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LAYWEL

Welfare implications of changes in production systems for laying hens

Specific Targeted Research Project (STReP)

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Deliverable 4.7

Final report for WP4

Behaviour

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Outline

4.1 Introduction

The objective of this chapter is to present results of the most recent experiments, concerning the needs, preferences, distribution, behaviour and use of facilities by birds housed in experimental and commercial egg production systems across Europe. Various hybrids kept at different group sizes and stocking densities have been the subjects of these investigations and information about spacing patterns, use of feeders, drinkers, litter areas, perches and nest boxes will be included.

4.2 Bird preferences

In the following the behaviour and preferences of laying hens using the proposed enrichment features for furnished (modified) cages, namely perches, nesting and dustbathing areas and increased space are reviewed. These facilities are also relevant for other alternative systems. For details and references see Deliverable 4.1.

Perching

A few studies have shown that hens are prepared to work to gain access to perches at night, but there has been insufficient research work to know the extent to which perching is a behavioural priority. When perches are provided, hens make use of them, with up to 100% of birds perching at night. In the absence of perches, they choose to roost on the highest fixtures and fittings available and it is possible that these could satisfy their behavioural needs. Particularly in spatially restricted environments hens may use perches to obtain more space, and social factors may influence the use

of perches. The value of perches for the physical and physiological welfare of laying hens is discussed in other WP sections.

Nesting

Considerable research on nesting and pre-laying behaviour indicates that hens not only have a preference for a discrete, enclosed nest site but also that they value it sufficiently to work hard to gain access to one in the period (approximately 40 minutes) before egg-laying. They appear to have an instinctive need to perform pre-laying (nest-building) behaviour for about 20 minutes before laying. Thus in practical terms, enclosed nest-boxes should be provided with access available to hens from about an hour before the first bird is expected to start laying. The number of nesting areas provided should be sufficient to enable all hens to spend an average of about 30 minutes in a nest box. There is no need for the nest boxes to be available after all birds have finished egg laying (i.e. during the afternoon and night).

Dustbathing

Despite considerable research effort, scientists have not definitively discovered the extent to which hens value dustbathing. This is in part due to effects of rearing experience and in part to the fact that litter may be used for foraging and egg laying as well as for dustbathing. Some research has indicated that dustbathing in litter is not a behavioural priority but there is strong evidence that it is a behavioural need. So-called 'sham' dustbathing may be a satisfactory alternative particularly to birds that have not previously experienced dustbathing in litter, but further research is needed to be certain of this.

Space and social preferences

Experiments carried out at given stocking density, group size or available space do not usually apply to other levels of these variables because of their inevitable link. Bird preferences in one context may change in a different social and environmental context. Evidence suggests that laying hens need a reasonable 'personal space' and that priority for space may vary during the day as activity and possibly social interactions alter. The smaller the total space available to a group of birds, the larger the space per bird needs to be in order to avoid crowding and to enable behavioural needs to be met. Birds may give greater priority to space than to small group size. They may have different social strategies in small groups where they can recognise each other and in large groups (over 100) where most encounters are between strangers and this can affect levels of aggression.

Agonistic and abnormal behaviour

The presence of apparently purposeless behaviour or of high levels of aggression or redirected behaviours such as feather pecking and cannibalism are indicators that the housing system is not satisfactory for bird welfare.

4.3 Litter substrates as enrichment components

In enriched cage systems some substrate should be provided to allow foraging behaviour and potentially dustbathing behaviour, but full expression of these behaviours is not possible. It has been shown that dustbathing behaviour in enriched cages is often disturbed and vacuum dustbathing on wire is common, indicating that the supplied litter is inappropriate. Alternative systems provide more opportunities to perform dustbathing and foraging but also here full expression of these behaviours is not observed. Thus, with respect to laying hen welfare it is important to know what resources are most appropriate for full expression of dustbathing and foraging behaviour. Moreover, it would be useful to know if there should be a requirement to provide additional resources over and above the pecking and scratching area in enriched cages, e.g. a dustbathing area.

As reported in deliverable 4.3, substrate preference of laying hens with respect to dustbathing and foraging behaviour were investigated in order to determine which resources should be provided in laying hen housing systems for the expression of these behaviours. The consumer demand approach was used to study the strength of preference. Hens had to push a weighted door to enter choice pens with a wire floor, sand, wood shavings or peat moss as substrate. Twelve Isa-Brown hens, reared on battery cages, successfully learned to open the push door. Most of the hens worked for getting access to all choice pens. The slopes of the demand curves for the number of entries to the choice pens were steep and not significantly different (Figure 1). Also no differences were found in the maximum price paid and the total expenditure. These data indicate that there seems to be no preference for wire or any substrate per se. However, with respect to dustbathing, almost all hens worked for getting access to peat moss to take a dustbath whereas only some hens worked for sand or wood shavings. The slope of the demand curve for dustbathing in peat moss was relatively shallow and the maximum price paid and the total expenditure to take a dustbath in peat moss were significantly higher as compared to dustbathing in sand or wood shavings. With respect to foraging no clear substrate preference was found. It could be concluded that the value of a particular substrate varies with the behaviour performed in the substrate and that there is a strong demand for peat moss for dustbathing.

4.4 Definitions of behavioural indicators for evaluating substrate quality

In the following the development of a set of behavioural criteria to evaluate the substrate quality in different housing systems for laying hens will be described. These criteria were developed using two approaches: firstly a short literature overview on problems associated with quality or availability of substrate and secondly an experimental approach. For details and references see Deliverable 4.4.

2.1. Substrate in laying hen housing systems

A number of studies have investigated substrate-directed behaviour in laying hens, in particular dustbathing. It has been shown that domestic hens are attracted to substrate and show a preference for substrate as a floor type (Dawkins, 1981; Dawkins, 1983; Matthews et al., 1995). Hens housed in battery cages are deprived of substrate and it has been shown that this increases the risk of outbreaks of feather pecking and cannibalism.

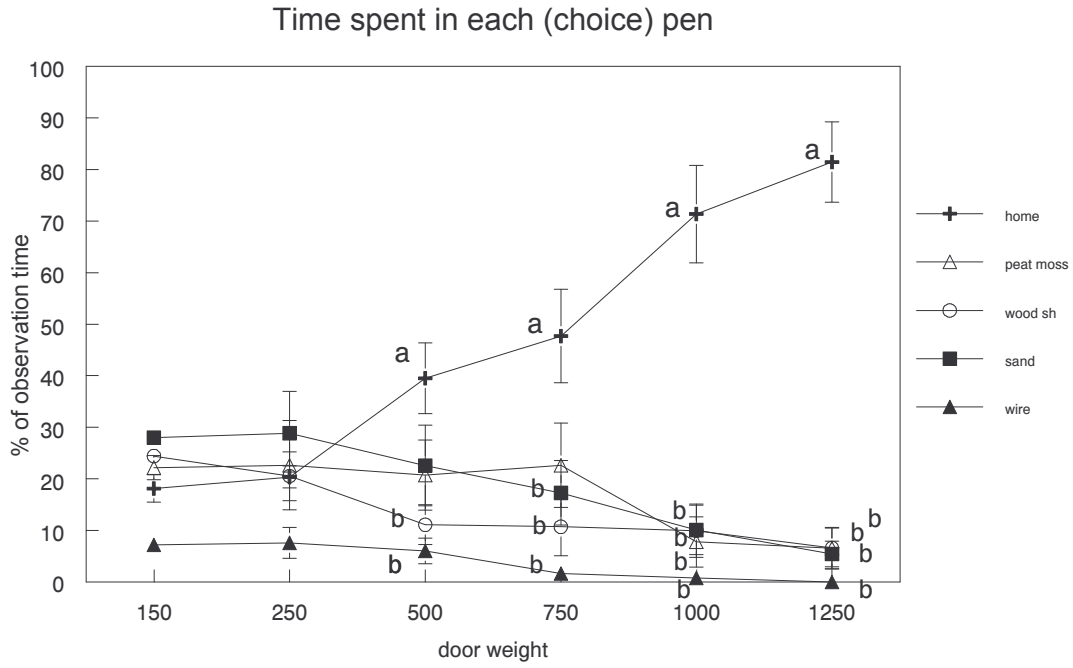

Figure 1 **The effect of door weight on the percentage of time in the unweighted home pen and each choice pen. Different letters indicate significant differences per weight category (P<0.05 at least) (n=12 hens). From Delivarable 4.3.**

The Council Directive 1999/74/EC laying down minimum standards for the protection of laying hens states that hens should be housed in enriched cages or alternative systems from 2012 onwards. Alternative systems should have at least 250 cm2 area with substrate per hen and in enriched cages hens should be provided with substrate such that pecking and scratching are possible (CEC, 1999). However, especially in enriched cages the substrate area is a point of discussion as it is often a small area and only small amounts of substrate are provided (Appleby et al., 2002). It is seriously questioned if this substrate area fulfils the need of the hens with respect to substrate related behaviours like foraging and dustbathing. Sham dustbathing is often seen and it does not reduce the

motivation to dustbathe in litter (Olsson et al., 2002b) which may suggest that the litter as provided in enriched cages does not fulfil the needs of the hens. In addition it has been observed that hens in enriched cages have a low motivation for using the litter areas to dustbath (Olsson and Keeling, 2002).

In a large study on different types of enriched cages it was observed that the substrate areas were frequently used but not as much as in alternative housing systems (Appleby et al., 2002). Although the substrate area per bird in alternative systems (aviaries, free range systems, organic systems) is much larger as compared to enriched cage systems it has been questioned if these litter areas do fulfil the needs of the hens. Abnormal behaviour related to the availability or quality of substrate has also been observed in these systems, like feather pecking and sham dustbathing (Fiks, personal communication; Oden et al., 2002). Oden et al. (2002) concluded that the substrate area was insufficient in two types of aviary systems. They observed a high frequency of aggressive pecks in substrate areas that might be related to the preference of birds to space out when foraging which was not possible due to the limited substrate space per bird (Keeling and Duncan, 1991, in Oden et al., 2002). Litter quality was poor in these aviary systems, especially at the end of the laying period, and fewer birds used the litter for dustbathing when it became less friable (Oden et al., 2002).

2.2. Behaviours associated with availability and quality of substrate

From the huge amount of literature on the causation of feather pecking in domestic fowl it becomes clear that the provision of good foraging material may reduce the prevalence of feather pecking (e.g., Huber-Eicher and Wechsler, 1997; 1998; Wechsler and Huber-Eicher, 1998; Aerni et al., 2000; El-Lethey et al., 2000; El-lethey et al., 2001; Nicol et al., 2001). However, feather pecking may be caused by multiple environmental factors like light intensity, group size and stocking density, food form and rearing conditions (see e.g. overview in Blokhuis and Wiepkema, 1989). The prevalence of feather pecking may be used as indicator of substrate quality but should therefore be combined with other behavioural measures. In addition to feather pecking the frequency of aggressive pecks in the substrate area may be related to overcrowding in the litter area (Oden et al., 2002) and may thus be used as criterion to assess substrate quality.

In the absence of suitable substrate for dustbathing sham dustbathing may be observed (Lindberg and Nicol, 1997; Olsson et al., 2002b) which thus may be used as a criterion to assess substrate quality. In addition, as also described in 3.1., in a substrate preferred for dustbathing the duration of a dustbath is longer as compared to substrate less preferred for dustbathing (Van Liere et al., 1990), and there is a greater probability of complete dustbaths (Van Liere et al., 1990; Vestergaard et al., 1990; Van Liere and Siard, 1991).

Laying hens have an innate behavioural rhythm for certain behaviours (like feeding, dustbathing, foraging or perching) (e.g., Oden et al., 2002) and therefore the opportunity to perform

these behaviours at the right time may be an important criterion to assess the quality of the substrate area. Under natural conditions laying hens synchronise these behaviours (Mench and Keeling, 2001). Thus, the number of hens performing foraging and dustbathing on the litter area in the preferred periods (middle of the light period for dustbathing and before lights off for foraging, see 3.3) may reflect the accessibility of the substrate area in housing systems (Oden et al., 2002).

Combining the results of the literature overview and the experimental approach we suggest the following criteria to assess substrate quality in different laying hen housing systems:

1. **Dustbathing:**

- number of hens dustbathing;
- whether the dustbaths are complete or incomplete, using focal animal sampling and the definitions as described in deliverable 4.4, chapter 3.3.2. (de Jong, I.C., and Wolthuis-Fillerup, M., 2005, p. 8)
- duration of dustbathing (using focal animal sampling);
- number of hens sham dustbathing;
- number of dustbaths that are disturbed (e.g. by other hens or feeders that run).

Observation period: middle 4 h of the light period.

2. **Foraging and pecking behaviour:**

- number of hens showing foraging behaviour in the substrate area;
- frequency of aggressive pecking in the substrate area;
- frequency of feather pecking.

Observation period: 2 h before lights off.

3. **Other parameters**

- substrate type;
- substrate quality (i.e., particle size, %dry matter, loose structure or clumped together, litter thickness in cm);
- system characteristics: type, manufacturer, housing density, substrate area, size and shape of entrance to litter area, accessibility of litter box.

4.5 Behaviour and use of resources in various housing systems

4.5.1 Prevalence of feather pecking

The prevalence of feather pecking has been investigated in a number of experiments the results of which are reviewed and presented in Deliverable 4.2 information. The results are summarized in a

Table showing studies (i) where large numbers of flocks have been examined and the % of flocks exhibiting feather pecking reported (ii) where birds within individual flocks have been observed and the % of birds exhibiting feather pecking or the mean pecks per bird per hour estimated. Only information from birds housed in commercial-scale systems (not very small experimental trials) was included in (i). A main conclusion from this survey is that feather pecking is still a very predominant welfare problem in non cage systems. In surveys covering around 340 commercial flocks the number of flocks suffering from feather pecking is between 40 and almost 80%. The prevalence of cannibalism was lower but still up to 20% of flocks was affected in one survey and up to 40% in another.

The LayWel database contained data on pecking behaviours from 35 flocks of various breeds (LSL, ISA White, Hyline White and Lohmann Brown) kept in furnished cages (Sweden) and in 6 flocks kept in single tier non cage system (UK), all of the Shaver 579 hybrid.

No effect of furnished cage type or breed on gentle nor severe feather pecking could be found significant in the Swedish data. Season, however, affected feather pecking significantly, with more severe feather pecking in the summer (0.32 pecks per bird per hour (pbh)) compared to winter, spring and autumn (0.16, 0.04 respectively 0.07 pbh). This effect could be due to heat stress affecting the level of feather pecking.

4.5.2: Use of litter and evaluation of litter quality

The criteria to assess substrate quality as suggested above (4.4.2) were used in an experiment where the substrate quality with respect to dustbathing and foraging behaviour were investigated in two housing systems for laying hens, see Deliverable 4.5 for details.

As only a small number of farms were evaluated the results should be interpreted with care and regarded as an indication. Dustbathing and foraging behaviour was recorded on five farms with a barn system (single tier, in The Netherlands) and two experimental farms with furnished cages (in Belgium (40 bird cages) and Germany (40 and 60 bird cages). Dustbathing and foraging behaviour was observed in the middle of the light period, and in addition foraging behaviour was scored at the end of the light period. In the latter period the number of hens showing feather pecking or aggressive pecking was scored.

Dustbathing behaviour was observed in about nine percent of the hens (in the substrate area) in barn systems and five percent of the hens (in the substrate area) in furnished cages. In addition, in furnished cages sham dustbathing was observed. On the German farm, significantly more hens in the 60 bird cages as compared to the 40 bird cages were dustbathing. However, no complete dustbaths were observed in furnished cage systems whereas in barn systems about 55% of the

dustbaths were complete (which means including all behavioural elements of a dustbath). Foraging behaviour was observed in about 17% of the hens in barn systems and five percent of the hens in furnished cage systems in the middle of the light period, and in about 38% of the hens in barn systems and 15% of the hens in furnished cage systems at the end of the light period. Aggressive pecking and feather pecking were hardly observed in both systems.

The results of this study suggest that substrate in barn systems gives more opportunities for laying hens to perform dustbathing and foraging behaviour as compared to the substrate area in furnished cage systems. The low proportion of hens performing foraging behaviour and the absence of complete dustbaths in furnished cage systems indicates that the substrate areas in these systems do not fulfil the needs of the hens, confirming the results of earlier studies in furnished cage systems.

The LayWel database contained data from 20 flocks on the use of the dustbathing area (mainly Swedish data from partner SLU on LSL hens, Deliverable 4.6). Only data from small furnished cages were available. These data showed an extremely variable use, from 5 to nearly 100% of the dustbathing areas occupied by hens at a given time of observation. There was a significant effect of cage model, the highest use of dustbaths being 81% in Big Dutchman Aviplus, 46% in Victorsson Trivselsbur, 22% and 21% in treatments Triotec Stimulansbur and Hellmann Miljösystem, respectively. In all types hens had 5 hour access to the dustbaths daily. The very high variability could partly be due to the sampling technique, as use of the dustbaths varies over the day**,** and thus is prone to sampling errors. No effect of season could be seen.

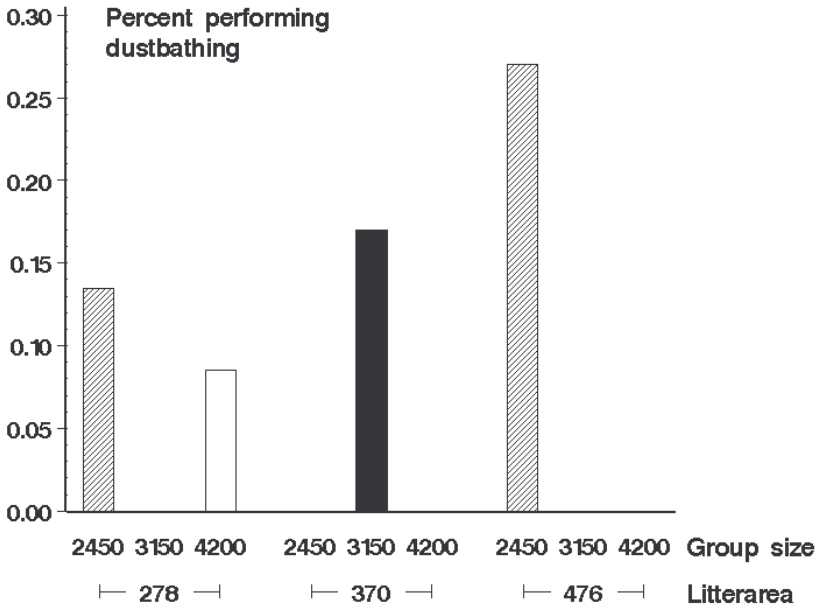

Figure 2 Dustbathing behaviour in Shaver 579 Leghorn hens as affected by litter area and group size. Data from UK, Univbris, Deliverable 4.6.

Given larger litter area (Figure 3) in single floor housed Shaver 579 (data from Univbris) there was an increase in the percent birds performing dustbathing. In this Figure some combinations were not available (split-plot-design) and litter area, group size and stocking density were partly confounded in the present analysis. But it is evident from the same graph that given the same litter area more hens perform dustbathing at the lower group size.

4.5.3 Use of perches

In Figure 3 is shown that the use of perches at night is higher in the smaller compared to medium or larger furnished cages. All data from FCL and FCM are from one partner only (PV) and for this partner the use of perches were 64, 64 and 74% on average for FCL, FCM and FCS respectively. For the other partners, SLU and UZ, resp. 87 and 82% of hens used perches at night in FCS. In non-cage systems our data is sparse, but there seems to be a better use of perches in multi-tier systems (comparable to the level seen in small furnished cages) compared to single-tier systems. The main part of the data was on White Leghorn (LSL) hens.

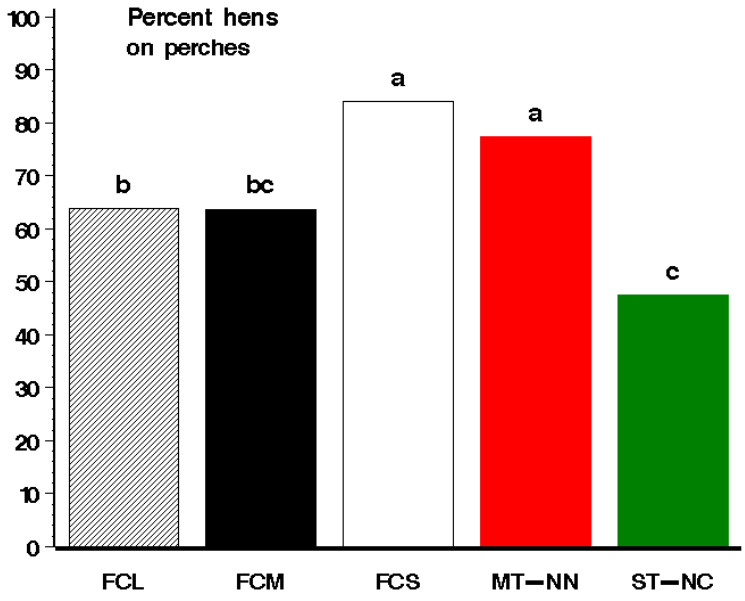

Figure 3 **The percentage of hens (ls-means) using the perches at night in furnished cages (FCL = large, FCM = medium and FCS = small group size) and multi tier, non-interg. nests (MT-NN) or single tier (ST-NC) non cage systems. N=114 obs. (Swedish (SLU), Dutch (PV) and Spanish (Unizar) data) Delivarable 4.6**

4.5.4 Use of nests (4.6)

A total of 146 flocks were available in the LayWel-database with recordings of percentage of eggs laid in the nests. Discarding flocks with crossed line birds or mixed flocks there was 134 flocks left. These flocks were reasonably well distributed over systems with 19% in FCL, 8% in FCM, 29% in FCS, 23% in MT and 22% in ST systems. Forty two percent were White Leghorn and 58% Medium Heavy. The distribution of flocks over systems, hen types and partners can be seen in Table 7 in deliverable 4.6.

Because Medium Heavy birds were not represented in FCL cages a two step approach was chosen. Firstly, analysis of variance was made on the two hen types separately with a model including systems. The results are shown in Table 8. White Leghorns laid more eggs in nests in FCM compared to FCL and FCS and MT with ST in between. Medium Heavy hens laid more eggs in nests in non cage systems compared to furnished cages. Secondly, a further analysis was made using a model including system, hen type and their interaction. This time data on FCL cages were not included. The LS-means were identical to those given in Table 1 and very significant effects of system, hen type and their interaction were found. White Leghorns used the nests in FCM and FCS better than Medium Heavy hens (indicated by different capital letters in Table 1), while no difference was found in non cage systems.

Table 1 LS-means of frequency (percent) of nest eggs in various systems and two hen types. In total 56 flocks of White Leghorn and 78 flocks of Medium Heavy hybrids

System	FCL	FCM	FCS	MT	ST	P-value
Hentype						
White Leghorn (white shell)	95.4b	99.1aA	95.8bA	94.8b	97.7ab	0.0522
Medium Heavy (brow. sh.)	-	89.4bB	86.7bB	96.7a	95.9a	<0.0001

Different letters in a row indicate sign. difference between systems within hen type (P<0.05)
Different capital letters in a column indicate sign. difference between hen type within systems (P<0.05)
There were no Medium Heavy birds in FCL cages

4.5.5 Use of space for other behaviours (4.6)

Aggressive social interactions

The LayWel database contained data on pecking behaviours from 35 flocks of various breeds (LSL, ISA White, Hyline White and Lohmann Brown) kept in furnished cages (Sweden) and in 6 flocks kept in a single tier non cage system (UK), all of the Shaver 579 hybrid.

Aggressive pecking was not influenced by production system. But as for feather pecking an effect of season was found significant. Less aggressive pecking ($P<0.05$) was recorded in the furnished cages in the spring (0.05 pbh) compared to the other seasons (from 0.18 to 0.24 pbh).

There were higher levels of aggressive pecking in Shaver 579 flocks kept at lower group sizes (Figure 4) and this could very well have had an influence on the level of feather pecking as described above in the data from Univbris.

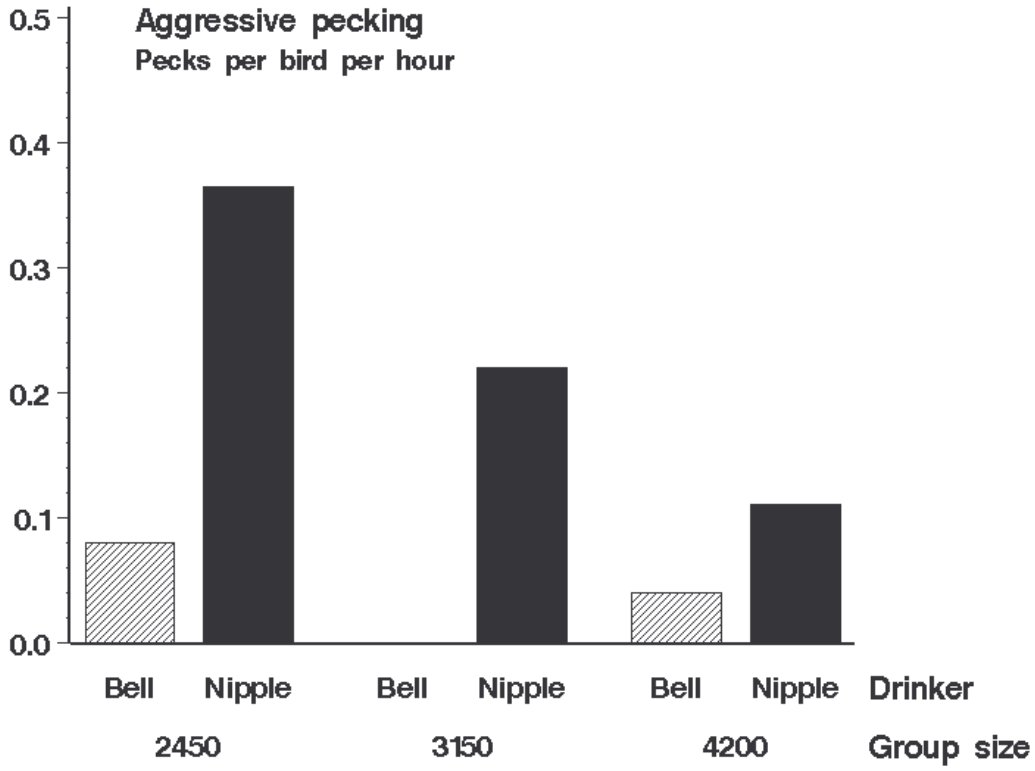

Figure 4 Aggressive pecking in Shaver 579 Leghorn hens as affected by drinker and group size. Data from UK, Univbris, Deliverable 4.6

Frequencies of preening

Data on preening frequency were provided from Univbris on 6 flocks kept in single tier non cage systems, all of the Shaver 579 hybrid and results are shown in Figure 5.

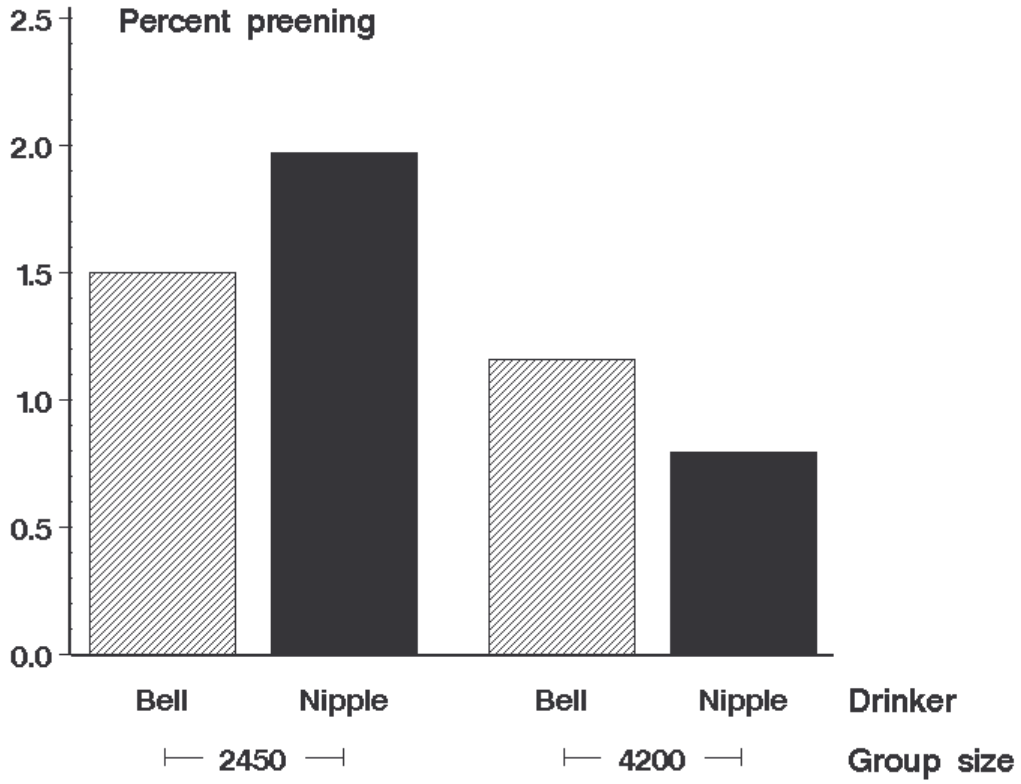

Figure 5 **Preening behaviour in Shaver 579 Leghorn hens as affected by drinker and group size. Data from UK, Univbris, Deliverable 4.6**

4.6 Conclusions

- Hens are prepared to work to gain access to perches at night, but there has been insufficient research work to know the extent to which perching is a behavioural priority
- Hens have a preference for a discrete, enclosed nest site and they value it sufficiently to work hard to gain access to one
- Scientists have not definitively discovered the extent to which hens value dustbathing, but there is strong evidence that it is a behavioural need
- The presence of apparently purposeless behaviour or of high levels of aggression or redirected behaviours such as feather pecking and cannibalism are important indicators that can be use to evaluate a certain housing system with respect to bird welfare
- The value of a particular substrate varies with the behaviour performed in the substrate and that there is a strong demand for peat moss for dustbathing

- Criteria to assess substrate quality in different laying hen housing systems should include recording of dustbathing behaviour activity and quality, foraging behaviour, substrate quality and housing system characteristics
- Substrate in barn systems gives more opportunities for laying hens to perform dustbathing and foraging behaviour as compared to the substrate area in furnished cage systems.
- The low proportion of hens performing foraging behaviour and the absence of complete dustbaths in furnished cage systems indicates that the substrate areas in these systems do not fulfil the needs of the hens, confirming the results of earlier studies in furnished cage systems.
- Hens in larger group cages (60 birds per cage) were found to perform more (incomplete) dustbathing than hens in 40 bird group cages
- Feather pecking is still a very predominant welfare problem in commercial flocks in non cage systems with a prevalence of between 40 and 80%. The prevalence of cannibalism is lower but with up to 20% of flocks were affected in one survey and up to 40% in another
- Hens kept in any of the four furnished cage models compared did not differ in level of feather pecking or aggressive pecking.
- The perching area of furnished cages was used typically of about 40 to 50% of the hens during the day and of 80 to 90% during the night.
- The use of perches at night was higher in the smaller compared to medium or larger furnished cages.
- The use of the dustbathing area was very different for the four models of furnished cages that could be compared from the LayWel data.
- Birds reared on floor had a slightly higher dustbating activity than cage reared birds.
- White Leghorns laid more eggs in nests in FCM compared to FCL, FCS and MT with ST in between.
- Medium Heavy hens laid more eggs in nests in non cage systems compared to furnished cages.
- White Leghorns used the nests in FCM and FCS better than Medium Heavy hens, while no difference between hen types was found in non cage systems.

4.7 References

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