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Behavior and Performance of Growing Rabbit under Various Floor Types

[1]Rashed R. Rashed and [2]M.A. El-Edel

[1]Department of Animal Husbandry and Animal Wealth Development,
Faculty of Veterinary Medicine Alexandria University, Edfina, Egypt
[2]Department of Animal Husbandry and Animal Wealth Development,
Faculty of Veterinary Medicine Damanhur University, Egypt

Abstract: The aim of this research was to assess the effect of floor type (plastic, wire or combination) on behavior, productive performance and the preference test as a welfare indicator for growing rabbits. A five weeks old fryers (n=108) of White V-line rabbits were randomly allocated into three groups with three replicates; the first group reared on wire floor, the second reared on plastic one while, the third group reared on combination floor using swing doors for preference test. Infrared video recording was performed once a week for behavior observations and the number of animals in each partition of the third group was counted every 30 minutes (48 times / day) for preference test. The feeding behavior was significantly higher in rabbits reared on combination floor than others. Significant differences were observed among all groups in drinking behavior 2.84%, 3.70% and 2.51% (wire, plastic and combination floor; respectively). Resting was significantly higher in rabbits reared on wire floor. Plastic alone or in combination with wire significantly increased walking, running, body care and exploration behaviors than those reared on wire. Higher preference to the plastic floor (55.4%) than wire one (44.6%) was found and it was increased at night. Body weights at 7th, 8th and 10th week for the group reared on plastic floor was significantly higher (955.63±45.05, 1275.52±60.81 and 1748.21±49.31g; respectively) than those of wire or combination floor. Daily weight gain (DWG) was significantly higher at periods from 42-49 days and 49-56 days for fryers reared on plastic floor (37.12±4.65 and 47.14±4.12 g) than others. Relative growth rate (RGR) was significantly higher for plastic floor than other groups at period of 56-63 day (14.36±2.46) and the overall RGR (111.47±2.15). It could be concluded that presence of plastic net floor increased welfare and productivity of V-line rabbits.

Key words: Rabbits · Floor · Plastic · Wire · Behavior · Productive Performance

INTRODUCTION

The welfare of farmed rabbit depends mainly on the housing conditions created by people. The ancestor of the domesticated rabbit, the European wild rabbit (*Oryctolagus cuniculus*), is a crepuscular animal and is mainly active during the dusk, night and dawn [1]. During the night, the European wild rabbit stay mostly outside the rabbit hole. Being a prey-animal its chances to escape from predators is higher during the night. The domesticated rabbit shows similar behavior if kept similarly to the ancestor. However, if the rabbits are housed in cages the behavioral patterns are changed considerably from the view point of their activity due to a limited floor space [2 - 4]. Floor type in rabbits did not affect any behavioral patterns (eating, drinking, resting, comfort, social and investigatory) significantly, however the growing rabbits have a preference for plastic net floor [5].

Nowadays, animal welfare raises interest worldwide. From the viewpoint of animal welfare, some authors consider the wire net floor unfavorable, however in large rabbit farms, cages are made almost exclusively from wire net. The wire net floor is easy to clean, cheap and it also meets hygienic requirements. Rabbits spent lower resting time in wire net floor compared to other floor type [3]. From the behavioral point of view there was no difference between floors of wire net or slats with galvanized steel

Corresponding Author: Rashed R. Rashed, Department of Animal Husbandry and Animal Wealth Development, Faculty of Veterinary Medicine Alexandria University, Behira, Rashid, 22758 Edfina, Egypt.
E-mail: eledel_m@yahoo.com.

bars, thus indicating the similar degree of comfort of both floors [6]. The growing rabbits prefer the plastic net but with the increasing of age and / or weight they accept wire net and plastic slat floor [7]. Under the free choice most rabbit choice was wire net than deep litter [8, 9]. Thus the analysis of the effect of floors type in animal welfare is justified. Rabbits preferred the plastic-mesh compared to wire-mesh floor, in both the active and in resting periods [5]. Final body weight of rabbits housed on deep-litter was 8% lower than rabbits housed on wire-mesh [8]. No differences in body weight, weight gain and slaughter performance of rabbits housed on plastic- or wire-mesh floors [10]. Body weights of rabbits between the ages of 7 and 10 weeks were significantly higher in the group on wire-mesh and plastic- mesh compared to the rabbits on deep-litter. However the twelve weeks-old rabbits showed no significant differences among the groups. The body weights of rabbits between the ages of 7 to 10 weeks were significantly higher in the group on wire-mesh and plastic- mesh compared to the rabbits on deep-litter [11]. Cage floor type had no significant effect on the final body weight but, daily weight gain (at 6-7 weeks of age) for rabbits reared in cages with wire mesh floor was significantly higher than those reared in cages with plastic and rubber mat floor [12]. At lower temperature, most rabbits preferred staying on plastic-mesh; however at medium and higher temperature more rabbits chose the wire-mesh floor during the final period of fattening [11]. Feed intake at 5 to 8 weeks of age was significantly higher in rabbits reared in cages with wire mesh floor than other types of cage floor, while between weeks 9 -11 the feed intake was similar in the three groups. In age of 7 to 8 weeks, the feed intake of rabbits was greater in groups of wire and rubber floor than the groups of plastic floor. No differences were observed among the three groups in feed conversion efficiency throughout the experimental period [12].

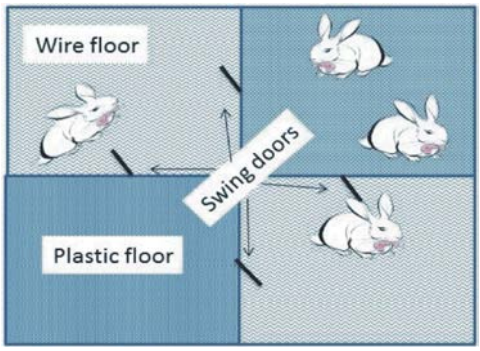
Concerning the effect of cage floor type on rabbit behavior and productive performance only a few papers have been published. The object of this study was to investigate the effect of cage floor type (wire, plastic net or their combination) on different behavioral patterns, productive performance and the preference of growing rabbits to different floor types.

MATERIALS AND METHODS

This experiment was carried out in a private rabbit farm, Alexandria province, Egypt, during the period from April to June 2014.

Animals, Environmental Conditions and Diets: A total of 108 fryers from both sexes (54 males and 54 females) of White V-line rabbits (Spanish breed obtained from faculty of Agriculture, Alexandria university) at weaning age with average weight about 660 g were identified by ear tag and randomly divided into 3 groups in cages differed only in floor types (plastic, wire or combination) with three replicates; The first group was 18 bunnies reared on cages with wire net floor (50 x 50 cm) made from galvanized wire with holes of 15 x 25 mm and 3mm wire diameter with a stocking density 24/ m^2. The second group was 18 bunnies housed in three cages with plastic net floor made from plastic net element with holes of 15 x 25 mm in size. The third group 72 bunnies were housed in three cages of combination (plastic & wire net floor) each cage was one square meter in size and divided equally into 4 chambers (50 X 50 cm) using swing doors (fryers can move freely among four cages). Two chambers had a wire net floor and the others had plastic net floor for preference test. Light period was 14-16 h of light/day. Daily temperature was ranged between 18 to 24 ºC and 50 to 60% relative humidity. Animal was feeding *ad-libitum* with commercial pellet diet contained the following nutrients as shown by the factory label: Ingredient% Crude protein 16.0%, Crude fiber 16.0%, Fat 3.0%. Rabbits fed the ration in feeding troughs and drinking water was available *ad-libitum* from nipple drinkers.

Behavioral Patterns: The behavior patterns were evaluated by using infrared cameras 24h video recordings at age 5.5 and 10.5 weeks. On the day of recording nobody entered the rabbitry avoiding disturbance to the rabbit behavior. Recording were made through 24 h /day time, dark and light periods and were evaluated by recording the behavioral patterns of the rabbits with a frequency of 2 min using scan sampling methods. Concerning the third group, the rabbit in each location was counted every 30 min (48 times / day) for preference test.



Behavioral observations: The behavior patterns recorded by using scan sampling according to Princz *et al*. [5] and their definitions are summarized as:

- Feeding: Consumption of feed from the feeder, gnawing the pellet.
- Drinking: Drinking water from nipple drinker.
- Caecotrophy: The rabbit turned his head to take soft pellet from anus showing it.
- Resting and Sleeping: lying at any position (unsleeping, stretched), sitting up.
- Locomotors behaviors: Any voluntary change of position (walking or running)
- Body care behaviors: Any behavior from connected with the own body of the animal (licking or scratching)
- Investigatory behaviors: Behavior forms connected to the cage or its equipment (rubbing, licking, gnawing, smelling, marking with the chin) or other investigation the animal investigate other animal (sniffing, marking each other with the chin).

Growth Performance Parameters: Body weight (BW) was recorded weekly from 35 to 70 days of age, daily weight gain (DWG) and relative growth rate (RGR) also recorded for the same periods. Daily feed intake (DFI) and feed conversion ratio (FCR) were measured weekly for the different floor types and their combination.

Statistical Analysis: The rabbit presence (in frequency percent) in the various cages and the behavior frequencies were evaluated by performing an analysis of variance. Statistical analysis was performed by mean of SPSS 11.5 [13] software package. The data of BW, DWG, RGR and DFI were analyzed by Statistical Analysis System SAS [14] using GLM. The ANOVA model included the following effects: $Y_{ij}=\mu+F_{tj}+e_{ijk}$ where μ is the general mean, F_{tj} the effect of floor type and e_{ijk} is the random error.

RESULTS

Housing of rabbits in different floor types (plastic, wire or plastic & wire combination) affected the majority of the behavioral patterns (Table 1). The feeding behavior was higher in rabbits reared on plastic & wire combination floor followed by the plastic and the lowest was for wire net floor. Moreover, there were significant differences in drinking behavior it was higher in plastic net floor. Resting behavior lying and sitting up time were significantly higher in rabbits reared on wire net floor than those reared on plastic or plastic & wire combination net floor. Presence of plastic floor significantly increase walking and running behavior (plastic and/or plastic & wire combination). More over the body care behaviors (licking and scratching) were also higher in (plastic and/or plastic & wire combination). Exploration behaviors were found to be increased in (plastic and/or plastic & wire combination) than those reared on wire net floor only. The preference test and operant conditioning have been used in a few studies to understand the preference of growing rabbit for different housing systems (Table 2).

In this study rabbits prefer cages provided with plastic floor by 55.4% than wire net floor which was 44.6%. Moreover, rabbit during day light prefer wire net floor (50.71%) versus plastic floor (49.29%). However during night rabbits prefer plastic net floor (60.78%) than wire net floor (39.22%).

Table 1: Mean ± SE to the effect of floor type on behavior frequency% of growing rabbits.

	Floor type				
Item	Wire net	Plastic net	Plastic&wire	F value	P value
Feeding%	11.50±1.21^{c}	14.32±1.59^{b}	16.52±0.92^{a}	3.80	0.031
Drinking%	2.84±0.55^{b}	3.70±0.65^{a}	2.51±0.44^{c}	3.71	0.040
Caecotrophy%	0.26±0.18^{a}	0.26±0.18^{a}	0.07±0.07^{b}	4.55	0.019
Lying%	66.80±2.41^{a}	63.93±2.25 ^{b}	52.87±2.87^{c}	3.40	0.041
Sitting up%	15.63±1.81^{a}	13.93±1.64^{b}	11.71±1.19^{c}	3.61	0.042
Walking%	1.94±0.51^{c}	4.30±0.77^{a}	3.66±0.56^{b}	3.41	0.041
Running%	0.39±0.29^{c}	1.30±0.48 ^{b}	1.51±0.35^{a}	3.30	0.045
Licking%	6.33±0.99^{c}	7.81±0.90^{a}	7.33±0.91^{b}	3.25	0.046
Scratching%	1.68±0.48^{b}	2.86±0.56^{a}	1.72±0.39^{b}	3.43	0.041
Exploration cage%	0.65±0.34^{c}	1.69±0.45^{a}	1.44±0.33^{b}	3.18	0.049
Exploration other%	0.00±0.00 ^{b}	0.39±0.29^{a}	0.07±0.10^{b}	4.50	0.022
Exploration trough%	0.52±0.03^{a}	0.13±0.01^{b}	0.57±0.06^{a}	3.20	0.048

The means within the same rows carry different superscripts are significantly different at (P<0.05).

Table 2: Rabbits choice (frequency%) between floor type and their interaction with the periods of day

Item	Preference%
Floor type	
Plastic	55.4[a]
Wire	44.6 [b]
F value	3.50
P value	0.03
Floor*period of day	
Plastic*Night	60.78[a]
Plastic*Day light	49.29[b]
Wire*Night	39.22[b]
Wire*Day light	50.71[b]
F value	3.90
P value	0.02

The means within the same rows carry different superscripts are significantly different at (P<0.05).

Table 3: Means ± Standard Errors (Mean ± SE) of body weight, daily weight gain and relative growth rate of rabbits subjected to various floor types

	Floor type				
Item	Wire net	Plastic net	Plastic & wire	F value	P value
Body weight (g)					
35d	556.14±21.00[a]	581.44±20.27[a]	550.87±13.77[a]	0.71	0.55
42d	650.00± 60.11[a]	690.33± 46.86[a]	705.00±34.12[a]	0.80	0.46
49d	797.14±46.67[b]	955.63±45.05[a]	846.79±30.60[ab]	3.81	0.04
56d	1057.83±62.99[b]	1275.52±60.81[a]	1100.41±41.30[b]	3.57	0.04
63d	1322.51±51.84[a]	1459.75±50.04[a]	1369.29±33.99[a]	1.78	0.19
70d	1586.22±51.08[b]	1748.21±49.31[a]	1631.12±33.49[b]	3.71	0.03
Daily weight gain (g)					
35-42	27.26±4.09[a]	20.83±4.09[a]	19.92±2.89[a]	1.13	0.34
42-49	22.95±4.66[b]	37.12±4.65[a]	27.61±3.29[a]	3.80	0.04
49-56	35.26±4.12[ab]	47.14±4.12[a]	36.50±2.92[b]	3.72	0.04
56-63	41.91±4.53[a]	23.33±4.53[b]	37.86±3.20[a]	4.87	0.02
63-70	39.17±2.72[a]	40.11±2.71[a]	37.20±1.92[a]	0.43	0.65
Overall 35-70	33.31±1.84[a]	33.70±1.84[a]	31. 82±1.30[a]	0.43	0.65
Relative growth rate					
35-42	27.77±3.29[a]	26.87±2.29[a]	23.76±2.33[a]	0.61	0.55
42-49	19.01±3.34[b]	33.82±3.32[a]	26.41±2.37[ab]	4.99	0.02
49-56	26.74±3.06[a]	32.01±3.04[a]	26.38±2.17[a]	0.80	0.46
56-63	22.30±2.48[b]	14.36±2.46[a]	21.57±1.76[b]	3.62	0.04
63-70	17.94±1.39[a]	19.22±1.38[a]	17.34±0.99[a]	0.39	0.68
Overall 35-70	101.68±2.17[b]	111.47±2.15[a]	105.80±1.54[b]	4.97	0.02

The means within the same rows carry different superscripts are significantly different at (P<0.05).

Growth Performance: Data of growth performance (BW, DWG and RGR) are presented in Table (3).

It could be observed that initial BW of rabbits at 35 and 42 days of age were non-significant among groups of rabbits reared with different floor types.

While, at the 7th, 8th and 10th week the plastic floor showed significantly higher body weights (955.63±45.05, 1275.52±60.81 and 1748.21±49.31g; respectively) than in wire or combination floor. Furthermore, at the ninth week body weight of fryers reared on plastic floor was higher than other groups but the difference was non-significantly differed.

It is interesting to point out that, the daily weight gain was significantly higher at period from 42-49 days and 49-56 days of age for fryers reared on plastic floor (37.12±4.65 and 47.14±4.12 g) than those reared on wire floor or the combination one.

In contrast, the daily weight gain at period from 56-63 days of age was significantly lower (23.33±4.53g) than other groups. On the other hand, the differences among the groups were non-significant for the overall daily weight gain.

No differences over time were found in the relative growth rates during the periods of (35-42 49-56 and 63-70 day). However, RGR was significantly higher for fryers

Table 4: Means ± Standard Errors (Mean ± SE) of feed consumption as well as feed conversion ratio of V-line rabbits subjected to various floor types

	Floor type				
Item	Wire net	Plastic net	Plastic & wire	F value	P value
Daily feed consumption (DFC) (g)					
35-42	67.39±1.50[a]	70.30±1.80[a]	69.50±1.77[a]	0.56	0.63
42-49	72.38±3.20[b]	76.33±3.14[a]	73.11±2.14[ab]	3.91	0.035
49-56	96.65±4.36[a]	97.55±4.36[a]	95.45±4.30[a]	0.61	0.66
56-63	118.12±3.95[a]	120.11±4.85[a]	121.05±4.75[a]	0.49	0.62
63-70	122.51±5.11[b]	127.51±5.25[a]	124.44±4.95[ab]	3.70	0.04
Overall 35-70	95.77±1.82[b]	98.30±1.90[a]	96.40±1.21[b]	4.21	0.03
Feed conversion ratio (FCR)					
35-42	2.47±0.43[a]	3.37±0.40[a]	3.49±0.39[a]	0.49	0.61
42-49	3.15±0.49[a]	2.06±0.37[a]	2.65±0.45[a]	0.57	0.63
49-56	2.74±0.45[a]	2.07±0.39[a]	2.62±0.75[a]	0.61	0.53
56-63	3.52±0.78[a]	2.15±1.10[a]	3.20±0.91[a]	0.71	0.54
63-70	3.13±0.95[a]	3.18±0.89[a]	3.35±1.01[a]	0.38	0.69
Overall 35-70	3.00±0.65[a]	2.92±0.90[a]	3.03±0.85[a]	0.39	0.67

The means within the same rows carry different superscripts are significantly different at (P<0.05).

reared on plastic floor during the period of 56-63 day (14.36±2.46) and the overall relative growth rate (111.47±2.15) than other groups.

Data presented in Table 4 revealed that, there were significant differences in DFI during the periods 42-49, 63-70 and the Overall from 35-70 for rabbits reared on plastic floor than other groups. On the other hand, there were no significant differences among all groups during the remaining periods. No differences were observed among the three groups in feed conversion ratio throughout the whole experimental period.

DISCUSSION

In the present study, the proportion of the time spent in feeding was higher for rabbits reared on plastic floor, plastic & wire and the lowest proportion was for rabbits reared on wire net floor. In our trial drinking proportion was also higher in plastic floor followed by wire net floor we hypothesize that, with the increasing of feeding rabbits need much drinking water to facilitate the swallowing and ingestion of such food. On the other hand, the proportion of resting periods were higher in growing rabbits reared on wire net floor than those reared on plastic net floor. A reverse results stated by Drescher [3] who found that the rabbits spent lower resting time in wire net floor compared to other floor type, while Princz *et al.* [5] stated that floor type didn't affect any of behavioral patterns. However, the movement activities (walking and running) and body care behaviors (licking and scratching) were significantly higher in rabbits reared on plastic or plastic & wire combination floor than wire net floor only. Exploration of cage were also higher for plastic floor while trough exploration was higher in plastic & wire followed by wire net floor, while the lowest proportion was for rabbits reared on plastic floor only. The previous data indicated that the behaviors are strongly affected with the floor types and the best results were for the plastic net floor that affects the welfare of growing rabbits. Princz *et al*. [5] compared the behavior of growing rabbits under different floor types and found that floor types didn't affect any of the behavior patterns. But he also found that the feed consumption was larger by 15.6% in rabbits reared on plastic net floor than those reared on wire net floor. Troncino *et al.* [6] studied the effect of floor type (wire net and wire slats) on behaviors of growing rabbits and found that the behaviors of rabbits wasn't affected by the floor type.

The well being of the rabbits is affected with floor type of their cage. Because the rabbits experience a permanent connection with the cage floor, it is one of the most important factors determining animal welfare [15, 16]. The results of our study are in agreement with Princz *et al*. [5] and Matics *et al.* [7] in that growing rabbits preferred plastic net compared to wire net. Matics *et al.* [7] compared wire net, plastic net, plastic slats and solid floors and found that the plastic net was chosen with most frequently by the young rabbits. According to the preference test, the choice between the two floor types depends on the periods of day (activity). During day light periods rabbits preferred wire net floor while during the night the rabbits preferred the plastic net floor, hence we hypothesize that higher environmental temperature during the day light forced rabbit trying to get rid of body heat and this easily in wire net floor than plastic one.

These results disagree with Princz *et al.* [5] who found that during the active periods, the rabbits stayed on the wire net than the resting periods.

Body weights of rabbits at 35 and 42 days of age were non-significant among groups of rabbits reared with different floor types. These results agreed with several authors [6, 5, 10, 12-17] in that cage floor type had no significant effect on the BW.

While, at the 7th, 8th and 10th week the plastic floor showed significantly higher BWs than in wire or combination floor. We suggest that rabbits reared on plastic floor were more comfortable and this was reflected on increasing feeding behavior. These results were in agreement with Gerencsér *et al.* [11] who stated that the BWs of rabbits between the ages of 7 and 10 weeks were significantly higher in the group on wire-mesh and plastic-mesh compared to the rabbits on deep-litter.

DWG was significantly higher at period from 42-49 days and 49-56 days of age for fryers reared on plastic floor (37.12±4.65 and 47.14±4.12 g) than those reared on wire floor or the combination one. On the other hand, Dalle Zotte *et al.* [10] found no differences in the DWG of rabbits housed on plastic- or wire-mesh floors.

DWG at the period from 56-63 days of age was significantly lower (23.33±4.53g) than other groups. On the other hand, the differences among the groups were non-significant for the overall DWG. No differences over time were found in the RGRs during the periods of 35-42, 42-49 and 49-56 days. However, RGR was significantly higher for fryers reared on plastic floor during the period of 56-63 days (14.36±2.46) and the overall RGR (111.47±2.15) than other groups. These results were in agreement with that obtained by Abdelfattah *et al.* [12] who showed that the DWG (at 6-7 weeks of age) for rabbits reared in cages with wire mesh floor was significantly higher than those reared in cages with plastic and rubber mat floor.

There were significant differences in DFI during the periods 42-49, 63-70 days and the Overall from 35-70 days for rabbits reared on plastic floor than other groups. On the other hand, there were no significant differences among all groups during the remaining periods. No differences were observed among the three groups in FCR throughout the whole experimental period. These results were in agreement with Abdelfattah *et al.* [12].

CONCLUSIONS

It could be concluded that presence of plastic net floor increased welfare and productivity of V-line rabbits.

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