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Effect of different bedding materials on the performance of rats

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Abstract

Bedding and nesting material provided in cages for laboratory rats has important consequences on welfare, directly through the comfort and utility in behaviour such as nest building, and indirectly through properties such as air quality. A study was conducted at Small Animal House, Veterinary College, Bangalore to find out effect of different bedding materials on the reproductive performance of laboratory rats. Thirty Wistar female rats were divided into three groups and subjected to the different bedding material used – paddy husk (PH), corncob (CC) and wood shavings (WS). Litter size and litter weight were recorded at birth and at weaning (day 21). Bedding material significantly ($P<0.05$) influenced litter size at birth, where it was significantly higher in WS (8.06±0.31) and PH (8.03±0.31) than in CC (6.8±0.3). Litter weight was higher in WS at all times, though not significantly ($P>0.05$) different from the other groups. The results indicate that wood shavings and corncob may be suitably used as alternative to other bedding materials for laboratory rats.

Key words: Rat, Litter size, Litter weight, Paddy husk, Corncob, Wood shavings

Introduction

The use of laboratory animals in scientific studies is a global practice and one that continues to generate considerable public concern. The rat is commonly used laboratory mammal next to mouse and amounts to approximately 20% of the total number of mammals used for scientific research purpose. The regular provision of the sterile bedding material to the laboratory animal is the standard laboratory animal husbandry procedure. The bedding material provided in cages for laboratory rats has important consequences on welfare, indirectly through properties such as air quality, and directly through providing a comfortable resting surface and opportunities for behaviors such as digging, chewing and nest building (Boyd, 1988). Studies have reported the adverse effect on health and reproduction by using the wrong bedding materials including microbial contamination. Bedding materials can influence litter size, lactation and number of offspring weaned (Norris and Adams, 1976). Burkhart and Robison (1978) reported increased mortality with use of cedar wood shavings due to presence of a constituent of cedar, possibly one of the volatile hydrocarbons, which acts as a toxin via the dam. In most of the laboratory animal facilities, corncob and paddy husk are used as bedding materials to provide comfort for laboratory rats. Because of the increased cost of the bedding materials there is a need to find alternatives to conventionally used bedding materials. Wood shavings and coconut coir are being used as a substitute for paddy husk in poultry sector but not in laboratory animals. Wood shavings have been used and recommended for other bedding materials (Krohn and Hansen,2008). No reports of using wood shavings as a bedding material in Indian literature could be found. Therefore the present study was undertaken forcomparing performance of laboratory rats on paddy husk, corncob and wood shavings as bedding materials.

Materials and methods

An investigation was carried out to evaluate the effect of different bedding materials on the reproductive performance of laboratory rats. The experiment was carried out at Small Animal House, Department of Livestock Production and Management, Veterinary College, KVAFSU, Bangalore. The experiment comprised comparing performance of laboratory rats reared on paddy husk, corncob and wood shavings as bedding materials.

Experimental design

The study was conducted in a switch over design with three treatments and three periods (each period was of 60 days). The treatment includes three bedding materials paddy husk (PH-T1), corncob (CC-T2) and wood shavings (WS-T3). The total number of animals used in study was 30 rats. The rats were selected and divided into three groups of similar body weight. The three treatments were allotted to three groups at random. All the animals are procured from Small Animal House, Department of Livestock Production and Management, Veterinary College, KVAFSU, Bangalore. Individual rats were identified by ear notching.

Housing and management of rats

The animal room was fumigated with 1:2 concentrations of the potassium permanganate and formalin. Rats were housed in individual, polypropylene solid bottom cages measuring 28 x 21 x 13 cm (L x B x H) size. During breeding, male and females in the ratio of 1: 3 were housed in large polypropylene solid bottom cages measuring 39 x 27 x 14 cm (L x B x H) size. All the animals had free access to clean water and *ad lib* pelletfeed. The standard housing condition for breeding colonies was maintained throughout the experiment period. The waterers were cleaned once in two days and bedding was changed once in three days.

Experimental procedure

All the experimental procedure was followed as per the ethical guidelines and necessary approval was taken from institutional animal ethics committee (IAEC). All the female rats were exposed to all the three T1, T2 and T3 treatments. Throughout the experiment the males were kept constant. Polygamous type of breeding was followed, where one male was allowed to matethree females. The animals in oestrous were identified based on vaginal smear technique, where the animals in oestrous were identified by presence of cornified epithelial cells. During breeding, the females were shifted to the male's cage and allowed to stay there till the pregnancy was confirmed. The pregnancy was confirmed by the enlargement of abdomen, increased body weight and by abdominal palpation where foetus was felt around fifteen to eighteenth day and thereafter the pregnant animals were shifted to the individual cages. The animals were allowed to breed, parturate and to nurse in the same type of bedding materials. For each animal, three litter's data, a total of 90 litter's data was recorded.

Parameters studied during the experiment

Litter size and litter weight at birth

Litter size was determined by counting of individual pup at the time of birth. The data of litter size at birth in each treatment was recorded. After each litter, weight of the litter were recorded and expressed in grams (g). The Litter weight at birth of each treatment of rats was maintained individually till the end of the experiment.

Litter size, litter weight and mortality at weaning

Litter size at weaning was determined by individual counting of pups after weaning. Pups were weaned at 21 days in all treatment groups. At weaning, weight of litter was expressed in grams (g). The litter weights at weaning of each treatment group were maintained individually till completion of the experiment. Mortality rate of pups was recorded up to weaning.

Mortality percentage was determined as follows:

$$\text{Mortality (\%)} = \frac{\text{Number of pups died}}{\text{Total Numbers of live pups born}} \times 100$$

Results

Litter size at birth (LSB) and Litter size at weaning (LSW)

The average LSB in the three littering is presented in Table 1. A total of 687 pups were born during the experimental study. The total number of pups at birth from three littering was 241, 204, 242 and average LSB was 8.03±0.31, 6.80±0.3 and 8.06±0.31 for PH, CC and WS, respectively. The LSB in WS and PH was significantly higher ($P < 0.05$) than CC.

The average LSW from three littering is presented in Table 1. A total of 665 pups were weaned. The total number of pups at weaning from PH, CC and WS was 234, 196 and 235, respectively. The average LSW was 7.8±0.31, 6.5±0.26 and 7.8±0.33 for PH, CC and WS respectively. The highest litter size at weaning was recorded in WS and PH group which was significantly different ($P<0.05$) than CC.

In the present study results revealed significantly ($P<0.05$) larger litter size at birth and at weaning in PH and WS groups compared to CC group. No significant difference ($P<0.05$) in litter size was observed in PH group when compared with WS group.

Litter weight at birth (LWB)and Litter weight at weaning (LWW)

The average LWB (g) from three littering is depicted in Table 1.Average LWB in PH, CC and WS, was 37.83±1.32, 35.10±1.61 and 37.87±1.41 respectively. There was no significant difference (P>0.05) in LWB among the treatment groups.

The average LWW (g) of PH, CC and WS is shown in Table 1.Average litter weight at weaning in three littering from PH, CC and WS was 133.83±4.12, 138.37±6.38and 143.6±4.24(g) respectively. There was no significant difference (P>0.05) with LWW in all the groups.

The average litter weight (g) at birth in three litterings was 37.83±1.32, 35.10±1.61 and 37.87±1.41, and average pup weight (g) was 4.71, 5.1 and 4.69, and average litter weight at weaning (g) in three litter was 133.83±4.12, 138.37±6.38and 143.6±4.24(g), and average pup weight (g) at weaning was 21.2, 17.15 and 17.87 for PH, CC and WS, respectively. There was no significant difference (P>0.05) in litter weight at birth and weaning among the treatment groups.

Mortality of pups

The percentage mortality of pups at weaning in different treatment groups is presented in Table 2. The per cent of mortality of pups was 2.90, 3.92 and 2.89 for PH, CC and WS, respectively. In the present study low mortality was recorded with wood shavings with 2.89% when compared to 3.92% on corncob bedding materials.

Discussion

The average litter size at birth and weaning in PH and WS was significantly (P<0.05) high compared to CC group. In the present study, the highest litter size was recorded from rats housed on wood shavings as a bedding material, which may be due to favorable environment for rats.

The results are in contrast to the results obtained by Burkhart and Robinson (1978) where they conducted a study on Sprague dawley rats housed on crushed corncobs and cedar wood shavings where they reported that on corncob bedding the average litter size at birth was 9.4 and at weaning 9.2, whereas on cedar wood shavings the litter size at birth was 12 and at weaning 5. The litter size was high at birth on wood shavings and corncob and low on wood shavings at weaning when compared to results obtained in present study. This variation may be because of different strain was used in the study.

Potgieter and Wilke (1997) conducted a study on AKR strain of mice housed on wood shavings and the average litter size at birth was 6±2.66 and at weaning 5.29±1.80. However the results obtained from present study was higher both at birth 8.06±0.31 and at weaning 7.8±0.33 with wood shavings as the bedding material.

Mulder (1975) studied the litter size at birth in Swiss mice housed on wood shavings and corncob bedding materials where litter size on wood shavings was 7.8 and 10 on corncob bedding materials, which was lower with wood shavings but higher with corncob than the results obtained in present study. Burkhart and Robinson (1978) conducted a study on Sprague dawley rats housed on crushed corncobs and cedar wood shavings where they reported that on corncob bedding the average pup weight(g) at birth was 6.5±0.5 and at weaning 45±8.0, and on cedar wood shavings at birth 6.4±0.4 and at weaning 37±10. The pup weight was more at birth and at weaning when compared to results obtained in the present study. This may be because of difference in the body weight of SpragueDawley rats and Wistar albino rats.

The mortality in pups is in contrast to the findings of Burkhart and Robinson (1978) with Sprague Dawley rats housed on crushed corncobs and cedar wood shavings where it was 3% and 60% respectively. This was due to ingestion or inhalation of compound which was toxic to them from cedar wood shavings, but in present study cedar wood shavings was not used.

It can be concluded from present study that the type of bedding materials used for housing of rat breeding colonies can influence on litter size at birth and weaning, where as it does not play a role in respect to weight of the litter at birth and weaning. In rat breeding facilities wood shavings and paddy husk may be used as a preferred bedding material where it may favor and facilitate larger litter size.

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Table 1:Average litter size and weight (g) at birth and weaning on different bedding materials (Mean±SE)

Parameters	PH	CC	WS
Average litter size at birth	8.0^{a}±0.30	6.8^{b}±0.29	8.0^{a}±0.31
Average litter size at weaning	7.8^{a}±0.31	6.5^{b}±0.26	7.8^{a}±0.33
Average litter weight (g) at birth	37.8^{a} ±1.3	35.1^{a} ±1.6	37.8^{a} ±1.4
Average litter weight (g) at weaning	133. 8^{a} ±4.12	138.4^{a} ±6.38	143.6^{a} ±4.24

(PH-Paddy husk, CC- Corncob, WS- Wood shavings)

Note: N=30,Mean values bearing different superscripts differ significantly (P< 0.05)

Table 2 : Mortality percentage of pups up to weaning in three litters on different bedding materials

Parameters	PH	CC	WS
Number of pups at birth	241	204	242
Number of pups at weaning	234	196	235
percentage of survivability	97.09	96.07	97.10
Percentage of mortality	2.90	3.92	2.89

(PH-Paddy husk, CC- Corncob, WS- Wood shavings)