Rocz. Nauk. Zoot., 45, 2 (2018) 143–150

FACTORS AFFECTING THE DEVELOPMENT OF FEATHER PECKING IN LAYING HENS*

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The intensive poultry production methods currently in use, aimed to maximise economic return, rely on the latest technological solutions that facilitate labour and increase productivity of birds. In general, however, they do not fully correspond to the natural needs of birds by limiting their instincts or normal behavioural patterns. This results in stress reactions which are usually manifested in pathological behaviours known as stereotypies, which present a significant health and economic problem. The most common pathological behaviours in poultry include feather pecking and cannibalism. Numerous studies have shown that stereotypic behaviours are a complex issue and depend on many factors, while the possible introduction of an EU ban on beak trimming in chickens makes the issue of feather pecking and cannibalism increasingly relevant in poultry rearing.

Key words: pathological behaviours, rearing conditions, stress, genotype

Domestication of animals has caused changes in both their anatomy and physiology, and, secondarily in the environment they are kept in (Brunberg et al., 2016). Contemporary poultry rearing, characterised by high stocking density, absence of a free range, movement restriction and considerable mechanisation does not allow the birds to manifest their innate instincts, thus causing frustration and provoking non-typical behavioural patterns known as stereotypies.

One of the most frequent behavioural disorders in laying hens with significant impact on their welfare is feather pecking (Sun et al., 2014; Hartcher et al., 2015; Brunberg et al., 2016; Giersberg et al., 2017; Birkl et al., 2018; Hu et al., 2018; Mellor et al., 2018). Two primary types of feather pecking behaviours have been characterised: gentle feather pecking, limited to a single location on a feather, where feather endings are gently pecked at or nibbled, and severe feather pecking, which involves vigorous pecking at and removal (eating) of feathers, resulting in destroyed plumage, development of wounds and bleeding. Severe feather pecking may turn into cannibalism in the final phase (Sun et al., 2014; Urban- -Chmiel, 2014; Daigle et al., 2015, Brunberg et al., 2016; Jung and

* The study was financed from the statutory funds, task: 01-12-04-11.

Knierim, 2018; van der Eijk et al., 2018; Zepp et al., 2018). The phenomenon does not apply exclusively to mature laying hens, but is also common among chicks and pullets (Gilani et al., 2013; Zepp et al., 2018).

Feather pecking and cannibalism are linked to stress and fear, and present a serious problem connected with the birds' well-being (de Haas et al., 2013; Heerkens et al., 2015; Janczak and Riber, 2015; Giesberg et al., 2017; van der Eijk et al., 2018). Additionally, they are perceived as a serious economic issue. Urban-Chmiel (2014) states that losses suffered by the world's poultry production due to cannibalism range from 10% up to 40% in extreme cases and are primarily related to destroyed plumage, increased forage consumption, greater mortality rate and considerable decrease in egg-laying performance (Gilani et al., 2013; Heerkens et al., 2015; Daigle et al., 2015). Also, Sun et al. (2014) and Peeters et al. (2012) report serious economic losses due to feather pecking and cannibalism.

Although many of these behaviours have received considerable research, the reasons behind feather pecking remain unclear. A literature review shows that feather pecking is attributable to a number of factors including flock size, stocking density, rearing system, stress, foraging, substrate type and genetic features (Gilani et al., 2013; Rodenburg et al., 2013; Daigle and Siegford, 2014; Daigle et al., 2015; Brunberg et al., 2016; van der Eijk et al., 2018).

Environmental factors and foraging

Feather pecking and cannibalism remain serious concerns in all rearing systems (Giersberg et al., 2017; Birkl et al., 2018), including organic farms (Bestman and Wagenaar, 2014). The feather pecking frequency and chicken mortality due to cannibalism is bigger in non-cage systems (Heerkens et al., 2015; Giesberg et al., 2017; Jung and Knierim, 2018), even though such systems are generally more bird-friendly, offering more space and allowing the birds to move naturally. Heerkens et al. (2015) and Gilani et al. (2013) suggest that this is because birds kept in cages (in smaller groups) are easier to control and the pecking specimen can be identified and removed from the flock faster than in non-cage henhouses. Additionally, in non-cage systems, there are more potential victims exposed to attacks of a single bird than in cages (Rodenburg et al., 2004a). Campo et al. (2013) reported higher mortality of egg-layers kept in free-range systems due to feather pecking and cannibalism compared to systems with no access to free ranges. On the contrary, Grafl et al. (2017) proved that free-range chickens had better plumage and better feather condition in the summer. His conclusions are consistent with research by Bestman and Wagenaar (2014), who showed that access to a free range is favourable to chickens, as environment enhancement reduces the prevalence of feather pecking. Other studies also confirmed that environment enhancement through the incorporation of materials encouraging the birds to find food reduces the incidence of feather pecking (Gilani et al., 2013; Daigle and Siegford, 2014; Zepp et al., 2018). Nevertheless, when interpreting the studies on impact of enhancing the birds' environment on feather pecking intensity, Hartcher et al. (2015) showed that the type and timing of the

enhancement are of crucial importance. In their research, they reported no impact of environment enhancement through scattering around whole oat grains, hanging out a string at the birds' head level or using additional bedding on the improvement of plumage in egg layers in the 43rd week of life. In the opinion of the authors, this may have been due to a too late introduction of the enhancement (from the 12th day of the rearing), since experiences from the earliest periods of life are crucial for the potential development of feather pecking tendency in mature birds (Mellor et al., 2018). Some researchers link feather pecking to the lack of early access to bedding. Bestman et al. (2009) proved that chicks with limited access to bedding in the first month of life manifest increased feather pecking tendencies in adult age. Similarly, Haas et al. (2014a) stated that disrupted or limited access to bedding in early life enhances fearfulness, feather damage and severe feather pecking in later periods.

Bestman et al. (2009) suggest that in order to reduce feather pecking incidence in chickens, chicks need to be reared in small flocks. Other studies, however, do not confirm the relationship between stock density and feather pecking whether in the rearing or production period (Gilani et al., 2013; Huo and Na-Lampang, 2016). Zepp et al. (2018) report that aggressive pecking is most frequent in small flocks with low stocking density, as in bigger flocks with denser stocking the birds are unable to establish a social hierarchy due to the large number of specimens, as a result of which chickens show no aggressive behavioural patterns.

There is abundant research devoted to the impact of light intensity on feather pecking incidence in laying hens. When comparing groups of chickens reared with luminous intensity of 5 and 30 lx, Kjaer and Vestergaard (1999) observed more severe feather pecking in the group where more intense lighting was used. Gentle pecking was in turn more frequent in conditions with low light intensity. Three years later, however, Kjaer and S0rensen (2002) reported no impact of higher light intensity (10 lx compared to 3 lx) on the development of feather pecking behaviours and cannibalism in chickens. Similarly, Hartini et al. (2002) confirmed that there was no connection between light intensity (60-80 lx compared to 5 lx) and cannibalistic behaviours of young hens in pre-laying and early laying periods. Going further, Janczak and Riber (2015) found that exposure of laying hens on daylight did not increase the risk of loss of plumage, while in research by Gilani et al. (2013) the risk of severe feather pecking in young hens grew together with reduction of the time during the day when the henhouse was illuminated.

It is commonly believed that crude protein, amino-acid or mineral deficiency in diet leads to pathological behaviours in chickens, including feather pecking (Kjaer and Bessei, 2013; Brunberg et al., 2016; Mellor et al., 2018). Although in this case the pecking can be easily and effectively eliminated through supplementing the birds' diet with the deficient ingredients, the already damaged feathers may give the birds an incentive to continue pecking (Brunberg et al., 2016). Rodenburg et al. (2013) maintain that severe feather pecking may be motivated by inappropriate fibre content in diet. Here, the primary motivation

behind pecking is eating the feathers, since ingested feathers have been shown to speed up food passage in the same way that fibre does (Rodenburg et al., 2013; Brunberg et al., 2016), thus making the birds feel satiated.

Numerous studies have shown that the structure of forage fed to birds (Kjaer and Bessei, 2013), diet changes in the rearing period (Gilani et at., 2013) and types of feed trays used (Gilani et al., 2014) may favour feather pecking tendencies in laying hens. On the contrary, a study by Hu et al. (2018) suggests that incorporation of probiotics into diet has a positive influence on mitigation of agonistic behaviours in layers through modification of their serotonergic system, with no negative impact on production performance.

Genetic and physiological determinants

Van der Eijk et al. (2018) have reported a connection between fear and feather pecking in birds. Many authors have emphasised in their research that the level of stress and fearfulness in chickens and their predisposition towards feather pecking tendency may be linked to their genetic background. Feather pecking expression and cannibalistic behaviours are observed in both pure-bred chickens and commercial crossbreds (Giersberg et al., 2017). De Haas et al. (2013) report that commercial lines of white-feathered egg-layers show longer tonic immobility (TI) and have higher blood corticosterone in response to stressful stimuli compared to brown-feathered chicken lines. Consequently, Leghorns reared in conventional cages were reported to be more stressed and have worse feathering due to feather pecking than Rhode Island Red Chickens (Uitdehaag et al., 2008). Additionally, blood serotonin in Leghorns was lower than in RIR (Uitdehaag et al., 2011), a fact associated with more pronounced fearfulness, feather pecking tendency and aggression (Daigle et al., 2014; Urban-Chmiel, 2014). Rodenburg et al. (2004b) found a strong negative correlation between the activity of pullets in an open field test of fear and the incidence of severe pecking in adult age, meaning that fearful pullets are more vulnerable to develop feather pecking in adult life. Similarly, De Haas et al. (2014b) and Grams et al. (2015) showed that fear in young birds is one factor that influences feather pecking tendency in adult life. On the other hand, Van der Eijk et al. (2018) concluded that chickens manifesting severe feather pecking tendency were more active in behavioural tests than chickens from the same genetic line manifesting gentle feather pecking, a fact suggesting that they were less fearful. Similar results were obtained by Bogelein et al. (2014) and Kops et al. (2017), whereas Rodenburg et al. (2010) found no differences in behaviours of birds with severe and gentle feather pecking tendency subjected to behavioural testing. The differing results obtained show the need for further studies on the correlation between fearfulness and feather pecking tendency in different chicken populations.

According to Hughes (1973), feather pecking exacerbates together with an increase in sex hormone levels (progesterone and oestrogen), suggesting that the onset of egg laying is crucial for the development of feather pecking in layers. Vestergaard et al. (1997) found a positive correlation between feather pecking and

serum corticosterone concentration. Likewise, El-lethey et al. (2001) reported increased feather pecking in barn-farmed birds fed with forage containing corticosterone. On the contrary, when comparing corticosterone content in adult chickens manifesting gentle and severe feather pecking tendencies, Korte et al. (1997) found out that birds from the second group had higher content of the hormone in their blood. Similar results were obtained by van Hierden et al. (2002) in their experiment on pullets aged 14 and 28 days.

In studies on pathological behaviours, attention was also paid to the role of neurotransmitters such as noradrenaline, serotonin and dopamine (Kops et al., 2017; Mellor et al., 2018). Kops et al. (2017) stated that increased dopamine and serotonin release by the body suppressed feather pecking. The results obtained by van Hierden et al. (2001) and by van Hierden et al. (2004) suggest that pullets with severe feather pecking tendency had lower serotonin and dopamine levels compared to pullets manifesting gentle feather pecking. However, research on adult chickens pointed to the opposite: specimens with severe feather pecking tendency had higher serotonin and dopamine turnover rate in virtually all brain regions than birds manifesting gentle feather pecking tendency (Kops et al., 2017).

Moreover, academic literature finds links between feather pecking and the immune system (Brunberg et al., 2016; Mellor et al., 2018). Brunberg et al. (2016) state that in commercial egg-layer flocks severe feather pecking is often observed secondary to the birds' infection with *E. coli* or to the incidence of chronic enteritis in the flock. Parmentier et al. (2009) found that both upon the induction of specific resistance in young birds and following the application of a standard vaccination regime, at an older age chickens were more exposed to severe plumage destruction due to feather pecking than in the control group.

The aforequoted literature suggests that feather pecking is a frequent problem in egg-layer rearing, as it applies to all farming systems and is correlated with a number of environmental, genetic and physiological factors. Additionally, the prevalence of feather pecking and cannibalism is likely to increase with the planned introduction of a ban on beak trimming in chickens by the EU, which is now successfully used as a pecking prevention measure. Therefore, we need further research on feather pecking in order to learn the reasons for and manifestation of the phenomenon, as well as its impact on the birds' welfare and health in more depth, and to be able to elaborate preventive methods or measures that will enhance the well-being of birds suffering from the disorder.

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Accepted for print on 11 January 2019

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SUMMARY

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