doi:10.1017/S004393391300086X

Injurious pecking in domestic turkeys: development, causes, and potential solutions

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Injurious pecking is a serious concern for commercial turkey production and welfare. The behaviour is thought to represent re-directed ground foraging, but the development and causes are poorly understood with little supporting literature. In the initial development of the behaviour, early lighting regimes and social facilitation may play contributing roles. Other factors such as the availability of foraging material, diet composition, stocking densities, and group dynamics may also affect levels of injurious pecking. Given that commercial turkeys are group-housed, alternative breeding techniques, like group selection based on social effects, might successfully reduce moralities from pecking without detracting selection pressure from economic traits. However, to better suit their behavioural needs, any genetic attempts to adapt turkeys to perform less injurious pecking should be done in combination with environmental and dietary improvements.

Keywords: injurious pecking; turkey; genetic selection; environment; nutrition; feather pecking; cannibalism; head pecking

Introduction

Injurious pecking is a significant welfare concern for raising turkeys in commercial facilities. The resulting injuries are responsible for the majority of culls and are a leading cause of mortality in adult turkeys (Hocking, 1993; Sherwin *et al.*, 1999; Duggan *et al.*, 2011). Very little is known about the development of, and relationships between, the multiple factors influencing this abnormal behaviour in turkeys. Research in laying hens has provided the basis for knowledge on pecking in group-housed poultry and this has been extrapolated to other domestic poultry. However, any attempts to reduce injurious pecking in turkeys will likely have limited success until the causation of the behaviour in this species is better understood.

To best assess strategies to decrease injurious pecking, we need to clarify the different

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World's Poultry Science Journal, Vol. 69, December 2013
Received for publication March 11, 2013
Accepted for publication May 6, 2013

https://doi.org/10.1017/S004393391300086X Published online by Cambridge University Press

types exhibited by turkeys (severe feather pecking, head pecking, and cannibalism) and the factors contributing to the development such as environment, genetics, and nutrition. With this information it should be possible to design strategies to reduce injurious pecking, to lead to improvements in both welfare and production.

Defining injurious pecking

Injurious pecking in turkeys can be divided into three types of problem behaviours: head pecking, severe feather pecking, and cannibalism. All three types have a negative impact on the welfare of the commercial turkey (Denbow *et al.*, 1984; Sherwin *et al.*, 1999). The first, head pecking (or aggressive pecking), is a form of aggression that typically follows a social disturbance, and is often used to retain dominance (Savory, 1995; Moinard *et al.*, 2001). This type of pecking is usually directed at the head, neck and/or snood of subordinate birds (Buchwalder and Huber-Eicher, 2003).

In contrast, feather pecking involves the repeated pecking or plucking of another bird's plumage, usually targeting feathers on the back, tail, base of the tail, and the wings. It sometimes includes the removal and consumption of the feathers (Savory, 1995). Since there are several ways a turkey may peck another, difficulty arises in distinguishing between the different types of pecking behaviour. Feather pecking is not always destructive and can be a form of social preening (Savory, 1995; Jendral and Robinson, 2004). Gentle pecking of other birds is a mild, social, investigatory behaviour directed at food particles or debris on the plumage (Savory, 1995; Hughes and Grigor, 1996). When pecking becomes more forceful, concluding with the removal and possible consumption of pulled feathers, the behaviour is considered severe. Severe feather pecking often results in plumage damage, feather loss, a distressed vocalisation, and the damaged turkey moving away to escape further pecking (Denbow *et al.,* 1984; Savory, 1995).

If bleeding occurs at the site of feather pecking, cannibalism often develops (Hale and Schein, 1962). Cannibalism in poultry refers to the repeated pecking of the exposed skin of another bird, leading to haemorrhaging, and the removal of blood and tissue, which may then be consumed by the pecking bird (Hale and Schein, 1962; Savory, 1995). Cannibalism can also manifest independently of feather pecking following aggressive pecking of denuded areas or the feet (Ensminger, 1992; Savory, 1995). All three forms of injurious pecking contribute significantly to animal suffering and production inefficiency in turkey rearing and must be addressed (Hocking, 1993; Sherwin *et al.*, 1999).

Development of injurious pecking

EARLY LIGHTING ENVIRONMENT AND ENVIRONMENTAL STABILITY

There is no consensus as to the reasons that social preening becomes destructive. It may be related to a mismatch between the behavioural needs of the growing turkey and features of the early environment (Hughes and Grigor, 1996; Sherwin *et al.*, 1999). In the first week of life, the appearance of ultraviolet (UV) feather markings on the wings and tails are temporally and spatially linked to the onset and initial targets of damaging pecking (Sherwin and Devereux, 1999; Moinard *et al.*, 2001). Most commercial facilities operate under fluorescent or incandescent lighting with a minimal UV content, so the distorted appearance of emerging UV feathers in young turkeys may become targets for investigatory pecking (Moinard and Sherwin, 1999).

Frequent fluctuations in the early environment of chickens have also been linked with

https://doi.org/10.1017/S004393391300086X Published online by Cambridge University Press

the initial appearance of feather pecking and could potentially have a similar impact in turkeys (Ensminger, 1992; Jendral and Robinson, 2004). In chickens, rough handling or disruptive events, like frequent changes to staff, temperature, or diet, can increase flock nervousness and cause birds to exhibit a heightened fear response (Ensminger, 1992; Jendral and Robinson, 2004). Similarly, fearful turkeys may also develop feather pecking as a coping mechanism to respond to environmental stress (Hughes and Duncan, 1972).

SEX DIFFERENCES AND SOCIAL FACILITATION

The highly-stratified social structure of domestic turkeys mirrors their wild counterparts with males using head pecking, when fighting other toms, to establish dominance or breeding access (Watts and Stockes, 1971; Buchholz, 1997). In domestic flocks, head pecking is consistently lower in hens compared to toms, which becomes more aggressive following sexual maturity (Leighton *et al.*, 1985; Buchholz, 1997; Buchwalder and Huber-Eicher, 2003). Busayi *et al.* (2006) showed males engaged in the highest levels of damaging feather pecking and pulling at three weeks of age, whereas females exhibited the most injurious pecking at nine weeks. However, their study terminated at nine weeks of age, far before sexual maturity, and inconsistent pecking terminology provides doubt that the pecking observed was damaging and not social preening.

Insight from wild turkey behaviour may also explain why social facilitation plays a significant role in the development of injurious pecking in commercial turkeys. In the wild, head pecking is learned by young birds as a fighting technique used by mature birds to determine the 'pecking order' (Watts and Stockes, 1971; Buchholz, 1997). In commercial environments, social learning is thought to facilitate the spread of damaging pecking (Sherwin and Kelland, 1998; Sherwin *et al.*, 1999). Taking into consideration how injurious pecking is learned, if producers isolate individual 'peckers' when pecking is observed, then the spread of this negative behaviour through the entire flock could be prevented.

Causes of injurious pecking

There are several hypotheses as to why domestic poultry injuriously peck. There is consensus that head pecking is an act of aggression (Savory, 1995; Moinard *et al.*, 2001). Alternatively, research in turkeys considers severe feather pecking and cannibalism to represent the re-directed ground pecking of foraging behaviour (Martrenchar, 1999; Sherwin *et al.*, 1999). It was suggested that both feather pecking and cannibalism occur due to a lack of environmental stimuli in barren housing systems and an inherent tendency to peck. This need to peck is shaped by both genetic and nutritional variables. In red jungle fowl, severe feather pecking was previously proposed to represent frustration when a bird is prevented from performing other highly-motivated behaviours such as dust bathing (Vestergaard *et al.*, 1993). Newer research by Dixon *et al.* (2008) in chickens challenged the role of dustbathing in facilitating domestic poultry to feather peck. This research showed that the motor patterns of foraging pecks in laying hens were almost identical to the behavioural sequence of feather pecking. Rodenburg *et al.* (2004) has also suggested that severe feather pecking in poultry reflects an over-expressed motivation for social exploration in large flocks of unfamiliar birds. While this explanation would link the appearance of gentle feather pecking in young chickens to high levels of severe pecking in later life, this theory has yet to be tested in turkeys and therefore, re-directed foraging is considered the underlying motivation in turkeys.

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AN INHERENT NEED TO PECK

Taking re-directed foraging as a major cause of severe feather pecking and cannibalism in turkeys, research began to investigate the precise mechanisms shaping the behavioural switch between foraging and damaging pecking. Hughes and Duncan (1972) proposed that poultry have a highly substitutable 'pecking requirement' so when an appropriate foraging material is unavailable, poultry will re-direct investigative behaviour from feeding to the destructive pecking of other birds. An inherent need to peck may be too simplistic to explain this abnormal behaviour. Hughes and Grigor (1996) noted that turkeys spent a large amount of time pecking other birds, even when foraging material was available. The type of forage provided may not have satisfied turkey preference, but likely the notion of a pre-determined pecking requirement is more complex (Hughes and Grigor, 1996; Busayi *et al.*, 2006). It appears severe feather pecking and cannibalism, like all forms of injurious pecking in turkeys, are controlled by multiple influences from the environment, diet, and underlying genetic make-up (Martrenchar, 1999; Sherwin *et al.*, 1999).

ENVIRONMENTAL CAUSES

Commercial environments are markedly different from the natural environment of the wild turkey. In the wild, turkey flocks will vary in size throughout the year and can be found in a diverse range of habitats, including dense woods and open grasslands (Watts and Stockes, 1971; Hawkins *et al.*, 2001). In comparison, commercial facilities generally consist of an open area barn with feeders, drinkers, a litter floor, and the lighting and ventilation provided either artificially in fully-enclosed barns or artificially and naturally if the barn is curtain-sided (Duggan *et al.*, 2011). Research suggests outbreaks of injurious pecking can be primarily attributed to a lack of suitable environmental features in commercial settings hindering the performance of a turkey's normal behavioural repertoire (Hughes and Grigor, 1996; Sherwin *et al.*, 1999; Jendral and Robinson, 2004). These deficiencies can include a lack of foraging or exploratory substrate and a nutritionally unsuitable diet or inappropriate feed form.

Environmental conditions that cause stress, such as high stocking densities or inappropriate lighting, may also lead to outbreaks of severe feather pecking and cannibalism within turkey flocks (Leighton *et al.*, 1985; Classen *et al.*, 1994). Leighton *et al.* (1985) suggested that severe bouts of feather pecking and pulling in female turkeys were more frequent when 9 week old females were assigned the smallest floor space in grower pens (140 cm^2/bird, range: 140-232 cm^2/bird) after previously being brooded in pens with the largest space allowance (93 cm^2/bird, range: 56-93 cm^2/bird). Although in larger flocks (>600 birds), Martrenchar *et al.* (1999) showed that stocking density (range – females: 100-160 cm^2/bird, males: 150-400 cm^2/bird) did not influence the percentage of total activity male or female turkeys spent pecking one another. Denbow *et al.* (1984) and Hughes *et al.* (1997) suggested that in the standard, large flock sizes of >100 birds in commercial barns, social hierarchy is too difficult to establish so feather pecking and cannibalism operate independently of group size. Inappropriate lighting, such as a drastic increase or decrease in photoperiod for toms, has also been shown to increase the frequency of cannibalism (Classen *et al.*, 1994). Other aspects of farm management, such as: poor ventilation, inappropriate humidity levels, constantly fluctuating or extreme temperatures, irritation from flies or ectoparasities, or the presence of dead birds or birds with leg problems (*e.g.*, foot pad swelling, arthritis, or deviated toes) may also heighten stress and contribute to damaging pecking in turkey flocks (Hughes and Duncan, 1972; Ensminger, 1992; Jendral and Robinson, 2004; Allain *et al.*, 2013).

Like feather and cannibalistic pecking, head pecking in turkeys may also be influenced

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by the frequency of environmental disturbances and stocking density (Gill and Leighton, 1984; Classen *et al.*, 1994; Buchwalder and Huber-Eicher, 2003). Both female and male turkeys will perform head pecking after an environmental disturbance to restore the pre-existing dominance hierarchy and settle the flock (Gill and Leighton, 1984; Cunningham *et al.*, 1992; Buchwalder and Huber-Eicher, 2003). This suggests that head pecking and its resulting injuries will be more prominent in commercial flocks that are exposed to frequent changes to husbandry or environment (Classen *et al.*, 1994; Buchwalder and Huber-Eicher, 2003). Gill and Leighton (1984) showed poorer feather scores for adult male turkeys when kept at higher population densities, likely reflecting increased aggression between sexually-mature males. Similarly, Hughes and Wood-Gush (1977) observed laying hens engaged in more aggressive head pecking in groups of six rather than three hens. Martrenchar (1999) suggested this evidence from laying hens may also explain the high incidence of injurious pecking amongst commercial turkeys in free-run flocks of thousands of birds.

However, unlike the other forms of injurious pecking, rates of aggressive head pecking in turkeys are affected by bird familiarity. The level of familiarity between group members also has a significant, negative correlation with the rate of agonistic pecking and fighting amongst turkey toms in both wild and domestic populations (Watts and Stockes, 1971; Buchwalder and Huber-Eicher, 2003; 2004). Buchwalder and Huber-Eicher (2003) noted that male turkeys will use aggressive pecking against unfamiliar individuals in group sizes containing as few as four males, especially at higher stocking densities (1.2 m^2/bird *vs.* 3.6 m^2/bird).

GENETIC CAUSES

Genetic selection against injurious pecking has never been documented in turkeys. This means that only direct comparisons between traditional lines and modern turkeys can tell us about the relationship between genetics and injurious pecking (Busayi *et al.*, 2006). Under the same environmental conditions, modern lines showed a higher propensity for severe feather pecking and pulling in contrast to the traditional lines. Since traditional lines displayed fewer injuries from severe feather pecking, the likelihood of cannibalism was lower (Busayi *et al.*, 2006). The numerous confounding variables in this investigation prevent meaningful insights. Many authors suggest that breeding programs selecting for larger and faster-growing poultry have unintentionally selected for higher rates of aggression and destructive pecking (Flock *et al.*, 2006; Rodenburg and Turner, 2012). Unfortunately, no knowledge currently exists of the specific traits affected by turkey breeding that have contributed to a higher incidence of injurious pecking in modern flocks.

THE ROLE OF DIET

Numerous studies have found correlations between diet form, frequency, or ingredients and feather pecking in turkeys (Hale and Schein, 1962; Hughes and Grigor, 1996; Hamilton and Kennie, 1997). The physical structure of feed and the amount of distributed food can have considerable effects on rates of damaging pecking, and several studies found that turkeys switched to a crumble or mash diet spent more time foraging, feather pecked less, and had better plumage cover compared to turkeys fed pelleted diets (Hale and Schein, 1962; Hamilton and Kennie, 1997). After switching turkeys from pellets to mash, and simultaneously increasing the fibre content from 5 to 22%, Hale and Schein (1962) also had fewer birds with denuded areas. Hamilton and Kennie (1997) found that providing feed *ad libitum* to growing turkeys reduced injuries from severe feather pecking in comparison to feed-restricted birds. Sherwin *et al.* (1999) showed the scattering of rough-cut wheat straw to non-beak trimmed toms lead to fewer

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wing, tail, and head pecking injuries. However, Mirabito *et al.* (2003) found the addition of whole wheat to turkey feed had no effect on feather pecking, which illustrates the importance of choosing appropriate high fibre forage delivered in a form suited to turkey preference (Hale and Schein, 1962; Hughes and Grigor, 1996). If dietary requirements are not met, turkeys may re-direct highly motivated beak-related behaviour from foraging to damaging pecking (Hughes and Grigor, 1996).

Mitigating the problem

CURRENT PRACTICES: ANATOMICAL ALTERATIONS AND LIGHT REDUCTIONS

Beak trimming (or treatment) in turkeys is presently performed with infrared lasers immediately following hatching to reduce the damage caused by pecking (Krautwald-Junghanns *et al.*, 2011). Compared to conventional hot-blade beak trimming, infrared laser trimming prevents open wounds, decreases operator error in trimming length, and produces fewer behavioural changes post-amputation by allowing the beak tip to gradually wear away (Dennis *et al.*, 2009). However, concerns still exist over beak trimming as a mutilating procedure performed without analgesia (Grigor *et al.*, 1995). Krautwald-Junghanns *et al.* (2011) found that a high number of the turkeys (12.8% of males and 13.8% of females) still suffered from skin injuries, such as pecking wounds, even when infrared trimmed. It has been suggested in laying hens that beak-trimming may actually increase the incidence of feather pecking and cannibalism, which may also apply to turkeys (Gentle *et al.,* 1982; Leighton *et al.*, 1985). Frustrated by the physical difficulty in grasping feathers, beak-trimmed poultry may experience a heightened motivation to continue feather pecking and pulling until the action is complete.

Other common management practices used in turkey rearing to decrease pecking include lowering light intensities and snood removal. Similar to beak trimming, these also have welfare implications beyond influencing pecking rates. Very low light intensities (<5 Lux at eye level) are often used to reduce injurious pecking, but can also lead to the development of eye abnormalities, including blindness and musculoskeletal disorders (Siopes *et al.*, 1984; Lewis *et al.*, 1998a). An additional disadvantage of a dark rearing environment is it may hinder staff from recognising injured and lame birds (Jendral and Robinson, 2004). Another common management procedure is the removal of the snood from male turkeys, a process usually performed in the hatchery. Removal prevents the snood becoming a target for aggressive pecking and deters cannibalism. Done incorrectly, this amputation may become chronically painful (Freeman, 1987). Concern over trading one welfare concern for another has fostered interest in developing less drastic alternatives, such as genetic selection for gentler birds, environmental enrichment, and changes to diet, to reduce injurious pecking in turkeys (Grigor *et al.*, 1995; Sherwin *et al.*, 1999; Moinard *et al.*, 2001).

USE OF GENETIC SELECTION

Until recently, genetic selection in turkeys has focused on a limited number of traits that improve profitability such as improvements in body weight, feed conversion, breast meat yield, and egg production (Wood, 2009). Increased consumer pressure is shifting breeding efforts to direct quantitative genetic selection for liveability or indirect selection for social effects and selection against injurious pecking in group-housed poultry (Muir, 1996; Moore *et al.*, 1997; Flock *et al.*, 2006; Rodenburg and Turner, 2012). There have been no reports on breeding against negative social behaviours in turkeys and previous genetic improvement programs in meat poultry show mixed success using survival as a

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selection parameter (Havenstein *et al.*, 2007). Newer research in turkeys indicated a low to moderate heritability for survival (0.14 ± 0.07) and this information could provide a basis for future selection against injurious pecking (Quinton *et al.*, 2011).

Damaging pecking can lead to death, so another strategy to reduce injurious pecking in laying hens has focused on selection to reduce mortality based on a social effects model (Muir, 1996; Rodenburg *et al.*, 2009). This model successfully decreased damaging pecking in lines of laying hens through group selection for survival without sacrificing productivity (Craig and Muir, 1996; Cheng and Muir, 2005; Ellen *et al.*, 2007). The success shown in the layers could conceivably be replicated in turkeys and merits research. Genetic selection has great potential to improve the lives of livestock, although Rodenburg and Turner (2012) warn that genetic selection will only achieve dramatic improvements to animal welfare when accompanied by environmental changes to better suit the species' natural behavioural repertoire.

Group selection for improved physical condition, such as better plumage coverage, may also reduce injuries from severe feather pecking and cannibalism in turkeys. Busayi *et al.* (2006) showed traditional line turkeys with better feather coverage experienced fewer pecking injuries than modern turkeys under identical environmental conditions. Research is still needed to clarify the association between plumage quality, particularly over the breast, and injurious pecking injuries within a line. Only then can plumage coverage be used as selection criteria for improved turkey welfare.

ENVIRONMENT AND LIGHT CHANGES

A focus of research into pecking in turkeys has been the relationship between damaging pecking and light intensity, photoperiod, and light source. The definition of the light source is important as it highlights such parameters as the use of an incandescent or fluorescent bulb, the visible light spectrum, and whether or not the light source contains UV radiation (Lewis *et al.*, 1998a; 1998b; Sherwin and Devereux, 1999; Sherwin *et al.*, 1999). Reduced light levels (<10 Lux) have been standard industry practice to manage feather pecking in turkeys for many years, since research substantiated the role of higher light levels (≥ 10 Lux for ≥12 hours) in injurious pecking (Lewis *et al.*, 1998a; 1998b; Martrenchar *et al.*, 2001). The use of intermittent lighting schedules to reduce injurious pecking in turkeys was only moderately successful (Lewis *et al.*, 1998b). Intermittent lighting operates by providing a varied programme of multiple, brief light periods throughout the day in an attempt to increase of value of performing highly-motivated, light-based maintenance behaviours - like feeding and drinking - instead of engaging in injurious pecking during the scarce lighting periods (*e.g.*, 8 (1Light:2Dark), 8 (1L:1D):8D, or 2 (2L:3D):2L:12D, Lewis *et al.*, 1998b; Sherwin *et al.*, 1999).

The source of light can have an effect on pecking in turkeys with fewer tail and wing injuries displayed under fluorescent compared to incandescent lighting (Sherwin, 1999; Moinard *et al.*, 2001). Moinard *et al.* (2001) showed that turkeys perceived fluorescent lighting to be less bright than incandescent due to the differences in spectral intensity. The incandescent light spectrum has a higher percentage of red wavelengths (70% red light) compared to fluorescent light (10% red light) (Lewis and Morris, 2000). This difference might alter a bird's visual perception of the environment and decrease the motivation to peck (Gill and Leighton, 1984). Research conducted in fully-enclosed housing also suggested the inclusion of UV light from hatching prevented the initial development of injurious pecking in these turkeys (Moinard *et al.*, 2001). Moinard and Sherwin (1999) speculated that pen mates resort to damaging pecking if they are unable to display and read plumage signals normally so communication breaks down. The lack of UV light may also inhibit birds from properly interacting with the available forage so

https://doi.org/10.1017/S004393391300086X Published online by Cambridge University Press

they negatively re-direct frustration into the pecking of others (Sherwin and Devereux, 1999; Moinard *et al.*, 2001). Conversely, Duggan *et al.* (2011) found turkeys in curtain-sided barns exposed to natural UV light had worse feather scores and higher mortality than fully-enclosed facilities without supplemental UV. The lack of UV light during early turkey development is undoubtedly linked to the onset of damaging pecking, but the relationship between UV lighting and injurious pecking in adult turkeys is still unclear and requires further research.

Altering the environment through the use of visual barriers and novel objects can also decrease feather pecking. An example of visual barrier enrichment was the use of four suspended, plywood boards to divide the open barn space into quarters (Sherwin *et al.*, 1999; Moinard *et al.*, 2001). Although the welfare benefits of visual barriers were not specifically tested, they demonstrated that turkey poults suffered significantly fewer wing, head, and tail peck injuries when provided supplementary visual barriers, UV radiation, and novel objects. Visual barriers may act to reduce injurious pecking by preventing the spread of this negative behaviour through social facilitation or by providing an escape for birds being pecked (Sherwin *et al.*, 1999). Martrenchar *et al.* (2001) found levels of injurious pecking amongst both male and female turkeys were higher in un-enriched pens than in pens containing straw bales and reflective 15 cm x 20 cm metal sheets. Conversely, Duggan *et al.* (2011) attempted to decrease feather pecking by adding coloured plastic balls to the floors of large flocks. No differences in feather pecking behaviour were observed between control groups and birds with supplementary ball enrichment. Although this particular enrichment was unsuccessful, the majority of the preliminary research in turkeys suggests novel enrichment chosen by bird preference can effectively deter injurious pecking and therefore, warrants further testing (Sherwin *et al.*, 1999; Martrenchar *et al.*, 2001).

DIETARY CHANGES

There is evidence to suggest that dietary changes can prevent outbreaks of feather pecking in some circumstances. Specifically, the availability and type of forage substrates appear to influence the rate of injurious pecking. Some dietary factors that have been shown to decrease pecking include the feeding of crumble or mash (rather than pellets), supplementary dietary salt, *ad libitum* feed, and the use of high fibre foraging substrates (Hale and Schein, 1962; Hamilton and Kennie, 1997; Sherwin *et al.*, 1999; Berger, 2006). Hughes and Grigor (1996) suggested that bulkier, high fibre diets for turkeys, delivered in part by scattering, will increase foraging and decrease destructive pecking. Further research is required into dietary consequences of feed composition, form, and distribution on abnormal pecking behaviour in turkeys. For instance, species-specific research is needed to test if the addition of dietary salt and other trace elements in turkey feed results in less cannibalism within flocks. Although these proposed solutions could potentially increase production costs, the welfare benefits of decreasing unnecessary mortalities from damaging pecking should outweigh the costs of these dietary changes.

Conclusions

While head pecking is primarily a reflection of social organisation and environmental disturbance, the two other types of injurious pecking in turkeys, severe feather pecking and cannibalism, appear to be multi-factorial products of genetics, environment, and nutrition. To develop practical solutions, further research is required to clearly understand the development and maintenance of injurious pecking. Group genetic

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selection using social affects may offer a promising alternative to the current mitigation methods without excessive costs or compromises to production or welfare. The multi-factorial nature of injurious pecking suggests genetic improvements will be limited without environmental and nutritional adjustments to support the behavioural needs of domestic turkeys.

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