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Major welfare issues in broiler breeders

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Under current practices, broiler parent stock (broiler breeders) encounter several welfare problems, such as feed restriction and injury during mating. Intensive selection for production traits, especially growth rate, is associated with increased nutritious requirement and thus feed consumption, but also reproductive dysfunctions and decreased sexual activity in broiler breeders. A resulting serious welfare problem is the subsequent severe feed restriction which is applied during rearing, in order to prevent health problems and to achieve better egg production. This severe feed restriction has negative effects on bird welfare as it causes chronic stress resulting from hunger. Recent research has focused on management practices to alleviate the negative effect of this feed restriction. Using both a more fibrous feed and an appetite suppressant seems most successful. There are welfare concerns involved in the mating of broiler breeders. In many countries mutilations (beak trimming, despurring and toe clipping) are carried out in male broiler breeders as a standard procedure to prevent excessive damage to the hens during mating. It has been reported that broiler breeder males show low libido but, at the same time, may be aggressive and show rough behaviour during mating, which can cause severe injuries to the hens, although some injuries may be caused by over-mating hens. Current studies aim to develop management practices to reduce hen injury due to over-mating and improve the sexual behaviour in both males and females. In the last part of the review, an examination of how breeding companies are taking welfare into consideration in their commercial selection scheme is made. In practice, although for example reduced mortality and some health criteria are included in selection programs and some alternative breeds as used, other welfare issues remain, such as feed restriction during rearing.

Keywords: broiler breeders; genetics; welfare; courtship behaviour; feed restriction

Introduction

Under the current commercial conditions, broiler parent stock (broiler breeders) encounter several welfare problems. In the present paper we will give an overview of recent findings with respect to two of the most important welfare issues in broiler

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breeders. In addition, we will discuss how welfare is taken into account in commercial selection schemes.

A first serious welfare problem in broiler breeders is the very severe feed restriction during the rearing phase, which leads to chronic hunger and has a clear negative effect on broiler breeder welfare. Due to the selection for faster growth and better feed efficiency broiler breeders have a very high feed consumption when fed *ad libitum*, which leads to birds becoming overweight and consequently causes severe health and reproduction dysfunctions (lameness, premature death, poor laying performance and poor fertility) during the laying period. The feed restriction is particularly severe during the rearing phase before the birds reach sexual maturity (see Mench, 2002 for an overview).

Besides this severe feed restriction during rearing, hens may suffer from skin lesions during the reproductive phase which may be caused by feather pecking and cannibalism, but are more often caused by mating. It has indeed been reported that aggressive male behaviour may contribute to these injuries (Millman *et al.*, 2000) but also over-mating of hens may cause injuries (Jones and Prescott, 2000; Leone and Estevez, 2008). In many countries mutilations like despurring, toe clipping and beak trimming are carried out as a standard commercial procedure to prevent excessive damage to the hens (Fiks and De Jong, 2007). In other systems, female broiler breeders are raised in collective cages and artificially inseminated, a practice which in turn may result in different welfare problems. From laying hen studies it is known that conventional cages without litter, perches and nest boxes do not fulfil the behavioural needs of the hens and have a negative effect on bird welfare (*e.g.* Blokhuis *et al.*, 2007). Artificial insemination involves regular handling of the birds which may have negative implications for bird welfare. It may also stimulate breeders for selection of extra-heavy male lines which is considered to be too risky in naturally mated flocks (Brillard, 2001) and has negative consequences for male welfare. In recent years, a lot of welfare-related research has focused on the problems of feather pecking and cannibalism and a large body of reviews is already available (*e.g.* Rodenburg *et al.*, 2008), but this review will only refer to these problems concerning mutilations and when discussing the commercial point of view. The problem of feed restriction during rearing and the sexual behaviour during the laying phase were important issues in recent research related to broiler breeder welfare.

Feed restriction and broiler breeder welfare

Despite the positive effect on health and reproduction efficiency when adult, there is substantial evidence that the applied feed restriction, especially during rearing, has negative effects on broiler breeder welfare. In commercially applied restriction programs food intake is restricted to about 25-33% of the intake of *ad libitum* fed birds of the same age during rearing (Savory *et al.*, 1996; De Jong *et al.*, 2002) and it is restricted to 50-90% of *ad libitum* intake of hens at the same age when they are in lay (Bruggeman *et al.*, 1999). Numerous studies have shown that feed restricted broiler breeders show behaviours indicative of frustration, boredom and hunger, such as stereotypic object pecking, over-drinking and pacing (see De Jong and Jones, 2006 and D'Eath *et al.*, 2009). It has also been reported that aggressive pecking, caused by feeding competition, is increasing in prevalence in commercial flocks of broiler breeders which is also detrimental for bird welfare (Jones *et al.*, 2004). In addition, feed restricted broiler breeders may show physiological signs of stress. Broiler breeders fed at commercially applied restriction levels show elevated plasma corticosterone levels, although, due to the biological roles of the corticosteroids (Mormède *et al.*, 2007), it is not clear yet whether these elevated plasma corticosterone levels reflect psychological

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stress, metabolic effects resulting from feed restriction or both (De Jong *et al.*, 2003). Some studies also reported increased H/L ratios in restricted fed birds (Hocking *et al.*, 1993; 1996; Savory *et al.*, 1993), that are indicative of chronic stress in chickens (Maxwell *et al.*, 1992).

ALTERNATIVES TO CONVENTIONAL FEED RESTRICTION

More recently, research has focused on practically applicable management strategies to reduce the negative effects of feed restriction while maintaining the desired growth rate. Environmental enrichment during rearing may alleviate frustration of the feeding motivation but did not reduce aggression due to competition for food (Hocking and Jones, 2006). Scattering the feed in the litter, which increased the 'foraging' time spent feeding also did not have any positive effects on indicators of stress and hunger (De Jong *et al.*, 2005b). Diluting the feed (sometimes referred to as 'qualitative restriction'), which also increased time spent feeding, seemed to be more promising (Hocking *et al.*, 2004; De Jong *et al.*, 2005a). Hocking *et al.* (2004) showed that diets with 50 g/kg sugar beet pulp or 200 g/kg oat hulls reduced stereotypic object pecking, indicating that welfare of birds fed these diets might be improved. However, these birds spent more time feeding than birds fed a standard commercial restriction ration, leaving less time available for stereotypic behaviour which may also explain these results (*e.g.* Mason *et al.*, 2006). De Jong *et al.* (2005a) tested four different diets during the rearing and laying period. The diet with the lowest density (8.4 MJ/kg) appeared to reduce hunger and frustration in the first half of the rearing period, which was indicated by reduced stereotypic pecking behaviour. However, it was concluded that for substantial improvement of broiler breeder welfare, more extreme diet modifications using higher fibre concentrations or combinations with appetite suppressants were required. Others did not find any positive effects at all of high fibre contents in broiler breeding diets (up to 6.6 MJ/kg) on behavioural and physiological indicators of welfare (Jones *et al.*, 2004; Hocking, 2006). In contrast, a combination of calcium propionate (an appetite suppressant) and oat hulls appeared to be a viable alternative to commercial quantitative feed restriction, which was indicated by a change in a couple of parameters indicative of hunger (Sandilands *et al.*, 2006). In addition, stereotypic pecking was virtually absent in this treatment group, the time spent sitting significantly increased and feeding motivation (by measuring rate of eating) was reduced as compared to broiler breeders fed a quantitative restricted diet, suggesting improved welfare due to reduced hunger in these birds (Sandilands *et al.*, 2005; Tolkamp *et al.*, 2005; Sandilands *et al.*, 2006). However, as the above studies all use indirect indicators of hunger, the question if these alternative diets indeed reduce hunger still remains controversial (D'Eath *et al.*, 2009) and more research will be necessary, both to develop alternative diets as well as to develop methods to measure a subjective feeling like hunger.

With respect to bird welfare the use of other genotypes of broilers, *i.e.* slower growing and dwarf breeds, are other alternatives to reduce the negative effects of feed restriction (Jones *et al.*, 2004; De Jong and Jones, 2006; Decuypere *et al.*, 2006). The dwarf genotypes only concern one sex (females), but numerically the problem of feed restriction concerns many more females than males and it thus may be a solution for a large part of the broiler breeder population. However, they will correspond only to a specific market demand, because their use is approximately 20% across Europe, but is around 85% in France, with 55% and 30% for dwarf and slower growth rate, respectively (Guémené, personal communication), and the use of dwarf or other slower growing genotypes is unacceptable for economical reasons in many cases.

Despite the considerable amount of research in this field, more research is necessary to solve this dilemma. Moreover, although restricted fed broiler breeders clearly show signs

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of chronic stress, there are still questions how to measure the subjective experiences of restricted fed broiler breeders as indirect indicators of hunger have thus far been used (D'Eath *et al.*, 2009). As *ad libitum* feeding of broiler breeders also leads to impaired welfare, it is unknown if a certain level of restriction or qualitatively restricted feeds may represent an acceptable balance in terms of welfare, where birds are not as hungry and at the same time are healthy and have an acceptable level of egg production and fertility.

Sexual behaviour in broiler breeders

It has been reported that male broiler breeders may display high levels of aggression towards females, predominantly during the performance of sexual behaviour, whereas courtship behaviour was virtually absent before mating (Jones and Prescott, 2000; Millman and Duncan, 2000a; Millman and Duncan, 2000b; Millman and Duncan, 2000c; Millman *et al.*, 2000; Jones *et al.*, 2001; Duncan, 2009). This may be one of the reasons why females tend to remain in the nests or on the slatted area instead of the litter area (where the majority of males are present), and may show severe wounds on the back, the back of the head and along the torso beneath the wings (Millman *et al.*, 2000). Sexual behaviour of male broiler breeders has been described as rough, the males pecking or chasing females and forcing copulations (Jones and Prescott, 2000; Millman *et al.*, 2000; Jones *et al.*, 2001). Also Leone and Estevez (2008) reported forced copulations resulting in females staying on the slatted area instead of the litter area, and injuries in female broiler breeders during lay. However, they suggested that the cause of the segregation of sexes may be that males reach sexual maturity earlier as compared to females. It is likely that both too early maturation of males and aggressive or rough mating behaviour may play a role in female injury and stress.

In a field study on eight Dutch broiler breeder farms the behaviour of males as well as females had been studied in more detail. It turned out that not only could male behaviour towards females be described as 'rough', but also female courtship behaviour appeared to be incomplete. Females in general did not show crouching behaviour in response to male approach. They frequently showed struggling behaviour during mating or tried to escape from the male. This may explain why only a maximum of 44% of the matings succeeded (between 20-28 weeks of age) and why at least 80% of the matings was forced (De Jong *et al.*, 2009). Courtship behaviour was almost absent before mating (De Jong *et al.*, 2009), confirming earlier research (Jones *et al.*, 2001; Millman *et al.*, 2000). Female behaviour may thus appear to be incomplete because females do not recognise male signals. On the other hand, it has recently been shown in different female broiler breeder lines that female behaviour evoked aggressive male behaviour towards the females (Moyle *et al.*, 2010). It was shown that feed restriction (Millman and Duncan, 2000b) did not play a role in the rough mating behaviour but that genetics may have an effect (Millman and Duncan, 2000a). De Jong *et al.* (2009) suggested that factors like separate rearing of males and females, large group sizes and high stocking density may also play a role by the development and recognition of courtship behaviour and proper responses to signals of the other sex. Separate rearing of males and females may hamper correct learning of sexual behaviour as the behaviour already begins to develop during rearing (Kruijt, 1964). Large group sizes and high stocking density may impede the recognition of male behaviour by the females. Preliminary results of recent research suggest that lowering the stocking density during the laying period leads to more successful copulations and less feather damage, but this study has not been fully completed yet (De Jong *et al.*, personal communication). Additionally, Leone and Estevez (2008) used vertical panels (of 70 x 70 cm) placed in a staggered pattern every 4.5 m in the central

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litter area and found that this improved reproductive performance in broiler breeders. These panels attracted females to the litter floor, thereby decreasing the competition for females. Technical performance improved, but no behavioural observations were done thus it remains to be questioned whether mating behaviour was positively affected with the use of these panels.

Mutilations

In many countries mutilations are standard practice to prevent excessive damage to the hens due to mating (Fiks and De Jong, 2007). Males are beak trimmed to prevent injuries on the backs of the heads of the females where the males peck them and grab them with their beaks during mating (Gentle and McKeegan, 2007; Duncan, 2009). Toe clipping and despurring are carried out on the males to prevent injuries on the torsos and beneath the wings of the females where the inside claws and spurs of the males rip the skin during mating (Duncan, 2009). Although mutilations may thus have a positive effect on female broiler breeder welfare, the procedures itself may lead to stress due to handling and to acute and chronic pain because the tissues are well innervated (*e.g.* Cheng, 2006; Gentle and Hunter, 1988) and compromise bird welfare. If broiler breeder mating behaviour can be significantly improved by changing housing conditions, management and/or genetic solutions, broiler breeders can possibly be housed without mutilations. But at present, not mutilating the males likely leads to higher mortality and severely injured females, as we found in a small scale pilot experiment (De Jong, 2006, unpublished observations).

Females broiler breeders are beak trimmed for other reasons, *i.e.* to prevent injuries due to feather pecking and cannibalism (Henderson *et al.*, 2009). However, there is no literature stating that feather pecking is a problem in broiler breeder flocks. It can therefore be questioned if beak trimming of females is necessary, and it should be studied if broiler breeder females can be housed with intact beaks without welfare problems due to injurious pecking.

Broiler breeder welfare from the breeder's point of view

In the present debates regarding welfare under commercial breeding conditions, the suitability of the provided environmental rearing conditions for a given genotype and also the possible selection for improving the genotype adaptability and robustness to a given rearing environment are major issues. This last approach is often questioned for ethical reasons, that we should leave nature as it is because untouched nature has a value of its own, or that we can not foresee the consequences of what selection is doing (D'Eath *et al.*, 2010). However, such a process is directly associated with the domestication process (Mignon-Grasteau and Faure, 2002).

Indeed, domestication consisted first of choosing species with adequate behavioural characteristics and gradually emphasised them. Nevertheless, since 1950, selection pressure has become much more intense with specialised lines being selected for specific parameters with emphasised dimorphisms between lines and/or sexes, and the use of cross-breeds for commercial production instead of pure breeds (McKay, 2009). Moreover, changes in behavioural repertoire and adaptive capacity in relation to selection on growth or laying rates have not been taken directly into consideration, until recently. Selection for higher growth and feed efficiency was associated with an overall decrease in activity, including sexual behaviour, and an increase in nutritional requirements and lameness (Rauw *et al.*, 1998). In contrast, selection for increasing egg rate was

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associated with higher levels of nervousness, aggressiveness and feather pecking (Star *et al.*, 2008). This raises questions about the consequences of the selection programs implemented until now and in the future on welfare (the breeding strategy dilemma). In addition, there are questions about the relationship between selection on production characteristics and the bird's abilities to adapt to diverse commercial conditions, whether extensive or intensive. Nowadays, commercial breeding companies do take this information into consideration in their selection strategies (McKay, 2009).

The first breeding strategy dilemma concerns the apparent impossibility of reconciling production requirements regarding both the breeders (good reproductive performance, good health and low mortality) and the offspring (satisfactory growth performance, high feed efficiency, viability) without recourse to severe feed restriction, which was entitled the 'Broiler Breeder Paradox' in an EU project (Decuypere *et al.*, 2006). Selection for production requirements is indeed a key component in terms of sustainability for both economical and environmental reasons and indirectly supported by the consumer through specific market demands. On the other hand, as discussed above, the severe feed restriction which is a prerequisite to lower mortality and to obtain optimal reproductive performance is questionable in terms of welfare. Alternative breeds requiring little or no feed restriction are available (*e.g.* Decuypere *et al.*, 2006) but they do not meet the range of present market demands, and in Europe their use is limited to France (Guémené, personal communication).

A second dilemma arises from the well-known existence of important interactions between the genotypes and the rearing environment, which include animal-caretaker relationships. In breeding programs, a lot of selection criteria have to be measured individually and some of them can only be measured in specific environments such as individual cages or challenging conditions (*e.g.* robustness in a poor environment). As a consequence, most often breeder rearing conditions differ from commercial broiler production conditions (for example, some grandparent lines are housed in cages in contrast to parent stock housed in large groups on (partially) littered floor), and one may ask if the selected breeders are the best adapted. Selection for some specific traits, such as social behaviours (*e.g.* broodiness, mating behaviour, feather pecking, cannibalism), requires the use of other rearing conditions or to submit the candidates to some challenge for traits' expression. To overcome this problem, some breeding companies house their grandparent stocks, progenies, sib-birds or even the potential breeders during all or a part of their life in commercial-like conditions so that they can show their normal behaviour and performance with respect to social interactions and reproductive and sexual behaviour. The combined use of electronic devices (microchips) and DNA markers may help to overcome some of these difficulties in the near future, as well as the potential localisation of Quantitative Trait Loci (QTL) and/or detection of Single Nucleotide Polyphormism markers associated with traits of interest (McKay, 2009).

A third dilemma arises from the difficulties to measure some parameters, such as behavioural measures, in terms of methods to be used and time needed for testing on a commercial scale a large number of animals at similar age in a short period of time. For this reason, group selection against feather pecking which has been shown to be experimentally effective (Kjaer *et al.*, 2001; Su *et al.*, 2006), although it is rarely used in commercial practice. Surprisingly, indirect selection on feather pecking using the 'peckometer' - equipment which allowed the quantification of peck bouts on fake feathers - resulted in the opposite response. The off-spring of the line showing the highest number of peck bouts to the equipment was the one showing the lowest level of feather pecking (Bessei *et al.*, 1997, Chapuis *et al.*, 2003, Boulay *et al.*, 2006). This example further illustrates the difficulties to select for behavioural parameters and the importance

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of the chosen method. A further question that remains is the relative weight that should be put on these parameters relative to more traditional production traits. Moreover, it should be kept in mind that the delay between the selection process and the production sector level ranges between four to five years. The delay is actually much longer, because the research and development of lines before they can enter the production pedigree itself is four to six years (Laughlin, 2007). The identification and localisation of QTL and/or markers (SNPs) combined with the promising tool of the genomic selection may also help to overcome these difficulties in the near future.

Conclusions

Intensive selection for growth and feed efficiency in broiler breeders is associated with increased metabolic requirements and thus feed consumption. Severe feed restriction is applied during rearing in order to prevent reproductive problems but has negative effects on bird welfare. Rough male mating behaviour as well as over-mating negatively affects the welfare of the hens. Commonly used preventive measures are also questionable, because, in order to prevent excessive damage to the hens, mutilations are carried out in many countries. Although recent studies focused on alternative management strategies to overcome these welfare problems (especially with respect to the feed restriction during rearing) no clear solutions have been found, although the results of the use of high fibre diets and/or appetite suppressants during rearing seem promising. Studying the behaviour and the physiological responses of the birds as indicator for welfare, under different housing and management conditions and in different genetic lines is necessary to find solutions to these problems.

In previous decades, intensive selection for production characteristics did not take into consideration the effects of selection on behavioural repertoire and adaptive capacity. Nowadays, commercial breeding companies are more aware of the indirect effects of selection programmes on bird welfare. Although reduced mortality, lameness and some health criteria are routinely included in selection programs, other welfare issues are not always addressed in practise. The rearing environment in breeding stock often differs from commercial conditions, whereas selection for traits related to welfare (*e.g.* feather pecking, social behaviours) requires other rearing conditions (social housing, no cages) and/or are not easily measurable at a commercial scale. These problems should however be taken into consideration. The identification and localisation of QTL and/or markers (SNPs), combined with the use of electronic devices (microchips) and the potential expectation of genomic selection will provide valuable tools to improve welfare in poultry breeding practices, although further research is needed in the evaluation of such methods.

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