THE SCIENTIFIC ASSESSMENT OF ANIMAL WELFARE AND ITS APPLICATION TO SOME ISSUES IN THE EGG INDUSTRY

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Summary

A recent government review of the layer hen industry in Australia has resulted in a number of resolutions by the State Agriculture Ministers that have implications for poultry housing. These include increased space in cages, scrapping of some older cages and research on furnished cages and non-cage systems. To help put these recommendations in some perspective, this paper examines the literature on some of the resolutions within the broader framework of the scientific assessment of welfare. It focuses on space and items of furniture such as perches, nest boxes, dust baths and abrasive strips. The homeostasis approach to the assessment of welfare is used in which welfare is evaluated on both how much has to be done by the animal in order to cope and the extent to which the coping attempts are succeeding. Using this approach there is evidence for increasing space in cages, based on reduced mortalities and increased production, and incorporating perches, based on a reduction in injuries at depopulation. Similar evidence for the inclusion of dust baths and nest boxes is lacking. The data on abrasive strips are equivocal with recommendations from overseas for their inclusion but local data indicating an increase in mortalities.

I. INTRODUCTION

Over at least the last 12 months there has been discussion by the Agriculture and Resource Management Council of Australia and New Zealand on options for a national approach to layer hen housing systems in Australia. At the last meeting of State Agriculture Ministers, in August, there were a number of resolutions that have implications for housing of poultry. These included that all new cage systems must provide a floor space of 550 cm²/hen, including the baffle, by 1 January 2001; that all cage systems that do not meet the 1995 standards are to be scrapped by 1 January 2008; research and development, based on furnished cages that include perches, nests, litter and abrasive strips, and non-cage alternatives such as barn and free-range be conducted in Australia by 2005, with the expectation that if the research is successful that industry will implement such system(s). The 1995 standards for cages include a space allowance of 450 cm²/bird, a slope on the floor of less than 8 degrees, a minimum of 40 cm height over 65 % of the cage floor area and more than 35 cm at all points, and cage fronts that are full height and width. In addition to resolutions on cage dimensions, the Code of Practice is being revised and this may result in additional changes. To help put some of these resolutions in perspective this paper examines some of the literature on space and cage modifications within the broader framework of the scientific assessment of welfare.

II. THE ASSESSMENT OF WELFARE

In making a decision on whether or not an animal's welfare is seriously compromised, individuals integrate moral views with biological facts. Thus, science has the important role of establishing the facts on how animals biologically respond to the practices under question.
However, the assessment of welfare is a controversial subject. Within scientific disciplines, variations in definitions of animal welfare exist and combined with variations in methods and, in turn, interpretation, lead to disagreement (Hemsworth and Coleman, 1998). The following definition of Broom (1986) is favoured: “The welfare of an individual is its state as regards its attempts to cope”. In this definition, the “state as regards its attempts to cope” refers to both how much has to be done by the animal in order to cope with the environment and the extent to which the animal’s coping attempts are succeeding. Attempts to cope include the functioning of body repair systems, immunological defences, physiological stress responses and a variety of behavioural responses. Therefore, using such a definition, the risks to the welfare of an animal by an environmental challenge can be assessed at two levels: firstly, the magnitude of the behavioural and physiological responses and, secondly, the biological cost of these responses (Barnett and Hutson, 1987; Broom and Johnson, 1993; Hemsworth and Coleman, 1998). These behavioural and physiological responses include the stress response while the biological cost includes adverse effects on the animal’s ability to grow, reproduce and remain healthy. This definition has been broadened to incorporate animal emotions (Broom, 1998) and there is no reason not to incorporate animal emotions into the homeostatic approach as they would have evolved on the basis of their survival values and contribution to biological fitness.

The disagreement over what is important for the welfare of animals led to attempts to study and conceptualise animal welfare in more scientific ways. It is generally accepted that there are three broad approaches used by scientists in studying animal welfare: the “feelings-based”, the “nature of the species” and the “functioning-based” approaches (Duncan and Fraser, 1997). A more descriptive title for the last approach, which will be used here is the “homeostasis” approach. A fourth approach, the “animal preferences” approach, is sometimes included in the feelings approach but does not necessarily provide direct information on feelings or emotions. This approach involves studying the animal’s choice for resources.

My colleagues and I favour the homeostasis approach, as outlined above, in assessing animal welfare. There is no reason why animal emotions cannot be incorporated into the homeostatic approach as they would have evolved on the basis of their survival values and contribution to biological fitness. This concept of biological fitness generally applies to natural populations and refers to “fitter” animals making a greater genetic contribution to subsequent generations (Pianka, 1974). This is based on their abilities to successfully survive, grow and reproduce. While the last attribute may not always apply to individual farm animals since reproduction is either controlled or absent for many farm animals, the ability to grow, survive and reproduce could be considered measurements of “fitness” within the limits of the management system. Most production systems in agriculture have breeding and growing components and these can generate considerable data on reproductive success of individuals. For example, conception rates and mortality, morbidity and growth of offspring can be used as a measure of “fitness”. Similarly, Beilharz and Zeeb (1981) and Beilharz (1982) have linked reproductive performance of domestic species with welfare.

An attribute of the “homeostasis” approach that provides it with credibility within scientific circles is that it contains some widely accepted criteria of poor welfare such as health, immunology, injuries, growth rate and nitrogen balance. Furthermore, there are some excellent examples of the value of this “homeostasis” approach in assessing animal welfare (Hemsworth and Coleman, 1998). For example, handling studies on pigs have shown that fearful pigs have a sustained elevation of plasma free corticosteroid concentrations (Hemsworth et al., 1981, 1986; Hemsworth and Barnett, 1991). The consequences of this chronic stress response in these fearful animals included depressions in growth and reproductive performance (Hemsworth et al., 1981, 1986; Hemsworth and Barnett, 1991).

A counter argument is that our current knowledge may not allow detection of some of
the more subtle or less serious risks to welfare. Nevertheless, less serious challenges should be reflected in biological changes, admittedly of lower magnitude, with consequent effects on fitness variables such as growth, reproduction, injury and health. Short-term challenges can also be studied with this approach. Lay et al. (1992) studied the behavioural and physiological responses of cattle to two branding procedures to assess the relative aversiveness of the procedures and Hemsworth et al. (1996) utilised behavioural and physiological responses together with growth performance to assess the welfare implications of a husbandry procedure regularly imposed (daily injections) on pigs.

With current knowledge the "homeostasis" approach appears to offer science the best assessment of the welfare of animals. As a research tool, this approach involves comparing housing or husbandry systems and risks to welfare are assessed on the basis of relative changes in biological (behavioural and physiological) responses and corresponding decreases in fitness. This is the approach that is utilised in this review.

III. IMPLICATIONS FOR POULTRY

There has been considerable research in recent years on developing furnished cages as a replacement for conventional cages (Appleby and Hughes, 1990; Abrahamsson et al., 1996; Abrahamsson and Tauson, 1997; Appleby, 1998; Tauson, 2000). Of particular interest has been the incorporation of perches (to improve bone strength), solid sides (to improve feather condition), abrasive strips (to reduce claw length and subsequent injuries), nest boxes (to provide for nesting behaviour) and sand-baths (to provide for dust-bathing behaviour).

(a) Space allowance

The literature on the effects of space allowance indicates that in general, within a range of 300 to 650 cm$^2$ per caged laying hen, increasing the area per bird increased egg production, food consumption and weight gain and decreased mortality (see Hill, 1977; Hughes, 1983; Adams and Craig, 1985). As identified by Hughes (1983), an obviously important explanation is the reduced feeding space that is generally associated with an area reduction in cages of generally constant depth. Another explanation is that crowding may lead to elevated corticosterone concentrations which, in turn, may adversely affect both production efficiency and health. Koelkebeck et al. (1987) reported an 11% increase in plasma corticosterone concentrations in caged hens when space allowance was decreased from 460 to 350 cm$^2$ per bird. However, Faure (1991) showed that birds would not consistently work for additional space. While these data, particularly those on production and mortality, would suggest that additional space is of benefit to birds, the precise area is difficult to define.

(b) Perches

A major problem that arises from keeping hens in cages is the problem of broken bones that occurs as a result of handling and transport (Gregory and Wilkins, 1989; Broom, 1990). Some of these problems occur as a result of cage design and certainly improved door design (eg S-shaped full width doors as described by Tauson (1985) and Elson (1990)) should improve access and reduce the risk of bone breakages when removing birds from cages. However, it would be preferable if bone strength was improved so that the risk of broken bones was reduced. While the provision of perches in cages improves bone strength (Hughes and Appleby, 1989; Norgaard-Nielsen, 1990; Gregory et al., 1991), there can be detrimental consequences on production. In cages with perches there were increased numbers of cracked
eggs (Ruszler and Quisenberry, 1970) and reduced egg mass output (Tauson, 1984). However, this can be influenced by both perch design and the age of pullets when exposed to perches (Appleby et al., 1998). While there appears to be clear advantages to the strength of some bones by the provision of perches, attention is required on the position, size and shape of the perch (see Tauson, 1984; Appleby and Hughes, 1990). Also, the effects of perches on non-load bearing bones is unclear and these bones may be adversely affected by, or derive no benefit from, perches; Appleby (1993) reported deformation of the sternum due to perches. Access to perches during rearing decreased cannibalism during the laying period (Gunnarsson et al., 1999).

From a scientific perspective of welfare there is good argument, on the basis of the potentially improved bone strength and its positive consequences for health, for the inclusion of perches within cages. However, depending on the shape and location of the perch there can be a production cost in terms of increased numbers of cracked or dirty eggs i.e. an economic cost (see Glatz and Barnett, 1996). Integrating these two pieces of information is a political decision not a scientific one.

(c) Dust baths

In addition to providing a substrate for birds to dust bathe another reason for the inclusion of dust baths is to reduce the use of the nest box as a dust bath. Nevertheless, the welfare benefits of dust baths are far from clear. Studies have shown that hens do not make any great effort to obtain access to litter or sand (Faure, 1991; Faure and Lagadic, 1994), although they prefer litter to wire mesh (Lagadic, 1992). Petherick et al. (1993) suggested birds are not highly motivated to dust bathe and Widowski and Duncan (2000) have shown that the bird’s motivation to gain access to litter is highly variable. Nevertheless, van Liere (1992) suggests that dust baths are essential to maintain feather integrity and for welfare. In terms of fitness variables, experiments with young chickens indicate a risk of pathological feather pecking when straw or wood-shavings are used as a substrate (Sanotra et al., 1995) although Norgaard-Nielsen et al. (1993) showed that rearing with access to sand or peat reduced subsequent feather pecking and that access to straw, as an environmental enrichment, during the layer phase also reduced feather pecking. Rudkin (1997) has also shown positive effects of hay, both during rearing and the laying period, in reducing feather pecking. Nevertheless, the implications of these rearing experiments for the provision of dust baths in cages to improve welfare is unclear.

(d) Nest boxes

Duncan (1992) considered the lack of a nest site in conventional cages was the biggest welfare problem in this system of housing. The importance of the nest box is based on evidence of preference tests and evidence of frustration in the absence of a nest box (see review by Ekstrand and Keeling, 1994) and the strong motivation of hens to use a nest (Hughes et al., 1989; Smith et al., 1990). Cooper and Appleby (1995) have considered the controversy as to whether animals can be frustrated or experience a sense of deprivation by not having certain resources they have never experienced. For nesting, they found no differences between birds previously experienced or inexperienced with a nest in their motivation to use a nest, although it is not known if this leads to chronic frustration. However, Hughes et al. (1995) showed that naive birds did not recognise a visual stimulus with some features of a nest, although it must be recognised that the birds in this study were unable to physically interact with the 'nest'. A study by Webster and Hurnik (1994) suggests that birds may synchronise their behaviours within cages and this may have welfare
implications if nest sites are limited. Cooper and Appleby (1997) have found considerable variation in choice of nest-site but not nesting motivation.

Several aspects of nest design have been examined and current commercial nests incorporate some of these features, such as the use of artificial floors to increase attractiveness, sloped (roll-away) floors to improve egg quality, nest excluders to improve nest hygiene (Reed, 1994) and enclosed nests to reduce 'stress-associated' egg abnormalities (Walker and Hughes, 1998). Notwithstanding that developmental problems with the use of nest boxes, including roosting in the nest boxes, laying eggs outside of nest boxes, a higher incidence of cracked eggs and using the nesting material for a dust bath, can or have been solved, there is no evidence that nests affect fitness.

(e) Abrasive strips

One of the criticisms of keeping birds in cages is the excessive length that claws can reach by the end of the laying period as hens in conventional cages are not able to wear down their claws as effectively as birds kept in non-cage systems. Floor layers spend time scratching litter or soil and this behaviour wears the claws and keeps them blunt. However, in cages, claw length of the middle toe can reach over 40 mm (Hill, 1975; Tauson, 1977; Fickenwirth et al., 1985) and in some strains the claws can become long, twisted and cracked and have a pronounced curl. A method by which claws can be kept short and blunt is to fit 8 mm wide strips of abrasive tape onto the egg guard; birds' claws scrape against this tape while they are feeding. Tauson (1986) showed that in cages with the strips, birds had significantly shorter claws than control hens throughout the laying period, the length of the claws of the middle digits did not exceed the length of those in pullets or birds kept on litter floors, and there were fewer broken or twisted claws. Rauch (1992) reported that the middle claw length of 42 week-old medium hybrid layers was 17.4 mm versus 7.2 mm for birds using the tape while for light hybrid layers at 61 weeks of age the measurements were 29.4 and 13.9 mm, respectively. Tauson (1996) considered an abrasive paint may improve the durability of the abrasive.

In Australia there have been two experiments with abrasive strips in layer cages. Both Murphy (unpublished data) and Stewart and Dingle (1997) indicated that abrasive strips were effective in reducing claw length. In the latter study the authors found that the angle and size of the egg baffle in different manufacturers' cages affected the reduction in claw length, although the abrasive strip was considered of benefit in all cage types examined. Glatz (2000) compared the effect of abrasive strips and abrasive paint in layer cages on claw length, claw sharpness, foot condition, feather cover, body scratches and mortality of hens. Abrasive paint was found to be more effective as a claw shortener than abrasive strips, based on length of claws and sharpness. However, hen mortality from prolapse and cannibalism combined was significantly higher in cages fitted with abrasives (6.3% for paint, 5.9% for strips and 1.6% for control. Glatz (2000) speculated that when birds were frightened or competed for a position at the feeder they might abrade their vent region on the paint or strip and this may encourage vent pecking. This finding raises concerns on whether claw shorteners should be installed in cages under Australian conditions. The increased light levels in the Australian study may account for the increase in cannibalism and prolapse.

IV. CONCLUSIONS

This review shows that there are welfare benefits from more space, on the basis of reduced mortalities, and from incorporating perches into conventional cages, based on a 'fitness' measure of the likely fewer 'injuries' due to improved bone strength. However, there
is no similar evidence for the incorporation of nest boxes or dust baths. Studies on solid sides and abrasives also indicate that overseas research may not be directly applicable to Australian conditions and that environmental factors (e.g. light or temperature) may affect behaviour, physiology or mortality. Therefore, it is important that these housing features are evaluated under local conditions prior to making any recommendations. Furthermore, the interactions between the items of furniture that together make up furnished cages also warrant examination as the findings from a furnished cage may be different from the reported literature on individual items of furniture. The issue of poultry housing is likely to remain a controversial topic until some fundamental issues, such as achieving an agreement on methodologies used to assess welfare, are addressed.

REFERENCES


