Experimental results on housing and welfare of growing rabbits in Hungary

Zsolt Szendrő

Kaposvár University, 7400 Kaposvár Guba Sándor str. 40, Hungary

Introduction

In Europe, the behaviour, housing and welfare of farm animals is an important area of research. The animal rights and protection organizations, green movements and activists put significant pressure on supermarkets, consumers, politics, and eventually on the farmers. Their knowledge of the housing and needs of animals is limited, but at the same time their ability to assert their interests, their advocacy capability is very good. They often formulate their expectations on emotional basis, believing that what is good for humans should be the same for animals. The farmed rabbit, which is also a favorite pet animal, is a particular target for these movements with the motto "End of cage age" have been launched in several European countries (Figure 1). The European Union is setting ever stricter standards for housing of farm animals. Only on the basis of scientifically based research results is there a chance of adopting housing systems that meet the needs of animals. Researchers therefore have a great responsibility to use the weapon of science to protect farmers and animals from being forced to use an inappropriate form of husbandry.

Figure 1: EU MEP, Stefan Eck demonstrates against rabbit housing in cages at EU headquarters in Brussels

Hungary is a small country in Central Europe. Fewer people living there (10 million) than in Sao Paulo. Rabbit farming is an important livestock sector. Former there were a lot of small farms, and that time live rabbits were collected and exported to Italy. Now it is characterized by large-scale farms; there are about 50-60 farms, and in the largest farm more than 2 million rabbits/year are produced. The special feature of Hungarian rabbit production is that 95-98% of the purchased and slaughtered rabbits are exported. All rabbits are slaughtered in two slaughter houses. Now the most important export markets are Germany and Switzerland,

where there are very strict expectations regarding the keeping of rabbits, which Hungarian producers must also comply with. This is why the topics of rabbit housing and welfare is very important in Europe and also in Hungary.

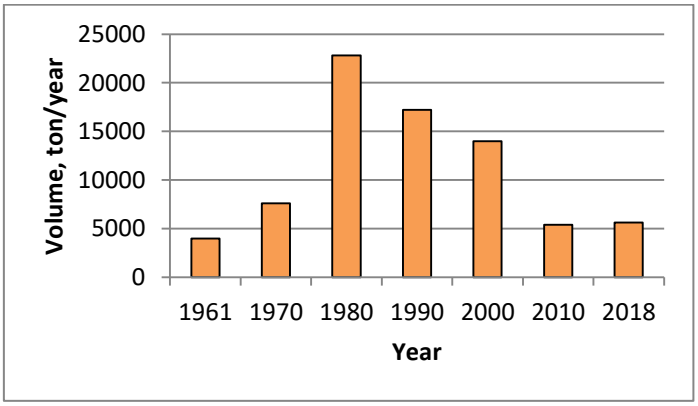

Figure 2: Yearly rabbit meat production between 1961 and 2018

(FAO database)

One of the most active research team in the world is working at the Kaposvár University. In this paper, primarily their experimental results are summarized, but occasionally some other results are also presented for a more complete overview.

In most experiments, the productive and reproductive performances, mortality, aggressive behaviour and injuries were evaluated. Whenever it was possible, preference tests were also carried out: "The rabbits were asked what housing conditions they chose?" The method is shown on Figure 3. The cage block consisted of four equal floor-space cages and the rabbits could move freely among the cages through swing doors. The cages differed only in the height of cages: 20, 30, 40 cm and open top. During the preference test a 24 h video recording was performed once a week using infrared cameras between the ages 6 and 11 weeks. Number of rabbits in each cage (of different heights) was counted in every half an hour (48 times per day; scan sampling). In another experiments the floor type, size of cages or illumination was different. Whichever cage contains more individuals, it is preferred, and it better suit their needs.

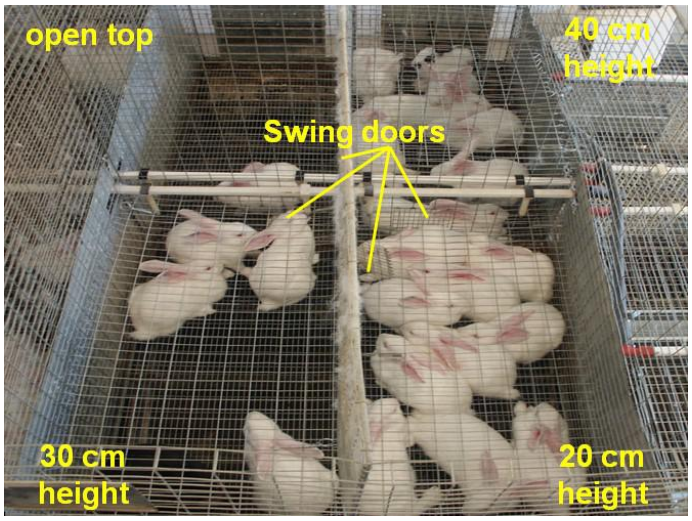

Figure 3: Preference of growing rabbits among cages with different height

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Several experiments were performed with rabbits. The effects of group size and stocking density were most frequently examined. More recently, the environmental enrichment has also been a frequently studied area. First, the results of experiments on effect of group size (number of rabbits in a cage or pen) will be summarized. In addition to our research, the most important results in a review paper were summarized (Szendrő and Dalle Zotte, 2011).

Group size

The best results were obtained with individually housed rabbits (Maertens and De Groote, 1984; Xiccato et al., 1999). If there were 2 or 4 rabbits in a cage, there was already a slight decrease in feed intake, weight gain, and body weight. However, individual housing of growing rabbits is not recommended, it is prohibited in Europe because there is no direct social contact between the animals, which can be stressful.

Compared to 2 rabbits/cage, feed intake of growing rabbits decreased in larger groups (Maertens and De Groote, 1984; Xiccato et al., 1999; Dal Bosco et al., 2002; Szendrő et al., 2009). This may seem surprising at first, because while in small cages the rabbits have limited possibility for movement, they theoretically use the consumed energy for requirement maintenance and growth, while in larger groups even need energy for movement. However, some studies have shown an opposite trend. The contradiction is resolved by the fact that there is more social stress in groups, which has been shown even in European wild rabbits. The chronic stress results a weakening of the immune system and thus gastrointestinal disease, and even poorer absorption of nutrients (Szendrő and Dalle Zotte, 2011). In a stressful situation, of course the feed intake of rabbits reared in large groups decreases, which of course also affects other production and slaughter traits. Figure 4 shows, based on several literature data, how the weight gain of rabbits decreases in a larger group compared to two rabbits per cage (Szendrő and Dalle Zotte, 2011). This means that a week longer rearing time is required for rabbits to reach the same final body.

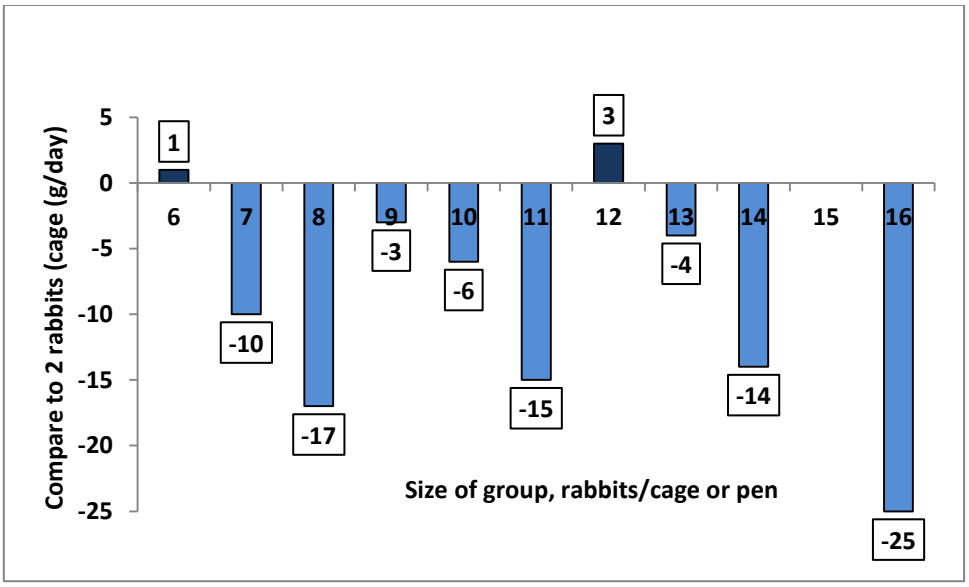

Figure 4: Effect of group size (6-16 rabbits/cage) on body weight gain of rabbits compared to 2 rabbits/cage (shown by the line at 0)
(Szendrő and Dalle Zotte, 2011)

Especially after weaning, when rabbits originated from different litters are put together, the stress is significant. Maertens and Van Herck (2000) observed that weaned rabbits were particularly sensitive to noise, human appearance. They run into a corner of the pen, climbing on top of each other, trying to escape. This fear reaction decreased with age. Like Belgian researchers, Princz et al. (2009) observed that weight gain in large-group rabbits decreased, especially in the week after weaning, which may be related to the stress described above.

Some researchers (Dal Bosco et al., 2002; Lambertini et al., 2001; Princz et al., 2008) studied the behaviour of rabbits. In larger groups, the rabbits rested less and moved more. Social contact and especially aggressive behaviour were more common. The question arises as to what extent more movement activity and less rest can be considered favorable, do rabbits

move more in the group only because there is more space, or does the escape from the aggressive (offensive) rabbit also contribute to this?

Housing of growing rabbits in large group may be criticized because of the more frequent aggressive behaviour and injuries. The decline in production is "only" an economic issue. However, the greater stress could be contrary to welfare. The injury and pain make the rearing of young rabbits in large groups questionable from the animal welfare point of view. As shown in Figure 2, aggressive behaviour begins at puberty, and at 11 weeks of age the proportion of injuries was already significant (Szendrő et al. (2009).

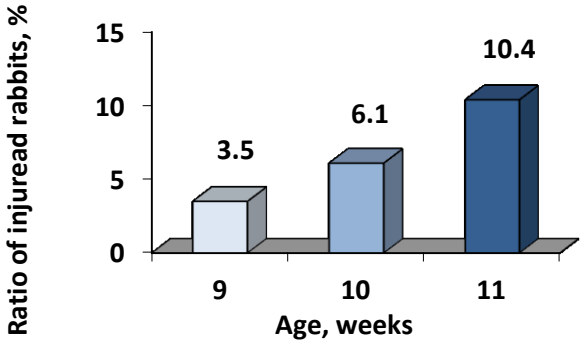

Figure 5: Incidence of injuries (%) due to aggressive behavior between 9 and 11 weeks of age

(Szendrő et al., 2009)

As the number of rabbits in a cage or pen increased, more injuries occurred due to the increasing frequency of fighting (Figure 6; Szendrő et al., 2009), and not only their number but also their severity increased (Bigler and Oester, 1996). Because of this, Rommers and Meijerhof (1998) suggested that fattening should be stopped at 80 days of age because between 73 and 80 days of age, the proportion of injured individuals increased from 6–16% to 20–41%.

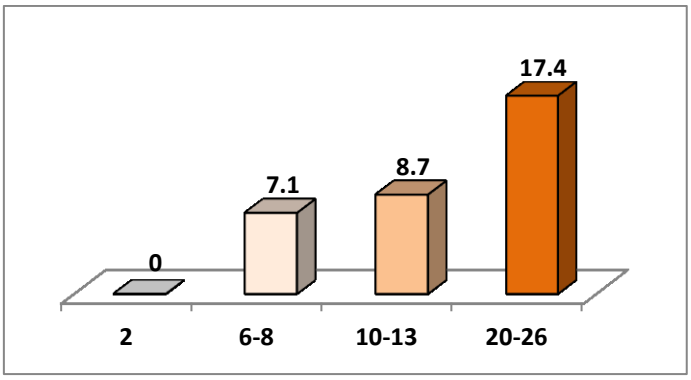

Figure 6: Incidence of ear injuries (%) depending on the number of rabbits in the group

(Szendrő et al., 2009)

It should be noted, however, that as the group size increases, there will be no more number of aggressive individuals within the rabbit stock, but their damage will be more severe. If rabbits are reared in pairs, the aggressive individual can injure only his/her companion, this is immediately visible and the animals can be separated, so the problem can be easily eliminated. In contrast, in a large group, an aggressive rabbit can attack more animals in the pen, and it is difficult, time-consuming, or even impossible to find and remove it. While in nature the attacked rabbit can escape, in the cage or pen, they have no way to do that.

The possibility of reducing aggression and injuries will be discussed in the part of environmental enrichment.

Considering the advantages and disadvantages of group housing of growing rabbits, we can state that the advantages that occur in nature (higher chance of survival against predators) do not occur in the farm either. There is no predator and there is plenty of feed. The only benefit remains the social contact. In contrast, almost all the disadvantages of living in a group occur in farmed rabbits (social stress, aggressive behaviour, higher risk of disease, etc.).

In the case of rabbits, the problem occurs above a certain number. Considering the advantages and disadvantages, housing 4-5 kits together may be ideal, but if there are littermates together, even one litter (8-10 kits) can be reared together. This is acceptable not only for the rabbit but also for the farmer, as any smaller reduction in production is offset by a lower risk of infection. Today, more and more European rabbit farms use the “dual system” and “dual purpose” cages. In this system, two buildings are equipped with the same technology (cages). In one, before kindling, the rabbit does are placed into dual-purpose cages, which are similar to that shown in Figure 7, and before weaning (before kindling), the does are moved to the other building, which has been cleaned and disinfected beforehand, and the kits remain in the cage where they were born. The cage is sized to accommodate 8-10 kits (littermates), and they are reared here until slaughtering, when the building and cages are completely emptied, and are thoroughly cleaned and disinfected. When it is finished, it is the time of next weaning, and does are moved again into these cages.

Figure 7: Dual purpose cage. The rabbit does give birth in this cage, and at weaning, the does are moved into another cage, and kits are reared in it until slaughter.

Stocking density

One indicator of production intensity is the stocking density, i.e., how many animals are kept compare to the floor area of the building, cage or pen. If the stocking density exceeds the optimum, production will decrease, there will be more stress, the health and well-being of the animals will deteriorate. However, housing fewer animals than the optimum it reduces the economy. Therefore it is necessary to find a stocking density that is appropriate for both the animal and the farmer.

The effect of stocking density on production of growing rabbits is also summarized in the review of Szendrő and Dalle Zotte (2011). Several researchers (Maertens and De Groote, 1984; Aubret and Duparray, 1992; Xiccato et al., 1999; Jekkel et al., 2007; Princz et al., 2008; Szendrő et al., 2009) examined the effect of stocking density on production and carcass traits of growing rabbits. Above 16-17 rabbits/m^2, feed intake, body weight gain (Figure 8) and body weight decreased in the majority of cases. If the stocking density was below 16-17 rabbits/m^2, an improvement in production or carcass traits has rarely been observed, i.e. a lower stocking density usually has no economic benefit.

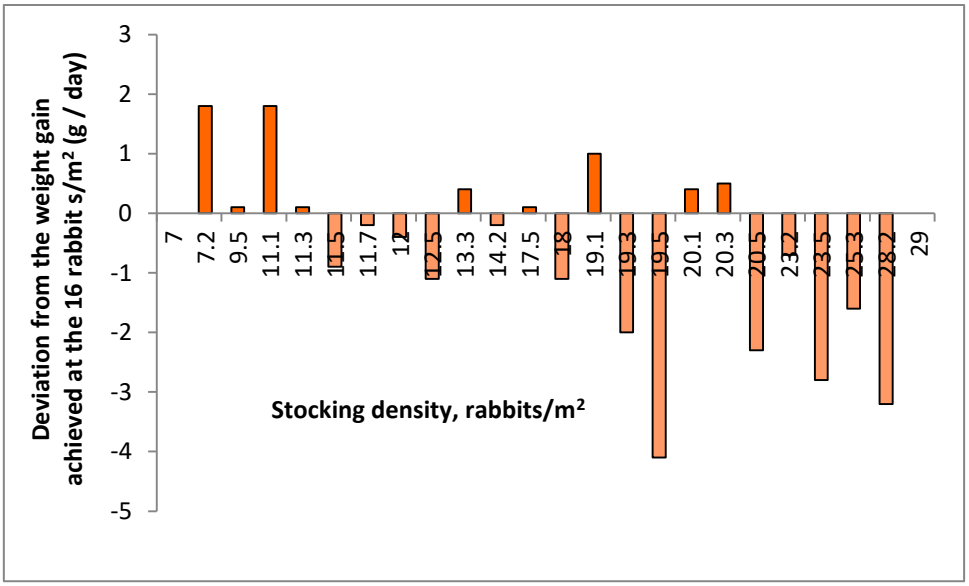

Figure 8: Effect of stocking density (7-29 rabbits/m^2) on body weight gain of growing rabbits compared to stocking densities of 16 rabbits/m^2 (shown by the line at 0)
(Szendrő and Dalle Zotte, 2011)

The effect of stocking density does not really depend on how many rabbits are housed per m^2 of cage floor area, but on how many kg of rabbits there are per m^2 of floor space. Aubret and Duperray (1992) and Maertens and De Groote (1985) have shown that daily weight gain decreased when the weight of rabbits was more than 46 and 40 kg per m^2, respectively. This can be clearly seen in Figure 9.

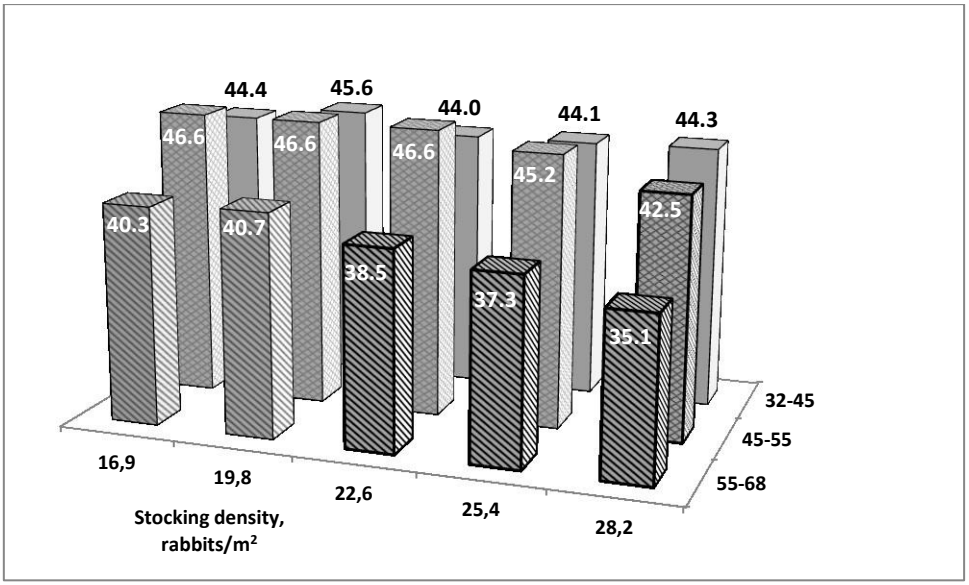

Figure 9: **Body weight gain of growing rabbits (g/day) depending on stocking density and age (32-45, 45-55, 55-68 days) (marked with darker columns if there were more than 45 kg rabbit per m^2 of floor area)**
(Aubret and Duparray, 1992)

There was no disadvantage for rabbits between 35 and 45 days of age when the stocking density was almost 30 rabbits/m^2. However, weight gain decreased at 28.2 rabbits/m^2 between 45 and 55 days of age and at 22.6 rabbits/m^2 between 55 and 62 days of age, because at these ages the weight gain exceeded 45 kg per m^2 weight of rabbits per cage area (Aubret and Duparray, 1992). Maertens and De Groote (1985) may have obtained slightly different results because rabbits were reared until older age (higher body weight). That is, the negative effect of higher stocking density occurs at the end of the growing period. This was also confirmed by our experiments. If 4 or 6 rabbits were placed in the cage after weaning (in which 2-3 rabbits are usually reared), and then the group size was halved at half of the fattening period (2 or 3 rabbits remained in the cage), did not cause any negative effect on production (Matics et al., 2004; Rashwan et al., 2007). These results demonstrate that theoretically two-phase fattening could improve utilization of buildings and cages without a decline in production. Of course, it should be borne in mind that double housing requires extra work and can cause stress to the animals.

Especially for young kits need social contact because they like huddling and warm each other after leaving the nest box, but even after weaning. In a free-choice experiment, Matics et al. (2002) examined how many rabbits chose the smaller sized cage (used for two rabbits) and twice, three, and four times large ones. Kits were weaned at a very young age of 3 weeks. By the first week, the vast majority of them were crowded into the smallest cage, barely able to push the swinging door to climb to the top of the rabbit heap. While the average rabbit density was 11 rabbits/m^2, in smallest cage the density was 70 rabbits/m^2 (Figure 10). Over the next two weeks, the rabbit density in the smallest cage was twice as high as average, and the difference between the cages was balanced only at 7 weeks of age.

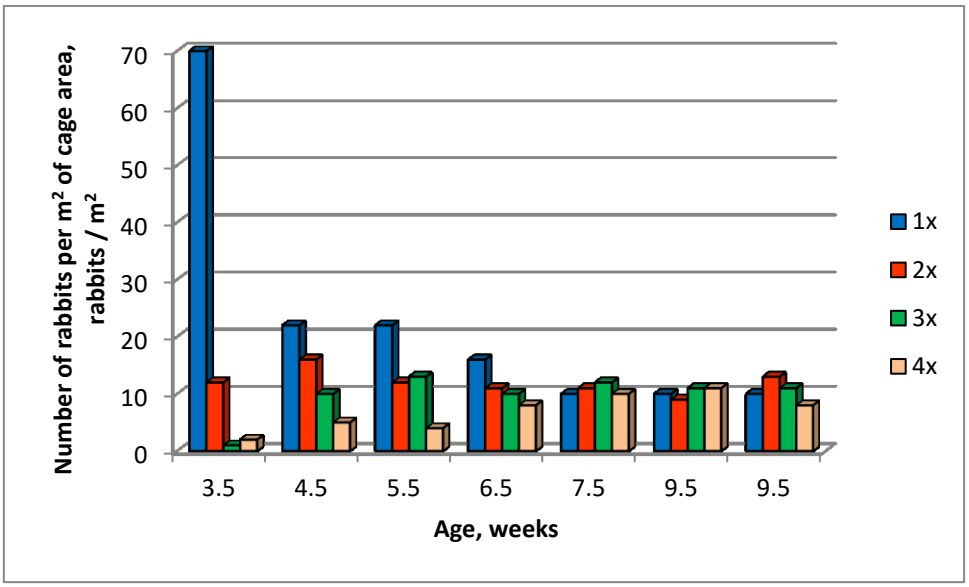

Figure 10: Rabbit density (rabbits/m^2) in cages of different sizes (1x: small and 2x, 3x, 4x larger area) in case of free choice, between 3 and 10 weeks of age
(Matics et al., 2002)

Comparing stocking densities of 12 and 16 rabbits/m^2, Trocino et al. (2004) did not observe any differences in the behaviour of rabbits. Morisse and Mourice (1997) examined the most important behavioural indicators of rabbits (rest, eating and drinking, comfort, discovery, social, antagonistic, exercise) at a stocking density of 15.5, 17.8, 20.4 and 23.0 rabbits/m^2. The conclusions were exactly the same as those found in the production results, according to which 40 kg rabbits/m^2 is the ideal stocking density. Of particular interest may be the study of aggressive behaviour. The results so far are contradictory. While Morisse and Mourice (1997) found no difference between the groups, Szendrő et al. (2009) recorded more ear injuries in group of 12 rabbits/m^2 than in 16 rabbits/m^2.

From the production and slaughter results, as well as from the observation of the behaviour, it can be stated that 16 rabbits/m^2 rabbit (if the weight at slaughter is 2.5-2.7 kg), which corresponds to 40 kg rabbits /m^2, can be considered an ideal stocking density. Above this density, production performances are already deteriorating and behaviour is changing. Lower stocking densities have no advantage in terms of production, behaviour or animal welfare.

Floor type

Animal rights movements and activists most often have objections to the cage floor. They say the wire mesh is not good and many of them recommend the deep litter. The wire mesh would be really uncomfortable for people, while it could be comfortable to stay on the deep litter. And would rabbits choose that too?

In a free choice experiment, one half of the pen floor was straw deep litter and the other half was wire mesh (Figure 11). There were similar number of feeders and nipple drinkers in both parts so that this could not influence the choice of location (Orova et al., 2004).

Figure 11: Choice of growing rabbits between deep litter and wire mesh floor

As it can be seen in Figure 11, most of the rabbits chose the wire mesh floor. This is not just a snapshot, as throughout the experiment, regardless of age of rabbit and of whether the stocking density was lower or higher (8, 12, or 16 rabbits/m^2), 80–85% of the rabbits were on the wire mesh floor (Figure 12). One would think that the litter was contaminated. To prevent this, we sprayed fresh straw on it every day and even changed the whole once a week. When the new material came in, the rabbits ran on the straw with interest (novelty), but after half an hour, the majority of rabbits were already on the wire mesh again. Although there were a large number of rabbits on the wire mesh floor, especially when the average stocking density was 16 rabbits/m^2, despite on overcrowding (23-24 rabbits/m^2 were found on wire mesh), they chose it instead of straw litter.

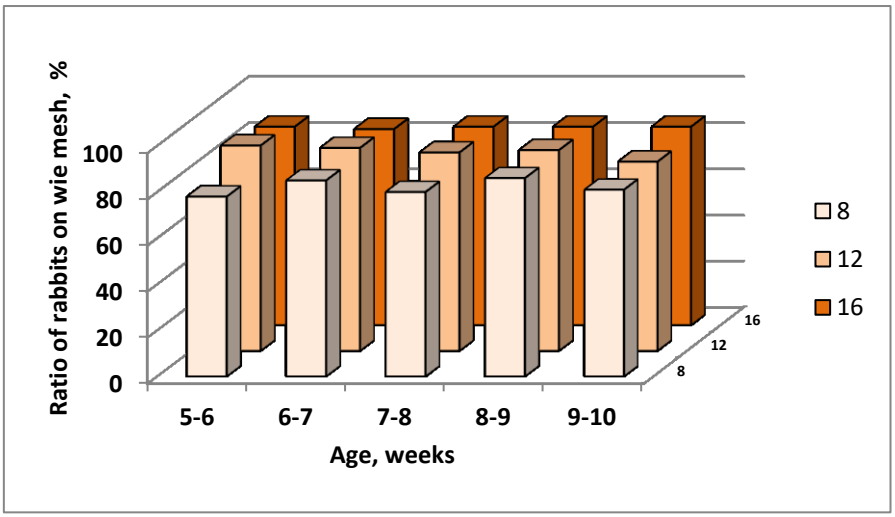

Figure 12: Location preference of growing rabbits between straw litter and wire mesh floor, depending on the socking density (8, 12 and 16 rabbits/m^2) between 5 and 10 weeks of age (ratios of rabbits choosing wire mesh floor, %)
(Orova et al., 2004)

According to Bessei et al. (2002), the choice between deep litter and metal grid depends on temperature. For this reason, a preference test was conducted in which the rabbits could choose between three floors (deep litter, plastic mesh and wire mesh), at three temperatures (cold: 10-11 ^{o}C, normal temperature: 17-20 ^{o}C and warm: 22-26 ^{o}C) (Figure 13). As with the other free choice experiments, the order of the floors was different in each repetition to eliminate any unforeseen random effects (Gerencsér et al., 2014).

Figure 13: Free choice of growing rabbits between three floors (straw litter, plastic mesh and wire mesh)

Irrespective of temperature, the fewest rabbits (5–14%) were on the deep litter. Plastic mesh floor was generally preferred, but as the temperature increased and age progressed, fewer and fewer rabbits chose this floor. In the cold, an average of 63% of the rabbits, at an average temperature 55%, and in the heat 47% were on the plastic mesh floor. Within this, between 5 and 11 weeks of age, the proportion of rabbits chose the plastic mesh decreased from 70% to 52% in the cold, from 67% to 43% at normal temperatures, and from 59% to 41% in the warm. An inverse trend was observed on the wire mesh floor: in warm temperature and in older ages more rabbits chose the wire mesh floor. An average of 25% was observed in the cold, 38% in the average temperature, and 45% in the heat. As age progressed, the proportion of rabbits on the wire mesh floor increased from 23% to 33% in the cold, from 28% to 49% at normal temperatures, and from 34% to 47% in the heat. The order of the rabbits preferring the plastic mesh and wire mesh floor was reversed from the age of 10 weeks at normal temperature and from 7 weeks of age in the heat, from this age there were more rabbits on the wire mesh than on the plastic mesh floor.

The question rightly arises, why do rabbits choose a floor that looks uncomfortable? The answer is simple, because rabbits have fur coats, only a few sweat glands and hardly lose any metabolic heat when the temperature is higher than optimum so they appear not to prefer to stay on deep litter (Bessei et al., 2002). This is evidenced by the fact that with increasing temperature and age (older rabbits consume more feed and therefore produce more metabolic heat). So it is more advantageous for them to choose a floor with good thermal conductivity (wire mesh) than a seemingly comfortable deep litter floor.

Straw and other litter have even more disadvantages. Rabbits believe it as feed and consume litter material mixed with urine and feces, and because of this the risk of gastrointestinal disease, primarily coccidiosis is high.

In an experiment, we applied straw litter on the wire mesh floor at different times after weaning (Kustos et al., 2003). In one group, the rabbits were on a wire mesh from 5 weeks of age to 11 weeks of age, and the other group was on deep litter also during the entire fattening period. The rabbits of the other two groups were weaned on wire mesh floor, and then the litter material was insert on the floor at 7 and 9 weeks of age, respectively. According to the results presented in Table 1, the rabbits on the deep litter from weaning, because they consumed also litter material, consumed less feed even between the ages of 5 and 9 weeks, and achieved lower body weight gain than the individuals of the other three groups. In the groups in which straw litter was applied at 7 or at 9 weeks of age, respectively, less food was consumed from the time when straw litter material was insert on the floor and their body weight gain also decreased. These results, similar to the observation of Jekkel et al. (2007), who demonstrated that rabbits consumed litter material and this had a negative effect on their production. Dal Bosco et al. (2002) studied the production of rabbits on wire mesh or straw litter floor. They also found that rabbits consume less feed on deep litter and reduced weight gain as well as body weight was detected. However, it has also been observed that mortality on deep litter increased compared to group on wire mesh floor.

Table 1: Feed intake, body weight gain and body weight of rabbits depending on the age when straw litter was placed on the wire mesh floor

(Kustos et al., 2003)

Age, week	Wire mesh all time	Wire meash:5-9 wk Straw litter:9-11wk	Wire mesh: 5-7 wk Straw litter: 7-11wk	Straw litter all time
		Feed intake, g/day		
5-7	124	124	125	119
7-9	131	126	116	113
9-11	156	143	149	148
		Body weight gain, g/day		
5-7	46.5	46.6	47.4	43.2
7-9	34.1	33.4	27.8	29.6
9-11	32.3	28.2	29.8	31.9
		Body weight, kg		
11	2.59	2.53	2.50	2.48

It can be concluded that housing rabbits on deep litter does not meet animal welfare expectations, because in the case of free choice, rabbits prefer to stay on a wire mesh or plastic mesh floor. At the same time, it is also detrimental to farmers because rabbits achieve poorer production results. Nevertheless, there are markets that prefer such a rabbit, paying a higher price for meat originated from rabbits kept on deep litter.

In another experiment, the location choices of kits between four floors (solid floor, plastic mesh, plastic slat, wire mesh) were studied (Figure 14; Matics et al., 2003). Rabbits were weaned at a very young age, at 3 weeks of age. As previously described, rabbits were allowed to move freely between cages through swinging doors.

Figure 14: Free choice of growing rabbits among four floors (solid floors, plastic mesh, plastic slat, wire mesh)

As shown in Figure 15, rabbits at all ages avoided the wet solid floor contaminated with feces and urine. The plastic mesh floor was generally preferred, but fewer rabbits stayed on it as they got older. Although initially avoided, the plastic slat also became accepted from the age of five weeks. It should be noted that the legs of the young kits may slip into the gap between the slats, which is why they accepted it less frequently at this age. The same was observed by Trocino et al. (2014), although in their experiment larger gaps were between the two slats than in our case. The choice of wire mesh floor also increased steadily (initially there could be a problem with a large gap for the young kits). By 9-10 weeks of age there were no differences between the choice of plastic mesh, plastic slat and wire mesh floors. In the experiment of Princz et al. (2008), the choice between plastic mesh and wire mesh floor was observed at stocking density of 16 and 12 rabbits/m^2. A decrease in the choice of plastic mesh and an increasing preference for the wire mesh was observed in older ages. However, the choice of two floors was not completely equalized; there was a greater difference between the two floors in groups with lower density. This result proves that the greater need for space associated with age and weight gain can also contribute to the choice between floors. The frequencies of behaviours (rest, exercise, eating, drinking, etc.) were also observed, and no

differences were found between the two floors, so the rest or locomotor activity of growing rabbits was not affected by the floor.

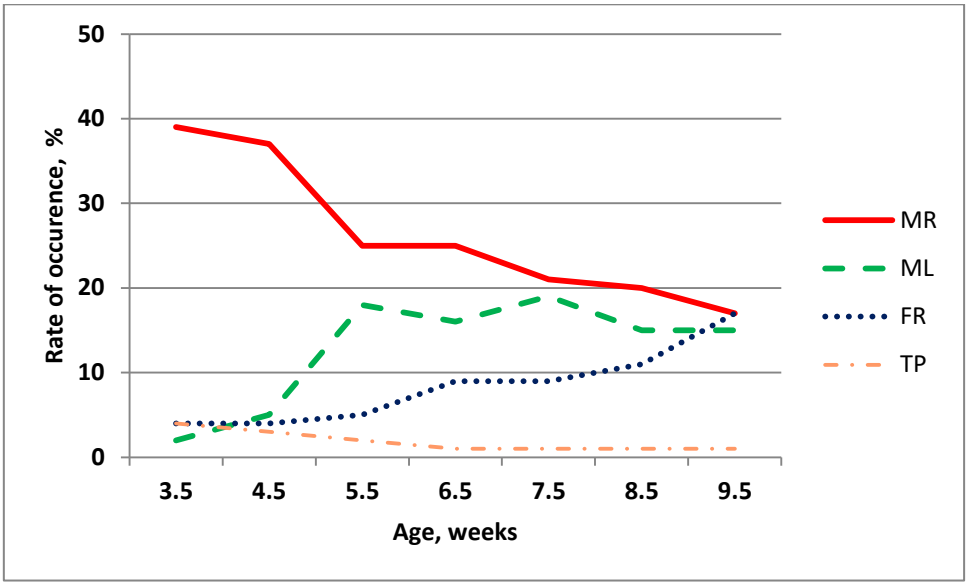

Figure 15: Free choice of growing rabbits among solid floor (TP), wire mesh (FR), plastic slat (ML) and plastic mesh (MR) floor
(Matics és mtsai, 2003)

A pen with plastic mesh floor and plastic mesh elevated platform recommended by animal rights group was tested (Figure 16). According to their idea, rabbits feel better in a larger groups, they also have the opportunity to go up and down the platform (more movement activity), and the plastic mesh is more comfortable than the wire mesh. The production performances were compared with the rabbits in cages with wire mesh floors, resting plates on it and plastic mesh platform which is used in Hungarian large-scale rabbit farms (Figure 17). Calculating the same stocking density, at weaning 8 siblings and 65 kits from different litters were placed in the cage and large pen, respectively (Gerencsér et al., 2012).

Figure 16: A pen for growing rabbits recommended by an animal welfare organization.

Figure 17: Large cage with plastic mesh elevated platform

In the large pen, the weight of rabbits was lower and their feed conversion rate was deteriorated. However, the largest difference was found in mortality, with six times more rabbits died in the large pen than in the cage (Table 2). This was due in part to the fact that in a larger group, a sick (diarrhea) rabbit was able to infect more companions than in the smaller group. Another reason was that the plastic floor got dirty more easily. At the beginning of the experiment, the pen was clean (new), but as shown in Figure 16, most of the rabbits chose the part under the platforms, rested there, and were usually emptied (manured and urinated) there as well. As a result, this part of the floor was quickly contaminated with manure (Fig. 18). Rabbits are characterized by exploratory activity; they smell everything and possibly lick it. If a healthy rabbit licks a part of diarrhea, there is a high chance that it will soon get sick and die.

Table 2: Productive performance of growing rabbits housed in large pens or cages

(Gerencsér és mtsai, 2012)

Taits	Large pen	Cage
Body weight at 11 wk, kg	2.44	2.54
Feed conversion ratio	3.61	3.39
Mortality, %	315	5.2

Although the plastic mesh is more comfortable than the wire mesh, the thicker the part between the holes, the more manure can accumulate on it, and a worse the hygienic conditions will be there. Therefore, it is better to make only the elevated platform from plastic mesh.

Figure 18: Plastic floor contaminated with manure

Based on the results a preference order can be established:

plastic mesh (it is the most preferred, depending on the temperature and age of rabbits)
↓
plastic slat = wire mesh
↓
high stocking density
↓
deep litter (in all circumstances, it is the least chosen)

Height of cage, elevated platform in the cage or pen

It may seem legitimate for animal rights activists to expect rabbits to be able to stand up position on their hind legs. This behaviour can also be observed in European wild rabbits. It

should be noted, that this observation posture is used to detect predators, and when a predator is seen, rabbits threw on the ground with their hind legs to alert the danger for other rabbits, so that they can run into the safety warren in time (Szendrő and Dalle Zotte, 2011). However, there are no predators in the rabbit houses, the rabbits stand out of curiosity on their hind legs, and this form of behaviour is very rare, not even accounting for 1% of the time (Martrenchar et al., 2001 and Finzi (2005). Jensen (2002) concluded that if the environment does not elicit certain behaviour (e.g. the look-out position) than it is not likely that the lack of this behaviour cause problem from the animal welfare viewpoint.

A preference test was performed in the cage-block shown in Figure 3 (Princz et al., 2008). Growing rabbits could choose between cages with 20, 30 and 40 cm high and open top. As shown in Figure 19, rabbits visited the 20, 30, and 40 cm high cages at a similar rate of 28–29% and clearly avoided the open top cage (16%).

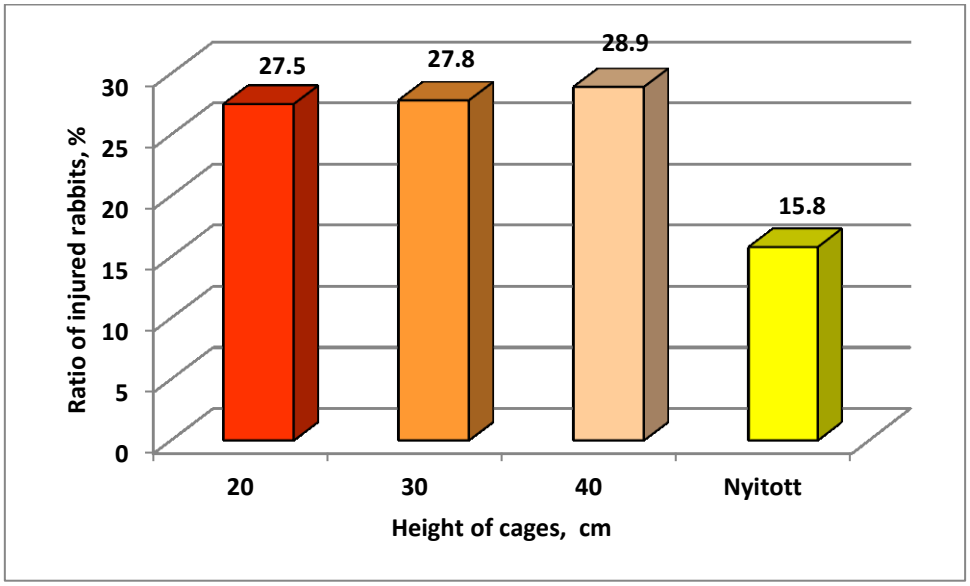

Figure 19: Location preference of growing rabbits between cages of different heights and open top (nyitott)
(Princz et al., 2008b)

In pens at different heights the production of growing rabbits and the incidence of aggressive behaviour was also studied (Princz et al., 2008b). Kits from 5 to 11 weeks of age were housed in 20, 30, and 40 cm high and open top pens. It is important to note that the large, 2 m^2 pens had feeders at one end and drinkers at the other end, 1.7 m away. Since rabbits eat and drink 30-40 times a day, they had to travel the distance between the feeder and the drinker many times, at a distance of at least 100 m per day. No differences in production performances were found, but it appears that movement in pens 20 cm high may have caused stress because 20.5% of the rabbits had bite-induced injuries on the ears. However, only a quarter of this was observed in the 30 cm high cage, and the incidence of injuries observed in the 40 cm high and open top cage did not differ significantly.

Based on the results of the preference test, production and aggressive behaviour, it can be concluded that the most common 30-35 cm high cage in practice fully meets the needs of rabbits. From an animal welfare point of view, the use of open top cages or pens recommended by some animal protection organizations is debatable because rabbits prefer roofed ones.

The question rightly arises as to why rabbits avoid the open top cage and even prefer a very low, 20 cm high cage? The answer is again very simple. Being pray animal, wild rabbit feels safe in narrow warren (cca 20 cm) or in bushes field and are usually reluctant to stay in the open field. According to them, this "fear" could be so deeply ingrained that it observed hundreds of years later, even in domesticated rabbits.

In another experiment, the location preference of growing rabbits was examined in pens with a wire mesh or deep litter elevated platform in the center (Figure 20). A box was also put at the end of the pen to make it easier for the rabbits to get on the platform. The frequency of staying of rabbits in three similar areas of the pens (on the platform, under the platform, cage part at the feeder and drinker) was studied (Szendrő et al., 2012).

Figure 20: Location of growing rabbits in pen with wire mesh elevated platform or covered it by straw

In the case of a deep-littered platform, rabbits were most often present under it and were observed much less frequently on the platform (Figure 20). In the case of a wire mesh platform, the preference changed, rabbits were most often on the platform and less frequently under it. What explains the different choice of rabbits for the two platforms? With a deep litter platform, rabbits prefer to go to the "safety" area under the platform, while avoiding the warm-feeling deep litter. In the case of a wire mesh platform, the explanation is much more prosaic. The rabbits on the platform urinate, so the others avoid the area under it, preferring to go up the platform. This was proved by installing a manure pan under the wire net. In this case, most of the rabbits had already visited the "safety" place under the platform.

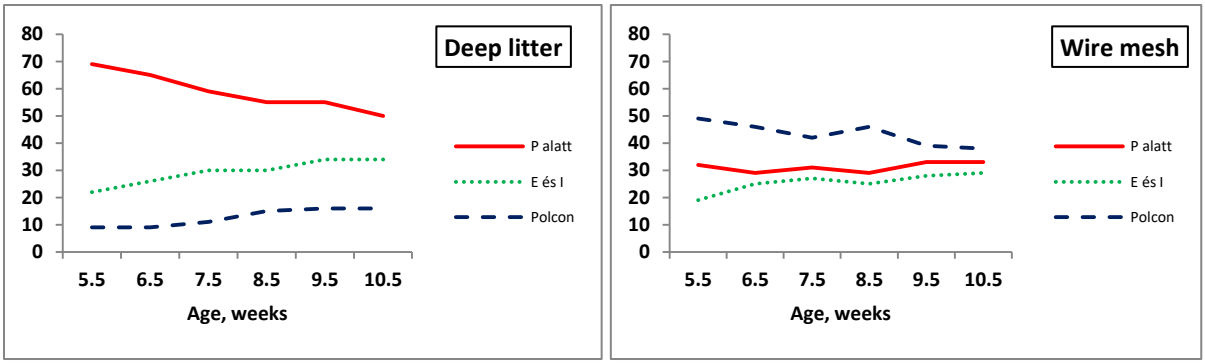

Figure 21: Location preference of growing rabbits in pens with deep litter or wire mesh platform (P alatt: under the platfom, E es I: at the feeder or drinker, Polcon: on the platform)

(Szendrő és mtsai, 2012)

Environmental enrichment

Many people have suggested that caged rabbits live in a low-stimulus environment, are bored, and therefore have various abnormal behaviours, e.g. chewing of the cage wire. In nature, wild rabbits spend a lot of time feeding, finding and consuming feed. In contrast, farmed rabbits can consume the required amount of feed very quickly, so they have to be occupied in the free time. Environmental enrichment elements are used for this, including the reduction of aggressive behaviour.

Hay, straw or gnawing sticks are most often given to growing rabbits. Jordan et al. (2006) summarized the benefits of environmental enrichment: it diversified the environment, increased the behavioural repertoire, and reduced the incidence of abnormal forms of behaviour. Gnawing stick did not affect the production of rabbits, but in several cases the incidence of abnormal behaviour was reduced, such as aggression or chewing of wire mesh

When rabbits had opportunity to choose between a cage without or with gnawing stick, they spent slightly more time in the latter cage (53%), especially during the active period (56%, Princz et al., 2008a), which may be related to the length of time when rabbits were engaged in gnawing.

The preference of gnawing wood from nine different tree species was examined by placing 3 different sticks of trees in each cage (Princz et al., 2007). Gnawing stick made of linden tree was consumed the most, followed by white willow and white horse chestnut. Of the others, they were either consumed little (e.g., white acacia) or rejected, meaning they were not suitable for gnawing. In another experiment (Princz et al., 2009), white acacia gnawing stick did not affect the production of growing rabbits, but a significant difference was found in the incidence of ear injuries depending on whether there was gnawing stick in the cages (1.2%) or not (18.5%). In addition the incidence of ear injuries in cages without gnawing stick, and with it made of white acacia or linden tree was compared (Princz et al., 2008). There was not

any difference in production performance, while hardwood reduced the incidence of injuries by half and softwood by almost a tenth (Figure 22).

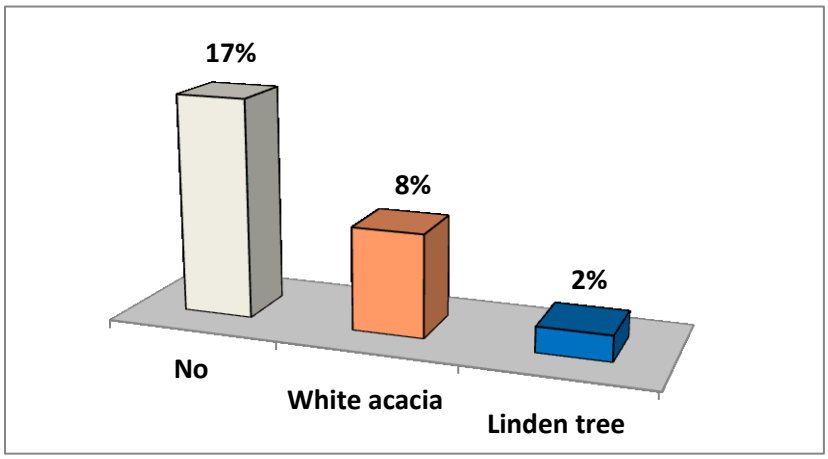

Figure 22: Incidence of ear injuries in growing rabbits depending on the absence of gnawing stick in the cage or inserted it made of White acacia or Linden tree
(Princz et al., 2008)

In addition to the gnawing wood material, its size and place in the cage are also important. Italians, for example, use thick and large hardwood gnawing stick hanging from the top of the cage (Luzi et al., 2003), which moves and rabbits can only chew its bark slightly. In our experience, a 2-3 cm diameter softwood gnawing stick that is horizontally attached to the side wall of the cage is best because rabbits have good access and can chew easily (Figure 23).

Figure 23: The chewing stick should be placed in the cage so that the rabbits have easy access

In addition, feeding hay was also tested (Szendrő K. et al., 2015). As its nutrient content is lower than that of concentrated feed, the production performance and slaughter results decreased slightly, while the incidence of ear injuries significantly reduced, especially in the pen, in larger groups. Based on the economic indicators, hay feeding was not favorable either. Against gnawing stick, when straw or hay are eaten, there is a problem with material falling to the floor, which can be contaminated with feces and urine, and rabbits can consume it, which is a health risk.

Conclusions

One can only hope that the research results published in the best scientific journals and conferences can overcome those who believe in misconceptions and ideas. If the question is, where does the rabbit feel good? Because the animals cannot think with the mind of people, ask the rabbits, use preference tests! At the same time we have to live with animal rights activists and other similar organizations that spread false, unprofessionally unfounded expectations that do not serve animal welfare and try to force livestock farmers in various ways, through campaigns. European farmers, with the help of researchers, should be much more united in order to better and more effectively represent their interests, especially if they coincide with animal welfare, to the decision-makers in their country and in the EU, using also the potential of the media.

The claims, opinions, and ideas that the domestic rabbit should be kept in as large groups as the wild rabbits live are erroneous. The primary motive for wild rabbits to live in groups is the higher chance of survival against predators (watching and escape in time). There are no predators in the rabbit house, so in group housing of growing rabbits has almost only disadvantages (aggression, injuries, higher mortality, stress, poorer production, etc.).

A stocking density of more than 16 rabbits/m^2 or 40 kg rabbits/m^2 is not advantageous from either a production or animal welfare point of view.

There are several disadvantages to keeping rabbits on deep litter. Because they eat from it, the chances of infection increase, at the same time rabbits feel uncomfortable on it, because they can’t lose the heat load. Both plastic mesh and wire mesh floor are recommended, but it is best to combine them; wire mesh floor and plastic mesh elevated platform.

The easiest way for environment enrichment is to use gnawing stick. Softwood gnawing stick placed at the head height of rabbits is best suited for this. It can reduce aggression, fights and injuries, especially in group-reared rabbits.

We must not forget that animal welfare costs money, it increases costs of rabbit production. Expectations can vary from country to country, from customer to customer, and it is only possible to go as far as the market will pay for it

At the same time, all cheaper methods of traditional rabbit farming that are not anti-welfare should be maintained, because rabbit meat is still expensive compared to pork and poultry. It would be important for as many people as possible to have access to the very valuable, healthy rabbit meat.

References

Aubret J. M., Duperray J. 1992. Effect of cage density on the performance and health of the growing rabbit. J. Appl.Rabbit Res., 15, 656-662.

Bessei W., Tinz J., Reiter K. 2002. Die Präferenz von Mastkaninchen für Kunststoffgitter und Tiefstreu bei unterschiedlichen Temperaturen. 12th Symp. Housing and Diseases of Rabbits, Furbearing Animals and Pet Animals, Celle, Germany, 133–140.

Bigler L., Oester H. 1996. Group housing for male rabbits. 6th World Rabbit Congress, Toulouse. France. Vol. 2, 411-415.

Dal Bosco A., Castellini C., Mugnai D. 2002. Rearing rabbits on a wire net floor or straw litter: behaviour, growth and meat quality traits. Livest. Prod. Sci., 75, 149–156.

Finzi A., 2005. Personal communication.

Gerencsér Zs., Odermatt M., Atkári T., Szendrő Zs., Radnai I., Nagy I.,Matics Zs. 2012. Study of production and slaughter traits of growing rabbits reared in small and large groups. Proc. 24th Hungarian Conference on Rabbit Production, Kaposvár, 71-76.

Gerencsér Zs., Szendrő K., Szendrő Zs., Odermatt M., Radnai I., Nagy I., Dal Bosco A., Matics Zs. 2014. Effect of floor type on behavior and productive performance of growing rabbits. Livest. Sci., 165, 114-119. .

Jekkel G., Milisits G., Nagy I. 2007. Effects of floor type and stocking density on the behaviour modes of growing rabbits. Agriculture, 13, 150-154.

Jensen, P., 2002. The ethology of domestic animals. CABI Publishing, Wallingford, Oxon

Jordan D., Luzi F., Verga M., Stuhec I. 2006. Environmental enrichment in growing rabbits. In: Recent advances in rabbit sciences. Eds. Maertens L., Coudert P., ILVO, Melle, Belgium, 113-119.

Kustos K., Tóbiás G., Kovács D., Eiben Cs., Szendrő Zs. 2003. Effect of stocking density, floor type and feeding method on production of growing rabbits. Proc. 15th Hungarian Conference on Rabbit Production, Kaposvár, 123-128.

Lambertini L., Vignola G., Zagnini, G. 2001. Alternative pen housing system for fattening rabbits: Effect of density and litter. World Rabbit Sci., 9, 141-147.

Luzi F., Ferrante V., Heinzl E. Verga M. 2003. Effect of environmental enrichment on productive performance and welfare aspect in fattening rabbits. Ital. J. Anim. Sci., 2 (Suppl. 1), 438-440.

Maertens L., De Groote G., 1984. Influence of the number of fryer rabbits per cage on their performance. J. Appl. Rabbit Res. 151–155.

Maertens L., Van Herck A. 2000. Performance of weaned rabbits raised in pens or in classical cages: First results. World Rabbit Sci., 8, 435-440.

Martrenchar A., Boilletot E., Cotte J.P., Morisse J.P. 2001. Wire-floor pens as an alternative to metallic cages in fattening rabbits: influence on some welfare traits. Anim. Welfare 10, 153–161.

Matics Zs., Szendrő Zs., Radnai I., Biróné Németh E., Gyovai M. 2002. Free chooce of rabbits among cages with different size. Proc. 14th Hungarian Conference of Rabbit Production. Kaposvár, 43-48.

Matics Zs., Szendrő Zs., Radnai I., Biró-Németh E., Gyovai M. 2003. Examination of free choice of rabbits among different cage-floors. Agric. Conspec. Sci., 68, 265-268.

Matics Zs., Szendrő Zs., Radnai I., Biró-Németh E., Gyovai M., Orova Z. 2004. Study of a two-phase rearing method for growing rabbits. In Proc. 8th World Rabbit Congress, Puebla City, 1141-1145.

Morisse J. P., Maurice R. 1997. Influence of stocking density or group size on the behaviour in fattening rabbits kept in intensive conditions. Appl. Anim. Behav. Sci., 54, 351-357.

Orova Z., Szendrő Zs., Matics Zs., Radnai I., Biró-Németh E. 2004. Free choice of growing rabbits between deep litter and wire net floor in pens. Proc. 8th World Rabbit Congress, Puebla City, Mexico, 1263–1265.

Princz Z., Dalle Zotte A., Metzger Sz., Radnai I., Biró-Németh E., Orova Z., Szendrő Zs. 2009. Response of fattening rabbits reared under different housing conditions. 1. Live performance and health status. Livest. Sci., 121, 86–91.

Princz Z., Dalle Zotte A., Radnai I., Biró-Németh E., Matics Zs., Gerencsér Zs., Nagy I., Szendrő Zs. 2008a. Behaviour of growing rabbits under various housing conditions. Appl. Anim. Behav. Sci., 111, 342-356.

Princz Z., Orova Z., Nagy I., Jordan D., Štuhec I., Luzi F., Verga M., Szendrő Zs. 2007. Application of gnawing sticks in rabbit housing. World Rabbit Sci., 2007, 15, 29-36.

Princz Z., Radnai I., Biróné Németh E., Matics Zs., Gerencsér Zs., Nagy I., Szendrő Zs. 2008b. Effect of cage height on the welfare of growing rabbits. Appl. Anim. Behav. Sci., 114, 284-295.

Rashwan A.A., Matics **Zs.,** Szendrő **Zs.,** Orova Z., Biró-Németh E., Radnai I. 2007. Effect of nursing method and stocking density on the performance of early weaned rabbits. Acta Agr. Kapos., 11. 1. 29-36.

Rommers J., Meijerhof R. 1998. Effect of group size on performance, bone strength and skin lesions of meat rabbits housed under commercial conditions. World Rabbit Sci., 6, 299-302.

Szendrő Zs., Dalle Zotte A. 2011. Effect of housing conditions on production and behaviour of growing meat rabbits: A review. Livest. Sci., 137, 296-303.

Szendrő K., Szendrő Zs., Matics Zs., DalleZotte A., Odermatt M., Radnai I., Gerencsér Zs. 2015. Effect of genotype, housing system and hay supplementation on performance and ear lesions of growing rabbits. Livest. Sci., 174, 105-112.

Szendrő Zs., Matics Zs., Odermatt M., Gerencsér Zs., Nagy I., Szendrő K., Dalle Zotte A. 2012. Use of different areas of pen by growing rabbits depending on the elevated platforms' floor-type. Animal, 6, 650–655.

Szendrő Zs., Princz Z., Romvári R., Locsmándi L., Szabó A., Bázár Gy., Radnai I., Biró-Németh E., Matics Zs., Nagy I**.** 2009. Effect of group size and stocking density on productive, carcass and meat quality traits, and agression of growing rabbits. World Rabbit Sci., 17, 153 - 162

Trocino A., Filiou E., Tazzoli M., Bertotto D., Negrato E., Xiccato G. 2014. Behaviour and welfare of growing rabbits housed in cages and pens. Livest. Sci., 167, 305–314.

Trocino A., Xiccato G., Queaque P. I., Sartori A. 2004. Group housing of growing rabbits: effect of stocking density and cage floor on performance, welfare and meat quality. World Rabbit Sci., 13, 138-139.

Xiccato G., Verga M., Trocino A., Ferrante V., Queaque P.I., Sartori A., 1999. Influence de l'effectif et de la densité par cage sur les performances productives, la qualité bouchère et le comportement chez le lapin. Proc. 8émes Jour. Rech. Cunicole, Paris, France, pp. 59–62.