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Animal Welfare 2004, 13: 361-365
ISSN 0962-7286

The ability of laying hens to negotiate perches of different materials with clean or dirty surfaces

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Abstract

Increasingly, perches for laying hens are being made from metals and plastics. There is nothing in the literature regarding how easily birds jump between perches of different materials, or how their ability to do so changes with faecal contamination of the perches. Forty-four medium hybrid brown hens negotiated perches of wood (5 cm × 5 cm, rounded edges), metal (half-round section, diameter 4 cm) or poly-vinyl-chloride (PVC: circular section, diameter 4 cm), which were either clean or dirty (poultry manure 0.5–1.0 cm deep). The time to jump to the destination perch (0.75 m from the start perch), number of squats (pre-jumping behaviour), slips, failures to jump (in 300 s) and crashes were recorded. Compared to wood and metal perches, birds took significantly longer to jump from PVC perches when they were clean, but there was no difference when the perches were dirty. Birds slipped significantly more on clean metal or PVC perches compared to clean wood perches. The birds took significantly longer to jump from metal or wooden perches when they were dirty compared to when they were clean. These data may suggest that PVC is not a suitable material for perches. Slipperiness is important. The birds apparently found the metal and PVC perch more slippery than the wooden perch, although the metal perch did not cause the birds to delay jumping. A slippery perch may deter the birds from attempting to jump. Manure on the perches reduced the slipperiness of the metal and PVC perches. Once perches become dirty, any welfare issues concerning the risk of injury from slippery perches cease to be as important as the potential slipperiness of the manure itself.

Keywords: *animal welfare, hens, manure, perches, perch material, slipperiness*

Introduction

Perching is a behavioural need for laying hens (Olsson & Keeling 2000, 2002) and may influence skeletal strength, particularly of the leg bones (McLean *et al* 1986). Welfare groups recognise the importance of perching behaviour, and legislative measures have been taken to ensure that perches will be a requirement in laying hen systems (including cage systems) within EC countries by 2012 (EC 1999). In non-caged systems, perches are used to allow birds to move through the system, to use the third dimension in the shed and for roosting purposes (Tauson *et al* 1992).

Wooden perches are most common. However, more recently, alternative materials have been considered for commercial use since they may be easier to form and keep clean than their wooden counterparts (Tauson & Abrahamsson 1994, 1996; Lambe & Scott 1998). However, the perch material and its shape can cause injury to birds (Lambe & Scott 1998). Duncan *et al* (1992) found that perches of circular cross-section caused more damage to birds than perches of rectangular cross-section. Wooden perches with a rectangular cross-section can cause foot problems (Oester 1994; Tauson & Abrahamsson 1994), and plastic perches cause poor foot condition (Oester 1994; Tauson & Abrahamsson 1994, 1996). Such conflicting evidence may indicate that it is not necessarily the material itself that causes problems but rather the shape and mechanical properties of the material. There is little evidence in the literature that the physical properties of perches have been considered. The main characteristics that have been discussed are only softness and hardness, or the presence of sharp edges (Lambe & Scott 1998). Furthermore, the physical properties of the perch material are likely to change with time. In commercial conditions, one major change that is likely to occur is that perches will become contaminated with faecal material. Chicken faeces can vary in their physical properties depending on their consistency. Factors that influence manure consistency include its moisture content and the diet, particularly if the food is high in fat or oils (Smith 1996). These factors may influence the 'stickiness' of the faeces and therefore the degree to which birds' feet will slip on a soiled perch.

Slipperiness depends on the friction between the foot of the bird and the surface of the perch. On a microscopic scale, the surface of a perch can be considered in terms of a range of peaks and troughs. As the skin of a bird's foot contacts the perch surface it will fill the troughs. There will be a certain amount of energy required to raise the skin out of the troughs so that the foot can slip across the peaks on the perch surface. This effect involves friction (Hutchings 1992). The height of the peaks and the depth of the troughs will depend on the material, and determine its smoothness and shininess. In general, the shallower the microscopic troughs, the smoother and shinier the material appears, and the less force is required to raise the skin on to the peaks. This means that there is reduced friction. The lower the friction, the more slippery the surface will be. It is possible to measure friction (or more accurately, the coefficient of friction) using a drag test. One material is dragged over a second material and the force required to do this is measured, either by a spring balance or by arranging a pulley system whereby the mass (and hence force) required to just cause the materials to slip can be determined (Hutchings 1992).

If another material contaminates a material's surface, its friction properties will change. For example, on roads, friction (or grip) between the road surface and a rubber tyre is important, and can be seriously reduced by standing water or ice. This is because water (or ice) can fill the troughs in the road's surface so that the friction properties are now between the tyre and the water or ice. Hence, the road surface is effectively no longer involved in the determination of friction properties. Similarly, if manure contaminates a perch surface, the friction between the manure and a bird's foot becomes important, independent of the perch surface. In this experiment, the ability of hens to jump between perches of different materials was investigated. The effect of applying poultry manure to the perch surfaces was also considered.

Materials and methods

Forty-four Shaver medium hybrid brown hens were taken from the commercial free-range flock at Harper Adams University College at 24 weeks of age. Each bird was individually identified using leg bands. The birds were randomly allocated to one of four groups. Each group was housed in a deep-litter pen (1.4 m × 2.0 m) with white soft wood shavings and containing three nest boxes (0.42 m × 0.31 m), three feeders (0.25 m × 0.12 m) and a bell drinker. Food and water were available *ad libitum*. The birds received 15.5 h of light and 8.5 h of darkness each day, and the temperature was maintained at 22°C.

The birds were exposed to wooden perches for a six week acclimatisation period. This was achieved by introducing perches to the home pen and observing the behaviour of each bird to ensure that the perches were used. Also, on a daily basis, for one week at the beginning of the acclimatisation period, individual birds were taken to an experiment room (4.6 m × 2.9 m) and gently placed on a single perch for 180 s before being returned to their home pen. If any bird showed signs of distress it was returned to its home pen and its identity was recorded. By the end of the week none of the birds showed noticeable signs of distress, and so exposure to the experiment room was discontinued. The aim was to familiarise the birds with the experiment room without distressing them. Care was taken to handle the birds gently to familiarise them with handling. For two weeks immediately prior to the experiment, all perches were removed to allow the birds to settle before the experiment began (Lambe & Scott 1998). During the experimental period, food was removed from the birds for 2 h prior to testing. Birds were then taken individually to a separate experiment room adjacent to the home pen (Figure 1).

In the experiment room, two identical perches (1 m long and 1 m above the ground) were positioned 0.75 m apart, on the basis that Scott and Parker (1994) report that laying hens are able to jump this distance relatively easily. The pairs of perches were made either from wood, metal or poly-vinyl-chloride (PVC). The perches could be removed from the wooden support stands and interchanged so that their heights remained constant. The wooden perches (which were the experimental control) were made of dressed pine (5 cm × 5 cm section) and had rounded sides to simulate those used commercially. The commercially available metal (silver coloured alloy) perches were semi-circular in section, with an effective diameter of 4 cm. The white PVC perches were made from commercially available drain-pipe (diameter 4 cm) so that their rounded surfaces had the same profile as the metal perches.

The effects of clean and dirty perches were also investigated. The same perches were used but each perch was smeared with fresh poultry manure (at depths of approximately 0.5–1.0 cm), which was taken at random as required from the neighbouring deep pit of a 60,000 bird caged hen unit. These fresh manure samples came from an environmentally controlled house, and the manure was a small sample from the centre of a large volume of manure. It was assumed that this material would be consistent, in terms of moisture content and stickiness, over the experimental period. It was not possible to accurately determine the moisture content or the coefficient of friction of this material when it was in actual use. Although attempts were made to measure the coefficient of friction between the perch and the birds' feet and between the manure and the birds' feet, it was not possible to create a model foot with any accuracy.

The birds were randomly allocated to each treatment (wood, metal or PVC perches that were either clean or dirty) in a balanced experimental design so that each bird was tested on each perch type in a random order to control for any effects of previous exposure to treatments. Each individual bird was placed on the start perch and, in order to encourage the bird to jump, a feeder (identical to those with which the birds were accustomed) was placed at the destination perch and given a standard shake (Scott & Parker 1994). Each bird was video-recorded on the start perch, and the number of times that it squatted, indicating that it was preparing to jump (Scott *et al* 1999), and the time taken for it to jump to the destination perch were noted. The number of times a bird's foot slipped on the perch was also recorded. A slip was said to have occurred when the foot was displaced in any direction and resulted in the bird having to respond to correct its stance, however minor that might appear to be.

https://doi.org/10.1017/S0962728600028487 Published online by Cambridge University Press

Table 1 Median time (with upper and lower quartile ranges) birds took to jump from the start perch when the perches were clean and when dirty (n = 44 per treatment).

	Time to jump to destination perch (s)					
	Wood		Metal		PVC	
	Clean	Dirty	Clean	Dirty	Clean	Dirty
Lower quartile	4	13	3	7	3	10
Median	6	55	7	24	16	30
Upper quartile	26	300	23	300	126	134

Each bird was allowed to remain on the start perch for up to 300 s, after which the test was terminated and the bird was allocated a recorded time of 300 s on the perch. If a bird attempted to jump but failed to reach the destination perch, it was given an arbitrary time of 400 s. This was to ensure that during the analyses, in which the birds were ranked in order of the time taken to jump, any failed attempts would be ranked after birds that had failed to jump within 300 s. This was done because it was believed that a failed jump would be more likely to cause injury than if the bird remained on the start perch. The data were analysed using either non-parametric Mann-Whitney or Kruskal-Wallis tests as appropriate (Mead & Curnow 1983).

Results

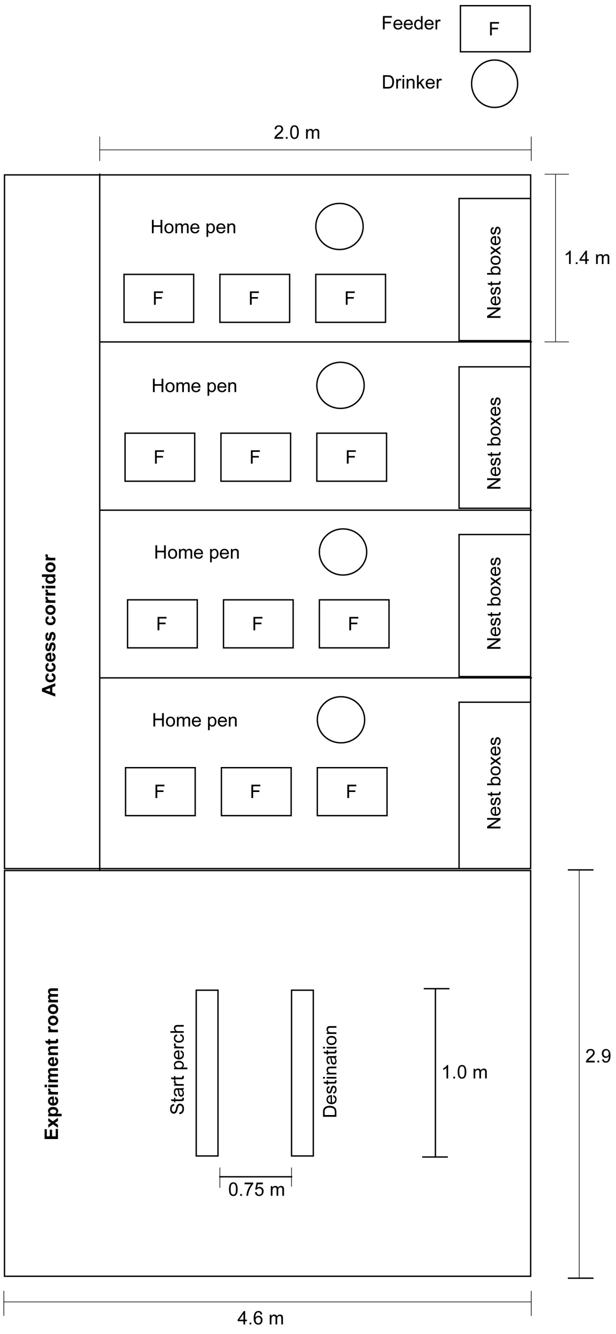
The median and inter-quartile ranges are presented for the time taken to jump from perches of the three materials when they were clean and when dirty (Table 1).

When the perches were clean, it took significantly longer for the birds to jump from the PVC perch than from the other two types of perch (Kruskal-Wallis test: $H = 3497.42$; $n = 132$; $P < 0.01$). However, when the perches were dirty, there were no significant differences in the times taken to jump. For the wooden and metal perches, the birds took significantly longer to jump when the perch was dirty compared to when it was clean (Kruskal-Wallis test: $H = 3492.85$; $n = 264$; $P < 0.01$), but this was not true for the PVC perch.

Table 2 shows that for the wooden and metal perches, the number of birds failing to jump increased when the perches were dirty. For the PVC perch, the number was reduced, although the number of refusals and crashes combined remained the same (12 birds). Importantly, it was not the case that the same 11 or 12 birds refused to jump or failed to reach the destination perch throughout the experiment.

There were no significant differences in the number of squats made on wooden, metal or PVC perches when they were clean (Table 3). However, when the perches were dirty there was a numerically greater number of squats made on the wooden perch. When clean, a greater number of slips were made on the metal and PVC perches compared to the wooden perch. For the metal and PVC perches, fewer slips were recorded when the perches were dirty compared to when they were clean (Table 3).

Figure 1



Plan of home pens and experiment room (not to scale).

https://doi.org/10.1017/S0962728600028487 Published online by Cambridge University Press

Table 2 Number of birds (from a total of 44) that failed to jump before 300 s or failed to reach the destination perch.

Number of birds	Wood		Metal		PVC	
	Clean	Dirty	Clean	Dirty	Clean	Dirty
Failed to jump before 300 s	3	11	3	12	11	8
Failed to reach destination perch	2	4	2	1	1	4

Table 3 Total number of squats and slips made by the birds (n = 44) whilst on the start perch.

	Wood		Metal		PVC	
	Clean	Dirty	Clean	Dirty	Clean	Dirty
Total number of squats	72	105	78	76	75	77
Total number of slips	9	8	95	18	57	7

Discussion

It is reasonable to assume that the ability of birds to jump from perch to perch is related to the time taken to jump (Scott & Parker 1994). In this experiment, while wooden and metal perches did not differ in their effects on jumping, the birds took significantly longer to jump from PVC perches, suggesting that they were perceivably less able to jump from the PVC perch or that there was some influence of the destination perch on their willingness to jump. This may suggest that plastic pipe is not a suitable material for hen perches. This is an important finding given that several designs of barn system incorporate perches of this type, and that enriched cages that include perches may also use this material.

Slipperiness does seem to be important. The birds apparently found the metal and PVC perches more slippery than the wooden perch, although for the metal perch this did not appear to delay their jump to the destination perch. However, the birds did delay their jump from the PVC perch (although there were fewer slips than on the metal perch). No measure was made of the severity of slips on the perches, and it may be that slight slips, which can be more easily corrected, are not as disturbing to birds. Also, a slip occurring just before take off may deter birds from attempting to jump to another perch.

The presence of manure on the perches appeared to change the perches' properties, with a significant reduction in the slipperiness of the metal and PVC perches. The depth of the manure will further affect the slipperiness of the perch. However, once a critical depth has been reached, the influence of the perch material itself may be significantly reduced. Potentially then, once perches become dirty, any welfare issues concerning the risk of injury from slippery perches cease to be as important as the potential slipperiness of the manure covering the perches.

An attempt was made to assess the coefficient of friction for the three types of perch material and for the manure. This proved to be extremely difficult because a sufficiently large sample of skin from a chicken's foot could not be obtained. A sample of chicken scaly leg tissue was obtained as, presumably, a closely related sample. This material was dragged along flat samples of the three perch materials; however, the results were inconsistent and probably did not accurately represent a chicken's foot gripping the perch. To gain more realistic assessments of the coefficient of friction, the skin from several chickens' feet would need to be obtained and presented in as natural a way as possible in a drag test on the perch materials. Also, the compressible footpad would need to be loaded, equivalent to the bird's weight, and forces applied to replicate the grip of the foot on the perch. A drag test on a chicken's foot in the fore and aft plane may yield different results than if forces are applied laterally.

Other factors may have influenced the birds' ability to jump from perch to perch: perch colour or hue may be important. Taylor *et al* (2003) noted that laying hens jump more readily between white perches than between black perches at light intensities similar to those used in commercial laying systems. In the current experiment, the wooden perches had a lighter hue when clean but were necessarily darker when chicken manure was applied. Also, the metallic perches were shiny and the PVC perches were white. However, when all of the perches were covered in manure, they had a similar hue and none was reflective. Spray-painting all of the perches the same colour was considered; however, this would have affected the slipperiness of the perches because the properties of the paint surface, rather than of the material itself (wood, metal, PVC), would have then been important.

The main conclusions of this experiment are that perches of different materials can influence the ability of birds to negotiate them and safely jump between them, and that faecal contamination substantially modifies the slipperiness of perches. Currently, the design and inclusion of perches of different materials appears to be selected mainly based on convenience or cost. With data of the type provided here, designers and manufacturers can include perches that meet the needs of the birds. Factors such as slipperiness, cleanliness and even thermal properties may influence the birds' ability to use perches safely. Of the materials used in this experiment, the birds used clean wooden and metal perches most successfully. However, modifications of the surface, such as the inclusion of grooves, may influence slipperiness, and hence should be investigated further.

https://doi.org/10.1017/S0962728600028487 Published online by Cambridge University Press

Animal welfare implications

Systems for laying hens, including cage systems, will soon be required to include perches. If birds perceive perches as slippery and cannot use them safely, they may become frustrated, stressed or even injured whilst attempting to use them. Research investigating how birds use perches (rather than just preference tests) can indicate which types of perch and/or material may be best suited to their purpose. Perch material must at least match the properties of clean wooden perches if birds are to use them routinely.

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