Question to EURCAW-Poultry-SFA

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Background context provided by the solicitor

Considering the future steps on rabbit welfare legislation, the solicitor would like to have an up-to-date scientific input from the experts of the competent EURCAW-Poultry-SFA, who also possess hands-on knowledge on practical implementation of rabbit housing systems.

Question

For reproducing does, EFSA scientific opinion 2019 'Health and welfare of rabbits farmed in different production systems' concluded that part-time group housing system was not possible to recommend for implementation to farms, as existing knowledge was not sufficiently developed.

a. If adaptations to housing conditions were foreseen, would the part-time group housing of does (e.g. grouping at 25 days after kindling for a period of 10 days) be recommended from a rabbit welfare point of view?

b. Based on existing scientific knowledge, which of the parameters for such part-time grouping approach would be recommended (e.g. number of days with individual housing with the kits, stocking density, other relevant management measures) and ***for which parameters more knowledge would be needed****?*

Answer

According to EFSA (2020), the actual individual cage for breeding does cannot fully guarantee the welfare of rabbit breeding females, as it does not satisfy the space and social contact needs of these animals and thus, several studies have been conducted for the application of group housing of these animals. However, the last EFSA report (2020), in agreement with EFSA (2005), also states that "*continuous group housing systems for reproducing does cannot be recommended because of the decreased welfare associated to aggression and lesions among does and to kits in current housing conditions. Subsequent studies have shown that part-time group housing systems are also associated with high aggression among animals and high injury rates. Nevertheless, these systems may have potential, but existing knowledge is not sufficiently developed to recommend them for implementation on farms*".

Therefore, the use of parks/elevated pens for part-time grouping of does, which could undoubtedly provide more space allowance and promote social interaction, is far from being easily applied on a large scale under commercial current conditions.
In addition, apart from having constant visual contact with other females, it should be noted that reproducing does raised individually are not really always alone since they are with their kits moving freely in the cages for at least half of the reproductive cycle (starting from when kits exit the nest) when using an insemination 12 d post-partum, even if we are not talking about animals of the same age.

To fully address the queries regarding part-time group housing, an opinion request was sent by email to well-recognised scientific experts on rabbit welfare that are currently studying the feasibility and applicability of such type of housing system. A total of 15 experts were contacted, but only few of them replied with an extensive opinion. Their contributions were taken into consideration when preparing the two replies below which are referred to each of the two queries (a and b) reported above.

a) Domestic rabbits' behaviour has not been qualitatively changed by domestication and breeding therefore, they behave similarly to wild rabbits.
It is important to note that rabbits are gregarious and social animals, living in groups and forming sex-specific linear dominance hierarchies, which are established and maintained by intensive fights (von Holst et al., 1999). For female rabbits, this means, besides positive social contact, they also fight to establish hierarchy, territory and nesting sites. Fights could be particularly intense at the beginning of the reproductive season (time span between conception of the first and birth of the last litter of a year, which usually lasts 6 to 7 months, from March-April to September-October), but they tend to decrease with time (Albonetti et al., 1990; von Holst, 1999 von Holst, 2002), especially when the group of rabbits remains stable, which is a very common condition when rabbits remain in the natal territory (Künkele and Von holst, 1996).

After kindling, does stay near their burrows and are intolerant of other rabbit does and other kits as well. Moreover, infanticide of other doe's kits can occur. Under semi-natural conditions in a two hectare-size field enclosure with group densities varying from 6 to 36 females/hectare, the occurrence of infanticide was 7% more frequent in groups consisting of females of the same-age compared to groups having a heterogeneous age structure. According to the authors, the same-age groups probably led to social instability, which might have enhanced competition for breeding resources and therefore increased the risk of infanticide (Rödel et al., 2008). Interestingly, infanticide rate was not related with group density (from 6 to 36 females/hectare). Rabbit pups appeared only to be vulnerable to infanticide during the early nest period between postnatal days 1 and 10. Moreover, in the previous study, during the first 20 d of lactation aggressive interaction (chasing and displacing) between females occurred in the near proximity of the burrows. According

to the authors, both the competition for breeding burrows and the reduction of the future local density of juveniles around the breeding burrow of the female's offspring were the driving forces for the occurrence of infanticidal behaviour of females.

In a more recent publication by Rödel (2022), which studied female rabbit behaviour and reproduction under semi-natural conditions (two-hectare field enclosure), the frequency of agonistic behaviour in which females were involved increased during the early breading season with increasing group density (varying from 6 to 26 females/hectare, based on data collected from different social groups over three years), and was lower in groups with a more heterogeneous age structure, the latter confirming the results of the previous study. Furthermore, it can be noted from that field enclosure study that the average territory size occupied and defended by a social group was around 2500 m^2, thus, females, even within groups, were able to keep larger inter-individual distances. The author also highlighted the importance of the presence of litter siblings to improve the individual's social environment, which will be further described in the second answer. According to the review by Szendro and McNitt (2012) about wild European rabbits, living in group has some disadvantages that, however, are exceeded by the benefits. The most important benefits are decreased predation risk and cooperative construction of the warren. The most important costs are increased competition–aggressiveness among group members, the stress of sub-dominant females causing lower productivity, a higher probability of infection, more visibility to predators, and consumption of energy for their territory defence against other rabbits.

It is clear that, under farming conditions, some disadvantages, i.e., aggressiveness towards other females and the related stress during group housing, could be exacerbated by the space allowance provided, which cannot be obviously compared to the space available that does have in the wild (Szendro et al., 2019) and cannot permit does to obtain isolation from group mates.

As stated before, the wild rabbit does seek seclusion from the main group to raise their kits, and close proximity with other group members to the nest is not tolerated. Under farming conditions, due to space restrictions, low-ranking rabbits may not have a sufficient distance from more dominant animals which would not permit them to safely escape from aggression. As a matter of fact, the average distance between two wild rabbit does in a large semi-natural enclosure is 20.7 m (Cornelissen et al., 2011). Compared to this, in a large, well-furnished pen, the flight distance and possibility to withdraw is limited to about 3 m (Szendro and McNitt, 2012). Thus, group housing of does with their kits in currently used commercial farms could be considered a mismatch between the needs of does as social animals and their need to be isolated from the group to raise their kits.

Therefore, because of high stress, increased mortality and morbidity, and low productivity, continuous group housing cannot be applied under current farming conditions (Szendrő et al., 2013). However, there is a growing attention of researchers in order to find a better farming system

that could provide more space allowance and social contact for does. The most accepted solution for rabbit breeding females could be the mentioned semi-group housing (also known as part-time).

Part-time group housing consists of separating the rabbit does a few days before parturition and regrouping them again at mid-lactation, normally when the litters begin to leave their nests (EFSA, 2020). Although the part-time housing system is starting to be used in some European countries, it is reported from these countries that, when the systems are applied commercially, there are many problems of aggression and mortality in animals and a high increase in farm work and investment (Prof. Pascual Amorós, personal communication). Whereas the application of group systems for the growing phase is being currently applied, the level of application of group housing in females in those countries is still marginal (de Greef and Rommers, 2021; Maertens, 2022).

Although compared to individual housing, reproductive performances of group housing are lower (Szendrő et al., 2019) but part-time group housing allows social contact, expression of natural behaviours and locomotion (Buijs et al., 2015; Van Damme et al., 2021). But, as mentioned above, major challenges are associated with aggression, which remains the major problem for the implementation of this system. Aggressions occur since animals re-establish a dominance hierarchy, causing serious lesions and animal injuries during the regrouping period (Buijs et al., 2015; Szendro et al., 2019; Van Damme et al., 2021).

Another negative consequence of regrouping is the drop-in production performance (body condition of the rabbit does and the size and weight of the kits) from that moment on (Cervera et al., 2018; Huang et al., 2021a, 2021b; Machado et al., 2019; Van Damme et al. 2021). Moreover, group housing reduces fertility i.e., on average to 40%, far from the 75% usually found in commercial farms (Braconnier et al., 2020), and does not allow a proper management of the feeding strategy of pregnant vs non-pregnant does, which should be differentiated, leading to increased culling risk (Prof. Pascual Amorós, personal communication).

To summarise, currently, the main problem is focused on problems of aggressiveness at regrouping and both feeding and reproductive management. Consequently, partial-time housing of rabbit does could theoretically be the only viable group housing system in the future, only after verifying the real social needs of the does during the period when they are kept together (indicatively from 22-25d-pp onward). According to scientific literature and the expert opinion, this system cannot be yet commonly applied, considering both the welfare and the health of the rabbit does and their litters, and the viability of the system. Part-time group housing of does should be possible and is desirable from a welfare point of view but not in the current commercial housing systems or farm management.

Science and technology improvement should be done prior to application on the field. Gaps of knowledge and possible solutions are detailed in answer part b).

b) Although, as mentioned above, it is not possible to recommend the application for does of the

part-time housing system to date, based on the literature consulted and expert opinions, research has focused on the following aspects to try to improve this system and make it potentially applicable in the future.

Group size and group stability

As one of the main problems is aggression after regrouping, stable coexistence groups should be created. Aggressions, injuries and stress are lower when the group of rabbit does is maintained since its creation (Andrist et al., 2012; Trocino et al., 2021). Most trials indicate that the aggressions are higher in the first group formation, but they are reduced by a few in the following regrouping events over time (Trocino et al., 2016; Zomeño et al., 2017 and 2018). Moreover, the physiological state of the doe at the grouping time (i.e. pregnant, lactating and lactation stage, presence of the kits out of the nests) plays an important role (Prof. Trocino, personal communication). For example, in the study by Zomeño et al., 2017, the presence of the kits in the pens from the 18th d of lactation onwards and the kit-doe interactions might have affected the social relationships within the pen and, accordingly, helped to control the aggressive interactions among does.

Under semi-wild conditions, i.e., in a two hectare-size field enclosure with group densities varying from 6 to 36 females/hectare, Rödel (2022) by observing 4 pairings of litter siblings (3 twins, 1 trio) which stayed together in the same social groups, (from their early juvenile period until their first reproduction in spring during the following year), found that their presence (in a larger group) resulted in significantly more positive social interactions compared to other females of the same age but without sisters in their group. Interestingly, the positive interactions involved all the groupmates and not only sisters. This suggests that the presence of sisters in a group generally could improve the social environment of females, with potential positive effects for their welfare. Moreover, the author also found better reproductive efficiency when the female rabbits stayed in a group in which sisters were present (not necessarily “their” sisters); suggesting that due to social support, in particular by sisters (of the same litter), young females may have been better able to successfully cope with challenge, such as with stressful competitive intra sexual agonistic interactions during the early breeding season.

Some works have observed that when defining the group size in part-time housing systems, a larger group size negatively influenced the rank stability, i.e., better 3 than 5 females per group (Bill et al., 2020). Grouping three instead of four does (with their litters) (Van Damme et al., 2023a, 2023b) or two instead of four does (Trocino and Xiccato, unpublished data) resulted in less aggressive events and severe injuries among the does. The experimental design of Van Damme et al. (2023a, 2023b), however, could not disentangle whether this effect was caused by the reduction in group size and/or the reduction in stocking density (as both were confounded), whereas in Trocino and Xiccato (unpublished data) the number of animals per m^2 were constant while the group increases in size. Prof. Trocino’s research group (University of Padua, Italy) highlighted that the smaller the

group size, the lower the aggressive interactions (unpublished data). The safest solution for intensive farming based on results about injuries and lesions at the present moment was to keep does in couples in part-time systems.

Therefore, according to these results, keeping a couple of does in a part-time system could permit to satisfy social needs for reproducing does and minimizing negative interactions, but further studies are needed to better define the optimal group size and the best management.

Time of group formation

While it is clear that under farming conditions in part-time housing systems females must be separated at least 3 days before parturition to prepare an adequate nest for their litters, an important aspect to consider is when to regroup the does after kindling. Some studies have been performed comparing re-grouping at different times starting from 2 d after kindling and until 25 d. Braconnier et al. (2020a, 2020b) evaluated regrouping at 12-, 18- and 22-days post-partum (d-pp) of rabbit does inseminated at 10 d-pp. They observed very low fertility of these animals in part-time housing systems (on average 40%). In any case, the fertility observed was 35, 42 and 46% for those regrouped at 12, 18 and 22 d-pp. The occurrence of aggression seems to be reduced when re-grouping is done later in respect to kindling (Buijs et al., 2015; Trocino et al., 2021; Trocino e Xiccato, unpublished data). In some trials where grouping was done at 12 d-pp, the group-housing was interrupted due to the severity of fighting among does (Huang et al., 2021a, 2021b). Conversely, an excessive regrouping delay could also negatively affect locomotion and social relations as assessed by behavioural observations with infra-red camera; thus, Van Damme et al. (2022) recommend no more than 22 d-pp for grouping does. Indeed, they found that for the kits, the least number of injuries and the least severe injuries were observed when group housing started 22 days after birth (compared to days 25 and 28 after birth). However, even when grouped at the age of 22 d-pp and with only three does (and their litters) per group, the prevalence of injured animals was still high, as shown by the percentage of injured animals on the last day of grouping (does: 61.9% and kits: 18.4%) (Van Damme et al., 2023).
In addition, hormonal regulation of aggression doesn't seem to have a relation with grouping time. Specifically, Bracconier et al. (2021), determined the concentrations of testosterone, progesterone and oestradiol during the pregnant-lactating phase of does and analysed their relationship with the agonistic behaviour in order to determine an optimal time point for grouping. In particular, the frequency of aggressive behaviour (=aggression score) of the does was not correlated with the testosterone levels following grouping or with the progesterone concentrations in any of the treatments.
Therefore, assuming a reproduction cycle of 42 days (artificial insemination 10-11 post-partum), it would be advisable to group the does not later than 28 days post-partum. Any day later would shorten the time in the group to less than one week and is possibly too short for does to benefit

from group housing (considering the first days of hierarchy fights). Despite the low number of studies, if regrouping has to be performed, it has to be done between 18 and 22 d-pp to reduce the incidence of aggressions and increase fertility levels. However, the aggression and the decrease of fertility that are consequences of grouping are a challenge from both an animal welfare and farm viability point of view.

Space allowance and enrichments

It is well recognized that having more space improves the welfare of rabbit does and permits to better respond to the behavioural needs of rabbits for more space, whereas enrichments could provide places to hide in case of aggression. However, to date, the use of environmental enrichments, such as platforms or PVC pipes, has not been able to significantly reduce injuries and aggression among reproducing does, according to several studies performed in conditions close to commercial ones (Rommers et al., 2014; Van Damme et al., 2023a, 2023b). In the study of Van Damme et al. (2023a), the use of platforms was higher when group size and stocking density increased. According to Gerencsér et al. (2021), aggressions cannot be reduced even when pens with solid walls in the park were provided (the ratio of injured does during the whole period was more than 50% in all the tested pens).

To date, there is a lack of knowledge to determine what are the correct space requirements that can prevent the agonistic behaviour of rabbits.

Another behaviour that is not encouraged in industrial systems is burrowing for nest construction. Recent research from the Czech Republic conducted in smallholding conditions in a continuous housing system with natural mating, indicates that if does had the ability to dig burrows (group size=6) in a soil floor pen, the level of aggression, kit mortality and the number of injured kits were reduced compared to does housed together in a concrete floor (Krunt et al., 2023; Moravcsíková et al., 2022).

Based on technical elements exposed here, future research should focus on: designing enclosures that allow isolation of the does from aggressive group mates by specific design or by the inclusion of specific enrichments.

Management

Possibly, the implementation of part-time housing systems should be carried out in single batch handling systems[1]. Most of the modern integrated rabbit production systems in Europe are moving

[1] In a single batch system, all rabbit does of a barn are inseminated on the same day according to the reproductive rhythm, they will give birth on the same day, kits will be weaned on the same day and sold at the slaughtering age and weight at the same time. In the two-batch system, two groups of does are present in the same barn, while the timing

towards multipurpose pens in a single batch, e.g., all in all out (Szendrő et al., 2019; EFSA, 2020). In such systems, rabbit does are transferred after weaning, and the litter remains in the same pen until growing rabbits are slaughtered. This management system allows for sanitation (cleaning and disinfection), as well as improving the planning of on-farm activities.

In addition, experts outlined that part-time housing systems could be associated to difficulties in the feeding management of breeding does when kept during the periods of group housing which could impair their body condition and their health and welfare. In details, low-ranking breeding does could have difficulties to access feeders due to attacks from the other does and fear. Additionally, if groups with pregnant and not-pregnant does with different nutritional requirements would be kept together in the last period of the pregnancy (after the weaning of the litters), not-pregnant does could risk overfeeding (considering their nutritional requirements) which would be associate to a greater health risk and culling of the females. This is manageable by removing the non-pregnant does when kits are moved, leaving only the pregnant ones in the group. New individual feeding systems, coming from the new precision livestock farming tools, could be a solution in this regard. However, to date, no work has yet been carried out on rabbit farming and its potential implementation is still very far away.

Genetic selection

Research groups and genetic selection companies should work on selecting rabbit does for low aggressiveness criteria when housed in groups, which could improve the side effects of aggression and reproduction in this type of housing. However, this process is slow due to its probable low heritability, although we do not yet have studies in this regard. Some preliminary results (Trocino and Xiccato, not published data) showed some differences in aggression level during part-time housing between two genotypes characterized by different reproductive results, which could be associated to differences in milk production capacity and, thus, with the hormonal profile of does.
Additionally, Krunt et al. (2023) and Moravcsíková et al. (2022) found that the floor type in interaction with the genotype had a significant effect on aggressive behaviours in group housed does. In fact, by comparing two genetic lines and two different floor types (on-ground soil with deep litter vs concrete with deep litter), the lowest incidence of aggression was in the does of one genetic line housed in the ground soil; reduced aggression was reflected in a lower number of injuries in does ($p < 0.0001$), number of injuries in kits, and kit mortality ($p < 0.0001$; $p < 0.0001$). Moreover, in their study, body weight had a significant effect on the number of attacks among does, with heavier females attacking significantly more often than lighter females. Indeed, this trend was higher in Hyplus does, a hybrid line selected for higher growth. The results indicate that the proper

of the operations on the two batches is equal to half of the interval between two kindlings. This last system does not allow to perform the all-in all-out.

combination of genotype and housing should be carefully considered for breeding to reduce aggression and injury in group housed does.

To summarise, more information on group size is needed (to confirm that even keeping does in pairs could be acceptable from a welfare point of view), as well as on the types of enrichment and/or structural elements that could allow animals to escape and limit aggression.
About grouping time, there are sufficient information to state that grouping does between 22 dd-pp and not later than 28 dd-pp is the best option for partial regrouping. However, more information on genetics and production level/aggression/hormonal profile animal relationships is surely needed.
About space requirements, more research is needed in order to define the minimal area per does, by taking into account quality of movement prevention of restriction of movement quantity of movement and possibility of resting.
Moreover, there is also the need for more studies based on the social contact needs of rabbit breeding females according to positive and negative welfare indicators, including the evaluation of the impact on the breeding period as well as the severity of the negative welfare issue (i.e., aggression) versus the benefit (i.e., increased social relationships).

Conclusions

There is still very little validated knowledge to define a part-time group housing system for rabbit females that ensures both the health and welfare of the does and the kits. According to the expert opinion, part-time group housing for rabbit does, could bring some advantages in terms of social relationships between females but could be also challenging for the welfare of animal (fights and aggressions between females and towards kits).

The few studies that have been carried out to date mainly point to drawbacks of part-time housing, such as aggression problems and very low reproductive results, which are closely related to the stress of animals housed under such conditions. New scientific information on the effects of genetic selection (breeds and hybrid genetic lines) and management in part-time housing systems, with corresponding interactions, should be developed, but there is still uncertainty whether the acquisition of new knowledge regarding these methods can actually lead to acceptable standards of welfare and health of the animals and productivity.

To date, all scientific studies conclude that in part-time group housing aggression between does cannot be avoided in the current commercial breeding system with current animal genetics.
Consequently, with the current commercial housing systems and farm management, it is not recommended to house does in part-time housing systems since technical specifications to make this possible without compromising the health and welfare of does and kits are not available.

Future research should focus on an alternative system for female rabbits that could guarantee their welfare. In particular there is a need to define management, facilities and genetics that will ensure social relationships between the does and good exploration, foraging and resting possibilities, without group stress and injuries due to fighting between does or kits' aggressions.

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- Prof Angela Trocino (*Department of Comparative Biomedicine and Food Science, University of Padova*)
- Dr Frank Tuyttens (Animal Sciences Unit, ILVO)
- Dr Liesbeth G.W. Van Damme (*Animal Sciences Unit, ILVO; Department of Veterinary and Biosciences, Faculty of Veterinary Medicine, Ghent University*)

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