Caged hen welfare

Background information

The use of enriched cages for egg production became increasingly common after battery cages were banned the UK in 2012. Enriched cages have the following provisions determined by EU regulation [1,2]:

a) at least 750 cm^2 of cage area per hen, 600 cm^2 of which shall be usable; the height of the cage other than that above the usable area shall be at least 20 cm at every point and no cage shall have a total area that is less than 2000 cm^2;
b) a nest;
c) litter such that pecking and scratching are possible;
d) appropriate perches allowing at least 15 cm per hen;
e) a feed trough which may be used without restriction must be provided. Its length must be at least 12 cm multiplied by the number of hens in the cage;
f) each cage must have a drinking system appropriate to the size of the group; where nipple drinkers are provided, at least two nipple drinkers or two cups must be within the reach of each hen.
g) to facilitate inspection, installation and depopulation of hens there must be a minimum aisle width of 90 cm between tiers of cages and a space of at least 35 cm must be allowed between the floor of the building and the bottom tier of cages;
h) cages must be fitted with suitable claw-shortening devices.

This paper aims to provide a comprehensive review of welfare associated with caged systems for housing laying hens. Wherever possible authoritative and evidence-based references are provided.

Environmental provision in enriched cages

Freedom of movement

Birds are typically housed in groups of 15 to 80 birds within one cage. The bird has freedom to move throughout the cage. In non-colony systems, the bird has freedom to move throughout the entire shed or pen and therefore will also have the opportunity to perform behaviours such as running or flying.

Reduced space to use environment (dust baths, perches)

Due to the nature of the system, birds in enriched colony cages typically do not have access to friable litter material to allow dry dustbathing. It is a mandatory requirement under Paragraph 2 of Schedule 4 to the Welfare of Farmed Animals (England) Regulations 2007 [1] for the system to provide some form of pecking or scratching device.

Foraging is a natural behaviour associate with food seeking and the behaviours performed by the birds when foraging are those such as scratching and pecking [3].

Some studies have shown that birds that have reduced opportunity to forage by means of lack of foraging substrate may be more likely to develop injurious feather pecking which can lead to poorer feather coverage and cannibalism – both of which are of significant welfare concern [4].

Other studies have shown that birds housed without foraging substrate did not affect levels of feather pecking, but greater stress responses to stimuli were noted [5].

Dustbathing is another behaviour that is deemed as a high priority [6] and where this behaviour is inhibited, this may cause stress within the birds and increases in stereotypical behaviour [7].

However, other studies have shown that birds in colony systems “sham” dust bathe [8] and that feather pecking can occur in the absence of dustbathing [9]

Perch provision

The body of literature on perches is limited. The European Food Safety Authority (EFSA) investigated the use of perches for laying hens in cage and non-cage systems [10]. Their opinion is based on a review of the effects of perch height and design on hen health and welfare. The review assessed hen motivation to grasp and seek elevation, the appropriate height of perches and other features (position, material, colour, temperature, shape, width and length). Relevant features of perches are often confounded with others. The most commonly used measures to assess perch adequacy are keel bone damages, foot pad lesions and perch use by hens.

Hens seek elevation during the day, and at night they select a site for roosting. Elevated perches allow hens to monitor the environment, to escape from other hens, avoid disturbances and improve thermoregulation. For night-time roosting hens show a preference for perches higher than 60 cm compared with lower perches. However, elevated perches risk increased prevalence of keel deformities and fractures. The risk of injury increases when hens have to jump a distance of more than 80 cm vertically, horizontally or diagonally to reach or leave a perch, or jump an angle between 45 and 90° (measured at the horizontal plane). Material, shape, length and width of the perch also influence perch preference by hens. The report concludes that for the design of an adequate perch, different features of perches need to be further investigated and integrated.

A review by Hartcher & Jones [11] investigated welfare of laying hens and provided an in-depth summary of perch provision. Perching is an innate behaviour and is thought to be a component of biological functioning and is necessary to avoid stress. The authors cite a number of studies which conclude that use of perches improve musculoskeletal strength thereby decreasing osteoporosis and fractures. Injuries were noted in cage-free systems in which perches were too high. Given the opportunity the majority of birds were found to use perches at night and were restless if unable to do so. Poorly designed perches were associated with an increase in the incidence of Staphylococcal foot infection and keel bone fractures. Perch provision was also found to reduce aggression, increase bone mineral content and increase muscle deposition. In order to encourage perch use it was recommended that perches be introduced during rearing through to placement as pullets.

Lack of access to outside/sunlight

Birds kept in enriched colony cages do not have access to natural daylight. The Welfare of Farmed Animals (England) Regulations 2007 [1] and the Code of Practice for the Welfare of Laying Hens and Pullets [2] do not refer to access natural daylight, only in that where natural daylight is insufficient then artificial light should be used to achieve 10 lux measured at the feed trough level. Apart from nest box areas which should be at 1 lux. To mimic natural daylight there should also be a period of twilight between 1 and 5 lux. Whilst birds do not need natural daylight to meet their physiological needs a broad-spectrum light should be used to closely replicate natural daylight. A colour rendering index over 80 is also recommended to good colour reproduction. Light frequency and flickering can be perceived by birds as a stressor and should be avoided.

Lack of environmental enrichment

The design of modern colony cages does incorporate environmental enrichment including nesting areas, perches and scratch areas with a minimum floor space allocation per hen [1]. However, the level of environmental enrichments is lower when compared to other production systems. Environmental enrichments can improve feather coverage [11], and bird health and welfare by reducing injurious pecking and allowing natural foraging behaviours. It is therefore critical that enrichment can be independently shown to improve animal welfare rather than simply increasing the complexity of an environment. Given the multifactorial influences on health and welfare indicators for any given flock in all production systems, including breed, feed, management and disease challenges, the levels of enrichment within the colony cages does not clearly demonstrate an overall negative impact [12,13,14].

"Scratch" area ill-defined

UK legislation clearly outlines that in order for layer housing to be considered an "enriched cage" system, both a scratching area and claw shortening device(s) must be installed and available for use, allowing birds to express natural behaviours.

However, what is less clear is the exact definition of either of these aspects of enriched cage structure – there are no regulations as to the size or type of scratch system. L kewise the nature of claw shortening devices is left open. Examples listed within international papers include the following forms of claw shortening devices: abrasive strips, abrasive paint, metal plates with holes/files, rubber mats with grooves, glue and sand. Interestingly, whereas all claw altering dvices and claw shortening devices (CADs/CSDs) investigated demonstrated a positive effect on bird welfare, literature suggests there is no one specific optimal design for the scratch area [15].

Difficulty noticing dead birds

Adequate training is compulsory for all staff to make sure they are capable of recognising ill birds and understand the importance of removing dead birds from cages as soon as is practical. Inspection of enriched cage systems to assess bird welfare and remove any carcasses is aided by the use of lights and safe step equipment that allows personnel to visually assess and remove dead birds more easily.

Red mite/ectoparasite control

The control of red mite (*Dermanyssus gallinae*) is difficult in all laying poultry systems and the size of enriched cage buildings adds another dimension to monitoring of ectoparasite population size [16,17,18,19] However effective monitoring can be achieved using traps at strategic places within the houses [20,21]. This allows for accurate estimations of population size and can assist in making decisions on when best to treat. Treatment in drinking water using fluralaner (Exzolt™) can have very good results in reducing red mite burdens. There are also other approved products that can be used in the house which will kill mites and impact on the parasite population both between flocks and also during production.

Use of shock wires

The primary use of electric wires (or shock wires) in colony systems is to prevent hens from eating eggs sitting on the egg belts before they are conveyed to the pack room. If egg eating behaviour starts in a colony unit, the producer's main income source is lost. They are also used in the layer sector in other housing systems (barn/free range) to prevent smothering.

Electric fences are used across many veterinary species including cattle, sheep, pigs and horses to control unwanted behaviours. Electric fence usage is a form of negative reinforcement training. The animal learns that exhibiting an unwanted behaviour results in a negative experience and therefore, stops performing the undesired behaviour.

There is a significant lack of poultry specific research into the welfare implications of electric fencing or wires in colonies or other layer systems. It is assumed that the effectiveness of the behavioural modification of the birds using electric wires in colonies mirrors negative experiences observed in other species. The Animal Welfare Act 2006 [22] requires those responsible for the animals ensure they are protected from pain, suffering, injury and disease. The use of electric fencing in any veterinary species is controversial given that it is an aversive means of behaviour modification.

Feather cover

One of the main focus points in commercial egg production is injurious pecking and the possible associated welfare implications. Feather loss is a key indicator of laying hen welfare. Feather coverage is now commonly measured as part of welfare outcomes on farm by many producers. The term injurious pecking is used for a group of unwanted pecking behaviours identified by the pecking or pulling of the feathers of another flock member which can cause distress, feather loss or even death. Hens can also display aggressive behaviour towards one another mainly targeting the head and neck region. However this behaviour has a different underlying motivation and is generally performed to establish and maintain social hierarchies. Although injurious pecking is prevalent in all housing systems, the spread of injurious pecking behaviour between birds is more of an issue in loose housing systems than in enriched cage systems.

Research has identified that injurious pecking is a multifactorial problem and can be triggered by an abundance of risk factors including environmental stressors, inadequate nutrition, presence of parasites (both external and internal), disease and genetics [23,24,25].

The Lion scheme (over 90% of UK egg production) requires feather cover and mortality data to be recorded at 40 and 70 weeks of age. This is to be used for benchmarking by individual packers and across the wider industry. The latest figures from Lion Code producers are recorded as averages for feather loss. In combining all the production systems, hens appear to have very little feather loss throughout lay. Although at 70 weeks enriched colony cages were reported to have more feather loss (some of which will be from abrasion), on average numbers were comparable for all systems.

It is important to recognise that few options in terms of environmental enrichment are available to prevent or control injurious pecking within the enriched colony cage (EC) system, although for all systems optimal nutrition and disease control are important. However, options do exist and are utilised by farms as needed.

Osteoporosis

Skeletal health is an important aspect of the welfare of laying hens. Osteoporosis in laying hens is a condition that involves the progressive loss of structural bone during the laying period which results in increased bone fragility and susceptibility to fracture [25,26,27,28,29,30]. The incidence of weakened bones and fractures is affected by a variety of aspects such as physical strain, nutrition, housing system and genetics. As the formation of eggshells requires the deposition of calcium, a continued high egg output can therefore lead to a loss of bone calcium and consequently high rates of osteoporosis. A major cause of osteoporosis is structural bone loss which can be accelerated by a reduced level of activity [25].

Allowing birds more exercise results in better bone quality but may not decrease the overall fracture incidence. It may be concluded that allowing birds more exercise in alternative systems will improve bone strength, but this does not necessarily improve bird welfare proportionately. Birds in alternative systems have greater opportunity to experience more damaging accidents.

Cage layer fatigue is a welfare concern associated with osteoporosis and bone brittleness which has been described in hens kept in battery cage systems. Since the introduction of the enriched cage systems, which allow the birds more freedom of movement and the ability to perch, the incidence of this condition has been reduced. Hens are at risk of obtaining fractures during collisions with objects during flight. Hens in enriched cage systems exhibit the lowest number of total fractures compared with other housing systems. This is probably due to improved musculoskeletal health due to the use of perches when compared to conventional cages, and an absence of the environmental complexity which can be present in cage-free systems. Although perches can potentially contribute to the incidence of keel fractures, hens should have access to perches due to the high motivation to perch, improved bone strength, improved feather quality, and improved foot pad, toe, and nail health.

The skeletal health in hens kept in enriched cage systems could be supported through a combination of selective breeding, optimised diets, the continuation of providing the hens with the ability to perch and sufficient exercise opportunity.

Keel bone fractures

The damage to the keel bone of hens can be considered in two ways – one being the presence of a fracture to the keel bone and the other being deviation within the keel bone so that the bone has a sharp, unnatural bend. [31].

Keel bone damage is a significant welfare concern with evidence that this condition is painful [32] and can be found in birds in all types of housing system. However, keel bone damage has been shown to be higher in birds housed in alternative housing systems compared to colony cages [33]. One study showed birds in colony units had a prevalence of 36% keel bone fractures, despite having weaker bones, whereas multi-tier units had a prevalence of 86% and the severity of the lesions was greater [34]. The difference is likely due to the freedom of movement alternative systems offer the birds which can lead to an increased incidence of falls and collisions with environmental structures. [35].

Health and Welfare outcomes:

Mortality

Mortality is one measurement of bird health and welfare. Several studies have shown that cumulative mortality in colony birds is lower than alternative systems. [36,37,12].

Diseases that require faecal oral transmission (e.g. intestinal worms) in particular have lower incidence in colony birds as all faecal matter is removed either via belts or pits [38].

Other viral and bacterial diseases were significantly lower in colony birds compared to alternative systems. [39]. The birds are typically exposed to fewer disease vectors (e.g. wild birds) by being housed.

Loss of birds by predation does not occur in colony units.

Smothers

Smothering is the phenomenon where birds pile en masse in an area resulting in traumatic injury and suffocation of birds. Research into the causes of smothering is lacking as the events occur unpredictably, are difficult to induce experimentally and birds behave differently in the presence of an observer [40].

Smothering on a large scale is not typically seen in colony units. This is likely due to the limited number of birds within individual cages and therefore the physical piling up of a vast number of birds is less likely to occur.

Production

Flock performance can be considered a welfare indicator since production parameters are reduced if birds are suffering ill health or due to environmental stressors. The number of eggs produced by a hen during its productive life is one measure of flock performance. Expected performance from birds in management guides for the major layer breeds found in the UK indicate more eggs per hen are expected from birds in colony units compared to those in alternative systems [41].

Another measure of performance would the proportion of saleable Class A eggs. Colony system eggs are typically contaminated with less bacteria than alternative system eggs. Bacterial contamination affects shelf life and may have human health implications. [42,43].

Predation

In alternative systems that allow birds outside to range, predation, mainly from birds of prey or foxes, is a risk to bird welfare. It is very difficult to completely stop predation when birds are allowed access outside of the hen house. Birds housed in colony cages do not experience a threat or stress associated with predators.

Disease resilience and health

Tibial strength is shown to be better in free range flocks, as is feather coverage [44,45]. However incidence of vent pecking is increased [12] as are footpad dermatitis lesions [44]. Incidence of nematode infection is also high; however this does not appear to be correlated with production parameters, suggesting that the burden is kept low enough to prevent signs of disease [46].

Drug usage

There is currently no comparative antimicrobial usage data between the various types of egg production in the public domain covering the whole of the UK production. However the consensus is that usage in colony system of production is below that of the industry average. One retailer supply chain had published antibiotic use in their colony eggs as half that of their free-range supply [47].

There is an expectation as indicated in the RUMA targets published at the end of 2019 [48] that “the next reporting period will include some significant structural changes of the industry with a move away from enriched colony cage production for retail supply towards ‘barn’ and free-range production. It is anticipated that this could increase certain health challenges” [48]. Antibiotic figures reported in the 2020 VARSS Report [49] show a continuing usage decline across the egg sector, despite a rise in the free-range percentage. However there is a range of other factors which could also be influencing this, including training, weather, feed raw materials, endemic disease status, housing orders and increased biosecurity.

The use of anthelmintics will increase as the egg sector moves away from colony production to alternative barn and free-range production where endoparasites can spread and replicate more readily given the increase faeco-oral transmission [38].

Environmental footprint – nitrates, ammonia emissions, FCR, water use

While being relatively efficient converters of feed to food, poultry diets are high in protein, and poultry manure is typically nitrogen rich. Therefor emissions in the form of ammonia, nitrous oxide, and nitrate leaching associated with poultry manure can have a large environmental impact. If the crop production required as feed inputs is taken into consideration as well, the impact can be substantial.

Feed is responsible for more than 90% of the impact on water use, land use, and resource use. Reductions in feed inputs are particularly efficacious for decreasing environmental impacts, as they not only decrease the direct contributions of feed inputs to life cycle impacts, but also decrease the contributions made by manure management as higher feed use efficiency translates to lower levels of excreted Nitrogen and Phosphorus. The feed input into enriched colony cage systems is approximately 1.54-1.58 kg per dozen eggs and in cage free systems feed input is 1.58-1.76 kg per dozen eggs (Hy-Line production guide). Fresh manure (75% moisture) dropped on a conveyor belt dries easily resulting in a significant reduction of ammonia and nitrous oxide emissions. The removal of manure from the house using conveyor belts aids in the drying process.

Trial results show that enriched colony houses have better air quality, especially in wintertime, due to less free-floating dust particles, lower carbon dioxide levels and the presence of lower levels of Ammonia compared to housing systems that provide litter [50,51,52,53,54].

Food safety

Due to the multifactorial influences on egg hygiene (rodent control, flock size, stocking density, etc.), multiple scientific investigations have been unable to identify significant differences in hygiene standards between eggs produced within caged layer and free-range layer production systems [55,56]. Egg hygiene can vary significantly within the caged layer environment depending on the litter management/flock husbandry set-up. The use of litter in the scratch area may impact negatively on egg hygiene via increased laying outside of the nest box environment and increased exposure to faecal contamination [57]

Due to the complex and enclosed space involved in cage layer systems, the ability to effectively remove *Salmonella* spp. from cage environments is reduced when compared to free range systems [58,59,60]. Therefore, once established, *Salmonella* spp. contamination is more difficult to remove from a cage environment. However, there is limited to no consensus on the prevalence of *Salmonella* when compared between production systems [61], and in fact when assessing areas of greatest contamination within a free-range environment, the area representing the highest prevalence of contamination is the range [62], a risk factor which clearly offers no risk within a cage production system.

VHWP

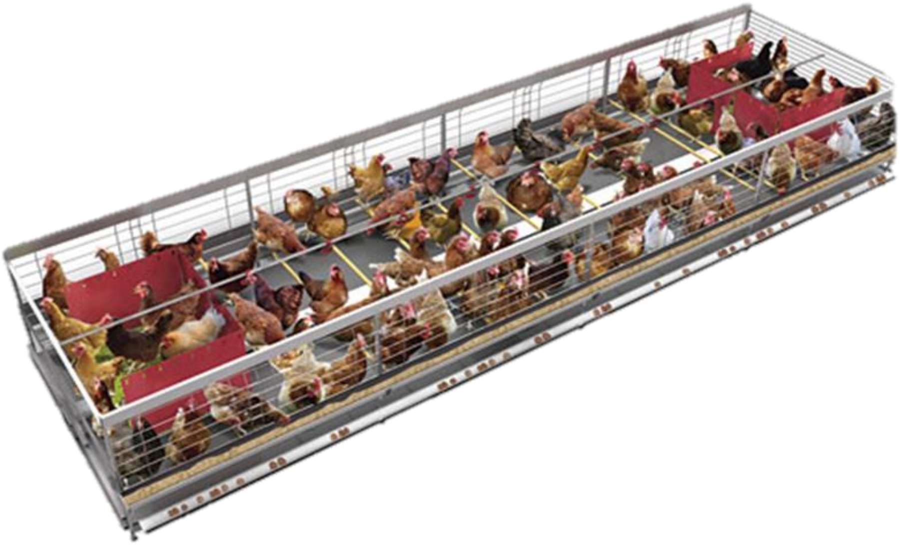
This plan is produced by the RSPCA [67] and provides guidance for the preparation of a written Veterinary Health & Welfare Plan (VHWP) for producers and their veterinary advisers. Routine visits are recommended, attended by the veterinarian, the producer and the stock-keeper. During the visits the stock are inspected and areas of concern addressed in all areas of health and welfare. The plan is underpinned by well-maintained records and staff trained in recognition of signs of ill-health and poor welfare.

Education and training of poultry keepers – Poultry Passport

Training of all staff associated with a poultry farm is key to maintaining health and welfare of the birds on that farm. An example of training available is through British Poultry Training [68] which provides a “poultry passport” detailing all training undertaken. This passport provides valuable evidence of staff competence and is increasingly required by assurance schemes.

Appendix

Images of typical enriched cages



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