably in the oat shell and sand rich diets. This result is in contrast with the expected compensation mechanisms which has been assumed in the previous experiments with a pelleted diet. The increase in feather pecking in this case may be explained by a mild deficiency of amino acids.

HPL hens were generally lighter (about 100-150 g) than the LPL birds. The interrelationships between body weight and feather pecking are not consistent throughout the results which have been reported in the literature. Positive genetic correlation coefficients indicating a higher pecking activity in heavier birds have been found by Bessei (1984b) in pullets. Kjaer and Soerensen (1997) reported negative genetic correlations of body weight and performing feather pecking in 51 weeks old layers. The authors suggested selection for smaller body size may increase the risk for feather pecking, which is in line with the present findings.

### Conclusions

The experiments have shown that measuring pecking activity of a feather dummy is a useful tool to identify the tendency of feather pecking of individually caged hens. It may be used to reduce the incidence of feather pecking and cannibalism in layer breeding programs, and to elucidate the reaction of hens to specific experimental conditions, such as feed structure and composition of the diets. With regard to the imprdictability of feather pecking in commercial hybrids it is recommended to produce laboratory lines with high and low tendency for feather pecking for particular experiments.

First experiments using HPL and LPL hens as selected by the frequency of pecking of a feather bunch showed that HPL hens increased VFP when fed a pelleted diet. This was expected from earlier experience comparing feather pecking in response to pelleted feed in cages and in deep litter systems. These results confirm the earlier assumption that feather pecking may be a compensatory reaction for a reduced need of feed pecking on the pelleted diet. Studies on the circadian rhythm of feed pecking and feather pecking in the HFP line showed similar results while no such compensation could be found in the LPL. The inclusion of 10% of oat shells or sand to an isocaloric and isonitrogenic diet produced a considerable increase in feed consumption and over-consumption of energy. Although feed pecking activity was not recorded in this experiment it was obvious that higher feed intake and the bulkiness of the oat shell diet increased necessarily the feed pecking activity in comparison with the control diet. Nevertheless the feather pecking activity of the HPL birds was increased considerably in the oat shell and sand rich diets. This result is in contrast with the expected compensation mechanisms which has been assumed in the previous experiments with a pelleted diet. The increase in feather pecking in this case may be explained by a mild deficiency of amino acids of the unconventional diets.

The fact that the HPL and LPL hens reacted in a different way to feed structure, sand and fibre, is consistent with the genotype-feed interactions which have been found in other experiments. It seems that the HPL hens react more sensitively to unconventional structure and composition of the feed than LPL hens.

### References


Bessei, W., G. Klingler and B. Peitz, 1984: Das Verhalten...
von Legehennen unter dem Einfluß der Leistungs-
selektion in Boden-und Käfighaltung. Archiv f. 
Geflügelkunde, 48, 29-35.

Bessei, W., 1984a: Genetische Beziehung zwischen 
Leistung, Befiederung und Scheu bei Legehennen. 
Arch. Geflügelk., 48, 231-239.

Bessei, W., 1984b: Untersuchungen zur genetischen 
Basis des Federpickens beim Huhn. 17. World's 
Poultry Congress, Helsinki, 458-459.

Bessei, W., 1985: Pecking and feather loss - genetical 
211-218.

Bessei, W., 1995: Genetics of feather pecking. 2nd Euro-
pean Poultry Breeders Roundtable.

Bley, T., 1998: Einfluß des Rohfasergehaltes im Futter 
auf das Federpickverhalten und das Futteraufnah-
merhalten von Legehennen. Diplomarbeit, Institut 
für Tierhaltung und Tierzüchtung, Universität Hohen-
heim.

Blokhuis, H. J., 1991: Effects of rearing conditions on 
feather pecking in laying hens. Applied Animal 

Craig, J. V. and W. M. Muir, 1993: Selection for reduction 
of beak-inflicted injuries among caged hens. Poul. 
Mar, 72, 411-420.

Cuthbertson, G. J., 1980: Genetic variation in feather 

Sci., 18, 711-714.

feeding of laying fowls in battery cages. Gleadthorpe 
Experimental Husbandry Farm. Poultry Booklet. 
MAFF.

Denmark, 37-41.

Huber-Eicher, B., 1997: Feather pecking in domestic 
chicks: its relation to dustbathing and foraging. 
Animal Behav., 54, 757-768.

Jensen, C. S., L. H. Merrill, C. V. Keddy and J. McGinnis, 
1962: Observations of eating patterns and rate of 
foood passage of birds fed pelleted and un pelletet 

Keeling, L. and M. Wilhelmsson, 1995: unveröffentlichtes 
Manuskript.

Kjaer, J. B., 1995a: Strain differences in feather pecking 
behaviour and floor laying in hens kept in aviaries. 
Proc. of the 29th International Congress of the Inter-
national Society for Applied Ethology Exeter, UK, 
191-193.

Kjaer, J. B., 1995b: Light intensity affects feather pecking 
behavior in chickens. 1st North American Sympos-
i um on Poultry Welfare, Edmonton, Canada.

Kondra, P. A., J. L. Sell and W. Guenther, 1974: Response of 
meat- and egg-type chickens of a high fiber diet. 

Moran, E. T., E. J. and E. Evans, 1977: Performance and 
nutrient utilization by laying hens fed practical rations 