

Effect of alternative rearing methods on the behaviour and on the growth and slaughter traits of growing rabbits

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Abstract

The aim of this study was to compare the behaviour and the production and slaughter traits of growing rabbits reared in different alternative rearing systems and in conventional fattening cages. The experiment was carried out with 312 Pannon White growing rabbits between 5 and 11 weeks of age. According to the pen size, floor type and stocking density 8 experimental groups were created. For analyzing the different behavioural patterns 24 h video recordings were performed weekly by using infrared cameras. The body weight and the feed consumption of the rabbits were also measured weekly. At 11 weeks of age all of the animals were slaughtered and dissected. For the comparison of the behaviour and production of the experimental and control animals the Dunnett-test was used. It was established that the different alternative rearing methods have a significant effect only on the social and stereotype behaviour of the rabbits. The daily weight gain was highest in the control animals, while lowest in the rabbits reared on deep litter. The feed consumption, the feed conversion ratio and the slaughter characteristics were not affected by the rearing method. It was concluded that from the ethological point of view housing rabbits in pens – particularly on deep litter – has a favourable effect on both of the social and stereotype behaviours' frequency. However, when rabbits are reared on deep litter, some consumption of the litter material should be calculated, but it does not decrease the pellet consumption and the final liveweight of the animals significantly.

Keywords: rabbit, growth, rearing method, behaviour, production, slaughter

Zusammenfassung

Einfluss verschiedener Haltungsformen auf Verhalten, Wachstum- und Schlachtmerkmale junger Mastkaninchen

Es wurden Verhaltens- Wachstums- und Schlachtmerkmale von 312 jungen Kaninchen der Rasse Pannon Weiße verglichen. Die Tiere wurden in der 5. bis 11. Woche bei unterschiedlichen Haltungssystemen bzw. dem konventionellen Käfig gehalten. Die Versuchskäfige unterschieden sich in ihrer Größe, der Bodengestaltung und der Besatzdichte. Wöchentlich erfolgten sowohl die Tierwägungen als auch die 24 Stunden Infrarot Videokameraaufnahmen zur Verhaltensbeobachtung. Im Alter von 11 Wochen wurden die Tiere geschlachtet. Es konnte festgestellt werden, dass die verschiedenen Haltungsformen signifikant Sozial- und andere Verhaltensparameter beeinflussten. Die

tägliche Gewichtszunahme war am höchsten in der Kontrollgruppe und am niedrigsten in der Gruppe mit Einstreuhaltung. Sowohl Futtermittelverbrauch, Futtermittelverwertung als auch die Schlachtmerkmale wurden durch die Aufzuchtmethoden nicht beeinflusst. Günstig auf die Verhaltensmerkmale wirkten sich vor allem bei Einstreu die größeren Käfige aus. Der geringe Verzehr von Einstreu beeinflusste nicht signifikant den Pelletverbrauch oder das Schlachtgewicht der Kaninchen.

Schlüsselwörter: Kaninchen, Mast, Aufzuchtmethode, Verhalten, Wachstum, Schlachtmerkmale

Introduction

In animal husbandry the requirement of efficient and safe production taking animal welfare and environmental viewpoints into account is gaining importance world-wide. During the last some years also the consumers' demands changed substantially and the meat originated from animals kept in (semi)natural conditions is favoured. Therefore, experiments also in rabbit breeding focused on developing alternative housing systems, which can increase the animal comfort and welfare during the rearing period (MARAI and RASHWAN 2003).

From the animal welfare viewpoint the most often mentioned problems are the too high stocking density and the restriction of locomotion (MANTEUFFEL and PUPPE 1997, TUCHSCHERER and MANTEUFFEL 2000, MANTEUFFEL 2002). According to the animal welfare aspects in rabbit breeding the application of deep litter and rearing in relatively large groups is currently advocated (VERGA 2000). However, under these circumstances rabbits achieve the slaughter weight in a longer period (DAL BOSCO *et al.* 2002, KUSTOS *et al.* 2003b) and the risk of coccidiosis (KUSTOS *et al.* 2003b) and the occurrence of injuries related to aggressive behaviours (PRINCZ *et al.* 2006) are higher.

In former experiments in rabbit breeding different types of alternative rearing methods were already tested for improving the comfort and welfare of the animals. Rabbits' behaviour and production was compared in different size of groups (MORISSE and MAURICE 1997, KUSTOS *et al.* 2003a), in different size of cages and pens (MAERTENS and VAN HERCK 2000, MARAI and RASHWAN 2004), on different types of floor (MORISSE *et al.* 1999, DAL BOSCO *et al.* 2002, TROCINO *et al.* 2004, MATICS *et al.* 2007, PRINCZ *et al.* 2008b, TROCINO *et al.* 2008) and also at different stocking densities (TROCINO *et al.* 2004, PRINCZ *et al.* 2008b, TROCINO *et al.* 2008). Avoiding abnormal behaviours and aggression, gnawing stick, hay, straw and mirror were also put into the cages or pens (SAMBRAUS 1997, HANSEN and BERTHELSEN 2000, MAERTENS *et al.* 2004, VERGA *et al.* 2004, PRINCZ *et al.* 2007, PRINCZ *et al.* 2008a; DALLE ZOTTE *et al.* 2008, ZUCCA *et al.* 2008). These experiments provided some clear tendencies, but many unanswered questions are still remained. In the face of these former data there are no official EU directives for rabbit housing yet, only recommendations are available in some countries (LUZI *et al.* 2006, HOY 2008).

Therefore, the objective of this study was to provide some new informations for preparing the directives by comparing the behaviour and the production and slaughter traits of growing rabbits reared in 8 different alternative rearing systems and in conventional cages.

Material and methods

Experimental animals, environmental conditions

The experiment was carried out at the Kaposvár University, Faculty of Animal Science with altogether 312 Pannon White growing rabbits, in two repetitions. The rabbits were weaned at 5 weeks of age and kept in a closed building – at 16-17°C room temperature and 16 h/day lighting – during the experimental period. The experiment took place between 5 and 11 weeks of age.

According to the pen size, floor type and stocking density the following experimental groups were created:

- large pen (100×170 cm), wire net, 16 rabbits/m² stocking density (n=26/repetition)
- large pen (100×170 cm), wire net, 12 rabbits/m² stocking density (n=20/repetition)
- small pen (50×170 cm), wire net, 16 rabbits/m² stocking density (n=13/repetition)
- small pen (50×170 cm), wire net, 12 rabbits/m² stocking density (n=10/repetition)
- small pen (50×170 cm), deep litter, 8 rabbits/m² stocking density (n=7/repetition)
- small pen (50×170 cm), deep litter, 12 rabbits/m² stocking density (n=10/repetition)
- large pen (100×170 cm), deep litter, 8 rabbits/m² stocking density (n=14/repetition)
- large pen (100×170 cm), deep litter, 12 rabbits/m² stocking density (n=20/repetition).

Thirty-six rabbits/repetition were placed into conventional cages (30×33 cm, wire net floor, 2 rabbits/cage, 16 rabbits/m²) as control.

The pens were equipped with a 40 cm long feeder and with two nipple drinkers, the cages with a 30 cm long feeder and with one nipple drinker. Rabbits were fed *ad libitum* with a medicated pellet (10.3 MJ/kg DE, 14.5% crude protein, 2.0% ether extract, 17.5% crude fibre, 50 000 mg/kg Tilmikozin, 0.025% Pulmotil 200) until 9 weeks of age, and with a medicament free commercial pellet (10.6 MJ/kg DE, 16.0% crude protein, 3.0% ether extract, 16.0% crude fibre) thereafter. Drinking water was available continuously from self-drinkers.

Measurement of production parameters

The body weight and the feed consumption of the rabbits were recorded weekly. The body weight was measured individually, while the feed consumption per pen or per cage, respectively. Based on the measured data the daily weight gain and the feed conversion ratio were calculated.

Behaviour analysis

Using infrared cameras 24 h video recordings were performed weekly, always on the same day. The video recordings were evaluated by recording the behavioural patterns of the rabbits in every 10th minute. The following behavioural patterns were examined: eating, drinking, locomotory behaviours, resting, comfort behaviours, social behaviours, agonistic behaviours, stereotype behaviour and frequency of deep litter consumption (for the rabbits reared on deep litter). According to GUNN and MORTON (1995) and MORISSE and MAURICE (1996) the definitions of the examined behaviour patterns were as follows:

- eating: consumption of feed from the feeder, gnawing the pellet;
- drinking: consumption of water from nipple drinkers;

- locomotory behaviours: any voluntary change of position;
- resting: sleeping, lying at any position, sitting;
- comfort behaviours: any behaviour form connected with the own body of the animal;
- social behaviours: the behaviour forms described at the comfort behaviours conducted on other rabbits;
- agonistic behaviours: biting, picking, scraping, chasing other rabbits, fighting;
- stereotype behaviour: any abnormal and continuously repeating behaviour;
- deep litter consumption: consumption of the litter material.

Slaughter and dissection

At the end of the experiment – at 11 weeks of age – all of the animals were slaughtered. Prior to the slaughter no fasting was applied. Immediately after the slaughter the hot carcasses – including the head, heart, lungs, liver, kidneys and fat – were measured and then stored at a temperature of 4 °C for 24 h. Thereafter the chilled carcasses were also measured and the heart, lungs, kidneys, scapular and perirenal fat were removed. The carcasses were then dissected according to the WRSA proposal (BLASCO and OUHAYOUN 1996). The weight of the different organs and body parts was weighted and their ratio to the chilled carcass weight was calculated.

Statistical analysis

For the statistical evaluation of the differences in the frequencies of the examined behavioural patterns and in the production and slaughter performances between the experimental and control animals the Dunnett-test was used. The statistical analysis was performed by means of the SPSS 10.0 software package (SPSS for Windows 1999).

Results and discussion

Behavioural patterns

Analysing the eating behaviour of the animals it was concluded that rabbits housed in conventional fattening cages performed this behaviour pattern more frequently (12.26%) than those kept in pens (9.68-11.91%, Table 1).

However, the higher frequency of the eating behaviour of the control animals was statistically not proven at $P < 0.05$ level.

Contrary to eating, the drinking frequency was mainly lower in the control group compared to that of the rabbits reared in pens. However, the difference from the experimental groups was not statistically significant ($P > 0.05$) also in this case.

The occurrence of the locomotory behaviours – except for one occasion – was more frequent for rabbits housed in pens than for the control animals. However, compared to the rabbits housed in conventional fattening cages significantly ($P < 0.05$) higher frequency of the locomotory behaviours could only be detected in that experimental group, where rabbits were reared in a large pen, using a stocking density of 8 rabbits/m² and applying deep litter. The reason of this can probably explained by the fact that aggressive animals were found only in this pen.

Table 1

Effect of pen size, floor type and stocking density on the frequency (%) of some behavioural forms of growing rabbits

Einfluss von Käfiggröße, Bodengestaltung und Belegungsdichte auf einige Verhaltensmerkmale wachsender Kaninchen

Behavioural forms	Large pen				Small pen				Control	SE
	Wire net		Deep litter		Wire net		Deep litter			
	12 ¹	16	8	12	12	16	8	12		
Eating	11.82	11.91	10.71	9.68	10.66	10.89	9.89	11.11	12.26	0.276
Drinking	1.42	1.99	2.14	2.14	2.01	2.04	1.75	1.85	1.50	0.066
Locomotory behaviours	4.72	4.82	6.72**	4.36	5.73	4.90	3.26	4.70	4.13	0.206
Resting	63.07	61.49	55.81	61.08	60.35	58.79	58.53	57.18	61.07	0.579
Comfort behaviours	15.43	15.10	11.12	9.93	15.86	17.72*	10.02	11.63	11.62	0.593
Social behaviours	3.03	4.41	6.86**	6.98**	5.39	5.67	7.36***	6.82**	3.06	0.314
Stereotype behaviour	0.54***	0.28***	0.45***	0.01***	0.00***	0.00***	0.00***	0.00***	5.88	0.260

¹Stocking density (rabbits/m²), The difference from the control is significant at * $P < 0.05$ level, ** $P < 0.01$ level, *** $P < 0.001$ level.

The resting frequency did not differ significantly between the experimental and control groups. However, both in the small and large pens it was observed – although it was not statistically proven ($P > 0.05$) – that the resting behaviour was less frequent on the deep litter than on the wire net floor.

Concerning comfort behaviour it is worth mentioning that rabbits in the control group showed similar frequency (11.62%) to that of rabbits housed in pens on deep litter (9.93-11.63%). The comfort behaviour of the rabbits housed in pens on wire net (15.10-17.72%) greatly exceeded that of the rabbits in the control group. However, significant difference from the control animals could only be detected for those rabbits, which were housed in small pens, on wire net floor, using a stocking density of 16 rabbits/m² ($P < 0.01$).

The social behaviour was observed more frequently for the rabbits housed in pens, but significant differences were only found for the groups reared in deep litter. In these groups the frequency of this behavioural form was more than twice higher (6.82-7.36%) than that of the control group (3.06%).

Stereotype behaviour was not observed in the small pens and it was only occasionally recorded in the large pens (0.01-0.54%). On the contrary, in the conventional cages the frequency of this behaviour form was substantial (5.88%) and it was significantly different ($P < 0.001$) from that of the experimental groups.

The frequency of the deep litter consumption varied mainly between 3.75 and 9.72% both in the small and large pens (Figure 1).

Higher values (11.53-12.80%) were only found between 9 and 10 weeks of age, when the rabbits' pellet was changed to medicament free. It was interesting to see that at the beginning of this period the rabbits rather consumed somewhat more from the deep litter and less from the »novel« taste pellet. After the rabbits got used to the medicament free pellet the frequency of the deep litter consumption changed back to its former value (4.69-6.35%).

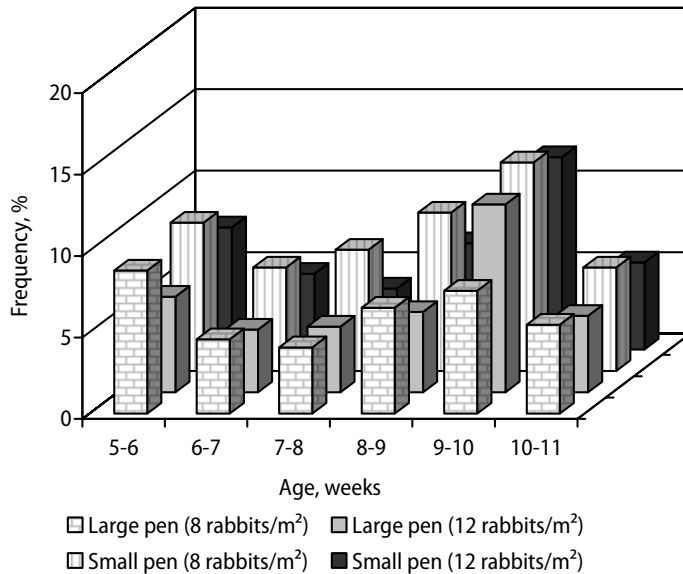


Figure 1
Effect of pen size and stocking density on the frequency (%) of the deep litter consumption of growing rabbits
Einfluss von Käfiggröße und Besatzdichte auf Einstreuverbrauch in den Versuchsabschnitten

Feed consumption

Similarly to the eating frequency no significant differences were found in the feed consumption of the experimental and control animals. The daily feed intake of the rabbits ranged between 115 and 130 g in all groups for the whole experimental period.

Daily weight gain

During the first week of the experiment – between 5 and 6 weeks of age – the rabbits kept in pens had significantly lower average daily weight gain compared to their counterparts reared in cages (Table 2).

Table 2
Effect of pen size, floor type and stocking density on the daily weight gain (g) of growing rabbits
Einfluss von Käfiggröße, Bodengestaltung und besatzdichte auf die tägliche Gewichtszunahme (g)

Age, weeks	Large pen				Small pen				Control	SE
	Wire net		Deep litter		Wire net		Deep litter			
	12 ¹	16	8	12	12	16	8	12		
5-6	40.63***	43.58**	39.93***	39.85***	40.90**	43.03 [†]	40.15**	35.32***	52.91	0.78
6-7	48.69 [†]	50.51**	38.77	42.72	46.31	49.96 [†]	38.04	41.62	42.41	0.58
7-8	50.01	46.12	44.58	42.59	46.46	49.75	41.67	44.97	46.23	0.47
8-9	46.61	50.05	45.89	44.90	45.27	46.42	39.17	43.97	45.93	0.55
9-10	42.12	34.59 [†]	46.69	42.44	41.56	42.60	45.19	45.30	41.62	0.58
10-11	37.61	34.86	41.85	40.73	40.44	34.00	42.03	38.78	38.03	0.63
5-11	44.28	43.29	42.95	42.20	43.49	44.29	41.04	41.64	44.52	0.28

¹Stocking density (rabbits/m²), The difference from the control is significant at [†] $P < 0.05$ level, ^{**} $P < 0.01$ level, ^{***} $P < 0.001$ level.

The control group rabbits' average daily weight gain exceeded 52 g, while rabbits housed in pens only gained between 35.32 and 43.58 g in this period of the experiment.

Between 6 and 7 weeks of age significantly higher weight gain was detected only for the rabbits reared on wire net floor. The rabbits housed on deep litter showed a similar - or a little bit lower - daily weight gain as animals in the control group.

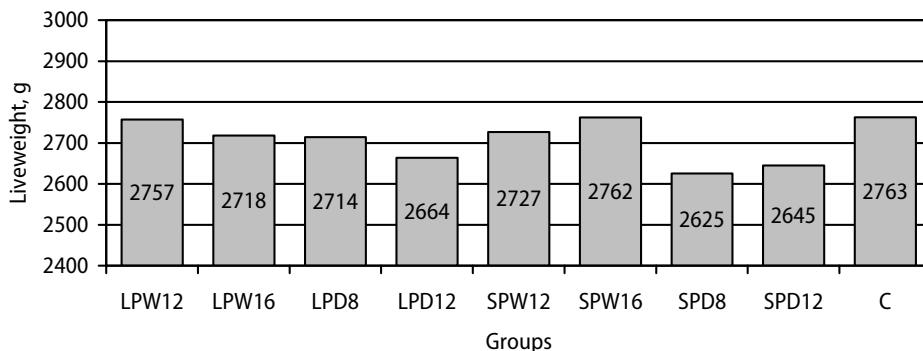
No significant differences were observed between the daily weight gain of the control group rabbits and that of the rabbits housed in pens between the ages of 7 and 9 weeks. However, it was observed that the average daily weight gain of the rabbits kept in deep litter showed lower values compared to that of the rabbits housed in cages.

On the contrary – between 9 and 11 weeks of age – rabbits reared on deep litter had higher daily weight gain than that of the rabbits kept on wire net floor. This can be explained by changing the pellet to medicament free at 9 weeks of age, which caused a decrease in the pellet consumption, which was compensated by the deep litter consumption, where it was available.

During the whole experiment the highest and lowest average daily weight gains were found for the control group rabbits and for the rabbits housed in deep litter, respectively.

Body weight

According to the above mentioned results the final liveweight of the animals reached its highest value in the control group and the lowest in pens, where deep litter was used (Figure 2).



LP large pen, SP small pen, W wire net, D deep litter, 8, 12, 16 stocking density (rabbits/m²), C control

Figure 2

Effect of pen size, floor type and stocking density on the liveweight of 11 weeks old growing rabbits

Einfluss von Käfiggröße, Bodengestaltung und Besatzdichte auf das 11-Wochengewicht

The liveweight of the rabbits reared in pens in deep litter was 49-138 g lower at 11 weeks of age, than that of the control animals, but the differences were not statistically proven ($P > 0.05$).

Feed conversion ratio

In the case of the feed conversion ratio no significant differences were found between the experimental and control animals. The obtained values varied between 2.72 and 2.96 kg/kg calculated for the whole experimental period.

Slaughter

In the examined slaughter parameters no significant differences ($P>0.05$) were found between the experimental and control animals (Table 3).

Table 3

Effect of pen size, floor type and stocking density on the slaughter characteristics of growing rabbits

Einfluss von Käfiggröße, Bodengestaltung, und Belegungsdichte auf Schlachtmerkmale

Traits, %	Large pen				Small pen				Control	SE
	Wire net		Deep litter		Wire net		Deep litter			
	12 ¹	16	8	12	12	16	8	12		
Warm carcass	61.26	61.48	61.47	60.10	61.00	61.18	61.00	61.84	61.06	0.11
Chilled carcass	59.61	59.62	59.70	58.33	59.09	59.33	59.23	59.89	59.39	0.10
Fore part	25.12	25.18	25.09	24.87	25.19	25.27	24.86	25.06	25.00	0.06
Intermediate part	26.01	26.00	25.98	25.97	26.13	26.02	25.90	26.06	26.35	0.06
Hind part	30.82	31.30	31.49	31.57	31.53	30.85	31.57	31.30	30.92	0.07
M. longissimus dorsi	9.73	9.84	9.87	9.78	10.03	9.83	9.87	10.19	10.02	0.04
Head	8.05	7.85	7.88	8.18	7.89	7.48	8.13	7.80	8.01	0.05
Skin	25.17	24.62	24.27	24.91	24.41	25.13	24.12	24.07	24.47	0.16
Paws	5.66	5.68	5.63	5.65	5.88	5.65	5.83	5.38	5.58	0.03
Gastrointestinal tract	27.97	28.15	29.13	31.68	29.36	28.36	30.21	28.44	29.56	0.26
Heart and lungs	1.33	1.33	1.42	1.41	1.31	1.34	1.38	1.36	1.32	0.01
Liver	5.37	5.35	5.14	5.44	5.06	5.13	5.36	5.37	5.27	0.05
Kidneys	1.01	1.05	1.04	1.06	1.03	1.05	1.21	1.04	1.07	0.01
Abdominal fat	1.91	1.84	1.73	1.45	1.71	2.21	1.63	1.84	1.79	0.04
Scapular fat	0.47	0.38	0.37	0.24	0.26	0.49	0.26	0.34	0.40	0.02

¹Stocking density (rabbits/m²)

Comparing the results of this experiment with the literature data it was established that in the case of rabbits kept on wire net floor the frequencies of the analyzed behaviour forms were very similar to the findings of TROCINO *et al.* (2004). The only exception was the locomotory behaviour, which frequency was more than double in our study.

The observed frequencies for eating and resting were in accordance with the results of MORISSE and MAURICE (1997) and DAL BOSCO *et al.* (2002), while the frequency of the comfort behaviour was opposite to the findings of these authors. It was interesting to see that the lower frequency of the comfort behaviour was observed on the deep litter, which is continuously becoming soiled, compared to the wire net floor, which could be kept clean easily during the whole experimental period.

In this study the effect of floor type was not detected on the locomotory and social behaviours' frequency, while DAL BOSCO *et al.* (2002) reported that the frequency of these behaviours is significantly higher in rabbits reared on deep litter.

The higher frequency of resting on the wire net floor was anticipated based on the results of some previous studies (MORISSE *et al.* 1999, OROVA *et al.* 2004).

The similar feed consumption of the experimental and control animals in the present study is contrary to the results of some former experiments, where lower feed consumptions were found for rabbits reared on deep litter (DAL BOSCO *et al.* 2002, PRINCZ *et al.* 2005, TROCINO *et al.* 2008). In the feed conversion ratio better results were obtained for the rabbits kept in cages by MAERTENS and VAN HERCK (2000) and also by PRINCZ *et al.* (2005), but no significant differences were found between the experimental and control groups in this study.

Similarly to the present findings some other authors (DAL BOSCO *et al.* 2002, METZGER *et al.* 2003, TROCINO *et al.* 2008) have found lower daily weight gain for rabbits placed to deep litter, which resulted in a longer fattening period. KUSTOS *et al.* (2003b) detected also a lower daily weight gain for the rabbits reared on deep litter, but they found that the fattening period was increased only by 2-4 days in this case. This may be explained by the consumption of the litter materials of low nutritive value as found by MORISSE *et al.* (1999) and also by the present study.

The lower final liveweight of the rabbits kept in pens compared to those reared in cages was pointed out by VAN DER HORST *et al.* (1999) and also by MAERTENS and VAN HERCK (2000). Similarly to these findings in this study also the rabbits reared in cages reached the highest liveweight at 11 weeks of age, but the liveweight of the rabbits reared in pens was not significantly lower in our case.

In spite of the results of METZGER *et al.* (2003) the unfavourable effect of rearing on deep litter was not pointed out in the present experiment on the slaughter characteristics of the animals. However, it must be mentioned that the cited authors applied very different stocking densities in their experiment (8 rabbits/m² on the deep litter and 18 rabbits/m² on the wire net), which does not allow the correct comparison of the results of the two experiments.

From the ethological point of view it was concluded that housing rabbits in pens – particularly on deep litter – has a favourable effect on both of the social and stereotype behaviours' frequency. Although the pen's larger basic area offers enough place for improving the moving activity, it seems that the rabbits do not use this possibility neither on the deep litter nor on the wire net floor. When rearing rabbits on deep litter, some consumption of the litter material should be calculated, but it does not decrease the pellet consumption and the final liveweight of the animals significantly. Rearing in pens – either on deep litter or on wire net floor – has no significant effect on the slaughter characteristics of the growing rabbits.

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