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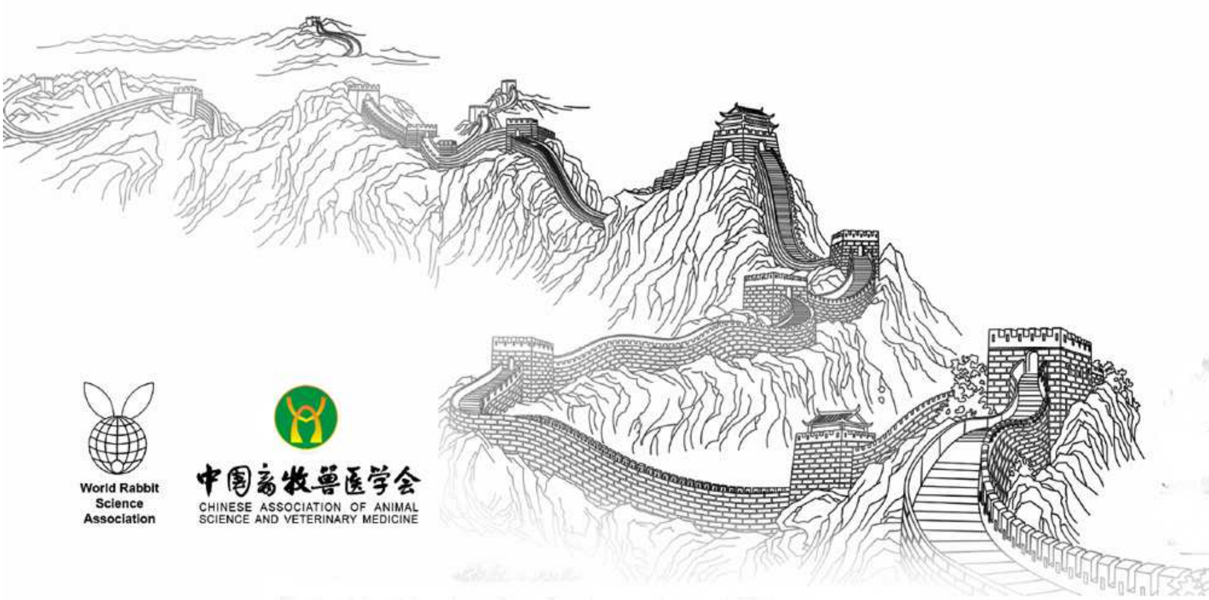

# IMPACT OF HOUSING SYSTEM (CAGE VS. PART-TIME HOUSING) AND FLOOR TYPE ON RABBIT DOE WELFARE

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## ABSTRACT

Welfare aspects were assessed in does housed either in single-doe cages (0.4 m², wire floor) or in part-time parks (2 m² for 4 does) with a wire floor or with a plastic slatted floor. Does were housed in these systems for 4 consecutive reproduction cycles (24 does/housing type). From 3 days before kindling till 18 days after kindling, each park was divided into 4 individual units. The other 3 weeks of the 42 days reproduction cycle, 4 does were housed together in each park. In the period immediately after grouping, hopping and sniffing/allo-grooming took up 4.3% and 1.3% of the part-time group does' time budget, whilst in cages these behaviors took up 0.7% and 0%, respectively ($p<0.01$). However, 4 and 11 days after grouping, treatment differences were much smaller. Semi-group does did not spend significantly more time in bodily contact than caged does in any of the observation periods. Immediately after grouping, agonistic behavior took up 7.3% semi-group does' time, whilst it was absent in the cages. Although agonistic interactions decreased very rapidly after grouping, they resulted in skin lesions in many does (58% showed slight lesions and 20% more severe lesions). No difference in adrenal weight or the prevalence of spinal deformations was observed between the systems, but tibia cortical thickness was greater ($p<0.05$) in part-time group does. In the absence of major changes in the behavioral time budget and indications of decreased stress, we could not provide clear evidence that our part-time group housing system had a major positive impact on doe welfare.

**Key words:** Housing, Rabbit does, Part-time group housing, Welfare

## INTRODUCTION

Reproduction does are commonly housed separately in a single-doe cages (SC). These cages have been suggested to restrict locomotion and social contact, a likely assumption because an adult rabbit needs approximately 70 cm to make one hop (EFSA, 2005). Restriction of social contact also seems likely as rabbits can only interact with their adult conspecifics through the wire cage walls, which bars most types of physical interaction. However, restriction will only occur if does are intrinsically motivated to perform these behaviours.

Although research on the effects of cage size and SC housing on rabbit welfare has been conducted, this research has focused on meat rabbits or non-breeding laboratory rabbits (e.g. Szendrö and Luzi, 2006; Fuentes and Newgren, 2008; Held, 1995). Effects on breeding does are likely to diverge, as they are in a different behavioural and physiological state and thus have different needs.

One way to alleviate potential restrictions on locomotor and social behaviour is to keep rabbits in group housing. However, such systems often suffer from problems with infertility, high kit mortality and aggression (Rommers et al., 2006; Szendrö et al., 2013). Therefore, we examined the merits of a part-time group housing system (does kept in groups of four from 18 to 30 days after kindling).

## MATERIALS AND METHODS

### Animals and housing

Hycole does (29 weeks old) were allotted randomly to one of three systems: SC (0.4 $m^2$ + 0.1 $m^2$ platform, wire floor with plastic footrest), part-time group (PTG) pens with a wire floor (2 $m^2$ + 0.6 $m^2$ platform / 4 does, wire floor with plastic footrests) or PTG pens with a slatted plastic floor. In the PTG systems, does were housed together from 18 days after kindling until 3 days prior to the next kindling. Does were placed 3 days before their 2nd kindling and stayed within treatment until the weaning of the 5th litter. 24 does were used per treatment. Does that did not become pregnant upon insemination were replaced between cycles, within treatment. Because these replacements meant we had to introduce animals in some of the groups, we chose to create totally new groups of unfamiliar does each cycle.

**Behavioural analysis**
Videos of a subset of the rabbits (16 rabbits / treatment in the 2nd experimental cycle) were analysed using continuous sampling during six 30-minute timeslots: immediately after grouping of the PTG does, 12 hours later, and at midday and midnight 4 and 12 days later.

**Lesion scores**
The increase in skin lesions during the first 4 days after grouping was assessed in each experimental cycle (skin lesions before grouping were subtracted from skin lesions after 4 days after grouping). This was done for the PTG systems only (SC does were not expected to show any lesions, which was confirmed once). Does were categorized on a 0-3 scale (0: no lesions, 1: 1-4 short superficial lesions, 2: 1-4 long superficial or short deep lesions or ≥ 5 short superficial lesions, 3: ≥ 1 deep long lesion or ≥ 5 long superficial or short deep lesions).

**Spinal deformation, bone quality and adrenal weight**
All does were euthanized after the 4th experimental reproduction cycle and two X-rays were made per doe (1 lateral, 1 ventrodorsal). Three types of spinal deformation were assessed from these X-rays: scoliosis, kyphosis and lordosis (lateral, dorsal and ventral deviation of the spine, respectively).
Measurements were made on both the tibia and the femur to determine cortical thickness in four places using digital callipers. Adrenal weight was measured as indicators of stress. At the end of the experiment both adrenal glands were removed and weighed.

**Statistical analysis**
Behaviour was analysed separately for each of the 6 timeslots using a Kruskal-Wallis test in R 3.0.1, with housing type as the independent variable. Adrenal weight was analysed using linear mixed models in SAS 9.4. Wound scores of PTG does by using a cumulative logit model in SAS 9.4. Spinal deformation by using a logistic regression model with housing (cage vs. PTG on wire vs. PTG on plastic) as the only fixed factor. All bone quality measures by a one-way ANOVA.

## RESULTS AND DISCUSSION

**Behaviour**
As expected, PTG does spent significantly more time for locomotion than those in SC housing. However, the difference was modest in the timeslot immediately following grouping (4.3 vs. 0.7%) and was even smaller in later timeslots (Table 1). Similarly, PTG does spent more time sniffing/grooming each other than SC does did in the timeslot following grouping of the PTG (1.3 vs. 0%), with less expressed differences in later timeslots. When first grouped, PDG does spent less time in bodily contact than their SC conspecifics (who could only keep contact with the wire wall between them). It seems likely that the PTG does had to become more familiar with each other before they felt comfortable enough to rest in bodily contact. However, even 12 days after mixing PTG does did not spend significantly more time in bodily contact than SC does. The limited amount of extra time spent on locomotor and social behaviour in PTG housing (which additionally provided more space per animal) does not provide clear evidence that SC restrict does severely in their locomotion or social interaction.

Agonistic behaviour (attacking/chasing and fleeing/retreating) was completely absent in the SC (although possible at the cage walls). In PTG, does spent 7.3% of their time on agonistic interactions immediately after grouping. This percentage decreased rapidly over time, remaining below 1% in all later timeslots.

**Table 1.** Median percentage of the time spent on different behaviours (+ interquartile range) by SC does or PTG does on the day of mixing and 4 and 12 d thereafter [(1)(2)].

| *Day of mixing* | Immediately | | | After 12 hours | | |
|---|---|---|---|---|---|---|
| | Cage | Group | P | Cage | Group | P |
| Locomotion | 0.7 (0.6-0.8) | 4.3 (3.8-5.0) | ** | 0.4 (0.3-0.5) | 3.0 (2.5-3.3) | **[(3)] |
| Flee/retreat | 0 (0-0) | 2.0 (1.1-2.5) | ** | 0 (0-0) | 0.5 (0.3-0.9) | ** |
| Attack/chase | 0 (0-0) | 5.3 (4.3-8.4) | ** | 0 (0-0) | 0.2 (0.2-0.5) | ** |
| Sniff/groom doe | 0 (0-0) | 1.3 (1.2-2.1) | ** | 0 (0-0.01) | 0.2 (0.1-0.9) | * |
| Bodily contact | 12 (11-15) | 1.6 (0.8-3.1) | ** | 11 (9-14) | 0.6 (0.0-3.0) | * |
| *4 days after mixing* | day | | | night | | |
| | Cage | Group | P | Cage | Group | P |
| Locomotion | 0.3 (0.2-0.5) | 0.5 (0.4-0.6) | NS | 0.6 (0.5-1.0) | 2.4 (0.4-0.6) | * |
| Flee/retreat | 0 (0-0) | 0 (0-0) | NS | 0 (0-0) | 0.3 (0.2-0.3) | ** |
| Attack/chase | 0 (0-0) | 0 (0-0) | NS | 0 (0-0) | 0.1 (0.0-0.1) | * |
| Sniff/groom doe | 0 (0-0) | 0.1 (0.0-0.2) | # | 0 (0-0) | 0.4 (0.2-0.6) | ** |
| Bodily contact | 2.9 (0.6-7.6) | 5.6 (4.5-8.4) | NS | 5.8 (2.3-9.1) | 2.8 (1.0-3.8) | NS |
| *12 days after mixing* | day | | | Night | | |
| | Cage | Group | P | Cage | Group | P |
| Locomotion | 0.1 (0.1-0.1) | 0.3 (0.2-0.4) | # | 0.2 (0.2-0.3) | 0.8 (0.6-1.4) | * |
| Flee/retreat | 0 (0-0) | 0.01 (0-0.01) | NS | 0 (0-0) | 0.1 (0.0-0.2) | * |
| Attack/chase | 0 (0-0) | 0 (0-0) | NS | 0 (0-0) | 0.01 (0-0.03) | # |
| Sniff/groom doe | 0 (0-0) | 0.1 (0.0-0.1) | * | 0 (0-0) | 0.4 (0.4-0.6) | ** |
| Bodily contact | 0 (0-1.8) | 3.5 (0.6-4.9) | NS | 0 (0-1.7) | 1.9 (0-7.8) | NS |

[(1)] n=16 does in cages *vs* 16 does in group housing [(2)]Behaviours not representative for welfare evaluation are not presented. [(3)]**: P<0.01,*: P<0.05, #: P<0.10).

## Lesion scores

Although agonistic interactions were found to decrease rapidly after mixing, they still led to a considerable percentage of PTG does, sustaining moderate (category 1 or 2: 58%) or severe (category 3: 20%) wounds (Figure 1). The odds of having more severe lesions did not decrease in later cycles (P=0.49), suggesting that the does' tendency to fight did not decrease as they got more familiar with the PTG procedure. This may have been due to the creation of new groups of does each cycle.

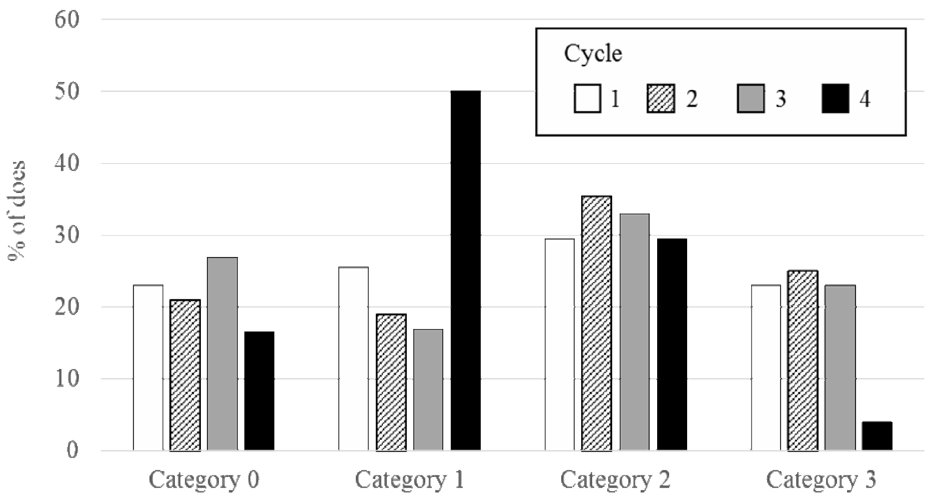


**Figure 1.** The percentage of does in each wound category in the 4 experimental cycles.

## Adrenal weight

Post-mortem weight of the adrenal glands did not differ between the housing systems, but within SC does the left adrenal gland was heavier than the right one (0.21 vs. 0.19 g ± 0.01, housing*side interaction, P<0.01). As such, the adrenal gland data did not provided support for our hypothesis that PTG housed does would be less stressed.

**Table 2.** Spinal deformation, hyperkeratosis and bone quality as affect by different housing systems.

| | Single-doe cage (wire floor) | Group (wire floor) | Group (plastic floor) | SEM | P-value |
|---|---|---|---|---|---|
| Number of does | 22 | 23 | 20 | | |
| Spinal deformation (%) | 32 | 39 | 45 | 11 | 0.677 |
| Hyperkeratosis (%) | **68[b]** | **65[b]** | **5[a]** | **9** | **<0.0001** |
| Tibia | | | | | |
| Length (mm) | 110 | 109 | 109 | 1 | 0.773 |
| Cortical thickness (mm) | **1.38[a]** | **1.45[b]** | **1.46[b]** | **0.03** | **0.045** |
| Femur | | | | | |
| Length (mm) | 104 | 104 | 104 | 1 | 0.771 |
| Cortical thickness (mm) | **1.21[a]** | **1.27[ab]** | **1.32[b]** | **0.03** | **0.015** |

[a,b] Means marked with different superscripts differ for P<0,05

**Spinal deformation and bone quality**

In line with previous research (Drescher and Loeffler, 1996) the overall prevalence of spinal deformation was high (38% of the does had at least one deformation). Contrary to our expectations, the prevalence of spinal deformations did not differ between the 3 housing systems (Table 2). Spinal deformations have been suggested to result from low cages. The lack of a difference in deformations between our roofed SC and roofless PTG pens does not support cage height as the main cause of deformations, although it is possible that our SC were simply high enough not to affect our does.

Does from SC housing had approximately 5% thinner tibia and femur cortices than those in PTG housing (Table 2). The decrease in bone cortex thickness is in line with previous findings that fattening rabbits have a decreased outer tibia width when housed in smaller cages (Dalle Zotte et al., 2009; Buijs et al., 2012). Increased activity leads to increased bone width (Gordon, 1989), and our PTG housing provided both more space and more incentive for activity. Thus, the improved bone quality in the PTG systems may be explained by increased activity. However, it needs to be remarked that such increased activity does not necessarily imply improved welfare, as observations of behaviour showed that much activity was due to agonistic interactions (fighting, chasing, fleeing, withdrawing).

## CONCLUSIONS

We found only limited advantages of our PTG system for doe welfare. As expected, locomotory and social behaviour were more common, but differences were small and mainly occurred immediately after grouping, when agonistic behaviour was also high. No positive impact of PTG housing on stress indicators was observed. A considerable proportion of our PTG does sustained skin lesions.

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