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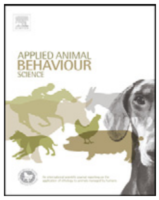

Fearfulness and feather damage in laying hens divergently selected for high and low feather pecking

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ABSTRACT

Feather pecking (FP) remains a major welfare and economic problem in laying hens. FP has been found to be related to other behavioural characteristics, such as fearfulness. There are indications that fearful birds are more likely to develop FP. Furthermore, FP can lead to increased fearfulness in the victims. To investigate further the relationship between FP and fearfulness, feather damage and behavioural fear responses were recorded in three White Leghorn lines of laying hens: a line selected for high FP (HFP line), a line selected for low FP (LFP line) and an unselected control line (10th generation of selection). We used 64 birds per line housed in 16 four-bird cages (cage was the experimental unit). At 25 weeks of age, birds were subjected to a tonic immobility (TI) test and a combined human approach (HA) and novel object (NO) test, and plumage condition was recorded. Line differences in fear responses between the HFP and LFP lines were not found, neither in the TI-test, nor in the HA or NO test. As expected, birds from the HFP line had considerably more feather damage than birds from the LFP line and birds from the unselected control line were intermediate. Cages that withdrew from the NO 30 s after placement had more feather damage on the back compared with cages that did not show a withdrawal response. These results suggest that although relationships were found between feather damage and fear response at cage level, lines divergently selected on feather pecking behaviour do not differ in their fear responses. Divergent selection on feather pecking may have altered pecking motivation rather than fearfulness.

1. Introduction

Feather pecking (FP) remains a major welfare and economic problem in laying hens. The occurrence of severe feather pecking in a flock results in feather damage, increased feed consumption, increased mortality rates and decreased egg production (Lambton et al., 2010). One promising way to reduce FP is by means of genetic selection (Jones and Hocking, 1999; Buitenhuis and Kjaer, 2008; Jensen et al., 2008; Rodenburg et al., 2008). It has been shown that FP has a heritable component, with heritabilities ranging from 0.07 to 0.56 (Cuthbertson, 1980; Bessei, 1984; Kjaer and Sørensen, 1997; Rodenburg et al., 2003). Kjaer and colleagues have shown that direct selection on FP is feasible. They created high (HFP) and low (LFP) FP lines, by selecting divergently on the trait 'number of bouts of gentle and severe FP per bird per hour' measured by direct observation (Kjaer and Sørensen, 1997; Kjaer et al., 2001). From the second generation onwards, HFP birds showed more FP than LFP birds (Kjaer et al., 2001).

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FP has been found to be related to other behavioural characteristics, such as fearfulness (Jensen et al., 2005). There are indications that fearful birds, that are less active in an open field test as chicks, are more likely to develop FP as adults (Rodenburg et al., 2004). Similarly, chicks from a line that showed little FP were more active in an open field than chicks from a line that showed high levels of FP (Jones et al., 1995). Low activity in the open-field test indicates fearfulness or a low exploratory motivation in laying hen chicks (Forkman et al., 2007). At the same time, FP can also lead to increased fearfulness in the victims, as indicated by results from a tonic immobility (TI) test: damaged hens had a longer duration of TI than undamaged hens (Hughes and Duncan, 1972; Vestergaard et al., 1993).

Fear responses can be assessed in various ways in laying hens, although the only tests that have been validated to measure fearfulness in laying hens are the open field test and the TI test (Forkman et al., 2007). Uitdehaag et al. (2008) used a combination of a human approach (HA) test and a novel object (NO) test to assess fear responses at cage level in a large number of cage-housed laying hens from 12 different genetic lines. They found that groups of birds from a White Leghorn origin developed more feather damage than birds from a Rhode Island Red origin and showed increased withdrawal responses from the NO over time (Uitdehaag et al., 2008).

When birds are subjected to various behavioural tests it elucidates the relationships between the tests as well as the underlying traits that may cause the individual differences in response. When birds from a selection experiment, selected on low mortality in group housing, were compared with birds from an unselected control line they were found to be more active in an open field as chicks (Rodenburg et al., 2009b). They were also found to be less fearful of humans, they struggled more during manual restraint (Bolhuis et al., 2009) and had lower corticosterone levels after manual restraint (Rodenburg et al., 2009a) than control birds. Furthermore, changes in the serotonergic system, which is involved in coping with fear and stress (Metzger et al., 2002), were found already after two generations of selection (Bolhuis et al., 2009). In the latter study, half of the birds from each line was beak trimmed. Beak trimming prevented development of feather damage, and led to a reduction in fearfulness in beak trimmed birds. This confirms that fearfulness can be influenced by the development of severe feather pecking and feather damage, as was found in previous studies (Hughes and Duncan, 1972; Vestergaard et al., 1993).

The aim of this study was to investigate fearfulness and feather damage of laying hens that were divergently selected for their FP behaviour for 10 generations. We hypothesized that hens from the LFP line are less fearful than hens from the HFP line. To test this hypothesis, hens from the HFP and LFP lines and from an unselected control line were tested in different behavioural tests, i.e. a TI test and a combined HA and NO test. Furthermore, their feather damage was assessed and relationships between fear responses and feather damage were studied.

2. Material and methods

2.1. Animals

In this study we used 192 White Leghorn laying hens from three different lines: 64 from the high FP (HFP) line, 64 from the low FP (LFP) line and 64 from the unselected control line. These lines originate from a selection experiment, in which divergent selection on FP was performed for 10 generations. In the present experiment offspring from the 10th generation of selection were used. Selection of the birds' parent stock was based on the sum of bouts of gentle and severe FP behaviour per hour in a social FP test (180 min in observation pens) at 30 weeks of age (Kjaer et al., 2001). The birds used for this experiment were housed in floor pens from 0 to 18 weeks of age (all three lines mixed, approximately 25 hens/8 m^2 pen). Hereafter, hens were moved to conventional battery cages where they were housed in four-bird cages with birds from the same line, resulting in 16 cages per line. From 18 to 25 weeks of age, birds were not tested and could adapt to their new housing environment. Cages were located on either row of the two-tier system, and the three lines were distributed equally between and along the two rows. The bottom row was located 70 cm above floor level and the top row 130 cm above floor level. Cages with birds from the same line were never housed next to or on top of each other. Birds had *ad libitum* access to water and commercial food pellets (crude protein 16%, and energy content 11.1 MJME/kg) in their home cages throughout the experiment. Lights were on from 6:00 till 18:00. These were of low intensity (approximately 12 lux at ground level), to minimize FP occurrences. This experiment was carried out under supervision of licensed and authorized personnel under approval of the Faculty of Agricultural Sciences at Aarhus University.

2.2. Human approach and novel object test

At 25 weeks of age, a combined human approach (HA) and novel object (NO) test was performed. This test was described in detail by Uitdehaag et al. (2008). In brief, the behavioural response (one score per cage) to an approaching person, to placement of a NO, and to that same NO 30 s after placement were measured. A brown pencil with a white tip was used as NO. First, a person stepped in front of the cage and recorded the response (1 = withdrawal, 2 = immobility, 3 = approach). After 10 s, the NO was placed on the feed trough, with the white tip pointing into the cage, and the immediate response to the placement of the object was recorded using the same scale as for the approaching person. Finally, the response to the NO 30 s after placement was recorded, again on the same three-point scale. All three responses were recorded at cage level, with the cage response reflecting the response of the majority of the birds in the cage (Uitdehaag et al., 2008). One experimenter tested all cages in about 2 h between 10:00 and 12:00. Cages tested consecutively were always separated in space by at least four cages to minimize pretest disturbance. The experimenter alternated between cages from the top and from the bottom row. At the end