

DESCRIPTION OF NESTBOX VISITS AND SUCKLING EVENTS IN A GROUP HOUSING SYSTEM FOR RABBIT DOES AS COMPARED TO INDIVIDUAL CAGES

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ABSTRACT: Research was conducted to study nursing associated events of lactating rabbit does. Nest box visits and suckling events were investigated using 6 group pens (8 does/pen) and 12 enriched individual cages. Each group pen and individual cage was observed by video for one day per week until weaning at 35 d of lactation, with exception of the third week of lactation. In the first 2 wk of lactation, videotapes were analysed for the frequency and duration of nest box visits per day. The fourth and fifth week of lactation, suckling events on the floor of the group pens and nest box visits in the individual cages were analysed for one day per week. The first 2 wk of lactation, does visits to the nest boxes were less frequent (respectively 1.9 ± 0.2 vs. 2.6 ± 0.3 , $P < 0.1$) and shorter (respectively 113 ± 9 s vs. 158 ± 15 s, $P < 0.05$) in the group pens than in the individual cages. In the group pens, 32% of the does had intervals of >24 h between nest box visits. In the cages, all does visited the nest boxes at least once a day. In the last 2 wk of lactation, in the group pens suckling duration (mean \pm standard deviation) was 89 ± 49 and 92.2 ± 37 s in respectively week 4 and 5. In 79% of the suckling events a mix of the does' own and other kits were suckled. No difference was found in suckling duration between litters consisting of own and/or other kits. Thirty-two per cent of the does in week 4 and 62% of the does in week 5 did not suckle kits on the floor of the pen, whereas all the does in the cages still visited the nest boxes at least once every 24 h. Based on this study, it can be concluded that in group housing less frequent and shorter nest box visits as well as suckling events were found as compared to individual housing.

Key Words: rabbit does, welfare, housing, nest box visits, nursing behaviour.

INTRODUCTION

In commercial rabbit production, rabbit does are normally housed individually in wire cages. Under laboratory as well as commercial conditions, does in cages frequently show disturbed behaviours such as repetitive hair chewing, bar and nipple chewing and head sawing, suggesting that the animal's needs are not satisfied and welfare could be impaired (Podberscek *et al.*, 1991; Stauffacher, 1992; Gunn and Morton, 1995; Chu *et al.*, 2004). Enriched individual cages are developed and used for does in several countries (e.g. The Netherlands, Belgium, Germany, and Hungary). These cages can contribute to better meet the needs of the does by providing them roughage and a raised platform to enable them to withdraw themselves from the kits when they leave the nest box (Stauffacher, 1992). Moreover, this platform also preserves the physiological capacity of the animal's locomotion apparatus (Stauffacher, 1992). However, these cages do not allow full social interaction among does.

Group housing of rabbit does would meet the natural need of the rabbits for full social interaction with each other (Stauffacher, 1992; Vastrade, 1986). Interest in group housing of rabbits is growing in several countries such as Switzerland, Austria, Belgium and The Netherlands. Belgium will be the first country where individual housing will be forbidden in 2022 (L. Maertens, personal comm.)

Ruis (2006) developed a group housing system for rabbit does based on the principles proposed by Stauffacher (1992). The group pen was divided into functional units for breeding, feeding and an area where kits can hide from does after leaving the nest boxes. Several experiments were conducted, focusing on reproductive performance, sanitary conditions and aggression among does in pens (Ruis and Coenen, 2004; Rommers and de Jong, 2005; Ruis, 2006). The results of these experiments showed that weights of the kits at weaning were lower (–15%) in the group housing system as compared to the conventional system. Lower weaning weights could be the result of altered nursing behaviour of group-housed rabbit does compared to individual housing, although to the authors' knowledge no information is available on this.

In rabbits, maternal care is restricted to suckling of the kits for a few minutes once or twice a day (Hudson *et al.*, 1996; Hoy and Selzer, 2002). A suckling event lasts for about 2-5 min (Deutsch, 1957; Ross *et al.*, 1963; Zarrow *et al.*, 1965; Lincoln, 1974; González-Mariscal *et al.*, 1994; Hudson *et al.*, 1996; Selzer and Hoy, 2002; Selzer *et al.*, 2004). Outside this period, does avoid the nest until the following suckling event. In this way, the kits remain hidden for predators in the wild (Cheeke *et al.*, 1987; Verga, 1978), but are also sheltered from sudden temperature changes (Verga, 1978; EFSA, 2005). In cages, does are near the nest boxes and closure of the nest box by the doe is not possible because substrate is lacking. Does enter the nest boxes more often as compared to natural conditions (>2 times) and leave the nest box with or without having suckled the kits (Baumann *et al.*, 2005a and b; Rommers *et al.*, unpublished data).

The objective of our research was to study nursing-associated events of lactating rabbit does. We focussed on nest box visits in the first 2 wk of lactation and suckling events in the last 2 wk of lactation of does in group housing as compared to individual cages to gain a better understanding of the nursing behaviour of rabbit does in group housing.

MATERIALS AND METHODS

The experiment was performed in 2 identical compartments at the experimental farm of Wageningen University and Research Centre (WUR). Three group housing pens and 6 individual cages were installed each compartment. The Animal Care and Use Committee of WUR approved all protocols.

Treatments

Group housing: The group pens (Figure 1) had dimensions of 2.3×1.7 m and were open at the top. Does had access to their nest boxes through a PVC pipe (35 cm long and 17 cm diameter) by an individual electronic nest box recognition system (IENRS) from the day they were placed into the group pens (10 d before the expected parturition date) onwards. The IENRS allows each doe unique access to her nest box (Ruis, 2006). This way, the relatively high loss of kits in the nest box due to disturbances by other does was prevented. Nest boxes were raised 40 cm above the floor of the pen. There was a separate area on the floor for the kits where does had no entrance. Thus, does could not access those kits that preferred this area at the time when does wish to nurse. Underneath the platforms, an area was created where does could rest, because a preliminary

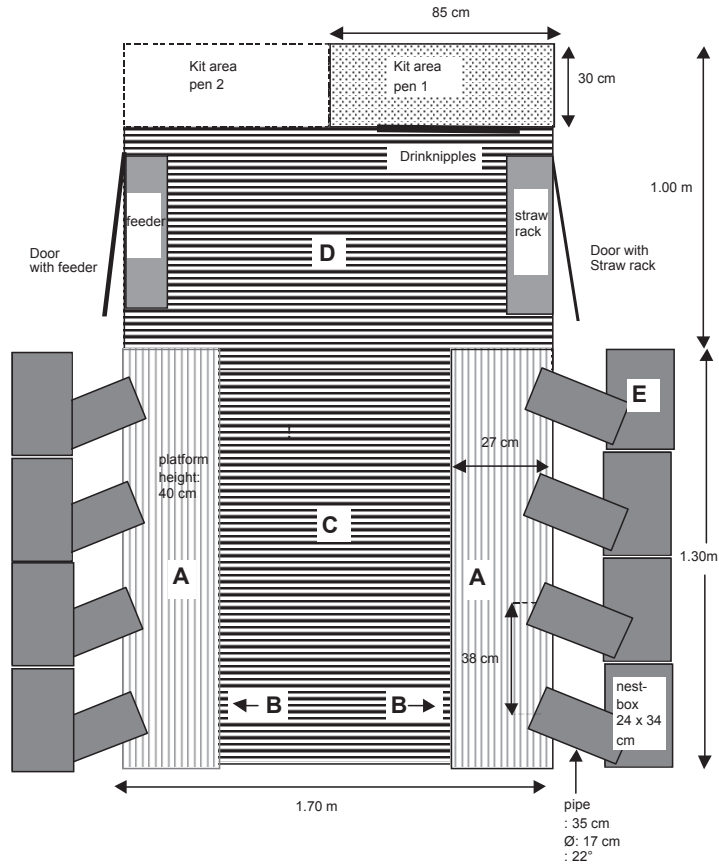


Figure 1: Group housing system. A, elevated platform. B, resting area underneath the platforms. C, free floor space. D, drinking and eating area. E, nest boxes.

study indicated that does prefer to lie underneath a cover (Rommers *et al.*, unpublished data). A straw rack was attached to a door (Figure 1). Eight does were housed in each group pen. In the group pen, the average amount of space per doe was 5128 cm² (nest boxes excluded).

Individual housing: The individual cage dimensions corresponded to the welfare regulation for the housing of commercial rabbits in The Netherlands and were 50×70×60 cm (length×width×height), consisting of wire with a raised platform (900 cm²: 50×18 cm) at 30 cm height for the does to withdraw themselves from the kits when they were out of the nest boxes. Metal nest boxes (23×30 cm; 700 cm²) were attached to the front of the cage. There was no tunnel to give the doe access to the nest boxes. Each cage had a straw rack. In the cages, does had access to 4400 cm² (nest box excluded).

Animals and Husbandry

The experiment started with 60 pregnant nulliparous hybrid does (Hycole) that were bred in individual cages at a commercial rabbit farm in The Netherlands. Pregnant does arrived at the experimental farm 10 d before expected parturition. Out of 60 does, 48 were randomly selected

to be housed in 6 groups of 8 (group housing) and 12 does were housed in cages (individual). Does that were culled during the experiment were not replaced.

The experiment started at parturition and lasted until weaning of the kits at 35 d of lactation. Nest boxes were provided at 5 d before expected parturition. Wood-shavings and straw were provided as nest material. Does were not inseminated or mated after parturition. After birth, litters were standardised at 8 kits. At 3 wk of age, kits in the group pens were removed from the nest boxes and put on the floor of the pens to stimulate consumption of pelleted food. In the group pens, kits could no longer enter the nest boxes, but nest boxes could still be entered by the does. Nest boxes remained open in the individual cages. Therefore, kits could suckle in the nest boxes as well as in the cage when they were old enough to leave the nest boxes (after approx. 14 d of age).

Does and kits were fed *ad libitum* a standard commercial lactating diet and straw was provided *ad libitum* in a straw rack in the group pens and in the cages. Water was provided *ad libitum* through 3 drinking nipples in a group pen and 1 nipple in a cage. The animals were kept in a 16 h light, 8 h dark lighting scheme (lights on at 6.00 a.m.).

Measurements

Video-recording: In group housing, does were marked individually before parturition with a spray using different colours. To distinguish which kits belonged to which doe in the group pens, kits in a litter were marked identically to their mother at 2 wk of age.

First 2 wk of lactation: Each week, the cages and group pens were videotaped for 24 h successively using time-lapse recording. A nest box visit was defined as a doe entering the nest box completely. The frequency and duration of nest box visits of each doe were recorded.

In the third week of lactation, kits started to move out of the nest boxes. Some of the kits were in the nest box while other kits of the litter were on the floor. Does could thus nurse kits in the nest box as well as on the floor or in the cage. This made it very awkward to analyse nest box visits and nursing behaviour on the videotapes. Because of this, we choose not to analyse week three of the videotapes.

Week four and five of lactation: Each week cages and pens were videotaped for 24 h successively. In the cages, frequency and duration of nest box visits as well as suckling events outside the nest box were recorded. In the group pens suckling events on the floor of the pens were registered. A suckling event was defined as one or more kits attached to the belly of the doe. In the group pens, it was registered if does were suckling their own and/or other kits.

Videotapes were analysed using The Observer software (version 5.0, Noldus, Wageningen, The Netherlands).

In the first 2 wk of lactation, the number and duration of the nest box visit of each doe in 24 h was determined in the group- and individual housing. In the fourth and fifth week of lactation, the number and duration of the suckling events per doe were determined on the floor of the group housing system, and number of nest box visits as well as the number of suckling events in the cage (outside the nest box) were recorded in the individual housing. Therefore, these 2 periods are described separately in the results.

Kit viability and growth: For each doe, number of kits was standardised at 8 kits after parturition. Litter weights were determined at 14, 21, 28 and 35 d of lactation. Mortality of kits and does was registered daily with the cause of death, if known.

Statistical analysis

Data were analysed using Statistical Analysis Software (SAS Inst. Inc. Cary, NC, USA).

Differences between treatments in number and duration of nest box visits in the first 2 wk of lactation were tested with the Generalised Linear Model (GLM) procedure of SAS, using the following model: $Y_{ij} = \mu + T_i + W_j + (T \times W)_{ij} + e_{ij}$ where Y_{ij} is dependent variable; μ = overall mean; T_i = treatment (group and individual); W_j = week of lactation (1 and 2); $T \times W$ = interaction between Treatment and Weeks and e_{ij} is the residual error. Differences between treatments in the distribution and number of nest box visits were tested using a Chi-square test (Freq procedure SAS).

Data of the last 2 wk of lactation are not analysed, as nest box visits were recorded in the individual housing, whereas suckling events on the floor of the pen were recorded in the group housing system. In the results, all data related to the nest box visits and suckling events are presented as means \pm standard deviation (SD).

Differences between treatments in total litter weight, average kit weight and average number of kits per litter were analysed per week with the GLM procedure of SAS, using treatment as factor. Data are presented as Least Square Means (LSM) and standard error (SE).

If P -value was <0.05 , it was considered a significant effect. If P -value was <0.1 , it was considered as close to significant.

RESULTS

After parturition, 4 does received no litter (2 does in 2 group pens and 2 does in individual cages), because all kits were stillborn or only a few kits were born alive and there were not enough kits to standardise all litters at 8. In the individual cages, they were removed from the experiment. Data in the first week of lactation are based on 3 group pens and 6 individual cages, because video recordings in one compartment failed.

Mortality of does and kits

Two does in the individual cages (20%) and 7 in the group pens (14.6%) died or were culled during the experiment, due to various reasons (broken leg, mastitis, Pasteurella infection, and extreme weight loss).

After standardisation of the litters at 8 kits, on average 10% (7.7 and 20.5% for group and cage housing, respectively) of the kits died or were culled during the experiment due to various reasons. There was no significant difference in mortality of kits from week 2 to week 5 of lactation between the group housing system and the individual cages.

Nest box visits in the first 2 wk of lactation

In the group pens, 32% of the does had intervals >24 h between nest box visits. It was not the same does that did not visit the nest box in the first and second week of lactation. In the cages, all does visited the nest boxes at least once per day.

In Figure 2 (section A), average number of nest box visits per doe in 24 h during lactation is presented for the does that visited the nest boxes once or more per day. In the first 2 wk of lactation, there was a trend for a higher number of nest box visits/doe 24 h in individual cages as compared to group housing (3.2 ± 1.7 vs. 2.0 ± 1.5 , respectively).

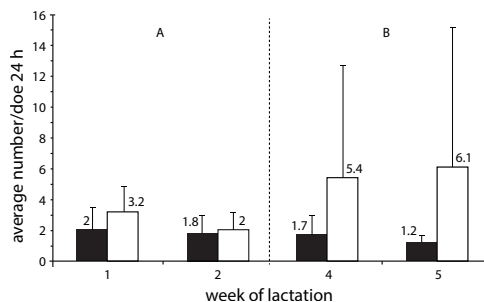


Figure 2: Average number of nest box visits per doe (mean±SD) in 24 h for group (■) and individual housing (□) in week 1, 2 (A) and 4, 5 (B) of lactation. In week 4 and 5 of lactation, the group housing data relate to suckling events on the floor. Data of week 1 are based on 3 group pens and 6 individual cages, data on week 2, 4 and 5 are based on 6 group pens and 10 individual cages.

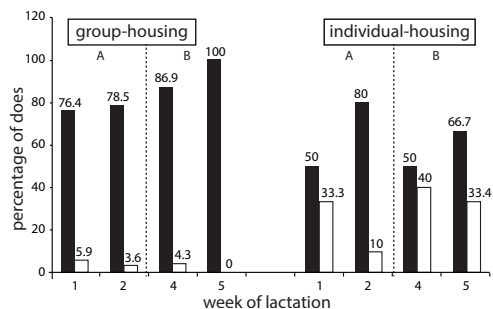


Figure 3: Percentage of does visiting the nest boxes 1 or 2 (■), or 5 or more times (□) in 24 h for group (■) and individual housing (□) in week 1, 2 (A) and 4, 5 (B) of lactation. In week 4 and 5 of lactation, the group housing data relate to suckling events on the floor. Data of week 1 are based on 3 group pens and 6 individual cages, data on week 2, 4 and 5 are based on 6 group pens and 10 individual cages.

The distribution of the percentage of does that entered the nest boxes only once or twice or five and more times a day is presented in Figure 3 (section A). In the first week of lactation, 76.4% of the does in group housing visited the nest boxes once or twice/24 h, whereas in individual housing this was 50%. In the first week of lactation, 33.3% of the does in individual housing visited the nest boxes 5 or more times a day, whereas in group housing this was only 5.9% of the does. In the second week of lactation, there was no difference in the percentage of does that visited the nest boxes once or twice/24 h. The maximum that does entered the nest boxes was 6 times/24 h.

Figure 4 (section A) shows the average duration of nest box visits. Individually-housed does visited the nest boxes longer than the group-housed does (158 ± 53 vs. 107 ± 63 in week 1 and 158 ± 50 vs. 119 ± 56 in week 2, respectively, $P < 0.05$). Figure 5 (section A) presents the percentage of nest box visits that lasted less than 2, 2 to 5, or more than 5 min. Group housing had relatively more short (<2 min) visits than individual housing (50 vs. 15.8% in week 1 and 51 vs. 20% in week 2, respectively, $P < 0.05$) and less nest box visits that lasted 2 to 5 min than in individual housing (50 vs. 84.3% in week 1 and 49 vs. 80% in week 2, respectively).

The short visits lasted no longer than 60 s in 94 and 100% in group and individual housing, respectively. It seems unlikely that kits were suckled in this short period of time. If the short visits were not included in the analysis, does in individual cages visited the nest boxes more often than does in group pens per 24 h (2.1 ± 0.2 vs. 1.2 ± 0.2 , respectively, $P < 0.001$) and these visits were longer (194 ± 8 and 165 ± 5 s, respectively, $P < 0.01$).

Suckling events in the fourth and fifth week of lactation

Individual housing: In weeks 4 and 5 of lactation, the nest boxes remained open and does could nurse their kits in the nest boxes as well as in the cage. All does did visit the nest boxes at least

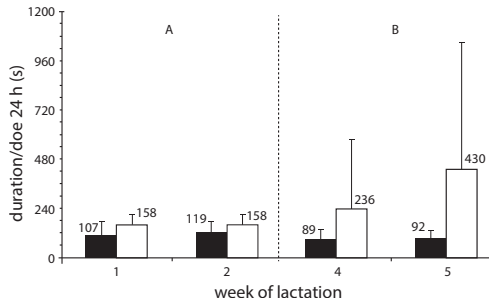


Figure 4: Average duration of nest box visits per doe in 24 h (means±SD) for group (■) and individual housing (□) in week 1, 2 (A) and 4, 5 (B) of lactation. In week 4 and 5 of lactation, the group housing data relate to suckling events on the floor. Data of week 1 are based on 3 group pens and 6 individual cages, data on week 2, 4 and 5 are based on 6 group pens and 10 individual cages.

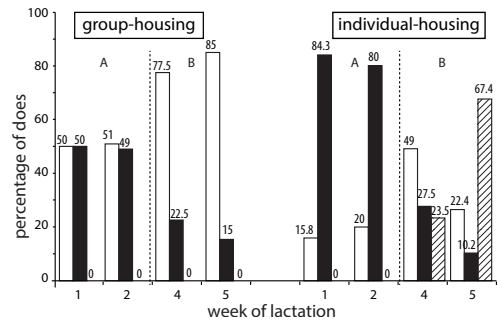


Figure 5: Percentage of nest box visits lasting <2 min (■), 2 to 5 min (□), >5 min (▨), group and individual housing in week 1, 2 (A) and 4, 5 (B) of lactation. In week 4 and 5 of lactation, the group housing data relate to suckling events on the floor. Data of week 1 are based on 3 group pens and 6 individual cages, data on week 2, 4 and 5 are based on 6 group pens and 10 individual cages.

once per 24 h. Nest boxes were visited on average 5.4 ± 7.3 and 6.1 ± 9.1 times/24 h in week 4 and week 5, respectively (Figure 2, section B). The average duration of these visits was 236 ± 339 and 430 ± 622 s in week 4 and 5, respectively (Figure 4, section B). Twenty-seven and a half per cent of the nest box visits lasted between 2 to 5 min in week 4, which decreased to 10.2 % in week 5 (Figure 5, section B). There were many long (>5 min.) nest box visits observed (23.5 and 67.4% in week 4 and 5, respectively), only displayed by 4 does. Three does entered the nest boxes quite often (14, 22 and 28 times/24 h, respectively) for short duration (<2 min) as well as very long durations (>5 min).

Only 1 doe suckled her kits outside the nest box twice; once in week 4 and once in week 5.

Group housing: Kits were only suckled on the floor of the group housing system. Sixty-nine per cent of the does in week 4, and 46% of the does in week 5 did suckle kits at least once a day (on average 1.7 ± 1.3 and 1.2 ± 0.3 times in week 4 and 5, respectively (Figure 2, section B). In both weeks does nursed kits mainly once or twice a day (86.9 to 100% in week 4 and 5, respectively, Figure 3, section B).

The average suckling duration was 89 ± 49 and 92 ± 37 s in week 4 and 5, respectively (Figure 4, section B). The short nursings (<2 min, Figure 5, section B) were often interrupted because the doe hopped away. In week 4 as well as in week 5 of lactation, in 73% of the suckling events a mix of the doe's own and other kits were suckled. There was no difference in the duration of suckling event if a doe suckled only her own, a mix or only other kits (73 ± 34 , 81 ± 12 and 125 ± 34 s, respectively).

In the group pens, does still entered the empty nest boxes 3.7 ± 3.6 on average in week 4 and 5 of lactation. They stayed in the nest boxes on average for 1681 ± 1834 s. In 59% these nest box visits lasted longer than 5 min.

Table 1: Total litter weight, average kit weight (g; LSM±SE) and average number of kits±SE per litter at 14, 21, 28 and 35 d of age for does in cages (n=10) and 6 group pens (8 does/pen).

	Group pens			Individual cages		
	Total litter weight	No. of kits/litter	Average kit weight	Total litter weight	No. of kits/litter	Average kit weight
14 d	2093±50 ^A	7.8±0.2	268±6	2157±91 ^B	7.5±0.3	291±12
21 d	2295±117	7.5±0.2	291±14	2236±157	7.2±0.4	314±19
28 d	3774±156	7.1±0.3	544±20	3304±295	6.9±0.5	480±38
35 d	5528±261	7.1±0.0	797±21	5226±502	6.0±0.6	853±39

^{AB} Means with different letters in same row and trait were close to be different ($P < 0.1$).

SE: Standard error.

Kit weights

Table 1 presents the number of kits per litter, the total litter- and average kit weight at 14, 21, 28 and 35 d of age for both treatments. In week 2 of lactation, there was a trend for a lower litter weight in group pens than in individual cages. At weaning, kits in individual cages were on average 6% heavier than kits in group pens (853 vs. 797 g, respectively). However, this difference was not significant.

DISCUSSION

According to several authors (Deutsch, 1957; Ross *et al.*, 1963; Zarrow *et al.*, 1965; Lincoln, 1974; González-Mariscal *et al.*, 1994; Hudson *et al.*, 1996; Hoy and Selzer, 2002; Selzer *et al.*, 2004) nursing in rabbits is limited to a few minutes (2 to 5) once or twice a day. The doe enters the nest and positions herself over the litter, remaining almost motionless and not giving the kits any direct support to suckle. Nursing is ended abruptly with the doe jumping out of the nest and leaving the kits alone until the next nursing (Hudson *et al.*, 1996). Although we did not record suckling bouts in the nest boxes, the time spent in the nest box gives an indication if normal nursing occurs. In both systems, we found nest box visits that lasted in between 2 to 5 min (50 and 49% in the group housing and 84 and 80% in the individual housing in week 1 and 2 of lactation, respectively, Figure 5), which can be regarded as normal nursing.

In group housing, average duration of nest box visits was shorter than in individual housing. This is due to the fact that 50% of the nest box visits in group housing lasted less than 2 min. In most cases, these short visits lasted no longer than 60 s and are likely without nursing. These short visits could be classified as inspections (Ruis, 2006) and may be regarded as abnormal behaviour (Baumann *et al.*, 2005a and b). According to Baumann *et al.* (2005a and b), these short visits can be explained by the fact that does cannot avoid nest stimuli. Although does could withdraw themselves further away from the nest boxes in the group pens and the entrance tunnel to the nest box acts as a visual separation between the doe and her litter, they still display more short visits than individually-housed does. It can be argued that does are still too strongly attracted to their nest, because does did not close the nest entrance (although straw was presented as roughage in both housing systems) and fail therefore to achieve the feedback of a successful removal of nest stimuli (Baumann *et al.*, 2005b). Another factor that might have contributed to the short visits is that in the group pens the nest boxes may also have been used as a place to hide from group mates. The fact that we used primiparous does might have been of influence on the many short nest box visits. In practice, it is noted that primiparous does can be less experienced and more restless than multiparous does in their motherly caring ability (personal observation).

Mother-kit interaction during parturition and in early lactation seems to play a crucial role for adequate display of maternal care. According to González-Mariscal *et al.* (1998) this may be more critical in primiparous does than in multiparous does, and maternal experience obtained in previous pregnancy also seems to be of importance. Besides the short nest box visits, group- and individually-housed does also visited nest boxes for very long durations (>5 min) in the last 2 wk of lactation, probably using the nest box as a resting place or as a place to withdraw themselves from their group mates in the group pens.

Most of the does that entered the nest boxes in the group pens did so only once or twice a day. In the individual cages, the number of visits per 24 h was higher. This is caused by relatively more does that entered the nest box 5 or more times per 24 h in the first 2 wk of lactation. Different opinions about nursing frequency of rabbit does are put forward in the literature. According to several authors (Venge, 1963; Zarrow *et al.*, 1965; Hudson *et al.*, 1996) rabbit does nurse their kits only once a day, whereas other authors state that, in cages as well as under semi-natural conditions, nursing events are observed more than once a day (Hoy, 2006). Maticz *et al.* (2001) reported that 25% of the does nursed more than once a day and Selzer *et al.* (2004) reports an average nursing frequency of 1.32 per 24 h in standard cages. Our findings support the opinion that rabbit does nurse their kits in general once or twice a day.

A disadvantage of the group pens is that not all does visited their nest boxes at least once a day in the first 2 wk of lactation. During this part of lactation, kits fully rely on the doe's milk, and less frequent suckling may negatively affect the kits' growth. Together with the shorter duration of nest box visits (with more short visits likely to be without nursing), this can explain the trend for the lower litter weight that was found at 2 wk of lactation in the group housing.

At week 4 and 5 of lactation it is difficult to compare the nursing behaviour of the does housed individually with that of the group-housed does. In group housing, all kits were on the floor of the pen and the frequency and duration of each suckling event could be recorded. In the individual cages, does could still enter the nest box and they did this 5 to 6 times a day on average. However, the average duration of nest box visits was much longer than in the first 2 wk of lactation. Only 29 (week 4) and 10% (week 5) of the nest box visits lasted between 2 to 5 min and can be regarded as normal suckling events.

In the group pens, kits were nursed on the floor of the pen and the number of suckling events declined from 40 to 20 from week 4 to 5. It seems likely that when kits start to eat solid food, they rely less on milk and suckling events decline. Not all does participated in nursing of the kits. This could imply that kits were consuming less milk than in the individual cages, where all does still visited the nest boxes. This can be compensated by the eating of solid food. However, under less favourable conditions this might not always be the case and could result in lower weaning weights, as we found in previous experiments. In this experiment, we found a difference of 56 g (6.6%) in weaning weight between kits raised in group pens compared with individual cages. In previous experiments, we found a difference twice as high (15%).

CONCLUSION

Based on the percentage of does that enter the nest boxes less than once per 24 h and the average frequency and duration of nest box visits, it may be concluded that nest boxes are less visited in the group housing system than in the individual cages. In this experiment, this did not result in a lower kit weight at weaning. However, under less favourable conditions, it might be expected that this would cause reduced weaning weights in group pens as compared to individual housing.

Based on the long durations (>5 min) of nest box visits in the last 2 wk of lactation, it can be concluded that the empty nest box serves as a resting place and/or as a place to hide/withdraw themselves from group mates in the group-housed system. This knowledge may help to improve the group housing systems for commercial rabbit farming.

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