DIFFERENCES IN FEARFULNESS INDICATED BY TONIC IMMOBILITY BETWEEN LAYING HENS IN AVIARIES AND IN CAGES

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Abstract *Animal Welfare 1993, 2:* 105-112

The aim of this study was to investigate whether there were differences in fearfulness between laying hens (Gallus gallus domesticus) *housed in aviaries and in cages. The tonic immobility (TI) test was used to assess the fearfulness. Norwegian light hybrid White Leghorn hens were housed in battery cages and in three types of aviaries: the Marielund, the Laco-Volétage and the Tiered Wire Floor. Each system housed about 1,500 birds. Tests were performed on 50 birds per housing system at 70 weeks of age in one laying flock and at 30 and 70 weeks of age in the next.*

At 30 weeks of age in the second laying flock, the duration of the tonic immobility response was unaffected by type of system. At 70 weeks, however, hens in cages showed tonic immobility of longer duration than hens in aviaries, in the first as well as in the second laying flock. No differences in TI between hens from the three types of aviaries were found. The duration of TI did not correlate with plumage condition or body-weight, except for a longer duration of TI with poorer plumage condition in aviaries at 30 weeks. These results indicate that the fearfulness of hens in cages, as measured by the TI test, increased considerably with time. The lower fearfulness shown by hens in aviaries suggests that this important aspect of welfare is more secured in aviaries than in cages.

Keywords: *animal welfare, aviaries, cages, fear, laying hens, tonic immobility*

Introduction

Freedom from fear is one of the five required freedoms of farm animals suggested by the Farm Animal Welfare Council (UK) in 1979 (Jones 1987c). Fearfulness can be tested in many ways, for example in an open field test, with different kinds of novel objects, with fear eliciting stimuli (eg sudden noise, the blowing up of a balloon), or in a tonic immobility test (Jones 1987c). In a Norwegian project, 'Alternative housing systems for laying hens', investigation of the fearfulness is included in the evaluation of the systems. In the present study, the fearfulness of layers housed in three different aviary types and in a battery cage system was examined using the tonic immobility test.

In evolutionary terms, the tonic immobility (TI) response is an anti-predator form of behaviour found in various species of birds, insects, fish, amphibians, reptiles and mammals (Ratner 1967). Fear is considered to be an important prior condition which affects the duration of TI (Gallup 1977, Jones 1987c), ie the longer the duration of the TI, the higher the propensity to be easily frightened.

The motor inhibition involved in TI is easily induced by physical restraint. A commonly used method for measuring the TI response of hens induced by humans is the cradle test (Jones & Faure 1981, Craig *et al* 1984). Several factors affect the duration of TI such as previous handling, management and taming, genetics, social factors and housing system (Jones 1986). There has been some discussion about the validity of the TI test, the opinion being expressed that it may measure a specific fear of human beings rather than being a general underlying fear response. The latter is the most likely, however, since the TI response is very closely correlated to results of other fear tests (Gallup 1974, 1979, Faure 1975, Suarez & Gallup 1981, Jones 1987a, Jones *et al* 1991).

It has been shown that adult hens housed in pens remain in tonic immobility for a shorter duration than those housed in cages (Jones & Faure 1981, Kujiyat *et al* 1983). Hughes and Black (1974) found that pen-housed birds showed a lesser fear response to a novel object than birds housed in cages. Because of the considerably larger population sizes in aviaries and the possibility that hens in large groups may have a higher fearfulness or increased propensity towards hysteria (Hughes 1982, Jones 1987b), it is not a priori certain that the lower fearfulness found in pens also applies to aviaries. Nevertheless, in this experiment the hypothesis was that hens in cages will show a more prolonged fear response than hens in aviaries.

Materials and methods

In the present study, Norwegian light hybrid White Leghorns were used. The pullets were reared on the floor in groups of 6,000 and transferred at the age of 15 weeks to four different housing systems in the same layer house (Hansen *et al* 1990). These were battery cages (700cm^2/hen, 3 hens/cage) and three different types of aviaries, which are group housing systems where the hens have access to litter, perches and nestboxes. The aviaries used in this experiment were the Mariclund, the Laco-Volétage and the Tiered Wire Floor (17 hens/m^2 ground area in each aviary). Each system housed about 1,500 birds. Birds from two successive laying flocks called Flock 1 and Flock 2 were tested. All the hens were inspected at least once a day. Floor eggs were collected four times a day from hens at the age of 30 weeks and twice a day at 70 weeks. Sixteen hours of light were used (0400h-2000h), with a dusk of 15 minutes.

The TI test was executed at 70 weeks of age on birds from Flock 1 and at 30 and 70 weeks of age on birds from Flock 2. For each of the three tests, 50 hens per system were chosen randomly from all tiers, giving an overall total of 600 test hens. Hens were individually caught, in cages by hand and in aviaries by a hook, and moved to a separate test room, one hen at a time. The first hen that could quickly be caught at the chosen site was picked in order to avoid undesirable chasing and disturbance. Testing was

carried out continuously from 0800h to 1930h, with breaks being only taken around feeding (4-6 times a day) and from 1545h to 1645h.

The TI test was performed mainly as described by Jones and Faure (1981). TI was induced by physically holding the hen down on her back in a cradle which was lined with a black cloth. Two observers induced TI alternately. The inducer stood 0.5m in front of the cradle and continuously watched the experimental hen. The interval between catching the individual and laying it down in the cradle was standardized to 60s. An induction time of 15s was used and maximum TI duration of 1,500s was defined. A new induction trial was performed on the same individual immediately if the last trial had failed.

The number of inductions required to obtain TI; the latency from induction until the first head movement, and the total duration of TI until righting were recorded. On finishing the TI test, plumage condition scores ranging from one (best) to five and data on individual body-weight were collected, after which the bird was put back in its cage or aviary. The tests were performed by different pairs of observers: the two first tests by JS and MT and the last (Flock 2, 70 weeks of age) by IH and her assistant. JS assisted initially in the last test, in order to ensure that identical procedures were followed.

The differences in TI parameters and plumage condition between the four housing systems were initially analysed with Kruskal-Wallis tests, those between aviaries and cages with Mann-Whitney *U* tests (Statistical Analysis Systems Institute Inc 1987). Differences in body-weight were tested with *t* tests. Ranked variables were compared by Pearson correlation. Individual birds from one system were considered independent.

Results

No differences were found between birds in the three aviaries at any age, therefore data from the aviaries were pooled. Histograms of the latency to first head movement and of the duration of TI are shown in Figure 1. In Flock 2, no significant differences between birds in cages and birds in aviaries were found in head movement latency or in duration of TI at 30 weeks of age. At 70 weeks, however, hens in cages showed a longer latency to first head movement ($P = 0.007$, *U* test) and longer duration of TI ($P = 0.012$, *U* test) than hens in aviaries. Whereas 22 per cent of the cage hens at this age were given the maximum time of 1,500s, only eight per cent of the aviary hens reached the maximum ($\chi^2 = 8.24$, $P = 0.004$). Corresponding results were found in Flock 1 at the same age (Figure 1).

In the birds of the second laying flock, which was tested twice, the duration of TI increased considerably from 30 to 70 weeks of age for birds in cages ($P = 0.008$, *U* test), but non-significantly in aviaries (Figure 1). This increase was associated with an increase in the latency to first head movement.

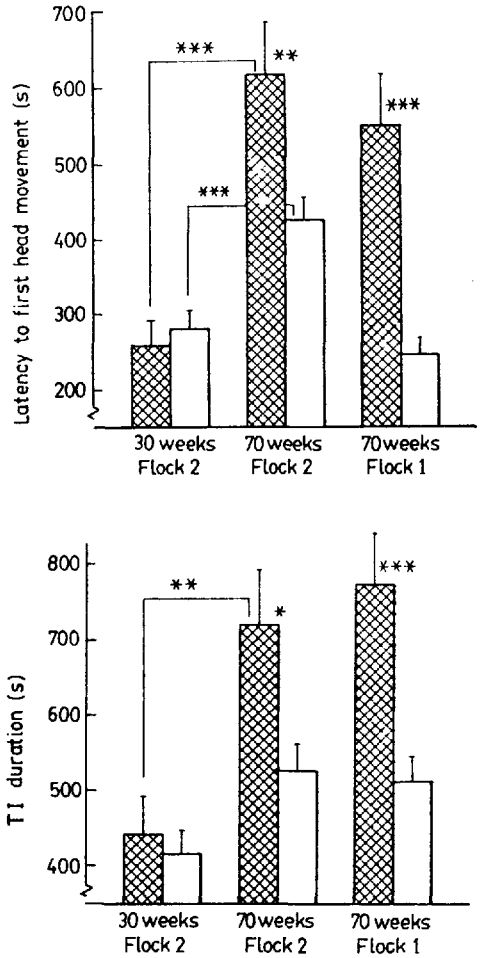

Figure 1 **Latency to first head movement (above) and total duration of tonic immobility (below) of laying hens in cages (hatched columns) and aviaries (open columns, mean ± SE).**

Asterisks indicate significant differences between the two types of systems and between 30 and 70 weeks of age within system: * $P<0.05$, ** $P<0.01$, *** $P<0.001$.

The number of inductions required to attain TI was usually one or two, but up to six, and irrespective of housing system the number decreased with age (cages: $\chi^2 = 12.7$, $P = 0.005$; aviaries: $\chi^2 = 3.4$, $P<0.001$). The plumage condition was poorer in aviary hens than in battery hens and in Flock 2 the difference in feather covering increased with age (Table 1). Except for a longer duration of TI with poorer plumage condition in aviaries at 30 weeks ($r = -0.19$, $P = 0.023$), there was no correlation between the duration of TI and plumage condition or body-weight. Caged hens showed less resistance and appeared to give in more readily when being captured and held in the cradle compared with aviary hens.

Table 1 **Body-weight and plumage condition of laying hens housed in cages and aviaries (M ± SE)[1].**

Flock no	Age (weeks)	Housing system	*n*	Body-weight (kg)	Plumage condition score
2	30	Cages	50	1.73 ± 0.03	1.58 ± 0.10
					*
		Aviaries	150	1.72 ± 0.01	1.89 ± 0.07
	70	Cages	50	1.89 ± 0.03	2.30 ± 0.11
					***
		Aviaries	150	1.87 ± 0.02	3.63 ± 0.10
1	70	Cages	50	2.02 ± 0.04	2.11 ± 0.15
				*	***
		Aviaries	150	1.93 ± 0.02	2.80 ± 0.10

[1] * $P<0.05$, *** $P<0.001$, *t* test

Discussion

Whereas the tonic immobility response was unaffected by the type of housing system at 30 weeks of age, hens in cages showed a considerably stronger TI response than hens in aviaries at 70 weeks of age. This finding raises the question as to whether the fearfulness of hens in cages could be a function of time spent in the battery system.

Increased fear with age in battery hens could reflect an increase in chronic frustration and stress caused by environmental inadequacies. Exposure to additional stimuli in the home environment enhances the animal's adaptation ability to novel situations and objects (Walsh & Cummins 1975, Jones 1982, Jones & Waddington 1992). Thus, an enriched environment reduces fearfulness, while a barren or restricted environment increases emotional reactivity (Henderson 1966). Since the chickens in this experiment were reared together on the floor, they were all subject to the same degree and quality of stimulation until moved to different layer systems at 15 weeks of age. The extra stimulation received by birds in the aviaries due to a richer environment and more frequent human exposure (collection of floor eggs), may have resulted in a lower increase in fearfulness with age compared to birds in cages. Moreover, it is possible that birds in cages realize that their escape possibilities are limited. Repeated unsuccessful avoidance reactions may cause elevated fearfulness in caged birds (Jones 1987b). The lack of any differences in results between the three aviaries could be due to better environmental stimulation in general in these systems, differences in details of construction exerting no significant effect in this regard.

Other factors affecting the TI response could be differences in group size or density. Kujiyat *et al* (1983) demonstrated that caged hens in groups of 17 showed a longer TI

response than those caged in groups of five and suggested that the group size was the major factor affecting TI. In the present experiment, the group size was far less in cages (3) than in aviaries (1,500). Hens in the large group sizes in the aviaries did not seem to give a long lasting TI response. We cannot rule out the possibility that the slightly lower density of birds in aviaries (one hen per 1111cm^2 available floor space vs one hen per 700cm^2 in cages) might have contributed to the lower fear reactions in aviaries compared with cages.

Inter-observer reliability could not be adequately analysed. However, the consistent results between the two flocks at 70 weeks of age indicate a limited effect of observer couples.

In this experiment, the methods of selection and capture of the test animals could potentially have influenced the results. It was impossible to catch the battery and the aviary hens in the same way. Jones *et al* (1982) underlined the difficulties of a random selection if the animals behaved differently; if some are easier to catch than others, this will bias the selected group. The collection of birds could have been done in the dark, but then other theoretical and practical problems would have arisen. The main finding, that TI was higher in cages than in aviaries at 70 weeks, but not at 30 weeks, could hardly be attributed to the selection and catching methods.

In the evaluation of different housing systems, the TI test should of course not be used alone, but as a supplement to other recordings, such as data on health, production and other behavioural and physiological studies. Such data are currently being analysed in our project.

Animal welfare implications

In recent years, housing systems which are alternatives to battery cages for laying hens have been developed and improved. In order to ensure that these new systems satisfy welfare demands, it is necessary to objectively record behavioural responses of relevance for the assessment of welfare. Fearfulness is an important indicator of welfare, and should in general be manifested at only a low level. In 1979 the Farm Animal Welfare Council (UK) suggested that animals should be provided with freedom from fear (Jones 1987c).

In the present study the fearfulness, as measured by the tonic immobility response, increased more with age in battery layers than in aviary layers. The more constant and lower fearfulness of birds in the aviaries suggests that with regard to the fear concept these systems offer a higher level of welfare.

Acknowledgements

The authors are grateful to Mr Oddbjørn Døving for his excellent management of the poultry house and for his assistance during the experiments and to Dr John Race for improving the language. The project was supported financially by the Norwegian Agricultural Research Council and the Norwegian Farmers' Egg and Poultry Sales Association.

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