Welfare issues of modern laying hen farming

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ABSTRACT

This review starts with a brief outline of poultry behaviour and biology and a description of the present laying hen farming situation in Italy. Moreover, it points out the situation of EU legislation currently in effect for laying hen welfare. It then reviews the main welfare issues of layer farming. The following aspects are considered: rearing system (e.g. stocking density, light intensity and photoperiod, equipment and facilities) and some health aspects. All these aspects represent important issues for farmed species, but special attention should be paid when we deal with intensively farmed species like poultry, where a lot of potential stressors may impair the welfare with consequences on health and production. The adoption of suitable housing systems and of adequate management techniques, as well as the presence of well trained stockpersons with a sound knowledge of poultry physiology and behaviour, are particularly important in guaranteeing a sufficient welfare level to poultry. Therefore, the adoption of specific codes of recommendations is highly desirable.

Key words: Laying hens, Welfare, Behaviour, Production.

RIASSUNTO

PROBLEMATICHE DI BENESSERE NELL’ALLEVAMENTO DELLE GALLINE OVAIOLE

L’allevaramento delle galline per la produzione di uova da consumo rappresenta una delle maggiori produzioni zootecniche italiane; l’estrema intensificazione che caratterizza tale produzione è spesso associata all’insorgenza di problematiche di benessere per gli animali allevati, problematiche che sono state affrontate dalla UE per cercare di conciliare le esigenze produttive con il benessere degli animali. Questo capitolo inizia con una breve introduzione che intende fornire alcune conoscenze di base circa la biologia ed il comportamento delle specie avicole. Viene fornito successivamente un quadro della situazione dell’allevaramento avicolo in Italia per quanto riguarda la produzione di uova da consumo. Si è poi fornito un quadro sulla normativa europea, già recepita anche a livello nazionale, che definisce gli standard minimi per il benessere delle ovaiole. La sezione successiva prende in considerazione alcuni dei punti critici dell’allevaramento dell’ovaiole con...
siderando in particolare i sistemi di allevamento (es. densità, intensità luminosa e fotoperiodo) e alcune patologie la cui etiologia è ascrivibile al sistema di allevamento quali la fragilità ossea. Questi aspetti rappresentano problematiche che coinvolgono tutti gli animali d’allevamento, ma assumono un ruolo prevalente in allevamenti particolarmente intensivi come quelli avicoli nei quali stressors di differente natura possono mettere a rischio il benessere degli animali e quindi la loro salute e produttività. In questo contesto, al fine di garantire un buon livello di benessere agli avicoli, sono di fondamentale importanza sia l’adozione di sistemi di allevamento e di management più consoni che la presenza di addetti con conoscenze approfondite del comportamento e della fisiologia degli animali allevati. A questo scopo sarebbe auspicabile la stesura e la diffusione di linee guida per l’allevamento che integrino agli aspetti produttivi anche questo tipo di conoscenze.

Parole chiave: Gallina ovaiola, Benessere, Comportamento, Produzione.

Introduction

The ancestor of the domestic fowl is the red jungle fowl (Gallus gallus). Wild populations of these jungle fowl are still abundant today in S.E. Asia and the domesticated bird can be regarded as a subspecies (G. gallus domesticus, Wood-Gush, 1959). With respect to behaviour, there have been remarkably a few changes in the behavioural repertoire. It is generally accepted that domestication and artificial selection have only modified the frequency of behaviour by changing the thresholds of the behaviours, rather than adding or eliminating behaviours to the animal’s behaviour repertoire (Hale, 1962; McBride et al., 1969; Wood-Gush et al., 1978; Price, 1998).

Behaviour may be secondarily affected by selection and studies of such correlated responses may offer new insights into how behaviour is modified under different environmental constraints, and hence into its evolution. However, few of the differences in behaviour between domesticated poultry and their ancestors are due to deliberate selection. Some patterns that first evolved in wild birds, such as nesting behaviour and anti-predator response, remain almost unchanged in modern poultry, presumably because they are widespread and stable in the genotype and there has been no selection against them. Selection for production traits in animal husbandry has been heavily intensified during the last century. For example, slaughter age in broilers has been reduced by about 1 d per year in the last 30 years, caused mainly by genetic selection for increased body weight (Havenstein et al., 1994). Unintentionally, selection for production traits has also affected the behaviour of the animals. It was reported by Dawkins (1989) that red jungle fowl spend 90% of their active time on feeding activities. Studies of layers and broilers showed a lower frequency of locomotion and feeding in broilers (Bessei, 1992) even though they consume twice as much food as layers and gain twice as much weight (Masic et al., 1974; Savory, 1975; Hocking et al., 1987).

Jungle fowl and domestic fowl are prey species and they are well designed to detect and avoid predators. Vision is important. They have a well-developed colour vision and a visual field of about 330°. Hearing is also important. They are sensitive to frequencies in the range of 15 to 10,000 Hz and have a repertoire of about 20 separate calls (Wood-Gush, 1971) including distinguishable calls for ground and aerial predators. Visual and acoustic signals are used for communication and social recognition. Sexual and aggressive displays are highly developed (Krujilt, 1964; Wood-Gush, 1971). Jungle fowl are
omnivores, spending a large portion of their day pecking and scratching in the ground for food (Collias and Collias, 1967). Studies in free ranging jungle fowl in zoos have estimated that birds spend up to 61% of their time ground pecking (Dawkins, 1989). Domestic hens also spend a large proportion of their day pecking and scratching (Hansen, 1994). The beak is the main exploratory organ for the bird. It is well innervated with a collection of touch receptors at the end which allows birds to peck accurately (Gentle and Breward, 1981, 1986).

Birds have pain receptors and show aversion to certain stimuli, as if they experience pain (Gentle et al., 1990; Gentle, 1992). They show fearful behaviour and avoid frightening situations, implying that they experience fear (Jones and Faure, 1982; Jones, 1986). Where possible domestic fowl will avoid or move away from situation that results in fear. Sometimes this stimulates beneficial avoidance action, but it can also lead to deleterious consequences in intensive housing systems, including panic and hysteria leading to injury (Rutter and Duncan, 1989; EFSA, 2005b). Stockpersons can minimize undue fear and distress by careful actions and by sympathetic handling of the birds (Jones, 1996).

The present laying hen farming situation in Italy and the legislation in force for laying hens

In Italy poultry production is one of the greatest livestock productions. Nowadays the number of laying hens reared for egg-shell production is almost 12 billion.

In spite of the European legislation about 86% of the hens are reared in cages and only the 3% of these cages are enriched. As far as the remaining 14%, 9% are reared in barn systems, 2% in free-range systems and 3% in organic systems.

The Council Directive 1999/74/EC, adopted in 1999, distinguishes three types of rearing systems for laying hens: enriched cages where laying hens have at least 750 cm² per hen of cage area, measured in a horizontal plane; unenriched cage systems where hens have at least 550 cm² of cage area per hen measured in a horizontal plane, non-cage systems (alternative systems) with nests (at least one for 7 hens), adequate perches and where the stocking density does not exceed 9 laying hens per m² usable area. Since January 1st, 2003 it has been forbidden to build non enriched cages. By January 2012 at the latest this system should be prohibited. The hens kept in the enriched cage systems and the non-cage systems must also have a nest, perching space of 15 cm per hen, litter to allow pecking and scratching and unrestricted access to a feed trough measuring at least 12 cm per hen in the cage.

In Italy both the directives 1999/74/CE and 2002/4/CE on the protection of hens and plant registration have been adopted in the D.lgs. n. 267 29 July 2003.

The category “alternative systems” comprises a wide variety of different types of systems, from very simple single level systems to multilevel aviaries with or without free-range facilities. The term “alternative systems” is used in the industry to indicate systems which are not conventional cages or to any non-cage system.

Main welfare issues for laying hens

Stocking density

The Council Directive 1999/74/EC states a maximum stocking density of 9 birds/m². However, where the usable area corresponds to the available ground surface, a stocking density of 12 hens/m² is allowed until 2012 in systems applying this density before 3 August 1999. There is no clear scientific evidence for the recommendation of
the maximum stocking density of 9 birds/m² because large-scale replicated experimental studies are few. Whether or not the welfare of hens is improved by housing birds at 9 animals m² or less, it can only be assessed by considering the effect of stocking density on a broad range of different welfare indicators. One of these indicators is behaviour. Higher stocking densities are associated with higher levels of feather pecking in laying hens in different housing systems (Nicol et al., 1999). Also laying hens (Hansen and Braastad, 1994; Huber-Eicher and Audige, 1999) and growing bantams (Savory et al., 1999) showed more feather pecking, measured by the amount of feather damage, at higher stocking densities. Furthermore, epidemiological studies showed that use of the outdoor range in free-range flocks of laying hens reduced the risk of feather pecking (Bestman and Wagenaar, 2003; Nicol et al., 2003), which might be the result of lower stocking densities within the barn. Other studies, however, failed to find a relationship between stocking density and feather pecking (Appleby et al., 1989; Carmichael et al., 1999; Gunnarsson et al., 1999; Oden et al., 2002).

Under commercial conditions, an increase in stocking density is often accompanied by an increase in flock size. An increase in flock size is associated with higher levels of feather pecking (Nicol et al., 1999; Bilčik and Keeling, 2000), higher levels of fear (Bilčik et al., 1998) and lower bodyweight (Keeling et al., 2003). However, levels of aggression are generally low in large flocks of laying hens (Hughes et al., 1997; Carmichael et al., 1999; Nicol et al., 1999; Estevez et al, 2002, 2003), possibly due to the formation of sub-groups of familiar individuals within a large flock (Grigor et al., 1995). Space needs of laying hens were studied in different ways. Faure (1994), for example, used operant conditioning to allow small groups of hens to modify their cage area, and hence demonstrated their preference for space; but this yielded inconsistent results. Other approaches were to measure the amount of space required for free expression of different behaviour patterns (Dawkins and Hardie, 1989), and to assess the influence of varying space allowance/stocking density on performance of such activities (Nicol, 1987; Keeling, 1994).

Recent assessments of spatial preference demonstrated that hens in furnished cages adopt an even spatial distribution when hens are allowed to move between two linked furnished cages (Cooper and Albentosa, 2004; Wall et al., 2002, 2004). These preference tests suggested that hens in furnished cages at 600 cm² cage floor area per bird are still attempting to maximise their personal space allowance. This preference outweighs any competing preference for additional cage height (Cooper and Albentosa, 2004). In commercially available furnished cages (Elson, 2004), increasing minimum cage height from 38 cm to 45 cm had no effect on fearfulness or bird position within the cage, and only a minimal effect on behaviour in the usable area. These results suggest that increased area offers more value to birds than increased cage height.

In non-cage systems, birds housed at 12 birds per m² have an average spatial provision of 830 cm² per bird. Although this is not much more than in cages, usable space is increased as a result of increased use of vertical space and furniture (Cooper and Albentosa, 2003). An understanding of how birds adapt to the space and social conditions of large flocks is gradually emerging. In larger groups spacing behaviour varies according to activity, time of day and other factors, and space is not evenly used (Carmichael et al., 1999; Appleby, 2004). Social factors such as gregariousness, affiliation, social facilitation, and environmental factors such as the provision of discrete limited
resources tend to reduce inter-bird distance and produce clumped distributions (Cooper and Albentosa, 2004). Laying hens seldom perform activities such as wing flapping, stretching, body shaking and tail wagging (Albentosa and Cooper, 2004). However, when space is so restricted that they cannot perform them, as in conventional cages, they exhibit rebound behaviour and perform them for much longer when subsequently given more space (Nicol, 1987). Moreover, Albentosa and Cooper (2004) found a significant reduction in the number of wing or leg stretches and tail wags in birds housed in groups of 8 in cages at 762 cm² each, compared with pairs of birds at 3084 cm² each. Thus, there is evidence that hens prefer to have personal space. In the case of high stocking densities hens will maximise their personal space by spacing themselves out evenly both in cage systems (Albentosa and Cooper, 2003) and in colony systems (Lindberg and Nicol, 1996).

**Drinking, feeding and foraging**

Domestic fowl are omnivores and have retained the typical feeding pattern of jungle fowl, which consists of pecking, ground-scratching and manipulating with the beak (pulling and flicking), followed by ingestion. Although the degree to which pecking and scratching behaviours were retained varies among strains of hybrids, they are still present and if frustrated these behaviours may be re-directed towards injury or even cannibalism (Huber-Eicher and Wechsler, 1998; El-Lethey et al., 2001; Sedačkova et al., 2004).

Laying hens should have at least daily access to food and access to water at all times. Hens have a strong preference for a littered floor for pecking, scratching and dust bathing. When litter is provided it should be maintained in a friable condition. The provision of litter can reduce the risk of feather pecking (Johnsen et al., 1998; Huber-Eicher and Sebő, 2001; Aerni et al., 2005; LayWell, 2006). With regard to drinking, even if nipples do not seem to allow the normal drinking pattern, there is little or no evidence that this could be a problem for laying hens, which were prepared for this type of drinker during rearing (EFSA, 2005b). In spite of that, it may be of interest to consider the findings of Green et al. (2000) who associated the use of bell-drinkers with an increased risk of feather pecking. It was suggested that the reason for this may be wet litter under the drinkers. Of course clean and fresh water has to be provided *ad libitum*. Simultaneous feeding of all laying hens may be a behavioural priority in small groups but probably not in larger flocks fed *ad libitum*, where birds can easily feed separately (Appleby et al., 2004). Faure (1986) observed that groups of 4 hens only rarely worked to obtain more than the 40 cm length of feed trough and concluded that there was no necessity to offer a larger feeder space. Although the ‘efficiency’ of eating (g/peck) was not impaired significantly at low illumination, hens showed a clear preference for and appeared motivated to eat in bright as opposed to dim light (Prescott and Wathes, 2002).

Exploratory behaviour and information gathering were vital for survival of birds. Foraging - a most important part of the exploration behaviour - includes walking, scratching, stepping back, pecking and manipulating and is one of the most time consuming behaviours even in housing systems where the food is provided *ad libitum* in food troughs. Dawkins and Hardie (1989) estimated the need of space for ground scratching as 856 cm² (range 655-1217 cm²) per hen. Carmichael et al (1999) showed that birds spent most time on the perch frame (47%) but also 23% in the litter area. Individual birds were seen to use about 80% of
the pen volume available to them. This value was similar for all densities and showed that individuals did not have separate home ranges. Foraging is also a key behaviour which helps to minimise feather pecking and cannibalism (Bearse *et al.*, 1949; Calet, 1965; Bessei, 1983; Aerni *et al.*, 2000; Green *et al.*, 2000). Gunnarsson *et al.* (2000) found that even if a substrate is not suitable for dust-bathing, caged laying hens have still a high demand for a substrate presumably for foraging behaviour. It is suggested that not only the quantity but also the quality of foraging behaviour elicited by a given material may be important to prevent the development of feather pecking (e.g., Huber-Eicher and Wechsler 1998).

**Light and photoperiod**

The primary biological rhythms in poultry, as in other animals, are seasonal and diurnal, both mediated by light. The main factor controlling seasonal changes in physiology and behaviour is day length. In laying houses the photoperiod length is usually between 12 and 17 hours, often increasing as the hens increase in age (for gonadal stimulation). Good production results could also be achieved with intermittent photoperiods (alternating short periods of light and darkness).

Light intensity necessary to keep a normal laying rate is 5 to 7 lux (Sauveur, 1988; Lewis and Morris, 1999). Morris (2004) showed a photoperiodic threshold at around 2 lux, but slightly higher values are recommend for laying houses because it is better for workers and allows for some variation in intensity in different parts of the house. However, bright light also has various effects on behaviour that are adverse for either the owner or the bird. It increases activity, and also increases aggression and feather pecking (Manser, 1996; Morris, 2004). An even light distribution is desirable to minimize problems such as floor eggs, pecking or smothering. Where there is natural light, apertures are often shaded or baffled to avoid direct sunlight and thus arranged in such a way that light is distributed evenly within the accommodation. For the first few days after housing light may be fairly bright. Later the light intensity should be such as to prevent health and behavioural problems (LayWell, 2006). There is no evidence to support a benefit of natural light as such, but certainly some aspects of natural light variation e.g. a gradual reduction of light at the end of the light period, rather than switching off lights abruptly help birds to adapt better to their environment (Tanaka and Hurnik 1991).

**Air quality and temperature**

Air quality includes humidity, and hot air blowers may cause problems by drying the air. Relative humidity of up to about 60% is beneficial to growth in chicks (Sainsbury, 2000). The large amount of litter and the greater bird movement in alternative systems result in greater concentrations of bacteria and fungi in the air and in greater dust concentrations compared with conventional and furnished cage systems. Greater dust concentrations were associated with more serious pulmonary lesions, typical of chronic bronchitis, in cage-free birds (Michel and Huonnic, 2003).

Furthermore, respiratory infections are more likely to occur in either dry air or very moist air, outside the range of about 40-80% humidity. High humidity can also cause birds to have difficulties in keeping their body temperature down, because in hot conditions body heat is dispersed mainly by panting and evaporative cooling. Problems with air quality are more common in floor systems than in cages, particularly where ventilation rates are low, although they may also be severe in cage houses with manure.
pits. In one study of a deep litter house stocked at low density, average airborne dust was 30 mg/m³ and average ammonia was 23 ppm and the birds were exposed to these levels over long periods (Appleby et al., 1988). Ammonia levels can also become unacceptably high during the winter months in northern climates even in cage houses, because building heat is conserved by decreasing ventilation rates.

Birds are homoeothermic animals and they can maintain their body temperature over a wide range of ambient temperatures. In adult White Leghorn hens, this range is about from 1 to 37°C (Esmay, 1978). Below this range, core temperature falls, while at higher temperatures rises. The thermo neutral zone for adult layers is wider than for pullets being reared, and it is estimated to be in the range of 12-24°C. Outside this range hens may adapt to temperatures by changing their behaviour and their feed (energy) and water intake, and in the case of high temperatures, by increasing their dissipation of body heat by means of an increasing heat loss by water ingestion (Appleby et al., 2004).

The main reason for close control of temperature is not productivity but food consumption. In cold conditions, the need for increased heat production stimulates higher food (energy) intake, so it is cheap to keep temperature in the thermo neutral range. For laying hens, 21-24°C is usually recommended. Above this, food conversion efficiency may be improved further, but egg weight may decline (Sainsbury, 2000) unless the concentration of nutrients in the diet is increased.

**Health**

The evaluation of the impact of housing systems on animal health, as a welfare problem, can be split into infectious diseases, parasitic infestations, production diseases and physical damage to individual birds.

Infectious diseases include a wide range of viral and bacterial diseases and are of great concern in modern production systems. Successful vaccination programmes and management routines have reduced the risk of outbreaks of some of these diseases, while others still pose serious risks in modern eggs production. However, infectious diseases may also be linked to housing conditions, such as the effect of group size, air quality, presence and quality of litter and access to outdoor areas. Most infectious diseases may occur in any housing system. However, some systems for layers increase the risk for specific diseases to develop and spread. The main potential risks lie in the area of biosecurity (i.e. the hygienic situation and the large number of birds kept in close contact). Hence, good management practices are extremely important in such systems. This does not exclude the fact that the risk of disease may be very sensitive to housing systems or their components *per se* (Jansson, 2001).

Some studies strongly suggest that wild birds, especially ducks, are a source of infections for domestic poultry (Halvorson et al., 1982). Keeping birds outdoors allows more contact with wild animals and birds. Closing birds in their houses during the migrating season in these regions may decrease this risk (EFSA, 2005a).

Parasitic infections include a wide range of external and internal parasites. Internal parasites are usually related to housing conditions. A parasitic infection where the number of parasites is below a certain level and there is a balance between host and parasite will not normally create a health problem for the host. If, however, this balance changes and the parasites increase in number, the infestation often produces clinical symptoms. Many factors affect this, particularly the host's general health status.
and immunological capacity and the parasite pathogenicity. The general hygienic level in the poultry house, including possibilities for cleaning and disinfection, are the factors producers can manage to keep the right balance between host and parasite (EFSA, 2005b).

The survival or reproduction of an ectoparasite like the red mite in a given egg production system is also influenced by environmental factors, including temperature, humidity and the construction of fittings. The poultry red mite, for example, has better opportunities to reproduce and to infest hens in poultry houses rich in fittings such as roosts, nests, slatted floors than in conventional laying cages where the mites may find it more difficult to survive outside the host (Loomis, 1984; Maurer et al., 1988). Höglund et al. (1995) reported from inquiries to commercial flocks on the prevalence of red mites to be 4% in conventional cages, 21% in non cage floor systems and 19% in hobby flocks on floor systems. However, when checked on the farm the true occurrence was found to be 6%, 33% and 67%, respectively. Van Emous et al. (2003) reported that all 25 commercial aviary free range flocks included in their survey showed the presence of red mites to varying degrees. Guy et al. (2004) in a survey on 29 UK farms, showed that the population of nymphs and adult mites was significantly higher in free-range compared with either non cage or cage systems.

Metabolic diseases which are not spread by infection were reported at a higher incidence in cages than in other systems (Duncan, 1978), while skeletal problems such as osteoporosis are most serious in the confined conditions of cages (Rowland et al., 1972).

Bone fragility in egg laying hens is a well-known condition that is related to several causal factors including nutritional imbalance, the level of egg production and the birds’ possibilities to move about and thereby keep their bones and muscles fit. As bone fragility may lead to bone fractures the condition is very important in relation to the welfare of laying hens. Skeletal weakness in hens was first reported as cage layer fatigue after the introduction of conventional cages in the USA (Couch, 1955). The problem was identified as a general loss of structural bone leading to weakening degeneration and fractures of bones. Wilson et al. (1992) confirmed that the bone loss is caused mainly by the progressive development of osteoporosis and Whitehead and Wilson (1992) described how an apparent lack of new bone formation in reproductively active hens leads to a progressive loss of structural bone during the laying period. Although lack of minerals in the feed of the high-yielding hen as well as egg production per se may weaken in particular the leg and wing bones, it is generally accepted that restriction of movement is the main cause of bone fragility in egg laying hens (Simonsen and Vestergaard, 1978; Hughes and Appleby, 1989; Knowles and Broom, 1990; Nörgaard-Nielsen, 1990; Fleming et al., 1994; Michel and Huonnic, 2003).

Environmental enrichment

The main proposed enrichment components for enriched cage systems, as well as alternative housing systems, include the provision of perches, nesting areas, dust bathing areas/substrates and more space per bird.

Hens appear to place little value on perching during daylight but are prepared to work to gain access to perches at night (Bubier, 1996a; Olsson and Keeling, 2000).

When perches are provided, hens make use of them, with up to 100% of their time spent perching at night (Appleby et al., 1993; Olsson and Keeling, 2000) as long as
there is sufficient space for all hens. When perches are provided in cages, hens may spend 25% of their time on them (Appleby et al., 1993), possibly making use of the extra space afforded. In alternative systems where perches are provided, birds may actually injure themselves and even break bones when they attempt to land on but miss the perch. Hence, access to perches in alternative housing systems may actually lead to broken bones. After depopulation (removal of birds for harvesting), previous evidence of bone breaks (due to the housing system) were found in 25% of birds from a cage-free housing system, whereas only 5% of caged hens had evidence of previous bone breaks (Gregory et al., 1990).

Furthermore, even for birds reared on the floor with access to perches and then housed in an aviary system (multiple tiers), bone strength was still reduced compared to birds that spent their entire life in an aviary system (Michel and Huonnic, 2003), highlighting that bone strength can still be compromised even in non-cage systems. Attempts to avoid the problem of keel bone deformity focused on altering perch design and on rearing practices. Tauson and Abrahamsson (1994, 1996) demonstrated that perches with a soft rubber cover did not significantly reduce keel bone lesions as compared to perches made of plain European beech hardwood. The design of perches is normally a compromise between creating a relatively flat surface to reduce pressure on the keel bone and minimise lesions, and making the perch sufficiently round for the birds to grip. Gripping reduces dirt on the perch surface and, consequently, the incidence of bumble foot, i.e. swollen footpads (Tauson and Abrahamsson, 1996). Moe et al. (2004) showed that rearing pullets on floors with perches compared to rearing in cages reduced keel bone lesions.

Nesting and pre-laying preferences of hens were reviewed in detail by Cooper and Alventosa (2003). There is considerable evidence that hens are prepared to ‘pay’ high ‘costs’ such as opening doors (Smith et al., 1990; Cooper and Appleby, 2003) to gain access to nest boxes before egg laying. As the time of egg laying approaches (approximately 20 minutes before oviposition), laying hens show behaviours such as pecking and treading of any nest substrates and circling or keel rotation (Hughes et al., 1989) and this has been interpreted as nest building behaviour. In deep litter systems for laying hens and in other alternative systems to battery cages, eggs are sometimes laid outside of the nests with consequent economic loss. The percentage varies greatly, but may be as high as 80% (Kjaer, 1994; Cooper and Appleby, 1996; Taylor and Hurnik, 1996). The mean proportion of eggs laid in a nest varied between 43% and 68% in a trial comparing four designs of furnished cages with standard cages, indicating that some designs failed to provide a satisfactory nest from the hens’ perspective (Guesdon and Faure, 2004).

Regarding dust bathing behaviour, Hughes and Duncan (1988) showed that in cage systems without a litter substrate, hens often engage in bouts of sham dust bathing (i.e. performing the sequences of activity that replicate dust bathing on bare wire floors). Also in furnished cages that provide a dust bath hens frequently ‘sham’ dust bath (Abrahamsson and Tauson, 1997; Olsson and Keeling, 2002) and the latter authors found that this was not due to social competition for access to the dust bath.

A lot of studies have tried to measure the value of dust bathing for hens and they have shown that hens give it a low behavioural priority (Petherick et al. 1993; Keeling, 1994; Bubier, 1996b) and sometimes they do not dust bath when given access to substrates after a period of absence (Gun-
There is a need for further research to establish the optimal substrate for dust bathing and, indeed, whether ‘sham’ dust bathing is perceived by hens to be satisfactory.

Conclusions

The welfare of laying hens in modern intensive production units is nowadays well recognized to be a problem. Many studies have been carried out in order to evaluate all the different aspects of new rearing systems for laying hens as required by legislation (EFSA, 2005b; LayWell, 2006). In any case, it seems that till now there are no sure and univocal answers to all the open questions. In fact, there is the need to improve knowledge about many aspects including, for example, the influence of rearing system design on behaviour during lay, and the optimum substrates for foraging and dust bathing (LayWell, 2006).

All cage systems tend to provide a more hygienic environment with low risk of parasitic disease. There is possibly a high risk of poor welfare on a flock basis in all systems with larger group sizes (above approximately 10-15 birds) from damaging pecking and cannibalism. All laying hens are also at high risk from sustaining fractures both during the laying period and at depopulation. There is evidence that both these problems are associated with genetic selection for high productivity. Some existing genotypes (mainly white feathered) show a lower tendency for damaging pecking. Much greater emphasis should be placed on selecting genotypes with reduced damaging feather pecking tendencies for use in alternative housing systems for laying hens. Recent studies showed that bone strength can be improved in laying hens by selection over only one or two generations without a great decrease in productivity. For good laying hen welfare it is a priority that actions are taken to reduce the current unacceptable level of fractures sustained during the laying period in all systems apart from conventional cages. This is likely to involve a combined approach of selective breeding, plus refinements to design and management including lighting. Conventional cages do not allow hens to fulfil behaviour priorities, preferences and needs for nesting, perching, foraging and dust bathing in particular. The severe spatial restriction also leads to disuse osteoporosis. These disadvantages outweigh the advantages of reduced parasitism, good hygiene and simpler management. The advantages can be matched by other systems that also enable a much fuller expression of normal behaviour. A reason for this decision is the fact that every individual hen is affected for the duration of the laying period by behavioural restriction. Most other advantages and disadvantages are much less certain and seldom affect all individuals to a similar degree.

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Welfare Issues of Hens

Welfare issues of hens are multifaceted and require a comprehensive approach to ensure the well-being of these animals. This includes understanding the impact of various factors on their physical and psychological health. This section highlights several studies that have contributed to our knowledge in this area.

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