Welfare issues in broiler breeders

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Summary
Under current practice, parent poultry breeding stock potentially face welfare problems. In the present review, broiler breeders are taken to illustrate welfare problems encountered at this stage of the production process. 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 first resulting serious welfare problem is the subsequent severe feed restriction which is applied during rearing, in order to prevent health problems and to reach better egg production. This severe feed restriction has negative effects on bird welfare as it causes chronic stress resulting from hunger. Recent research focused on management practices to alleviate the negative effect of this feed restriction. Using both a more fibrous feed and an appetite suppressant seems thus far most successful. In many countries mutilations (beak trimming, despurring and toe clipping) are carried out in broiler breeders as a standard procedure to prevent excessive damage to the hens caused by mating. It has been reported that broiler breeder males show low libido but in the mean time aggressive and rough behavior during mating, which may cause these severe injuries to the hens. Others state that overmating causes injured hens. We suggest that probably both play a role. Current studies aim at developing management practices to reduce hen injury due to overmating and improving the sexual behavior in both males and females. In the last paragraph, we examine how breeding companies nowadays are taking welfare into consideration in their commercial selection scheme. In practice, although for example reduced mortality and some health criteria are included in selection programs, other welfare issues remain, such as the rearing environment used or the problem of feed restriction during rearing which remains, unless alternative breeds are used.

Keywords: broiler breeder, genetics, rearing practice, welfare, behavior, feed restriction, sexual behavior

Introduction

Under the current commercial conditions, parent breeding stock of broilers and layers potentially face several welfare problems. As for all types of productions, they can originate from acute and/or chronic stressful events. Among the stressful events, the chronic ones are most often the more deleterious. They generally relate to housing conditions and/or rearing practices, from which some are specific to a peculiar genotype. Indeed, a genotype would for example need specific rearing conditions to enable its production and/or to prevent the expression of problematic behavior.
In the present paper, we have considered the broiler breeders to illustrate the welfare problems encountered at this level of the production process. A first serious welfare problem in broiler breeders where much attention in welfare research has focused on 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 overweight and consequently severe health and reproduction dysfunctions (lameness, premature death and poor laying performance and fertility) during the laying period. Therefore, broiler breeders are customarily food restricted in order to limit their growth. The feed restriction is particularly severe during the rearing phase before they 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 are caused by feather pecking and cannibalism, but also by mating. It has indeed been reported that aggressive male behavior may cause these injuries (Millman *et al.*, 2000) but also overmating 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 others, female broiler breeders are raised in collective cages and artificially inseminated, a practice which in turn may result in different welfare problems. In the past years, a lot of welfare related research 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 we will only refer to these problems when discussing the commercial point of view. Relevant in terms of welfare research efforts during the recent years were the problem of feed restriction during rearing and the sexual behavior during the laying phase. We will here give an overview of recent findings with respect to these subjects. In addition, we will discuss the point of view on broiler breeder welfare from the perspective of the breeder organizations.

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 behaviors indicative of frustration, boredom and hunger, like stereotypic object pecking, overdrinking and very high activity levels due to pacing (see De Jong and Jones, 2006 for an overview). It has also been reported that aggressive pecking, associated with hunger, 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 ubiquitous role of the corticosteroids (Mormède *et al.*, 2007) it is not clear yet whether these elevated plasma corticosterone levels reflect psychological stress, metabolic effects of feed restriction or both (De Jong *et al.*, 2003). Some studies also reported increased H/L ratios in restricted fed birds (Hocking *et al.*, 1996; De Jong *et al.*, 2003).

Alternatives to conventional feed restriction

More recently, research focused on practically applicable management strategies to reduce the negative effects of feed restriction while maintaining the desired growth rate. Environmental enrichment during rearing did not reduce aggression due to competition for food (Hocking and Jones, 2006). Scattering the feed in the litter did also not have any positive effects on indicators of stress and hunger (De Jong *et al.*, 2005b). Diluting the feed (qualitative restriction) seemed to be more promising. 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 behavior. However, it was concluded that for substantial improvement of broiler breeder welfare, more extreme diet modifications were required. Others did not find any positive effect at all of high fiber contents in broiler breeding diets (up to 6.6 MJ/kg) on behavioral 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. Besides that stereotypic pecking was virtually absent in this treatment group, also the time spent sitting significantly increased and feeding motivation 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).

With respect to bird welfare the use of other types of (slow growing) birds will be another viable alternative to reduce the negative effects of feed restriction. Dwarf broiler breeders do not need to be (severely) feed restricted, as well as slow-growing strains (Jones *et al.*, 2004; de Jong *et al.*, 2005b; Decuypere *et al.*, 2006). However, the use of these strains may be economically unacceptable to many breeding companies and farmers without compensatory inducements such as premium prices.

Despite the considerable amount of research in this field there still remain questions to be resolved. Although restricted fed broiler breeders clearly show signs of chronic stress, there are still questions about the subjective experiences of restricted fed broiler breeders. As *ad libitum* feeding of broiler breeders also leads to impaired welfare, it is unknown if a certain level of restriction is acceptable in terms of welfare, when birds are able to show adaptive responses without their welfare being negatively affected.

Sexual behavior in broiler breeders

It has been reported that male broiler breeder fowl 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; Millman *et al.*, 2002). This may be one of the reasons why females tend to remain on the slatted area, and may have 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 stress and injuries in female broiler breeders during lay. They also observed that females favour the raised slatted area whereas males stayed on the litter area, 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 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 male behaviour towards females could be described as 'rough', but also female 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.*, 2002). It was shown that feed restriction (Millman and Duncan, 2000b) did not play a role in this behaviour but that genetics may have an effect (Millman and Duncan, 2000a). We (De Jong *et al.*, 2009) suggested that factors like separate rearing of males and females, large group size and high stocking density may also play a role. Preliminary results of recent research suggest that lowering the stocking density during laying seems to lead to more successful copulations and less feather damage at least up to 40 weeks of age, but this study has not been finished yet (De Jong *et al.*, personal communication).Leone and Estevez (2008) used vertical panels in the 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.

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, but also the possible selection for improving the genotype adaptability to a given rearing environment are important questions. This second approach remains questionable for ethical reasons although it 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 emphasized them. Nevertheless since the year 1950, selection became much more intense with specialized lines being selected for specific parameters with emphasized dimorphisms between lines and/or sexes, and the use of cross-breeds for commercial production instead of pure breeds. Moreover, changes in behavioural repertoire and adaptive capacity in relation to selection on growth or laying rates have not been taken 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. In contrast, selection for increasing egg rate was associated with higher levels of nervousness, aggressiveness and feather pecking. The remaining question is which alleles have been selected concomitantly. Thus, relations between selection and animal welfare problems raise numerous questions in terms of birds' abilities to adapt to commercial conditions, whether intensive or extensive, as well as the consequences on welfare of the selection programs implemented until now and in the future. Nowadays, commercial breeding companies do take this information on board in their selection strategies but difficulties remain in practice due to the increased diversity in production systems (e.g., barn with or

without free range access, organic production) and the possible negative side effects on production (the breeding strategy dilemma's).

The first dilemma concerns the apparent impossibility of reconciling production requirements (good reproduction performance, good health and low mortality of the breeders, offspring's satisfactory growth performance and high feed efficiency) without recourse to severe feed restriction, which was entitled the "Broiler Breeder Paradox" in a EU project (BBP – QLK5-2000-01732) (Decuypere *et al.*, 2006). The selection on 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 reported above, the severe feed restriction which is a prerequisite to lower mortality and to obtain optimal reproductive performance is questionable in terms of welfare. Other welfare related problems are health disorders like ascites, non-infectious skeletal disorders, viability and mortality. Different parameters are presently taken into account in the breeding selection programs and do somehow at least partially respond to this demand. Thus mortality is systematically recorded by cause of death during the broiler period and breeding values are calculated for these traits. Moreover, selection candidates are measured for Oxygen Saturation capacity, a trait which is associated with ascites' resistance. Although non-infectious skeletal disorders, especially leg weakness, can have different origins, heritability of such traits is sufficiently high (Le Bihan-Duval et al, 1996) to be taken into consideration. In practice, all individuals are carefully checked for leg, toe and keel defects, breast blisters as well as foot pad lesions, and birds showing defects are culled. Furthermore, tibial-dischondroplasia is recorded on processed sib-birds. If not sufficiently effective, as it may be indicated by an increase in leg defect occurrence on commercial broiler farms, an intra-familial selection will be practiced. In terms of welfare improvement, one may ask if it would not be reasonable to routinely use this last approach. Research on genetic disease resistance is also intensively carried out. Concerning the problem of hunger, due to the necessity of using feed restriction, alternative breeds requiring lower or no feed restriction are available.

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. As a consequence, most often breeding rearing conditions differ from commercial broiler production conditions, 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 commercially-like conditions so that they can show their normal behavior and performance with respect to social interactions and reproductive and sexual behavior. The combined use of electronic devices (microchips) and DNA markers may help to overcome some of these difficulties in the future, as well as the potential localisation of QTL and/or SNP markers.

A third dilemma arises from the difficulties to measure some parameters, such as behavioural ones, in terms of techniques or time needed for a large number of animals on a commercial scale. For this reason, group selection against feather pecking which has

been shown to be experimentally effective (Kjaer *et al.*, 2001; Su *et al.*, 2005), is rarely used in commercial practice. A further question remains the relative weight that could be put on these parameters relative to more traditional production traits. The identification and localisation of QTL and/or markers (SNPs) 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. Likely, rough male mating behaviour as well as overmating negatively affect the welfare of the hens. The used preventive measures are also questionable, because to prevent excessive damage to the hens mutilations are carried out in many countries, or hens are housed in cages and artificially inseminated. In previous decades intensive selection for production characteristics did not take into consideration the effects of selection on behavioural repertoire and adaptive capacity, until recently. Nowadays commercial breeding companies are more aware of the effects of selection programmes on bird welfare. In practice, although for example reduced mortality, lameness and some health criteria are routinely included in selection programs, other welfare issues are not addressed. 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 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), seem to be valuable tools to favour welfare in poultry breeding practices, although further research is needed.

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