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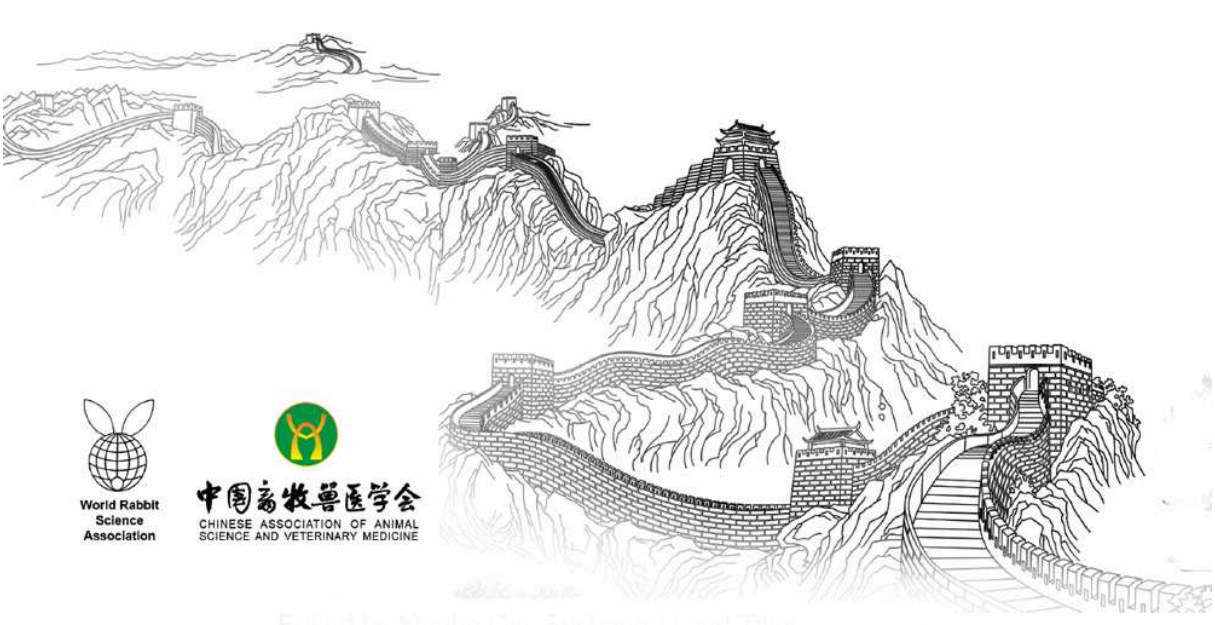

ALTERNATIVE HOUSING SYSTEMS FOR RABBIT DOES

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ABSTRACT

Single housing of does with kits will remain the common housing system in intensive rabbit production in the near future. The occasionally enlarged single cages are enriched by an elevated platform, foot rest when wire net is used and hay rack or access to other material (e.g. wooden sticks) for engagement. The third dimension (the elevated platform) seems to be more important than a larger space. In continuous group housing systems the production performance is lower than in single housed does, and fighting and injuries are frequent. In some semi-group housing systems the overall performance level was high, but after each regrouping a high level of aggressiveness and serious injuries could be seen. A new combi system for does with kits promises great benefits from the hygienic and welfare point of view. In the system, the does are kept in single boxes until weaning followed by group housing of fattening rabbits until slaughtering after removal of side walls and transfer of does to another unit. This gives the chance to clean and disinfect the unit and to interrupt chains of infection. In the next future, the use of group housing systems for does with kits does not seem to be realistic in practice because of many unsolved problems.

Key words: Rabbit does, group housing, semi-group housing, combi system, single housing.

INTRODUCTION

Breeding rabbits are kept to a large extent in intensive husbandry systems, mainly in cages with wire net floor. But, the current housing of rabbits requires putting emphasis on the aspect of welfare of animals. The development and testing of new animal friendly housing systems for does with kits and for growing rabbits play an important role in order to take in account the specific needs of animals and the aspects of animal health.

The aim of the paper is to give an overview about current developments in housing of does with kits worldwide. The results of different housing systems are summarized according to the following scheme:

- Group housing of rabbit does (continuous and semi-group housing systems).
- Combined housing system for does and growing rabbits.
- Individual housing of rabbit does with special focus on new developments concerning animal welfare.

In the international rabbit research project RABHO (Development and assessment of alternative animal-friendly housing systems for rabbit does with kits and growing rabbits) on ANIHWA ERA-Net platform (anihwa = animal health and welfare) partners from Italy (I), Hungary (H), Spain (SP) and Germany (D) work together to develop new solutions for housing of rabbit does. First results are reported.

1. GROUP HOUSING OF DOES

The aim of group housing of does is to provide near-to-nature environmental conditions for domestic rabbits similarly to their ancestor European wild rabbit (*Oryctolagus cuniculus*) which lives in smaller or larger groups in burrow systems. Group-housing facilitates social contact between does, allows

more total space and permits the expression of species-specific reproductive and maternal behaviour (Bigler and Oester, 2003; Bigler, 2004; Ruis and Coenen, 2004a, b; Rommers and Kemp, 2012; Rommers *et al*., 2012). It is desirable to house domestic rabbits in groups, as they still have a need for social interactions, and many analogies exist between the social behaviour of wild and domestic rabbits (Hoy and Selzer, 2002; Selzer and Hoy, 2003; Selzer *et al*., 2004). More total space makes a division into functional areas (e.g. for resting, a separate area for the young) possible.

1.1. Continuous group housing

Szendrő (2012) at the last World Rabbit Congress and Szendrő and McNitt (2012) summarized the present knowledge on group housing of rabbit does continuously together. This is why the main results in this field are shortly summarized.

In the first investigation for group housing of four does and one buck (Stauffacher, 1992) good results were achieved, but nobody has been able to repeat this results. Mirabito *et al.* (2005a, b) did not find differences in the kindling rate and litter size between group and individual housed does. However, the occurrence of kindling by two or three does in the same nest box was high and as a consequence, the suckling mortality was two times higher.

Also, Szendrő *et al*. (2013) compared the performance of single-caged (S) and group-housed does (G). The group housing resulted in lower kindling rate, similar litter sizes and higher suckling mortality. In 18% of cases a second doe kindled in the same nest box and destroyed the nest of the other. From the faeces of G does three times higher corticosterone concentration was detected. Group housed does had worse health status and higher rates of culling, as well as shorter lifespan. In experiment of Andrist *et al.* (2013) group housed does had low kindling rate, adequate litter size and high occurrence of injuries was observed caused by aggressive behaviour among rabbits.

As mentioned above, the free entrance of does to nest boxes of other does is one of the main problems in group-housing, causing a high mortality of young rabbits. Rommers *et al*. (2012) used an (expensive) individual electronic nest box recognition (IENR) system, only allowing a doe to have access to her own nest box (Ruis, 2006). Nesting boxes were elevated, in order to create a resting area below. Using this system, low kindling rate, adequate litter size and suckling mortality, and low weaning weight was observed (Rommers *et al.*, 2006). Furthermore small and superficial bites were observed around the formation of groups, but on average the frequency was rather low and seemed to be the result of species-appropriate fighting for establishing and maintaining the social hierarchy. No aggressive behaviour by adults towards kits was observed (Ruis, 2006).

It was shown that parts of floor bedded with straw and solid elevated floors became very dirty (on average 50% covered with (smears of) droppings – Ruis, 2006). The risk for coccidiosis was assessed by counting the numbers of oocysts in the manure. Oocysts were always present in group-housing, and could not be found in individual housing after several rounds (Ruis, 2006). Therefore, it seems that the interaction between animals is a risk factor, in addition to the extent to which animals are in contact with manure.

Absence of a buck does not lead to social instability. Schuh *et al*. (2003) and Hoy and Schuh (2004) have shown by analysing the social structure in groups of wild and domestic rabbits kept in enclosures that bucks are not involved in the social interactions between does. Szendrő *et al.* (2016) examined the aggressive interactions in group housing of four does and one buck. In homogenous (HOM) group were 17 weeks of age. During the first month after groups were established numbers of fights were 154 and 108 in groups HOM and HET, respectively. In HET group the older doe clearly occupied the first position in hierarchy, in HOM group more group mates fought for the better rank position, so the group stability was better in HET than in HOM group.

Group-housing leads to major changes in management and housing, and is associated with specific new problems (including welfare aspects). The major difficulties in group-housing systems are:

- A free entrance of does to nest boxes of other does may cause a high mortality of kits.
- Aggression may occur in groups of does with higher level of stress and negative impact on productivity.
- The system requires high hygienic standards to prevent infectious diseases.
- The system is labour-intensive because of its complexity.
- Production costs in group-housing systems are higher than in regular individual housing systems (Ruis, 2006).

Currently in the anihwa project RABHO, an experimental group-housing system (Figure 1) is investigated under the aspects of animal behaviour, animal health and performance (Buhl *et al*., 2015b).

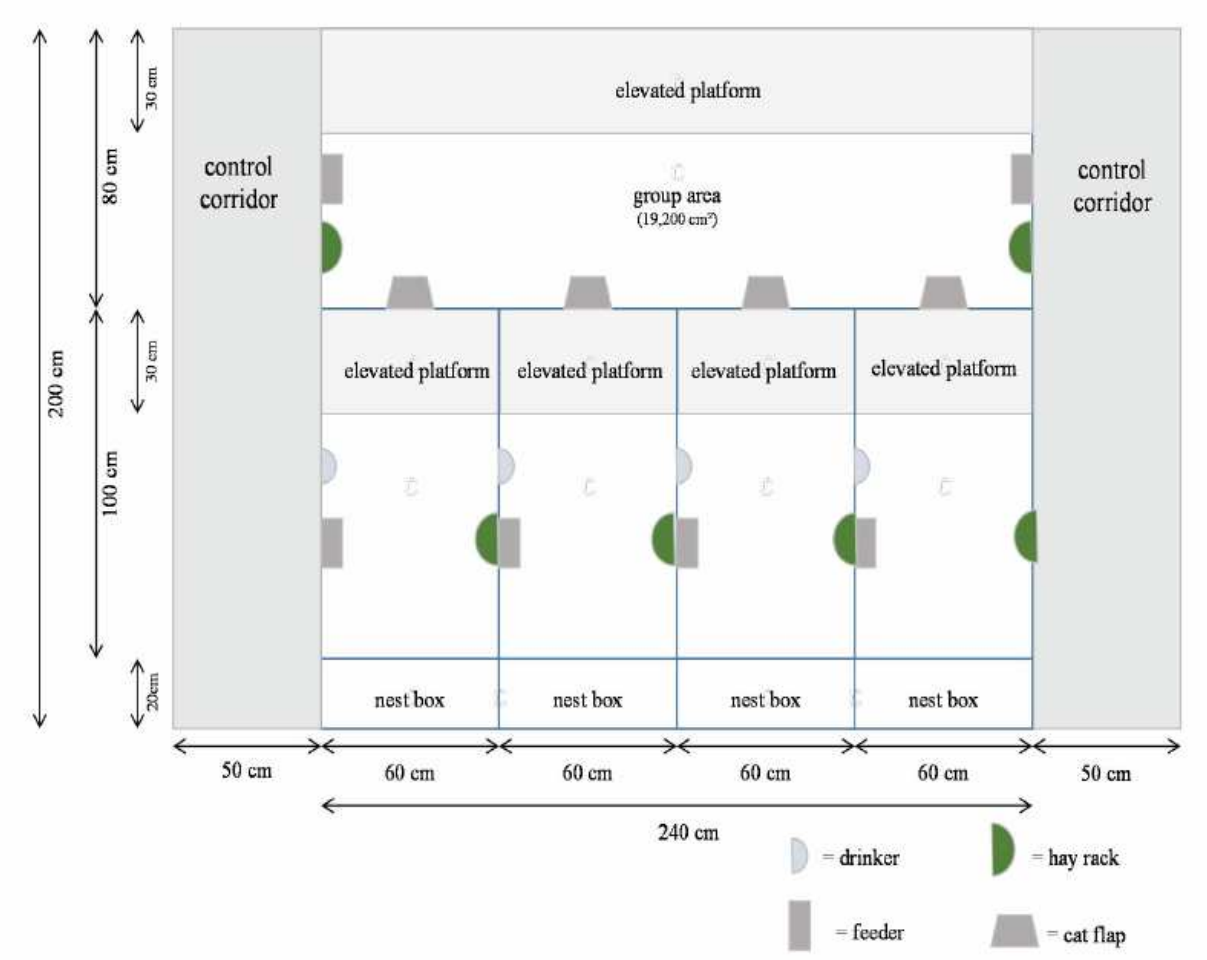

Figure 1: Scheme of experimental group housing system for does with kits (Buhl *et al*., 2015b)

The group-housing system provides space for 4 does with kits. After 35 days the kits leave the system. The housing system consists of 4 single areas (with nest boxes) with 6,000 cm² each and a group area of 19,200 cm². The problem of the free entrance of does to nest boxes is solved by a commercial individual electronic nest box recognition system, only allowing a doe to have access to her own nest box. The special feature is the use of commercial "cat flaps" at the entrance to nest, individual space respectively (Fig. 2). The animals hold a microchip which makes it possible for the does to get to their own assigned single area.

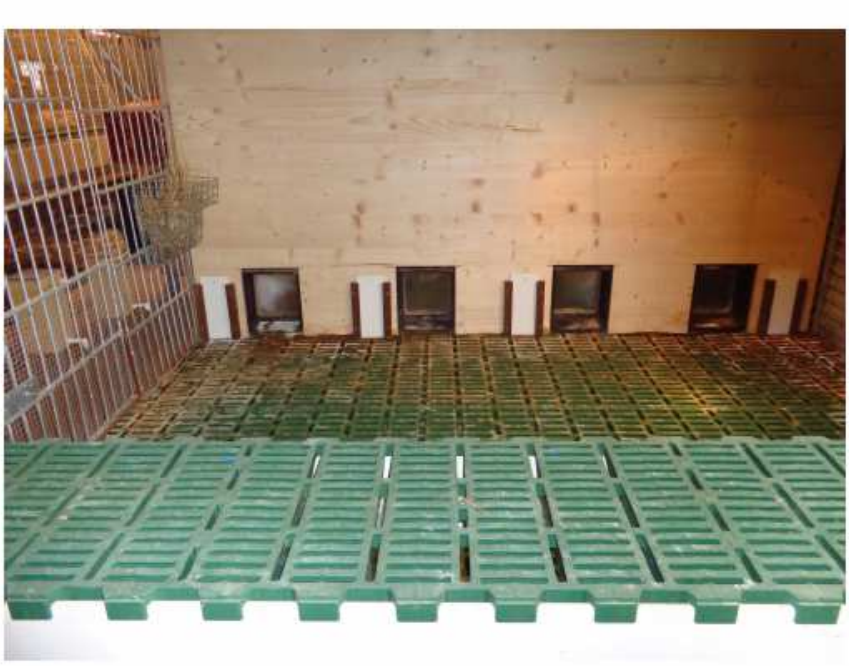

Figure 2: Group area and entrances to single areas through cat flaps of experimental group housing system for does with kits (Buhl *et al*., 2015b)

Both areas (single area – Fig. 3 – and group area) are provided with feeders, nipple drinkers, hay racks and an elevated platform.

Figure 3: Single areas of experimental group housing system for does with kits (Buhl *et al*., 2015b)

The following preliminary results can be presented: The litter size at birth was 9.95 kits per doe on average. Losses of kits occurred in the amount of 5.3 to 44.4% during the suckling period. So, the mortality rate was extremely high in some rounds. Summarizing all rounds the mortality rate was twice as high (18.1%) as in combi system (9.2%) which was installed in the same room (see the next chapter). The reasons that can be cited are: leaving of kits outside the nest and losses of unknown cause. The weaning weight was on average 0.75 kg (in combi system: 0.84 kg on average – see Table 2). Ethological investigations were carried out showing that not all of the 4 does used the group area. In each round in minimum one doe did not use the group area whereas the other 3 does used this area in a very different percentage of time. Further results are shown in Table 1. The results show a

significantly lower weaning weight of kits from group housed does compared with single housed does (difference: 156 gram on average) and a larger coefficient of variation (by 7.7%) in weaning weight of kits raised in the experimental group housing system. The reason is that the kits of different litters used sometimes the same nest box because they were able to leave the own nest box. If the doe visited the own nest box they nursed not only the own kits but obviously the strongest kits of different litters causing the growing apart.

Table 1: Performance of does and percentage of kit losses during nursing period in the group housing system

Round	1	2	3	4	5	6	**Mean**
Litter size born alive	10.0	9.0	12.25	9.5	9.5	9.0	**9.95**
Birth weight (g)	86	62	61	68	60	71	**66.0**
Weaning weight (kg)	0.96	0.96	0.74	0.69	0.67	0.72	**0.75**
Kit losses (%)	25.0	44.4	16.3	5.3	13.2	14.8	**18.1**

In Italy, a colony cage system was developed and investigated (Dal Bosco *et al*., 2004). The housing system strongly affected the behaviour of animals. Does kept in colony cage (Figure 4) performed the broadest species-specific behavioural repertoire, while those of the control group showed some stereotypes, which substituted the normal behaviour. Reproductive performance was not affected by the type of cage. In both groups the sexual receptivity of does was satisfactory as well as the number and the weight of weaned kits. The cage prototype seemed to fulfil ethological and physiological needs of animals, also allowing good performance. The current Italian investigations (Dal Bosco *et al*., 2015 – personal information) are focused on the further development and testing of the colonyhousing system with removable walls. The does are singly kept from 5 days before until one week after kindling. Then, they are housed in a group. At weaning with an age of 30 days the does are transferred to the upper boxes and the weanlings remain in the lower group housing system. In Spain (Villagra Garcia *et al*., 2015 – personal information), investigations on differently enriched single boxes (50 x 50 x 80 cm) and on group housing of does with kits take place.

In Hungary, the motivation for social contact or seclusion of the does is also examined. In this experiment 4 does are housed in a pen (3.6 m2) with one commonly used and four smaller “individual” areas in it (0.45 m2 – free access). The walls of the different individual cages (areas) are made of wire net (visual contact) or solid wall. Rabbits can stay in group (social contact) or individually, if they move into the individual compartment (seclusion). All parts of the pen are equipped with feeders and nipple drinkers. Using 24-hour video recording the motivation (preference) of does is observed; how frequent they stay in a group (2, 3 or 4 does together), or they choose the individual compartment, depending on the time of day. The types of aggressiveness among does and injuries on the body are also examined. The observations of behaviour and aggressiveness are under evaluation.

To eliminate disadvantages as lower kindling rate, higher suckling mortality caused by multiple kindling in the same nest box and lower weaning weights with higher standard deviation, new systems have been under development called semi-group housing.

1.2. Semi-group housing systems

Semi-group housing means that a pen system is used which allows temporarily group housing of does. The does are alternately housed during some weeks individually and then during some weeks in a group (Buijs *et al.*, 2014; Maertens and Buijs, 2015).

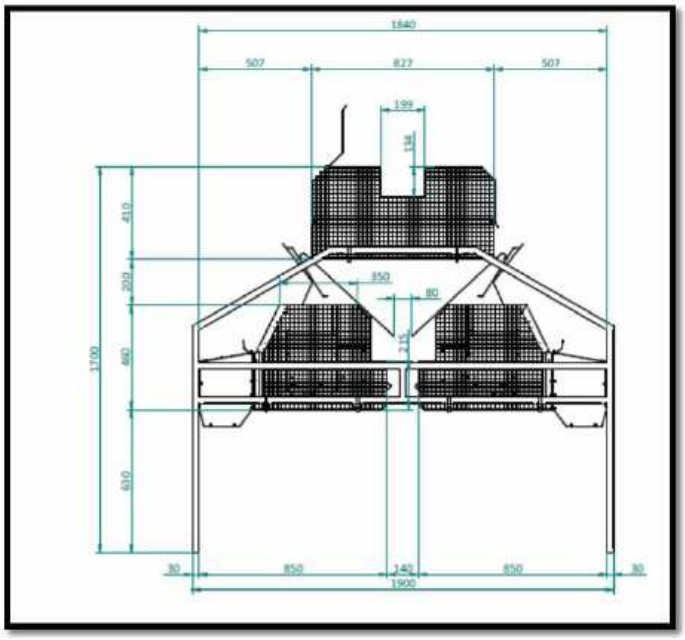

Figure 4: Colony system which is studied in Italy (Dal Bosco *et al*., 2015 – personal information)

In Belgium and The Netherlands 4 individual cages (1.0 m length x 1.5 m width x 0.6 m height) with elevated platforms are used for this system. With opening doors on cage walls or removal of the three inner walls a large group pen can be created. Rabbit does are housed in individual cages from 3 days before to 18 days after kindling and group pen is used from the 18th day of lactation to 3 days before the next kindling. Small entrances are formed on the nest boxes to give the possibility for kits to escape from does. Artificial insemination (AI) and 42 d reproductive rhythm are applied. After weaning, the kits stay in the large pen in groups of four litters and the pregnant does are mixed when new groups are formed. It provides using all-in, all-out system (Maertens and Buijs, 2013). In Switzerland, rabbit does are housed in modified Stauffacher system (Andrist *et al*., 2013). Individual housing is applied from 30th day of pregnancy till 12th day of lactation with 42 d reproductive rhythm, using AI. In a 5.7 m2 open top pen (with elevated areas, hiding places, 8 nest boxes, and area for kits) individual cages can be separated for single housing period and for introducing new members into the group.

In experiments of Buijs *et al*. (2015a, b) and Maertens and Buijs (2015) the semi-group housed does spent a greater percentage of time on locomotion and social sniffing/grooming than does in single-doe cages. Semi-group does spent a smaller percentage of the period following mixing in physical contact with group-mates than does from single-doe housing (who could only make contact through the wire walls). Even 12 days after mixing the percentage of time animals in semi-groups spent in physical contact did not exceed that in singles. Adrenal weights did not differ between systems.

In some recent experiments, the performance of semi-group housed does was compared to that of individual housed. Maertens *et al.* (2011) applied AI at 11, 15 or 18 d after kindling in semi-group housing system and AI at 11 d of lactation in individual housing. They did not find differences among the performance of the groups in kindling rate, litter size and suckling mortality. Maertens and Buijs (2013, 2015) also compared the reproductive performance of does in semi-group housing (the parks were equipped with plastic-mesh or wire-mesh platforms) and individual housing. They observed low suckling mortality in each housing condition (3.7-3.9% vs 1.5% in semi-groups and individual housing, respectively; $P<0.05$). However, higher number and individual weight of weaned kits was found in individual housed does (10.2 weaned kits and 657 g weaning weight) compared with semi-group housed does (9.9 weaned kits and 595-609 g weaning weight).

In continuous group housing system the structure of the group is only changed when dead or culled does have to be replaced. Introducing a new doe into an existing group can increase the frequency of aggressive behaviour as the hierarchy changes. In case of semi-group housing, groups are made of pregnant does and as a consequence in each reproductive cycle new group structure has to be formed.

Rommers *et al.* (2011) observed the behaviour of does in semi-group housing. Eight does were housed individually in cage block consisted of eight wire cages equipped with elevated platform. The doors among cages were opened from 14 d after parturition until three days before the following parturition. On day 1 after regrouping all does of groups were involved in aggressive interactions, the total number of agonistic events was 148. Slightly lower frequency of aggression was recorded on day 3 (4-5 does/group showed aggressive behaviour against the group-mates, 51 agonistic interactions/group in total). Although it was obvious on day 3 which doe was in dominant position (hierarchy has been formed) the aggression continued, the dominant doe provoked many aggressive interactions and won most of them. Also in experiment of Maertens and Buijs (2013) not any doe died or was culled because of fighting, but high frequency and intensity of fighting after regrouping was observed. Andrist *et al*. (2013) made a survey in Swiss rabbit farms where does were housed in groups. In 86% of the farms aggressive behaviour among rabbits was observed. They identified that using an isolation phase between parturition and AI caused increasing number of agonistic interactions after regrouping and higher ratio of injured animals.

It is obvious from the above mentioned results that in semi-group housing some of the problems present in group housing of does (pseudopregnancy, double littering) can be solved but the injuries and stress caused by aggressive interaction after regrouping remained unsolved. To eliminate these problems different methods were examined in recent years.

Mugnai *et al*. (2009) housed four rabbit does in colony groups in 76 x 150 x 60 cm pens with four external nest boxes. Pregnant does were transferred into each pen 5 days before kindlings. In trained group (TC) the same doe was put into the same nest box for 10 minutes during the first 2 days after grouping, the other group was not trained (UC). They found two times higher frequency of attacking behaviour (chasing, biting and scratching the other) in UC group compared to TC does (1.29% vs 0.60%, in UC and TC groups, respectively; $P<0.05$). This observation shows that the special training of does for their own nest boxes can decrease the frequency of aggressive behaviour but not eliminate it.

Rommers *et al*. (2013) investigated the effect of different hiding places on frequency of aggressive behaviour, percentage of injured does and average score of injuries in semi-group housing. From four enriched cages with elevated platforms group pen could be transformed by doors on the walls or by taking out three side walls. The applied hiding places were: 1. PVC pipes (50 cm long, 20 cm of diameter); 2. wooden panels underneath the platform; 3. a hidden corridor at the front of the compartment (1.5 m of length wooden panel, 18 cm behind the front wall, 20 cm of diameter holes at both ends of the corridor). It was found that in case of aggressive interactions, panels and PVC pipes seemed to give better opportunities for escape while corridor was unsuitable for this purpose. Neither of the studied hiding places was effective for avoiding aggression and injuries. In another experiment, Rommers *et al*. (2014a) examined the injuries on semi-group housed rabbit does using different treatments. The does were housed individually 21 days long in the cages, allowing them to mark their own territories before grouping or the does were transported to cleaned pens for regrouping. As environmental enrichment straw or elevated platform and PVC pipe were used. Overall 52% of the does had injury on the body and 9% of does were removed because of severe wounds. The hiding places only slightly decreased the percentage of injured animals.

Graf (2010) and Graf *et al*. (2011) tested the effect of different regrouping methods on the aggressive behaviour and injuries of does. Rabbits were regrouped in the home pen or in a “new” pen which was freshly cleaned and disinfected. They put 2 unfamiliar rabbits into each group. After regrouping, fewer does were injured in home pens than in “new” pens but the treatments did not affect the number and

duration of aggressive interactions. It was concluded that does should be regrouped in the home pen, because it slightly reduces the stress and occurrence of severe injuries.

The effect of group stability was examined by Andrist *et al*. (2012). They applied a 12 days long isolation period in semi-group housing of does. After isolation half of the groups remained in the same composition while 2 or 3 unfamiliar does were replaced in the other groups. Higher stress hormone level was detected in groups where the composition was changed and the new does in the group had more injuries than those which stayed in the same group. They recommended maintaining the group composition as long as possible. From the point of view of farmers it is difficult to comply, because not to replace the culled or died animals leads to lower number of producing does and lower production. In a recent study of Andrist *et al*. (2014) rabbits were sprayed with different odours (alcohol or vinegar) before placing unfamiliar does into the group after isolation phase. The odour masking had only little effect on aggressive behaviour and the resulting injuries. Thirty-two percent of does suffered severe injuries during the first five days of regrouping.

Semi-group housing of rabbit does can be applied also in large farms (AI, all in-all out systems can be used). In recent experiments good reproductive performance of does was reached with semi-group system because some problems of the group housing (pseudopregnancy, double littering) had been solved. As in semi-group housing applying a regrouping period is inevitable the injuries caused by agonistic interactions have remained an unsolved problem.

2. COMBINED HOUSING SYSTEM FOR DOES AND GROWING RABBITS

In the anihwa project RABHO a new combined housing system for does with kits kept in single boxes followed by group housing of fattening rabbits is studied (combi system, Meneghin, I) (Buhl *et al*., 2015a). The combi housing system provides room for 16 does with kits in one unit. Several units can be installed in one rabbit room. The floor is made of metal mesh with foot pads or plastic grids. The cages are equipped with an elevated platform of plastic slatted floor and with a hayrack. The feeder is the same for the doe and the growing kits (Fig. 5).

Figure 5: Combi system for does and growing rabbits (Meneghin, I)

Does are kept in single cages until weaning of the kits. Thereby, after weaning of the kits the does but not the kits are transferred to another housing system and the side walls are removed. The weaned rabbits are kept in large groups (4 or 8 litters) until slaughtering. To use the combi system under practical conditions a cyclogram of production was developed as shown in Figure 6. Two rooms are required. With a rhythm of 42d, 35d of suckling period, 41d of fattening and an age at slaughtering of

76 days the two rooms will be used alternately as nursing or fattening compartment. Seven days before kindling the pregnant does are introduced to the single cages. Twelve days after kindling the does are inseminated. After 5 weeks of nursing period the kits are weaned and the does are transferred to the second room. The side walls are removed so that large groups for weanlings are formed. On average 7 days later the next kindling takes place. The remaining weanlings in the large groups from 4 or 8 litters will be kept until slaughter with an age of 76 days. After the growing rabbits are slaughtered a one day-break in order to clean and disinfect the whole room is provided. This gives the possibility to realize the all out – all in procedure and to interrupt chains of infection before pregnant does are once again placed in the refitted single cages.

Until now, totally 657 weaned rabbits were fattened over a period of 55 days after a suckling period of 35 days. Animals were weighed after weaning and at the end of each round. Daily weight gains were calculated and lesions of legs and sex organs were determined in a final scoring at the date of the final weighing (four-stage system 0-3, 0 = without lesions).

The following preliminary results can be presented. The weaning weight in groups of 8 litters was (not directed) higher (0.86 kg) than in the groups of 4 litters (0.82 kg). The final weight (2.98 kg) was significantly higher in the large groups compared with the small ones (2.87 kg). So, rabbits in large groups reached significantly higher daily weight gain compared with growing rabbits in groups of 4 litters (38.4 vs. 37.2 g). The losses during fattening period were nearly the same in both groups. The percentage of lesions at the legs was very low but in tendency higher in groups of 8 litters (0.4 vs 0.2%). The percentage of lesions at the sexual organs was significantly higher in the large groups with 8 litters each (9.7%) than in the smaller groups with 4 litters each (2.6%, $P<0.05$, Table 2).

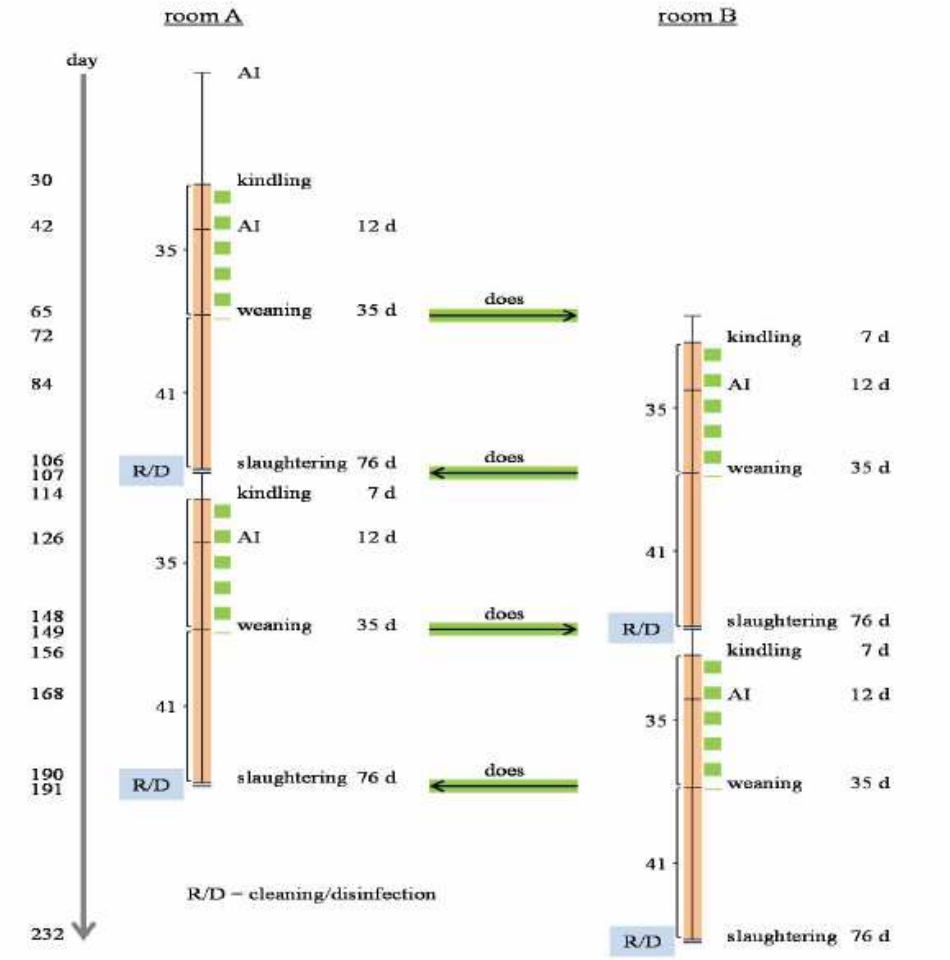

Figure 6: One phase housing of fattening rabbits from kindling until slaughtering (combi system) (42d-rhythm, 35d nursing period, 41d fattening period, 76d age at slaughtering) (Hoy, 2015)

Table 2: Fattening performance, losses and lesions within the groups of 8 and 4 litters

		8 litters	4 litters	P
Weaning weight	kg	0.86	0.82	<0.05
Weight at slaughter	kg	2.98	2.87	<0.01
Daily gain during fattening	g	38.4	37.2	<0.01
Losses	%	6.2	5.8	n.s.
Lesions at legs	%	0.4	0.2	n.s.
Lesions at sex organs	%	9.7	2.6	0.05

Summarizing the preliminary results it can be concluded that rabbits in groups of 4 litters kept in the combi system reached significantly lower daily gains than in groups of 8 litters whereas the percentage of lesions at sexual organs was higher in the larger groups

3. SINGLE HOUSING OF DOES

In intensive systems in most countries rabbit does are housed individually in 40-45 cm wide (W) cages, with length (L) of 85-95 cm and height (H) of 33-35 cm, including also the nest place. These cages are used for does from some days before kindling till weaning. The young and non-pregnant/lactating does are often kept in somewhat smaller cages (W: 30-38 cm, L: 40-43 cm, H: 33-35 cm). Usually the width (40-48 cm) and height (30-35 cm) of the nest box is similar to the size of doe's cage, while its length is 24-27 cm. In most cases the nest place is a part of the doe's cage (built-in), but it can also be separately outside. The entry of nest box could be closed.

The different sizes of cages were examined in preference tests. Mikó *et al*. (2012) observed that nonpregnant does spent 37% and 63% of time in standard and double sized cages, respectively, which shows an approximately random ratio of choice (1/3 vs 2/3). When the does kindled in the nestbox of standard or double sized cage they preferred to stay in the other cage which was farther from the nest. In a preference test (Matics, unpublished results) non-pregnant does could choose among cages with different height. The does spent 26, 31, 32 and 11% of time in 30, 40, 50 cm heights and in open top cages, respectively. The open top cage seems to be the less preferable while 40 and 50 cm height of cages are preferable by rabbit does.

The effect of cage size on performance of does was examined by Rommers and Meijerhof (1998), Mirabito *et al.* (2005 a, b) and Bignon *et al.* (2012). Although larger cages allow more space for moving which is beneficial from animal welfare point of view, larger cages had little or no effect on performance of does.

Footpad injuries remain a problem. Surprisingly, the number and severity of footpad lesions was high on alternative plastic slatted floorings, as well as on the already existing floor types of thick wire with a diameter of 3 mm (all types of floors: between 20 and 25% of animals with moderate to severe injuries) (Ruis, 2006). It is hypothesized that the permeability of these floors was too low, leading to more manure on the floor and more moisture. It is obvious that this also may have hygienic disadvantages, although it didn't lead to more health-problems in this study.

The floor of cages for breeding does is mainly made of wire net (2.5-3 mm with a rectangular shape 73 x 13 mm), but in increasing tendency covered with plastic foot-rest. The application of foot-rest on the wire net floor is recommended to provide a comfortable resting area and to avoid footpad injuries (Rosell and De la Fuente, 2009; Rommers and de Jong, 2011). Rabbit does spent most of the time on foot mats (on av. 57.7%, Alfonso-Carrillo *et al*., 2014). De Jong *et al*. (2008) studied footpad injuries in does housed on 2 mm, 3.02 mm wire floors and 3.02 mm wire floors with a plastic mat. Results indicate that there are no differences between 2 and 3.02 mm wire floors. After two reproduction cycles footpads became injured which had a negative effect on the welfare of the does. The effect of

different floor types in breeding cages on the footpad injuries of rabbit does was examined by Mikó *et al*. (2014). At the 5th insemination, the percentage of does with intact footpads were 4, 22, 35 and 42%; while the percentage of does with wounds on footpads were 48, 0, 5 and 0% in flat deck cages without and with footrest, in cages with wire net platforms (and footrest on the floor) and in cages with plasticmesh platforms (without footrest on the floor), respectively. Plastic mats seemed to have a positive effect on the footpads. From 1 January 2016 in Hungary, it is declared that in breeding does' and bucks' cages with wire net floor usage of minimum 25 x 40 cm footrest is obligatory (32/1999. (III. 31.) FVM ministerial decree on the protection of farm animals, *Hungarian Ministry of Agriculture*). In some cases the bottom of the cage is slatted plastic floor.

The walls of cages for breeding does are mainly made of wire, though sometimes also of solid metal sheets. The solid walls can be advantageous if the air speed in the building is high but they prevent any contact between the individually housed does. Dalle Zotte *et al.* (2009) observed that caged rabbits preferred to stay in cages enriched with mirrors. In examination of Negretti *et al*. (2004, 2008) rabbits looked towards neighboring cages with rabbit more frequently than towards an empty one. Seaman *et al.* (2009) observed that rabbits were highly motivated to enter the cage which allowed having visual contact with another rabbit. These results show that from the viewpoint of welfare, the wire net wall is suggested to allow the individually housed rabbit does to have social (visual) contact with their neighbours.

In general, automatic feeders and nipple drinkers are used at commercial rabbit farms, and only limited experimental results are available in this field.

One of the reasons to build an elevated platform in a "two-floor" cage is to increase the floor surface, maintaining the base area of the cage unchanged. The usable surface may be increased by 70-80% (Margarit and Finzi, 2000). In experiments of Mirabito *et al*. (1999, 2005a) and Mirabito (2002) no differences were found in the reproductive performance of rabbit does in cages with or without elevated platform. Similarly, comparing the reproductive performance (conception rate, litter size, mortality, weight of kits and feed consumption), there was no difference between traditional and enriched (double height with platform) cages (Bignon *et al*., 2012). In contrary, Alfonso-Carillo *et al.* (2014) found higher litter weight at 21d with better feed conversion ratio (3-21d) in cages with elevated platform compared to cages without platform. Mikó *et al*. (2014) also observed the benefit of using elevated platform. Higher litter weight and individual weight of kits were found at 21 days of age (3.72 and 3.51 kg, 409 and 385 g, in cages with or without elevated platform, respectively).

The third dimension (the elevated platform) seems to be more important than a larger space. The other function of the platform is to keep the does away from their kits when they leave the nest box and want to suckle any time of the day (Barge *et al*., 2008; Alfonso-Carrillo *et al*., 2014). Selzer (2000) demonstrated that the doe reacted to kits' attempts to suck in 89.5% of all cases by jumping on the platform. In the unstructured concrete box, the doe had only the possibility to lay down (80.7%) or to run away (13.8%) as a reaction on kits' attempts to suck. According to Mirabito (2002), does spent more time on the platform (32-42%) when they were housed together with kits than in case of housing does and kits in separated cages (12-16%). Mikó *et al*. (2014) examined the preference of does for platforms during the lactation period. Half of the cages were equipped with wire mesh platforms (with footrest on the floor) while the platform of other cages were made of plastic-mesh (without footrest on the floor). In general, plastic-mesh platforms were used by does more frequently than wire mesh ones (55-65% vs 25-35%, respectively). When the kits left the nest boxes the does spent more time on the platform, but after some days the kits were also able to jump up onto the platforms and after that the does spent less time on it. At 31 days of age, the kits spent 66% of time on plastic-mesh platforms while the percentage of time when kits stayed on wire net platform was only 8%. From the aspect of animal welfare cages/pens enriched with platforms can be considered advantageous especially when the platform is made of plastic-mesh (Mikó *et al*., 2012). Cages with platform may cause hygienic problems if solid platforms are used because the manure can accumulate on it. On the other hand, if wire net platforms are used droppings and urine can fall onto the kits, feeders and drinkers

The importance of the environmental enrichment for the welfare of rabbits was underlined in some recent publications (e.g. Maertens *et al*., 2012, Machado *et al*., 2014; Rommers *et al*., 2014b). One of the former studied enrichments in growing rabbits is the gnawing stick which is beneficial from the viewpoint of animal welfare (Princz *et al*., 2007, 2008, 2009; Jordan *et al.*, 2008, 2011). Inserting soft wooden stick on the cage wall can decrease the frequency of aggressive behaviour and lesions and it has no negative effect on production. Also in rabbit does different gnawing materials were investigated. Maertens *et al*. (2013) studied the effect of wooden blocks supplemented with wood mash, wood mash + chicory pulp and wood mash + inulin syrup. The block consumption was higher in case of wood mash supplementation compared to chicory pulp or inulin syrup. The examined blocks had neither an effect on reproductive performance of does nor on feed consumption. In experiment of Rommers *et al*. (2014b) also different types of enrichment were compared: pen without enrichment, pen with pinewood stick, straw in a plastic bin, compressed wooden block and combination of straw and pinewood stick. They observed that straw was the most preferred enrichment (it was eaten by the rabbits), and wooden block was the less preferred. Abnormal behavioural patterns were not recorded when enrichment was used. The authors concluded that gnawing blocks could be considered as cage enrichment.

Generally, wood shavings are used as nest material, though sometimes other materials are applied as well. But, investigations showed that straw as bedding material is preferred by primiparous does (Blumetto *et al*., 2010). There were no differences between different bedding materials concerning litter size and weight at birth and at weaning (Oliveira *et al*., 2014). In Hungary, the application of different nest materials was investigated. Farkas *et al*. (2016a) examined the effect of different nest materials on performance of rabbit does (n=200 does). Hay, straw, wood shavings or Lignocel® (wooden, thin, long, fibrous material made by Rettenmaier & Söhne GmbH) were used for bedding the nest tray. The quality of nests was evaluated on 4-5 days after parturition based on a 1-5 scoring system (1: poorest; 5: best). The quality order of nests made of different materials was the following: hay (4.11), straw (3.76), Lignocel® (3.56), wood shavings (3.13) ($P<0.001$). The nest material did not influence the litter size (born total, alive, stillborn, at 21d), litter weight and individual weight of kits at 21d and suckling mortality (0-21d).

In other experiment (Farkas *et al*., 2016b) preference of rabbit does among different nest materials was examined. In each 1.0 x 0.91 m sized pen one rabbit doe and one empty nest box (0.37 x 0.23 m and 0.31 m height) and three 0.30 x 0.40 x 0.125 m racks were placed with 400 g nest materials: hay, straw or Lignocel®, in random order in the experiment 1 (n=27 does). In the case of the experiment 2 (n=20 does) two racks were used with hay or straw in the same scheme. The racks were made of wire mesh (mesh width: 2.5 x 5.0 cm and the openings were 5.0 x 25.0 cm). The experiments started on the 27th day of pregnancy. During the preference test it was observed that the frequency of nest material carrying occasions was the highest on the day of parturition. Most of the rabbit does used the Lignocel® nest material or mixed it with other nest materials. Straw and hay were not preferred so much to build a nest. In experiment 2, straw was much more preferred nest material by does than hay.

Also in preference test, the choice of rabbit does among nest boxes bedded with different nest materials was observed (Farkas *et al*., 2015). In a 1.0 x 1.83 m pen one rabbit doe (n=37 does) and four 0.37 x 0.23 m nest boxes were placed and bedded with different nest materials: hay, straw, wood shavings or Lignocel®, in random order. The experiment started at the 27th day of pregnancy, so rabbit does had at least three days for building the nest. It was observed which nest box bedding was preferred by the rabbit does for kindling and how often they carried nest material from one nest box to another one. Rabbit does kindled in pure Lignocel® nest boxes the most often. Much less does kindled in nest boxes bedded exclusively with hay or straw. None of rabbit does kindled into a nest box containing only wood shavings. Lignocel® was found in every mixed nest. The preference of Lignocel® was clear from the fact that 91.9% of nests contained it purely or mixed. Only 8.1% of the nests contained wood shavings (mixed with other material), which are generally used in every day practice. The percentage of nests with different materials were the followings: Lignocel® only: 40.5%; straw only: 5.4%; hay only: 2.7%; wood shavings only: 0.0%; straw + Lignocel®: 21.6%; hay +

Lignocel®: 10.8%; wood shavings + Lignocel®: 8.1%; straw + Lignocel® and hay: 5.4% and Lignocel® + hay and straw: 5.4%.

Summarizing the published results it can be finally concluded that the cages (size, equipment etc.) used in rabbitries are suitable for the production and at the same time do not impair the welfare of rabbits (Szendrő, 2006).

CONCLUSIONS

Single housing of does with kits will remain the common housing system in intensive rabbit production in the near future. The further development is focused on the enrichment of single boxes. A new combi system for does with kits and growing rabbits promises great benefits from the hygienic and welfare point of view and started to be used in the practice. Semi-group housing with defined consecutive periods of single and group housing is intensively studied at the moment but the problems caused by regrouping are not solved. Group housing of does with kits is characterized by a lot of problems and will not be used in intensive rabbit production in the near future.

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REFERENCES

Alfonso-Carrillo C., Martin E., De Blas C., Ibanez M.A., Garcia-Rebollar P., Garcia-Ruiz A.I. 2014. Effect of cage type on the behaviour pattern of rabbit does at different physiological stages. *World Rabbit Sci., 22, 59-69*.

Andrist C.A., Bigler L.M., Würbel H., Roth B.A. 2012. Effects of group stability on aggression, stress and injuries in breeding rabbits. *Appl. Anim. Behav. Sci., 142, 182-188.*

Andrist C.A., van den Borne B.H.P., Bigler L.M., Würbel H., Roth B.A. 2013. Epidemiologic survey in Swiss group-housed breeding rabbits: Extent of lesions and potential risk factors. *Prev. Vet. Med., 108, 218-224.*

Andrist C.A., Bigler L.M., Würbel H., Roth B.A. 2014. Masking odour when regrouping rabbit does: Effect on aggression, stress and lesions. *Livest. Sci., 170, 150-157.*

Barge P., Masoero G., Chicco R. 2008. Raising rabbit does in platform cages. *In: Proc. 9th World Rabbit Congress, June 10- 13, 2008 Verona, 1153-1157*.

Bigler L. 2004. Group housing of breeding and fattening rabbits in Switzerland. *In: Proc. 3rd meeting of WG2: Welfare and housing, COST Action 848, Wageningen, 7-8 May*.

Bigler L., Oester H. 2003. Gruppenhaltung in der Zucht: Viele Faktoren entscheiden über den Erfolg. *DGS Magazin, 23/2003, 48-50.*

Bignon L., Bouchier M., Coutelet G., Galliot P., Souchet C., Fortun-Lamothe L. 2012. Individual housing of young does in different sized cages: impact on welfare, economic costs and productive data. *In: Proc. 10th World Rabbit Congress, September 3 - 6, 2012 Sharm El-Sheikh, Egypt, 1045-1049.*

Blumetto O., Olivas I., Torres, A.G., Villagrá A. 2010. Use of straw and wood shavings as nest material in primiparous does. *World Rabbit Sci., 18, 237-242*.

Buhl M., Damme K., Hoy, St. 2015a. Ergebnisse zu einem kombinierten Haltungssystem für Häsinnen und Mastkaninchen. *In: Proc. 19th Int. Symposium on housing and diseases of rabbits, furproviding animals and pet animals, Celle May 27-282015, 58-67*.

Buhl M., Damme K., Hoy, St. 2015b. Erste Ergebnisse zu einem Gruppenhaltungssystem für Häsinnen mit Jungen. *In: Proc. 19th Int. Symposium on housing and diseases of rabbits, furproviding animals and pet animals, Celle May 27-28 2015, 229-236.*

Buijs B., Hermans K., Maertens L., Van Caelenberg A., Tuyttens F.A.M. 2014. Effects of semi-group housing and floor type on pododermatitis, spinal deformation and bone quality in rabbit does. *Animal, 8, 1728-1734.*

Buijs S., Maertens L., Hermans K., Vangeyte J., Tuyttens F.A.M. 2015a. Behaviour, wounds, weight loss and adrenal weight of rabbit does as affected by semi-group housing. *Appl. Anim. Behav. Sci., 172, 44-51*.

Buijs S., Hermans K., Maertens L., Tuyttens F.A.M. 2015b. Welfare effects of semi-group housing of rabbit does. *In: Proc. 19th Int. Symposium on housing and diseases of rabbits, furproviding animals and pet animals Celle, May 27-28 2015, 12-21*.

Dal Bosco A., Mugnai C., Castellini C., Laudazi S. 2004. A prototype of colony cage for improvement the welfare of rabbit does: preliminary results. *In: Proc. 8th World Rabbit Congress, September 7-10, 2004, Puebla, 1229-1234*.

Dalle Zotte A., Princz Z., Matics Zs., Gerencsér Zs., Metzger Sz., Szendrő Zs. 2009. Rabbit preference for cages and pens with or without mirrors. *Appl. Anim. Behav. Sci., 116, 273-278.*

De Jong I.C., Reimert H., Rommers J.M. 2008. Effect of floor type on footpad injuries in does: a pilot study. *In: Proc. 9th World Rabbit Congress, June 10-13, 2008, Verona, Italy, 1171-1175*.

Farkas T.P., Szendrő Zs., Matics Zs., Mayer A., Radnai I., Gerencsér Zs. 2015. Choice of rabbit does among nest boxes bedded with different nest materials. *In: Proc. 19th Int. Symposium on housing and diseases of rabbits, fur providing animals and pet animals Celle May 27-28 2015, 68-74*.

Farkas T.P., Szendrő Zs., Matics Zs., Radnai I., Mayer A., Gerencsér Zs. 2016a. Effect of different nest materials on performance of rabbit does. *In: Proc. 11th World Rabbit Congress, Qingdao, China 16-18 June, (in press).*

Farkas T.P., Szendrő Zs., Matics Zs., Radnai I., Mayer A., Gerencsér Zs. 2016b. Preference of rabbit does among different nest materials. *In: Proc. 11th World Rabbit Congress, Qingdao, China 16-18 June, 667-670.*

Graf S. 2010. Aspekte des agonistischen Verhaltens weiblicher Zuchtkaninchen in der Gruppenhaltung. *Thesis Univ. Gießen.*

Graf S., Bigler L.M., Failing K., Würbel H., Buchwaldera T. 2011. Regrouping rabbit does in a familiar or novel pen: Effects on agonistic behaviour, injuries and core body temperature. *Appl. Anim. Behav. Sci., 135, 121-127.*

Hoy St., Schuh D. 2004. Sociometric investigations in groups of wild and domestic rabbits with one buck and two or three does. *In: Proc. 8th World Rabbit Congress, Puebla, Mexico, 7-10 September, 1235-1240*.

Hoy St., Selzer D. 2002. Frequency and time of nursing in wild and domestic rabbits housed outdoors in free range. *World Rabbit Sci., 10, 2, 77-84.*

Hoy St. 2015. Aktuelle Forschung beim Kaninchen: anihwa-Projekt – Development and assessment of alternative animal friendly housing systems for rabbit does with kits and growing rabbits (RABHO). *In: Proc. 19th Int. Symposium on housing and diseases of rabbits, fur providing animals and pet animals, Celle May 27-28 2015, 32-42*.

Jordan D., Gorjanc G., Kermauner A., Štuhec I. 2008. Wooden sticks as environmental enrichment: effect on fattening and carcass traits of individually housed growing rabbits. *World Rabbit Sci., 16, 237-243.*

Jordan D., Gorjanc G., Kermauner A., Štuhec I. 2011. The behaviour of individually housed growing rabbits and the influence of gnawing sticks as environmental enrichment on daily rhythm of behavioural patterns duration. *Acta Agric. Slovenica, 98, 51-61.*

Machado L.C., Ribeiro B.P.V.B., Geraldo A., Heker M.M., Noronha C.M.S., Pimentel F.E., Silva I.M. 2014. Intelligent cage with nesting chambers for does. *V Congreso Americano de Cunicultura, México 2014, 465-469.*

Maertens L., Buijs S. 2013. Performances de femelles logées temporairement en groupe dans des parcs polyvalents et en système tout plein tout vide. *In: Proc. 15èmes Journées de la Recherche Cunicole, 19-20 novembre 2013, Le Mans, France, 35-38.*

Maertens L., Buijs S. 2015. Production performances of semi-group housed rabbit does. *In: Proc. 19th Int. Symposium on housing and diseases of rabbits, furproviding animals and pet animals Celle May 27-28 2015, 22-31*.

Maertens L., Buijs S., Davoust C. 2012. Gnawing blocks as cage enrichment and dietary supplement for does: performance, intake, and behaviour. *In: Proc. 10th World Rabbit Congress, September 3-6, 2012, Sharm El-Sheikh, Egypt, 1039-1043.*

Maertens L., Rommers J., Jacquet M. 2011. Le logement des lapins en parcs, une alternative pour les cages classiques dans un système "duo"? *In: Proc. 14èmes Journées de la Recherche Cunicole, 22-23 November 2011, Le Mans, France, 85-88.*

Maertens L., Buijs S., Davoust C. 2013. Gnawing blocks as cage enrichment and dietary supplement for does and fatteners: intake, performance and behaviour. *World Rabbit Sci., 21, 185-192.*

Margarit R., Finzi A. 2000. Setting of feeders, waterers and nest-boxes in two-floor cages for animal welfare. *In: Proc. 7th World Rabbit Congress, Valencia, 553-557*.

Mikó A., Matics Zs., Gerencsér Zs., Radnai I., Odermatt M., Nagy I., Szendrő Zs. 2012. Location preference of lactating rabbit does and their kits in pens with elevated platform. *In: Proc. 10th World Rabbit Congress, September 3-6, 2012, Sharm El-Sheikh, Egypt, 1029-1032*.

Mikó A., Matics Zs., Gerencsér Zs., Odermatt M., Radnai I., Nagy I., Szendrő K., Szendrő Zs. 2014. Performance and welfare of rabbit does in various caging systems. *Animal, 8, 1146-1152.*

Mirabito L. 2002. Le bien-être des lapines: impact de nouveaux systèmes de logement. *Journ. Nationale ITAVI, Elevage du lapin de chair, Nantes, France, 13.*

Mirabito L., Buthon L., Cialdi G., Galliot P., Souchet C. 1999. Effect du logement des lapines en cages rehaussées avec platforme: Premiers résultats. *In: 8émes Journ. Rech. Cunicole, Paris, France, 67-70.*

Mirabito L., Galliot P., Souchet C., Dumont F., Thomeret F. 2005a. Logement collectif des lapines reproductrices: Conséquences zootechniques. *In: Proc. 11émes Journ. Rech. Cunicole, Paris, France, 53-56.*

Mirabito L., Dumont F., Galliot P., Souchet C. 2005b. Logement collectif des lapines reproductrices: Conséquences sur le comportement. *In: Proc. 11émes Journ. Rech. Cunicole, Paris, France, 57-60.*

Mugnai C., Dal Bosco A., Castellini C. 2009. Effect of different rearing systems and pre-kindling handling on behaviour and performance of rabbit does. *Appl. Anim. Behav. Sci. 118, 91-100.*

Negretti P., Albani A., Finzi A. 2004. Location and social behaviour of young rabbit bucks. *In: Proc. 8th World Rabbit Congress, September 7-10, 2004, Puebla, Mexico, 1257-1262.*

Negretti P., Bianconi G., Finzi A. 2008. Mutual visual relationships of rabbits raised in individual cages. *In: Proc. 9th World Rabbit Congress, June 10-13, 2008, Verona, Italy, 1213-1216.*

Oliveira M.C., Mesquita S.A., Silva T.R., Lima S.C.O., Machado L.A., Oliveira H.C., Oliveira J.C., Oliveira E.S. 2014. Use of different materials for nest bedding of pregnant does. *V Congreso Americano de Cunicultura, México 2014, 156-160*.

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., 15, 29-36.*

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

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*.

Rommers J.M., Boiti C., de Jong I., Brecchia G. 2006. Performance and behaviour of rabbit does in a group-housing system with natural mating or artificial insemination. *Reprod. Nutr. Dev., 46. 677-687.*

Rommers J.M., de Jong I.C. 2011. Technical note: plastic mats prevent footpad injuries in rabbit does. *World Rabbit Sci., 19, 233-237*.

Rommers J.M., Kemp B. 2012. Effect of group-housing of young does during rearing on reproductive performance and aggression. A pilot study. *In: Proc. 10th World Rabbit Congress, September 3-6, 2012, Sharm El-Sheikh, Egypt, 1101-1105*.

Rommers J.M., Meijerhof R. 1998. La dimensions de la cage influence-t-elle la productivité et la bien-être des lapins. *Cuniculture, 25, 67-72.*

Rommers J.M., Gunnink H., Klop A., de Jong I.C. 2011. Dynamics in aggressive behaviour of rabbit does in a grouphousing system: a descriptive study. *In: Proc. 17th International Symposium on housing and diseases of rabbits, fur providing animals and pet animals, Celle, Germany, pp. 75-85.*

Rommers J.M., Kemp B., Houwers H.W., Gunnink H., de Jong I.C. 2012. Description of nestbox visits and suckling events in a group housing system for rabbit does as compared to individual cages. *World Rabbit Sci., 20, 231-240.*

Rommers J.M., Gunnink H., de Jong I.C. 2013. Effect of different types of places on aggression among does in a grouphousing system: A pilot study. *In: Proc. 18th International Symposium on housing and diseases of rabbits, fur providing animals and pet animals, Celle, Germany, pp. 59-68.*

Rommers J., Reuvekamp B.J.F., Gunnink H, de Jong, I.C. 2014a. Effect of hiding places, straw and territory on aggression in group-housed rabbit does. *Appl. Anim. Behav. Sci., 157, 117-126*.

Rommers J.M., Bracke M.B.M., Reuvekamp B., Gunnink H., de Jong I.C. 2014b. Cage enrichment: rabbit does prefer straw or a compressed wooden block. *World Rabbit Sci., 22, 301-309*.

Rosell J.M., de la Fuente L.F. 2009. Effect of footrests on the incidence of ulcerative pododermatitis in domestic rabbit does. *Anim. Welfare, 18, 199-204.*

Ruis M. 2006. Group housing of breeding does. *In: Maertens L., Coudert P. (Eds.) Advances in Rabbit Research. INRA/University of Valencia*.

Ruis M., Coenen E., 2004a. Group-housing of breeding rabbits in The Netherlands: an overview of research from 2002-2004. *In: Proceedings 3rd meeting of WG2: Welfare and housing, COST Action 848, Wageningen, 7-8 May*.

Ruis M., Coenen E. 2004b. A group-housing system for rabbit does in commercial production: a new approach. *In: Proc. 8th World Rabbit Congress, Puebla, Mexico, 7-10 September, 1501-1506.*

Schuh D., Selzer D., Hoy St. 2003. Einfluss der Gruppengröße auf das Sozialverhalten von Wild- und Hauskaninchen. *In: Proc. 13. Arbeitstagung über Haltung und Krankheiten der Kaninchen, Pelztiere und Heimtiere, Celle, Germany 14-15 May, 248-257*.

Seaman C.S., Waran K.N., Mason G., d'Eath B.R. 2009. Animal economics: assessing the motivation of female laboratory rabbits to reach a platform, social contact and food. *Anim. Behav., 75, 31-42.*

Selzer, D. 2000. Vergleichende Untersuchungen zum Verhalten von Wild- und Hauskaninchen unter verschiedenen Haltungsbedingungen. *Thesis, Univ. Giessen.*

Selzer D., Hoy St. 2003. Comparative investigations on behaviour of wild and domestic rabbits in the nest box. *World Rabbit Sci., 11, 13-21*.

Selzer D., Lange K., Hoy St. 2004. Frequency of nursing in domestic rabbits under different housing conditions. *Appl. Anim. Behav. Sci., 87, 317-324*.

Stauffacher M. 1992. Group housing and enrichment cages for breeding, fattening and laboratory rabbits. *Anim. Welfare 1, 105-125.*

Szendrő, Zs. 2006. Single housing of breeding does. *In: Maertens L., Coudert P. (Eds.) Advances in Rabbit Research. INRA/University of Valencia, 107-111*.

Szendrő Zs. 2012. New perspectives of housing reproducting and growing rabbits. *In: Proc.10th World Rabbit Congress, Sharm El-Sheikh, Egypt, 3-6 Sept, 979-996.*

Szendrő Zs., Matics Zs., Szabó R.T., Mikó A., Odermatt M., Gerencsér Zs. 2016. Aggressivity and its effect on lifespan of group housed rabbit does. *In: Proc.11th World Rabbit Congress, Qingdao, China 16-18 June, 719-722* .

Szendrő Zs., McNitt J.I. 2012. Housing of rabbit does: Group and individual systems: A review. *Livest. Sci., 150, 1-10*.

Szendrő Zs., Mikó A., Odermatt M., Gerencsér Z., Radnai I., Dezséry B., Garai R., Nagy I., Szendrő K., Matics Zs. 2013. Comparison of performance and welfare of single-caged and group-housed rabbit does. *Animal, 7, 3, 463-468*.

32/1999. (III. 31.) FVM *(Hungarian Ministry of Agriculture)* ministerial decree on the protection of farm animals, Hungary.

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Alternative housing systems for rabbit does

11th World Rabbit Congress
June 16, 2016 Qingdao

Steffen Hoy and Zsolt Matics

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Animal Health and Welfare ERA-Net

Introduction

- ✓ Breeding does are mainly kept in cages with wire net floor.
- ✓ In western countries, the discussion about animal welfare started and some governments enacted animal welfare legislation rules for rabbit husbandry (e.g. Austria, Belgium, The Netherlands, Germany, Switzerland…)
- ✓ The aim of the paper: overview about current developments in housing of does with kits with the following topics:
  - ✓ Group housing of does (continuous and semi-group housing)
  - ✓ Combined housing system for does and growing rabbits
  - ✓ Individual housing of rabbit does with special focus on new developments

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E, I, G, H

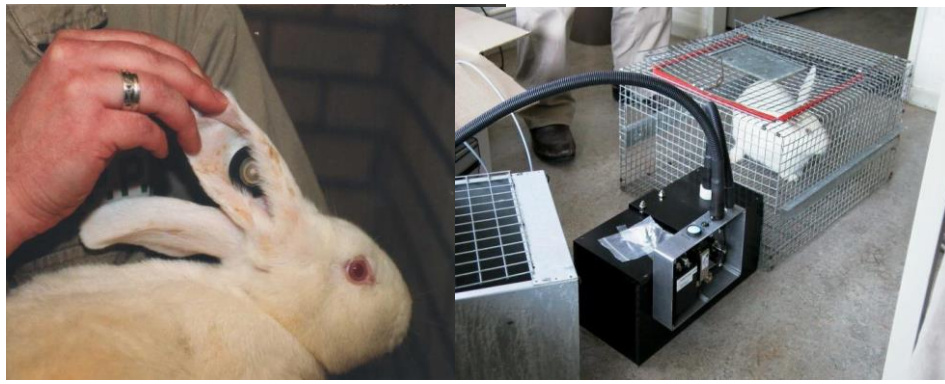
Continuous group housing

- ✓ Szendrö *et al.* (2013) compared single-caged (S) and group housed (G) does
- ✓ G resulted in lower kindling rate, similar litter sizes and higher suckling mortality
- ✓ In 18 % of cases a second doe kindled in the same nest box and destroyed the nest of the other.
- ✓ From the faeces of G does three times higher corticosterone concentration was detected. G had worse health status, higher rates of culling, shorter lifespan.
- ✓ In experiment of Andrist *et al.* (2013) G had low kindling rate and high occurrence of injuries caused by aggressive behaviour among rabbits.

Continuous group housing

(Ruis 2006; Rommers *et al.* 2012)

Prerequisite: electronic nest box recognition (chip in the ear)



Continuous group housing

(Ruis 2006; Rommers *et al.* 2012)

Single vs group housing of does with kits

(Ruis 2006, Rommers *et al.* 2012)

number of coccidiae oocysts in faeces

type	after 1 month	after 2 months	after 3 months
elevated seat from wooden board, straw	+	+/-	+/-
elevated seat from slatted floor, straw	+	+	+/-
elevated seat from slatted floor, straw rack	+/-	+/-	+/-
single housing, metal wire 2.5 mm diameter	+	0	0

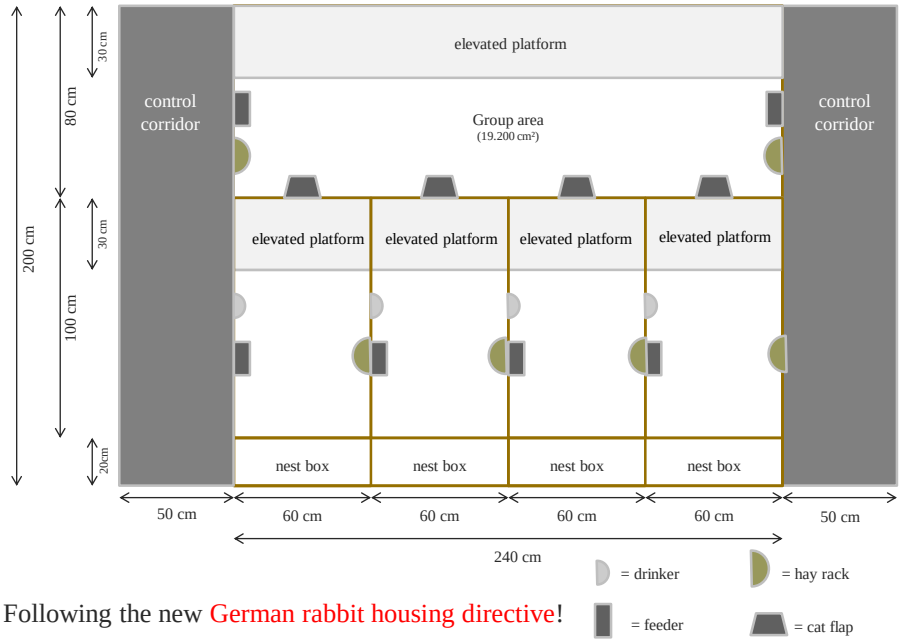
number of oocysts in faeces: many: +, less: +/-; no: 0

Problems of group housing of does with kits

(Ruis 2006, Rommers *et al.* 2012)

- high number of nest visits and behavioural disorders
- high kit mortality
- health control is difficult
- high risk of health problems (e.g. coccidiosis)
- replacement of does remains a problem leading to aggressive behaviour
- higher costs of production
- electronic identification and individual access to nestbox is essential for general function!!

Experimental group housing system (Buhl and Hoy 2016)



Following the new German rabbit housing directive!

Experimental group housing system

commercial cat flaps

at the entrance to the (individual)

areas with nest box

Results of group vs single housing of does with kits (Buhl and Hoy 2016)

Parameter	Group housing	Single housing	
litter size born alive	9.9	8.2	
birth weight (g)	66.0	64.6	
weaning weight (kg)	0.75	0.87	*
kit losses (%)	18.1	8.5	*

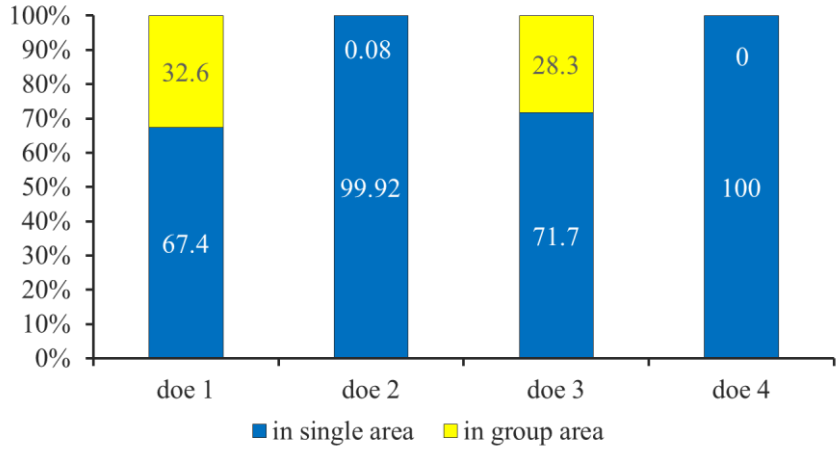
* $P < 0.05$

AND: not all of the 4 does used the group area, in each round in minimum one doe did not use the group area whereas the other 3 does used this area in a very different percentage of time.

Frequency of stay in single or group area

(4 does, round 2, one week before kindling until weaning)

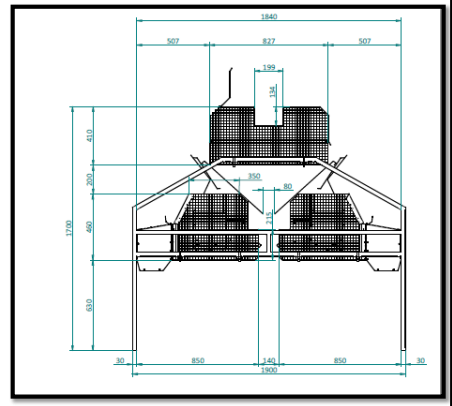
(Weigel, Buhl and Hoy 2016)

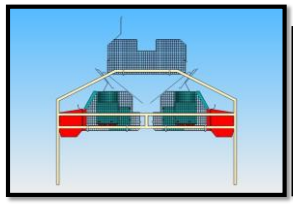


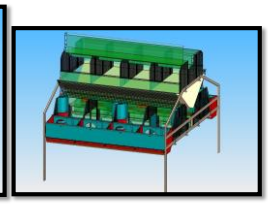
Investigations in Italy
Colony cage system

(Dal Bosco *et al*. 2016)

- ✓ 3 colony cage prototypes equipped with partition walls
- ✓ rabbit does were isolated 5 days before kindling till 1 week after it
- ✓ then they were housed in groups
- ✓ after weaning (30 days) does were moved in the colony cage on the upper floor, while young rabbits remained in group in the original cage





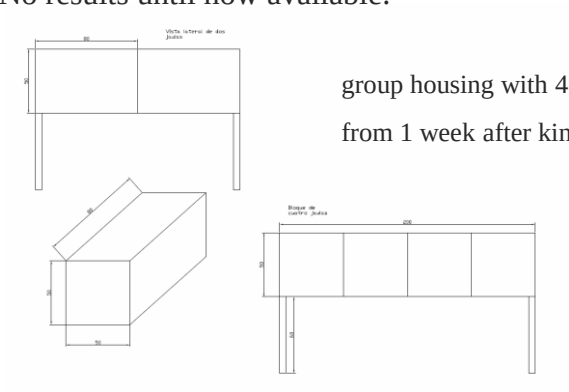


Preliminary results:

- ✓ reproductive performance was not affected
- ✓ sexual receptivity was satisfactory
- ✓ also number and weight of weaned kits

Investigations in Spain (Villagra Garcia *et al*., 2015)

Investigations on differently enriched single boxes (50 x 50 x 80 cm) and on group housing of does with kits take place.
No results until now available.



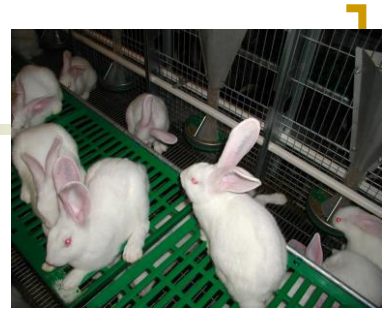
group housing with 4 boxes (50 x 50 x 80 cm), from 1 week after kindling

Semi-group housing in B and NL

- ✓ Semi-group housing = a pen system which allows temporarily group housing of does; does are alternately housed individually during some weeks and then in a group during some weeks (Buijs *et al.*, 2014; Maertens and Buijs, 2015).
- ✓ Maertens *et al.* (2011) did not find differences in performance between the variants (semi-group vs. single housing) regarding kindling rate, litter size and suckling mortality.
- ✓ Aggressive behaviour is a problem also in semi-group housing (Rommers *et al.*, 2011).
- ✓ Andrist *et al*. (2013) found aggressive behaviour among rabbits in group housing of does in 86 % of the Swiss farms.

Combined housing system for does and growing rabbits

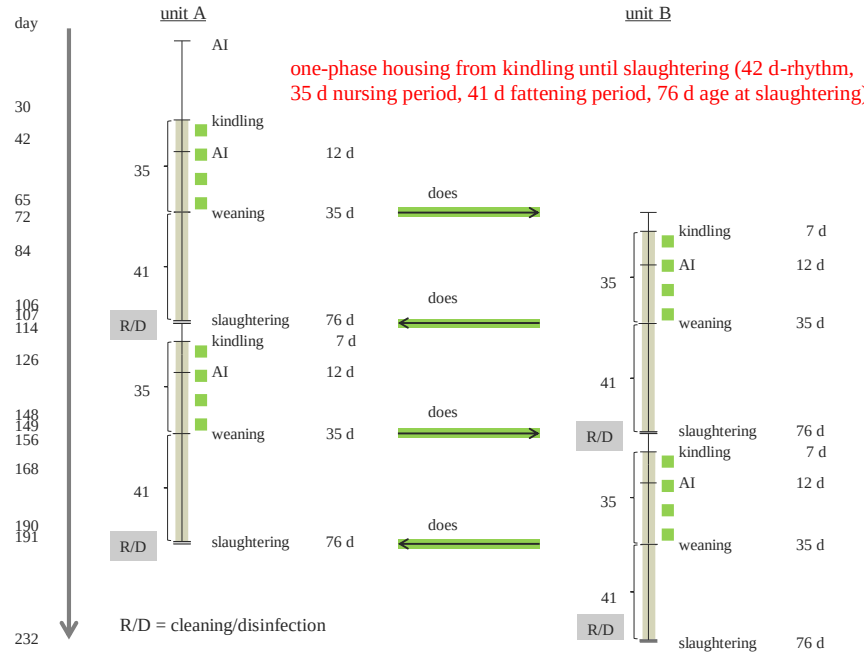
- ✓ Does are kept in single cages until weaning of the kits.
- ✓ After weaning of the kits the does but not the kits are transferred to another housing system and the side walls between cages are removed.
- ✓ The weaned rabbits are kept in large groups (4 or 8 litters) until slaughtering.
- ✓ Floor ➔metal mesh with foot pads or plastic grids.
- ✓ Elevated platform of plastic slatted floor
- ✓ Hayrack
- ✓ Same feeders for does and growing rabbits



Advantages of combi-system

- ✓ all in – all out after each round to interrupt chains of infection
- ✓ cleaning and disinfection in an empty unit is possible
- ✓ does are transferred, but not kits
- ✓ less weaning stress, weanlings remain in familiar surroundings
- ✓ rabbits are kept in the same system from birth to slaughtering

Cyclogramme of production



one-phase housing

from kindling to slaughtering

(combi-system,

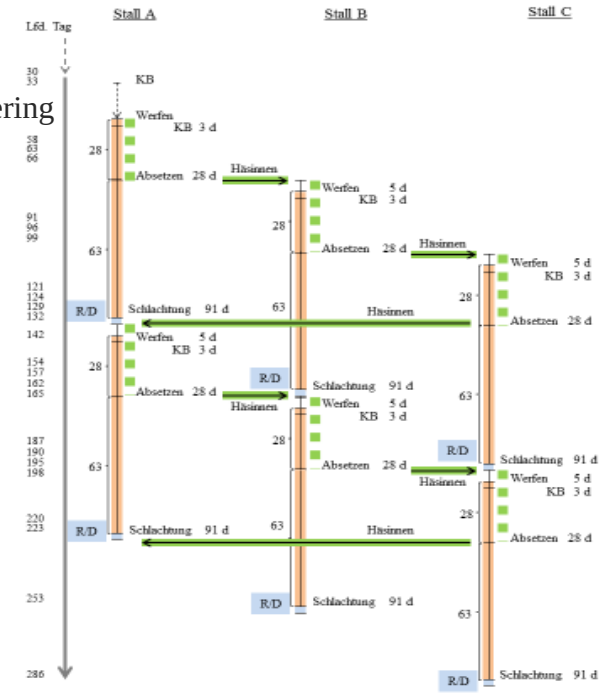
Meneghin, Italy)

33 d-rhythm,

28 d nursing period,

63 d fattening period,

91 d age at slaughtering



Performance and losses in groups from 4 or 8 litters (Buhl and Hoy 2016)

77 litters with 644 weanlings and 55 fattening days each round

		8 litters each group	4 litters each group	P
n		261	383	-
weaning weight	kg	0.88	0.86	-
final weight	kg	2.97	2.92	-
daily gain	g	38	37	≤ 0.01
feed conversion ratio	1:	3.62	3.69	-
losses	%	6.2	7.1	-

Frequencies of lesions in rabbits at slaughtering in groups from 4 or 8 litters

(Buhl and Hoy 2016)

n = 635		score for lesions at legs, sexual organs resp. 0 = without ……. 3 = severe			
		0	1	2	3
legs	%	99.7	0.3	0	0
sexual organs	%	94.2	4.3	1.3	0.3

Single housing of does with kits

- in cages with 40 - 45 cm wide, 85 - 95 cm length and 33 - 35 cm height, including nest box
- young and/or pregnant does are kept in somewhat smaller cages
- nest boxes, different litter materials – mainly wood shavings
- floor mainly made of wire net (2.5 – 3 mm diameter), partially covered with plastic foot-rest (to avoid footpad injuries)
- walls made of wire, sometimes also of solid metal (no visual contact between does)
- an elevated platform increases the floor surface – the third dimension seems to be more important than a larger space
- automatic feeders and nipple drinkers are used at rabbit farms

Conclusions

1. Single housing of does with kits will remain the common housing system ➔ development is focused on enrichment.
2. Combi system for does with kits promises great benefits from the hygiene and welfare point of view.
3. Semi-group housing is studied but the problems caused by regrouping are not solved.
4. Group housing for does with kits is characterized by a lot of problems and cannot be recommended yet.

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