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USE OF STRAW AND WOOD SHAVINGS AS NEST MATERIAL IN PRIMIPAROUS DOES

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Abstract: In rabbit production, several materials such as hay, straw, wood shavings or waste wool and cotton are used as nesting materials during parturition. In this work, straw and wood shavings were studied as potential materials for nest boxes, and a choice test was designed for this purpose. Two replicates of 30 primiparous does each were carried out. Does were housed 10 d before parturition in a double commercial cage, so each doe had access to 2 different nest boxes. One of the nests was filled with 8 cm of barley straw and the other with 8 cm of wood shavings, so the doe could choose which of them she prepared and gave birth in. During the 24 h prior to parturition, the state of the nest was assessed, according to the mixing of the material and the doe's hair and the preservation of the original material, as well as the chosen nest box. When the does gave birth, the number of live and dead newborn was recorded. In the first replicate, 87% of the does chose the straw nest box, while in the second replicate 93% of the does did so. The number of live kits at birth did not differ statistically for straw and wood shavings nests (8.36±1.74 *vs.* 6.85±3.44), but litters reared in straw reacted a higher size at weaning (7.98±1.73 *vs.* 6.29±3.35; $P<0.05$). Finally, all the nests achieved a good level of mixing between the original material and the hair of the doe and only 5% of the does removed the original material (regardless of whether it was straw or wood shavings) and made the nest only with their hair. In conclusion, our results suggest that does might have a strong preference for straw rather than wood shavings as nest material.

Key Words: nest material, preference, rabbit husbandry, behaviour.

INTRODUCTION

Nest building is a behavioural need in some species both for the raising of the young and for resting and shelter (Morgan and Tromborg, 2007). In rabbits, it has more to do with nursing behaviour than any other factor, as in natural conditions does only visit the nests for nursing (Baumann *et al*., 2005). As the pups are born very immature and have very poor thermoregulatory abilities, good nest quality is crucial for successful rearing of the young (Weber and Olsson, 2008).

In wild conditions, towards the end of the approximately 31 d pregnancy, the doe normally digs a short nursery burrow lined with some grass or other plant material and fur pulled from her chest and belly (Hudson *et al*., 2000). Under commercial conditions, rabbits are housed in wire cages, where the development of natural activities such as social behaviour, exploring, foraging, gnawing or nest building is impaired. Does are housed individually in standard cages and before parturition they are provided with a nest box, in which they can build the nest for their kits. Nesting in this nest box is in general an important

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activity highly performed by does, both pre- and post partum (Fernández-Carmona *et al*., 2005), and both adult wild and domestic rabbits spend a considerable part of their time in the nesting boxes (Selzer and Hoy, 2003).

This nest box consists of a plastic box in which a certain material is inserted and then the doe mixes it with its own hair. The main aim of nest construction is to protect the kits from cold during their first days, as they are very sensitive to cold and need temperatures between 30 and 35ºC. Consequently, the quality of the nest becomes crucial. Nesting material is important in several animals such as rats, mice, guinea pigs, gerbils or hamster, as well as rabbits (Baumans, 2005). In general, it is important because it helps keep the kits warm and enables the animals to create appropriate microenvironments for resting and breeding (Baumans, 2005). In addition, in rabbits in the second postnatal week the kits start nibbling at the nest material (Hudson *et al*., 2000), so all these factors have to be taken into account when choosing nesting materials. In this sense, it is considered that hay satisfies guinea pigs' need for roughage and wood sticks can be used for chewing and gnawing in guinea pigs or gerbils (Baumans, 2005), but on commercial rabbit farms, the material used usually depends on the country, the most common being hay, straw, wood shavings, wool and cotton waste or even saw dust.

Taking all these aspects into account, it seems reasonable to suppose that some materials could be more suitable than others in terms of nest temperature, ease of mixing with doe's hair or gnawing possibilities. Furthermore, it has been observed in other species that animals might have some preference for certain substrates to perform given behaviours, such as laying hens' preference for sand to dust bathe (Shields *et al*., 2004).

In this context, the aim of this work was to assess two different substrates as nesting materials and the possible preference of does for either of them.

MATERIAL AND METHODS

Eighty does from synthetic line V from the Polytechnic University of Valencia (Baselga, 2002) were subjected to natural mating and sixty of these does which were confirmed as pregnant were used in the choice test in this study in two replicates. The study was carried out in an experimental house located in Las Brujas (Uruguay) and all the animals were primiparous, so had no previous experience with any nesting material.

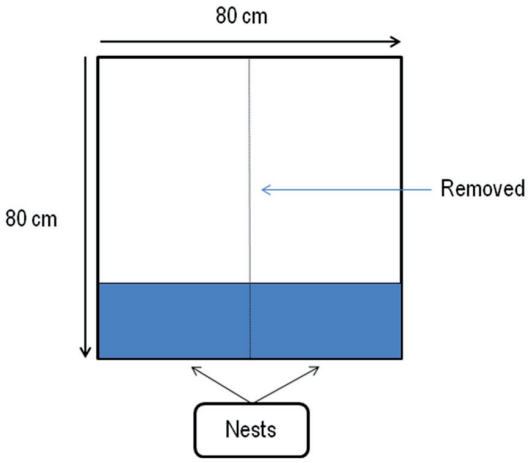

Figure 1: Experimental cage for the does with the two materials provided

The does were individually housed in commercial cages from weaning. Cage dimensions were 40 cm width×80 cm length×35 cm height, with a nest box area. Ten days before parturition, the animals were transferred to the experimental cages, which were a modification of the commercial ones. This modification consisted of placing two cages together by removing the division between the two cages, so in practice each animal had a cage of 80×80 cm and could move freely (Figure 1) and consequently had access to two nests.

Two days before parturition, the plastic nest boxes were introduced in the nest box area. In each experimental cage, one of these nests was filled with 8 cm depth of pine wood shavings and the other was filled with the same depth of barley

straw, so the animals could decide which nest they used. These materials were chosen because they are widely used in Uruguay, where there is no availability of any other material such as cotton waste, for example. Half of the straw nest boxes were located in the right side of the experimental cage, and the rest in the left part. This distribution was done randomly. Relative humidity and temperature inside the building were recorded every 30 min using a data logger (HOBO H8 RH/Temp, Onset Computer Corp., Pocasset, MA, USA).

From the introduction of the nests, their status was assessed by one observer twice daily (at 08:30 and 16:30 h, in order to assess the nest as close to parturition as possible). This consisted of measuring the nest temperature and a qualitative analysis in which were assessed: level of mixing (1: no evidence of mixing between the material and the doe's hair; 2: an important level of mixing between them; 3: almost the totality of the material was mixed), hair (1: there is no hair in the nest; 2: it is observed that more than 50% of the nest has the material visible; 3: it is observed that more than 50% of the nest has the material invisible; 4: only hair can be seen) and material, in which the preservation of the original material was assessed (1: less than 30% of the original material is kept; 2: between 30% and 60% of the original material is kept; 3: more than 60% of the original material is kept). This observation finished once delivery took place, as nest building ceases after parturition and there are no reports of does adding to or modifying the nest after this time (Hudson *et al*., 2000).

Finally, the nests in which parturition took place were assessed the day after birth and the final observation of the level of mixing, presence of hair and preservation of the original material was used for the statistical analysis, as it reflected the state of the nest in the period close to parturition. In addition, the presence/absence of faeces in the non-chosen material and the presence/absence of the non-chosen material in the nest with the litter were also assessed.

In addition, litter size and weight were recorded after parturition and the kits were individually weighed at weaning to assess the growth.

Statistical analysis

Statistical analyses were performed using SAS System 9.1 software (SAS, 2009). Those data which met the assumptions of normality and homogeneity of the error (total live born, total dead at birth, litter weight and nest temperature, litter size at weaning and mean weight at weaning) were analysed with an analysis of variance (proc glm) with the material type factor as independent variable.

Data which did not meet these assumptions were analysed with non parametric statistics. The type of litter material was compared using a binomial test (proc freq); variables "level of mixing", "hair", "material", presence of faeces and presence of the other material were analysed with a Fisher's exact test (proc freq) and the Mann-Whitney U test (proc npar1way) and the correlation between the three variables was assessed with Kendall correlation (proc corr). Furthermore, we examined whether the probability of a nest being classified in higher scores for "material", "hair" and "level of mixing" was influenced by the difference in relative humidity or nest temperature, using an ordinal logistic regression in the SAS logistic procedure (SAS, 2009). Logistic regression is expressed in terms of the logistic regression coefficient (β_i) and the odds ratio (which shows the strength of association between a predictor and the response of interest and can vary from 0 to infinity)

RESULTS

The binomial test showed that straw was used as litter material much more often than wood shavings (88.71% *vs* 11.29% respectively, $P<0.001$), and this choice was not affected by nest temperature ($\chi^2=1.1957$, $P=0.27$), environmental temperature ($\chi^2=0.6227$, $P=0.43$) or relative humidity ($\chi^2=0.0288$,

Table 1: Rabbit data at birth and weaning in the two studied nest materials.

	Straw	Wood shavings	*P*-value
Litter size	8.36±1.74	6.85±3.44	0.2421
Litter weight at birth	432.16±107.65	400.83±107.65	0.7123
Litter size at weaning	7.98±1.73	6.29±3.35	0.0343
Mean weight rabbits at weaning	701.68±152.66	685.25±129.33	0.8009

P=0.87). As regards nest temperature, means did not differ significantly (34.86±1.53 for straw and 35.13±2.16 for wood shavings), although it was influenced by relative humidity (P<0.001).

Litter size (including total live born and total dead) and litter weight at birth did not present any significant difference between the two substrates, as shown in Table 1, but litters reared in straw reached a higher size at weaning, although the mean weight of each rabbit kit was not affected by substrate type (Table 1).

Regarding the variables related to the state of the nest in the period close to parturition (level of mixing, hair and material), none resulted statistically significant (H=1.2926, 1 d.f., P=0.26; H=0.0755, 1 d.f., P=0.78; H=0.2664, 1 d.f., P=0.61, respectively). This means that both materials were mixed with does' hair and the animals did not eat or throw away either of the materials more than the other one.

On the other hand, the logistic regression analysis showed that environmental temperature, relative humidity and nest temperature had no significant influence on the "hair" and "level of mixing" variables. Nevertheless, the model for "material" was significant according to its likelihood ratio (χ^2=8.5359, P<0.05) and was affected by relative humidity (P<0.05) and nest temperature (P<0.05) in such a way that the probability of obtaining higher scores when assessing the nests increases with nest temperature (β_i=0.5232, Odds ratio=1.687) and decreases with relative humidity (β_i=−0.2295, Odds ratio=0.795).

The Kendall rank correlation coefficients (τ) between these three variables indicated that level of mixing and material are negatively correlated (τ=−0.346, P<0.01), so the more mixing between the material and the hair, the less original material there was in the nest.

Regarding the presence of the non-chosen material in the nest with the litter, Kruskal-Wallis and exact Fisher's tests showed that the differences between the two substrates were statistically significant (χ^2=27.7894, P<0.001) and the nests of rabbits who chose wood shavings had some straw in 85.71% of cases, whereas this percentage decreased to 14.29% in those animals who chose straw to give birth.

Nevertheless, no difference was found in the presence of faeces in the non-chosen substrate (χ^2=0.8194, P=0.37).

DISCUSSION

These findings show that does clearly choose straw as nesting material when they have it available compared to wood shavings. There is no literature regarding this possible preference for nesting materials in rabbits, whereas in other species such as hamsters (Lanteigne and Reebs, 2006), rats (Ras *et al*., 2002), mice (Van de Weerd *et al*., 1997) or laying hens (Kruschwitz *et al*., 2008), some works have been done.

One possible explanation for this result could be the similarity to the materials they use in wild conditions (grass and plant material according to Hudson *et al*., 2000). Another possibility could be related to the comfort of the materials, as according to Morgan and Tromborg (2007), when animals are given a choice they appear to select substrates partly for their softness. Wood shavings are also supposed to be powdery

and may be less attractive for the does. It could be interesting to determine the strength of these preferences of does through devices such as push doors, which seem to be appropriate to test nests (Kruschwitz *et al*., 2008). These preferences might be taken into account when deciding nest materials, but there may be other important points in this decision. For example, as kits urinate simultaneously and vigorously as soon as the doe leaves the nest after nursing (Hudson *et al*., 2000), the fact that nesting material absorbs the urine properly could be important.

To the best of our knowledge, the mean litter size for wood shavings is quite low, as the range of litter size at birth for this synthetic line is between 8.3 and 11.5 (Baselga, 2002). However, this could be due to the fact that the number of does whose delivery took place in wood shavings was very low and one of them had only one pup. On the other hand, the straw data are again within the theoretic range of litter size at weaning for line V (7.0-10.0 pups/litter, according to Baselga, 2002), whereas wood shavings data are lower than expected as a consequence of the lower litter size at birth. In pigs, Damn *et al*. (2005) indicated that larger amounts of straw and other nesting materials are relevant for piglet survival and growth. In rabbits, González Redondo (2010) found a higher accumulated mortality until weaning in function of the presence of straw and hair in the nest box. However, the amount of nest material provided in our study was the same for straw and wood shavings.

Apart from these facts, it was found that an increase in nest temperature implies an increase in the level of preservation of the original material and an increase in relative humidity means a decrease in the preservation. One hypothesis could be that preservation of the original material is important to maintain nest temperature, whereas the increase of relative humidity might be perceived by the does and so they may get rid of some nest material to compensate for the increase. Nevertheless, further research is needed in order to identify the reasons of these findings.

As was observed, "level of mixing" and material were negatively correlated, but this may be considered an artificial result, because when the better the material is mixed with hair, the more difficult it becomes to see the original material inside the nest, so it may be assessed as not present, whereas the material is actually in the nest but cannot be properly seen.

On the other hand, and as pointed out in results, 85.71% of the does whose delivery took place in wood shavings transferred some straw to build their nests. This result could indicate that they use available materials to improve the quality of the nests as occurs with hamsters, which transfer some wood shavings to other nest materials for this purpose (Lanteigne and Reebs, 2006). At the same time, it was found that does defecated in the nest indistinctly in both materials, and it is common that they do so before and several days after parturition (Hudson *et al*., 2000). In this sense, the kits may eat their mother's faecal pellets but also nest materials, and this might have functional values on gut flora (Hudson *et al*., 2000), so it could be interesting to compare gut flora of kits raised with different types of nest material.

CONCLUSIONS

According to all these findings, it may be concluded that does choose straw as nesting material, when they have this option, more than wood shavings. These results should be carefully studied and the strength of preference assessed, in order to assess the importance of nest material for these animals. In addition, measured environmental parameters have an impact on the preservation of the original material in the nest, so their causes and consequences should be assessed in depth, as there is no information available in this regard.

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