EFFECT OF ENVIRONMENTAL ENRICHMENT ON BEHAVIOUR, PERFORMANCE AND WELFARE OF NEWZEALAND RABBITS

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ABSTRACT

Ten males and ten females white NewZealand rabbits approximately 4 months of age were divided into two equal groups five males and five females were housed separately in conventional cages (50 - 80 - 40 cm) and five males and five females were housed in enriched cages (50 - 80 - 40 cm) at the back 40 cm of the cage were raised to 80 cm in 'height and a box of (50 - 25 - 20 cm) made of wood with a roof perforated plastic like in the bottom plate was inserted to study the effect of environmental enrichment on behaviour, performance and welfare of rabbits .

Results showed that, ra bbits kept in the conventional cage system especially the females showed more restlessness, excessive grooming , bar-gnawing and timidity than rabbits kept in the enriched cage system , this indicates increased stress in the rabbits kept in the conventional cage system. Only few rabbits particularly the females ,used the box as a shelter or resting place. On the other hand, they more often used the roof of the box as a resting place. Also the rabbits using the raised height in the enriched cage system. The results indicate that rabbits kept in an enriched cage system particularly the females had better welfare and performance than rabbits kept in the conventional cage system which might be due to they had an access to shelter and a better chance of interacting and copy with the environment.

INTRODUCTION

Rabbits which kept individually in small barren cages with a restricted amount of food and water often show different types of abnormal behaviour as wire gnawing, hopping back, excessive fur liking, eating the fur, pawing against the cage wall, playing with water nipple etc. **(Laboratory animales,1993 Gunn,1994)**. They have also been found to develop osteoporosis of the femur **(Lehmann, 1984)** and intestinal disordars **(Jackson, 1991)**. The major cause is probably that the cages were too small to give the rabbit enough space to move around **(Stauffacher,**

1992). Efforts have been made to improve the housing of laboratory rabbits by placing groups of females in floor pens **(Love,1994)** and by keeping breeding females with a male **(Stauffacher, 1992)**. Male rabbits are difficult to be kept in groups and probably also in pairs because at the time of sexual maturity they become aggressive and often attack each other **(Harkness and Wagner, 1989)**. The behaviour and physiological states of an animal are influenced by the environment, the content and construction of the cage, space available, social contact ,food and physiological conditions are all important factors and their handling and genetices may also play apart **(Fox, 1986)** . The rabbit is a social animal and is able to utilize complex environment so housing in cage will hardly satisfy many of its behavioural needs **(Love,1994)**. The temporal structure of their behaviour can be disruhted if the feed back from behaviour is not optimal because of the environmental limitations on the full expression of the behavioural reportric i.e changing behaviour more frequently **(Metz, 1987)** and showing several kinds of abnormal behaviour as bar biting , excessive grooming and sterotypic activities **(Love, 1994)**. However ,barren cages systems can be enriched by stimuli that will elicit patterns of behaviour that are otherwise limited by these systems . The effect of stressors in the environment may also be mitigated, but the enrichment e.g. aceess to a shelter ean have different effects depending of the species **(Jeppsen and Pedersen, 1991)**. **Lehmann (1987)** found that caged rabbits with no chance of scape or to hide were more restlessness than rabbits with hidding place .. The height of the cage is an important parameter since in the wild a vigilant rabbit will sit on its hind legs with ears pricked (lookout position) and in addition utilize natural rises **(Gibb ,1993)**. Domesticated rabbits will climb into objects for instance a shelf or a nest box , to explore and rest if that is possible **(Whary et. al, 1993)** .

The aim of this work was to investigate the behaviour, performance, welfare and utilization of the cage by rabbit kept in enriched cages with access to shelter and raised height at the back compared to conventional cages.

MATERIALS AND METHODS

This work was carried out in a rabbit farm of Faculty of Veterinary Medicine Zagazig University, in the period of the 1st of October to the end of December 2000. Ten males and 10 females NewZealand white rabbits approximately at the age of 4 months were housed separately, five males and five females were housed in coventional cages (wire cage measuring 50 X 80 X 40cm). with a food hopper, a water bottle and a brick of wood attached to the front of the cage, on the gride floor a perforated plate of plastic was placed to avoid leg injuries, the plate coverd the entire floor except for approximately 20 cm at the front of the cage to prevent the drinking water

from pooling. While the other five males and five females were housed in ten enriched cages (had the same construction except at the back, 40cm of the cage was raised to be 80cm in height and a box of 50 X 25 X 20cm made of wood with a roof of perforated plastic like in the bottom was inserted).

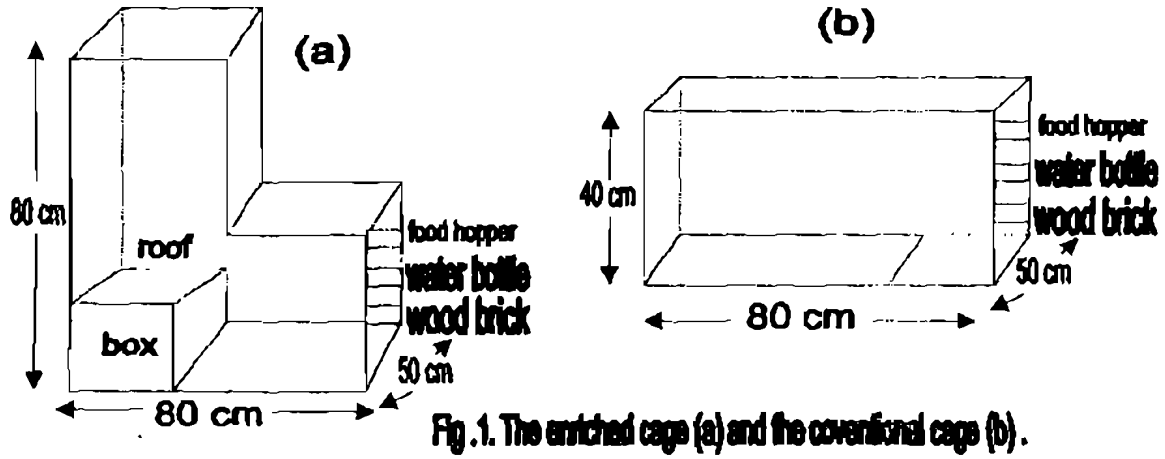

Fig.1. The enriched cage (a) and the conventional cage (b).

Rabbits were given a balaneed pelleted rabbit ration and water adlibitum in addition to green food (berseem). Ambient temperature was varied between 20-25°C during the experiement. The light duration was continuous for 13 hours during night. The house was well ventillated through 4 windows distributed allover the building with 3 electric rotating fans and two exhaustion fans which allowed proper air circulation in the building The rabbits were given aprotective doses of viral vaccine and the other protective medicine. Behavioural observations (**Gunn and Morton, 1995**) using of foeal sample technique (**Altmann, 1974**), each animal sample was observed for 10 minutes every two hours for 4 periods daily and 3 times weekly for each group .

- The following parameters were observed and recorded in minutes

active head :- the rabbit sniffing the surroundings with the movement of the head and /or fore limbs, the hind limbs staying at the same place.

Active other :- It is divided into four variations .

Active side to side :- movement of the fore limbs from side to side, the hind limbs stay at the same place .

Active circle :- hopping in circle around itself.

Active quickly :- quickly running around in the cage.

Parallel running :- two rabbits running parallel with elevated gait and tail erect .

Ambulate :- forward movement achieved by alternate extension of fore limbs and hind limbs .

Ingestion :- eating rabbit pellets from the hopper.

Gnawing :- gnawing of the rabbit immediate environment such as bars, wooden brick box and plastic plate occasionally interrupted by rapid scratching with the fore legs .

Gromming :- licking , scratching or nibbling of the body .

Lying :- resting with the trunk on the ground, hind limbs tucked under the body, the fore legs laying under the body or stretched forward from the body .

Lying stretched :- resting with the body trunk on ground , hind limbs out stretched and belly exposed .

Bounding :- moving upwards or forwards with all feet from floor this can be accompanied by sideward or up ward swinging of the ears .

Freezing :- the fore legs are forward, the hind legs staying in the place and the heels are visible behind the body.

Marking :- ean be performed into two ways.

Chin marking :- rubbing the chin over the objects .

Urine squirt :- with hind limbs typically extended and tail erect , the rabbit squirts a short jet of urine out behind.

Rearing :- standing /sitting on hind limbs with both for paws off the ground .

Sitting :- rear and fore paws on ground with the fore limbs straight, the thorax & abdomen clear of the floor &visible ears down or erect .

The rabbits were individually weighed (gm) monthly from4th month, daily body gain(gm), feed conversion (gm feed/gm body weight gain), and viability %) were calculated.

The statistical analysis was carried out according to **Snedecor and Cochran, (1982).**

RESULTS AND DISCUSSION

Results in Table (1) showed that, the rabbit in the enriched cage system performed the behavioural patterns active head and rearing with longer duration ($p<0.05$) while these had the shorter duration of active other ($p<0.01$), ambulate ($p<0.01$) and grooming ($p<.05$). There were no significant difference between the two eage systems for the other behavioural patterns.

Results in Table (2) revealed that, rabbits in the enriched cage system performed the behaviours grooming, lying and rearing more frequently ($p<0.01$) while active head, active other, ambulate, gnawing, lying stretched and sitting were less frequently compared with rabbits kept in the conventional cages.

These results are in agreement with **Lehmann (1987)** who found an increase in number of activity changes/hour in cages compared with rabbits housed under semi-natural and this was interpreted as restlessness. Animal is designated restless when it does not complete ongoing activities and this is a behavioural sign of increased stress in the animal. These results, therefore, indicate that rabbits in the conventional cage system seemed to be more easily affected by the environment

Rabbits kept in the conventional cage performed the behavioural patterns ambulate with longest duration. The difference could also be caused by rabbits being kept in a more restricted enriched cage system, as they would be limited in the performance of continuous jumps. The frequency of ambulation was less in enriched than in the conventional. These differences are probably caused by the lack of the space in both cage systems were often observed sitting for a longer time duration during a disturbance, compared with rabbits kept in the enriched system that appear to calm down more frequently to rest .There was no sign of apathy in any of the cage systems **(Gunn and Morton, 1995)**.

Rabbits in both systems spent much of their time in grooming the fur . In studies of wild rabbits grooming made up 2% of their active period **(Gibb, 1993)** and in 24 hours recording of the rabbits behaviour **(Mykytwoycz and Fullagar, 1973)** this was much lower than this study (time 18% enriched cages and conventional 20%) when grooming is performed in short sequences it can be a displacement activity caused by disturbance **(Guild and Dunn, 1982; Gunn and Morton, 1995)**. The excessive grooming in both cage systems can indicate an under stimulation from environment or as **Gunn and Morton (1995)** suggest social deprivation is the cause. This further confirmed by another experiment where grooming activity decreased significantly when the rabbits had access to hay **(Barthelsen and Hansen, 1999)** The behaviour active other included activity that resembled the parallel running that is seen in wild rabbits, territorial behaviour and activity with repeated movements (active side to side) as a stereotype. There was no difference in the frequency of marking and therefore it is unlikely that, there should be a difference in parallel running between the two cage systems. Because of there were other indications of increased stress in rabbits kept in the conventional system, it is possible that the higher frequency of the behaviour (active other) can be explained as stereotypic behaviour .

Results in table (3) showed that , female rabbits in the conventional cages performed the behavioural patterns grooming, gnawing, standing rear and sitting rear with longer duration ($p<0.01$) than the males and both sexes in enriched cages. There were no significant differnces in other behavioural patternes between males and females in both systems.

Regarding frequency there were no significant differnces in all behavioural patternes between

males and females .

Females performed more sitting, rear and standing rear , the letter being performed most frequently in the conventional cage system and so it seems that their exploring especially the females were not a territorial behaviour, but more a searchfore escape . Females also had a higher number of gnawing at the bars mainly observed in the conventional cage system. This behaviour was performed in a continuous and repetitive (a stereotypic) manner and that kind of behaviour is often characterised as an abnormal behaviour **(Lidfors, 1997)**.

This can be totally indicate that the females were more affected by the environment and therefore had more difficulties in coping with the environment . In this study the females were more often stayed in the box than the males and in the wild females stay more often in burrows than the males as found by **Kolb, (1994)**.

The fact that the females showed more timidity and more gnawing in the conventional cage system could indicate that, particularly, females in the enriched cage system had need fulfilled by having access to a hide. The box can therefore a potential flight possibility contribute to improved welfare of the rabbits. Sudden disturbances often caused rabbits to jump up on the roof of the box and rear. It seems to give the advantage of being able to survey the surroundings.

Rabbits in the enriched cage system performed rearing significantly more than the rabbits in the conventional cage system (Table1) and it was furthermore observed several times than that the rabbits utilised the full height in the enriched cage by standing upright. The possibility of stretching out to full height may also, presumably, reduce the incidence of skeleton abnormalities and strengthen the bones of the rabbits in the longer term **(Drescher, 1992)**.

Results in Table (4) showed that, high performance of NewZealand white rabbit (high body weight, daily body gain and food conversion) in enriched cages comparing to rabbits in conventional cages, while daily feed consumption was more in conventional cages comparing to enriched cages, mean while the viability % was the same. This may be attributed to that, conventional cages causing increased number of activity changes per hour leading to increase restlessness which causing the rabbits unable or they do not complete ongoing activities and this is a behavioural signs of increased stress, in this condition they were unable to copy with their environment.

CONCLUSION

Animal needs can changed according to its age, learning, diurenal rhythm, season and genetic relations. Environmental enrichments must consider the needs of animals to avoid creating

despite good intentions, more problems for the animal.

This work indicates that, the enriched environment fulfilled a need for the rabbit .

Environmental enrichment can reduce abnormal activity, timidity and disruption of behavioural elements. Rabbits kept in conventional cage system, espeeially the females, had more excessive grooming, gnawing bars, changed behaviour more often and showed a higher degree of timidity.

This indicates difficulties in coping with the environment and considered as behavioural signs of stress in the animales so, access to shelter and possibility to attend the environments should be considered as environmental enrichments in the attempts to improve the wellare and performance of rabbits.

Table 1 : Mean duration (min±S.E.) of behavioural pattern of rabbit in conventional and enriched environmental cages.

Behavioural patterns	Mean duration (min ± S.E.)	
	Enriched	Conventional
Active head	530 ± 5.2*	50.2 ± 3.6
Active other	1.5 ± 0.5	3.5 ± 1.2**
Ambulate	22 ± 2.5	41.1 ± 4.5**
Ingestion	165.2 ± 6.2	161.5 ± 4.2
Gnawing	27.2 ± 4.2	42.7 ± 7.5
Grooming	262 ± 10.5[1]	290 ± 9.5*[2]
Lying	625.2 ± 22	602.8 ± 13.5
Lying stretching	120.2 ± 20.6	85 ± 15.4
Marking	14.3 ± 3.2	25 ± 11.2
Rearing	3.5 ± 0.8*	0.3 ± 0.2
Sitting	141.1 ± 10.2	151.2 ± 10.8

* Significant at $p < 0.05$ 1 = percentage of time spent in grooming in enriched cages 18 %.

** Significant at $p < 0.0$ 2 = percentage of time spent in grooming in covenional cages 20 %.

Table 2 : Mean frequency of behavioural patterns of rabbit in conventional and enriched environmental cages .

Behevioural patterns	Frequency (number ± S.E)	
	Enriched	Conventional
Active head	2.8 ± 0.2	3.2 ± 0.1
Active other	0.2 ± 0.1	0.2 ± 0.1**
Ambulate	2.2 ± 0.2	0.3 ± 0.2**
Ingestion	13 ± 0.2	13.8 ± 0.3**
Gnawing	4.2 ± 0.2	4.5 ± 0.2
Grooming	8.5 ± 0.5	7 ± 0.3**
Lying	10.6 ± 0.3	7.5 ± 0.3
Lying stretching	8.1 ± 0.2	9.6 ± 0.3**
Marking	0.2 ± 0.03	0.2 ± 0.1
Rearing	0.2 ± 0.03	0.1 ± 0.02
Sitting	5.6 ± 0.2	6.5 ± 0.2**

** Significant at $p < 0.01$

Table 3 : Mean duration (min. ± S.E.) and frequency (number ± S.E) per rabbit of both sexes in enriched and conventional cages.

Behavioural patterns	Enriched		Conventional	
	Males	Females	Males	Females
Duration				
Active head	52 ± 4.5	50 ± 4.6	49.2 ± 3.4	48 ± 3.2
Ambulate	21 ± 2.3	20 ± 2.2	19 ± 1.8	18 ± 1.6
Grooming	2.1 ± 0.1	3.4 ± 0.2	3.2 ± 0.2	4.5 ± 0.15**
Gnawing	7.2 ± 0.2	7.8 ± 0.3	7.3 ± 0.2	9.0 ± 0.3**
Paw scraping	2.3 ± 0.8	1.5 ± 0.1	2.2 ± 1.7	1.3 ± 0.3
Sitting	90 ± 6.0	80 ± 5.4	75 ± 4.5	81 ± 5.6
Sitting rear	13.6 ± 1.1	18.1 ± 1.5	14.2 ± 1.2	19.2 ± 1.2**
Standing rear	35.1 ± 2.1	38.2 ± 2.4	36.5 ± 2.1	44.1 ± 2.2**
Frequency				
Bounding	2.3 ± 0.2	2.1 ± 0.2	2.3 ± 0.3	1.2 ± 0.1
Defecation	5.6 ± 0.3	4.7 ± 0.3	5 ± 0.4	3.2 ± 0.2
Marking	11.3 ± 1.2	14 ± 1.6	15 ± 1.7	14 ± 1.1
Thumping	0.1 ± 0.09	0.1 ± 0.09	0.1 ± 0.01	0.2 ± 0.09
Urination	0.6 ± 0.1	0.5 ± 0.1	0.5 ± 0.1	0.7 ± 0.1

** Significant at $p < 0.01$

Table 4 : The difference in performance of rabbits in conventional and enriched cages .

Age	Items	Enriched	Conventional
4 months	Body weight (gm)	2690.63 ± 46.75	2420.61 ± 44.95
	Daily body gain (gm)	22.5 ± 1.03	17.94 ± 1.10
	Daily feed consumption	120.18 ± 9.42	130.32 ± 15.65
	Feed conversion	5	6.5
	Viability %	100	100
5 months	Body weight (gm)	3350.85 ± 50.20	2960.55 ± 48.50
	Daily body gain (gm)	15.5 ± 0.93	12.60 ± 0.85
	Daily feed consumption	115.50 ± 8.43	120.15 ± 9.40
	Feed conversion	7.45	9.53
	Viability %	100	100
6 months	Body weight (gm)	3815.65 ± 55.2	3368.55 ± 52.20
	Daily body gain (gm)	12.3 ± 0.83	10.80 ± 0.71
	Daily feed consumption	110.5 ± 7.75	115.50 ± 8.30
	Feed conversion	8.98	10.69
	Viability %	100	100
7 months	Body weight (gm)	4184.65 ± 58.3	3692.55 ± 5
	Daily body gain (gm)	10.5 ± 0.65	8.5 ± 0.60
	Daily feed consumption	105.50 ± 6.90	110.3 ± 7.55
	Feed conversion	10.04	12.97
	Viability %	100	100

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الملخص العربى

تأثير إسكان الأرانب فى أقفاص غير تقليدية على كفاءة سلوكيات ورفاهية الأرانب النيوزيلندى

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أجريت هذه التجربة لدراسة تأثير إسكان الأرانب فى أقفاص غير تقليدية على كفاءة، سلوكيات ورفاهية الأرانب النيوزيلندى.

إستخدم فى التجربة عشرة ذكور، عشرة إناث من سلالة النيوزلندى الأبيض عمرها أربعة شهور تقريباً.

قسمت الأرانب إلى مجموعتين متساويين كل مجموعة تحتوى على ٥ ذكور، ٥ إناث، أسكنت المجموعة الأولى فى أقفاص تقليدية حجمها ٥٠ × ٨٠ × ٤٠سم، أسكنت المجموعة الثانية فى أقفاص غير تقليدية حجمها ٥٠ × ٨٠ × ٤٠سم بزيادة الجزء الخلفى ليصبح ٨٠سم بدلاً من ٤٠سم ووجود صندوق خشبى حجمه ٥×٥×٢٠سم يحتوى على سقف به ثقوب من البلاستيك فى القاع.

أوضحت النتائج : أن الأرانب التى سكنت فى الأقفاص التقليدية وخصاصاً الإناث أظهرت زيادة فى سلوك عدم الراحة والتطمير ولحس القضبان والجبن على خلاف الأرانب التى سكنت الأقفاص الغير تقليدية ودل ذلك على زيادة الإجهاد فى الأرانب التى سكنت فى الأقفاص التقليدية.

أظهرت النتائج أيضاً : أن عدد قليل من الأرانب خاصة الإناث أستخدمت الصندوق الخشبى كواقى أو مكان للراحة وكذلك سقف الصندوق كمكان للراحة أيضا، والجزء العلوى من القفص، وأن الأرانب المرباه فى أقفاص غير تقليدية أظهرت كفاءة ورفاهية عن مثيلتها المرباه فى الأقفاص التقليدية لزيادة فرصتها للوصول إلى الغطاء والتفاعل ومحاكاة البيئة.