

New Housing Conditions: Improving the Welfare of Experimental Animals

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Summary — As animal experiments and testing are still a necessary part of the discovery and development of new drugs and do not seem likely to be totally replaced in the foreseeable future, it is important that the care and use of these animals are continuously refined. Since the housing facilities are where most experimental animals spend the major part of their lives, this area should be given special attention to ensure optimal welfare for the animals. In a unique collaboration between a pharmaceutical company and an animal welfare organisation, the housing conditions of mice, rats, guinea-pigs, rabbits and dogs, respectively, were reviewed with focus on the basic needs of the animals. Prototypes for new housing systems satisfying the most important of these basic needs of the animals were developed, with valuable input from international experts with special knowledge of the behaviour of experimental animals. These new housing systems and species-specific, newly introduced socialisation programmes contribute to improved animal welfare and a better occupational health of the animal caretakers. Since these new housing systems are more pleasant and appealing, they may also have the added benefit that they contribute to a broader public acceptance of the use of experimental animals.

Key words: animal welfare, dog, environmental enrichment, guinea-pig, mouse, rabbit, rat.

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Introduction

The principle of the Three Rs (*Reduction, Refinement and Replacement*), given by William Russell & Rex Burch in 1959, in their famous book *Principles of Humane Experimental Technique* (1), provides the foundation for a rational and stepwise strategy for the minimisation of animal use and of the suffering caused by that use without compromising the quality of the scientific work being done.

The Three Rs are a central part of Novo Nordisk policy for using experimental animals. As drivers of the implementation of the Three Rs, Novo Nordisk supports the Three C Principles (*Common sense, Commitment and Communication*) proposed by Coenraad Hendriksen in Bologna in 1999, at the Third World Congress on Alternatives and Animal Use (2).

Another central part in the Novo Nordisk policy is the wish for dialogue with key stakeholders. At the end of 1999, Novo Nordisk A/S and the Danish Animal Welfare Society established a unique collaboration on improving the welfare of experimental animals with the purpose of developing a common understanding of good animal welfare and to identify areas for improvement. Internationally recognised experts within animal welfare were invited for several workshops, in order to establish the most important needs of the animals in their natural habitat.

Based on the results from these expert workshops, new prototypes for housing of experimental

animals have been developed, which take into consideration the needs of the animals to a much larger extent than was previously the case.

Focus on Housing

The initial focus was on the housing conditions, partly because this was identified as very important for the well-being of experimental animals, and partly because of the negotiations in the Council of Europe concerning the revision of the *Convention ETS 123* guidelines for housing of experimental animals.

The housing conditions of mice, rats, guinea-pigs, rabbits and dogs were reviewed based on the needs of the animals, disregarding the existing housing systems, and financial and technical considerations. The identified basic needs of the animals were then prioritised, resulting in a description of how these needs ideally could be met in captivity.

The general main conclusions from the workshop were:

1. It is important for mice, rats, guinea-pigs, rabbits and dogs to have social contact with conspecifics.
2. It is important to have sufficient freedom of movement and a complex and enriched environ-

ment that allows for the natural species-specific behavioural patterns to take place.

3. The individual animal species have specific needs with regard to patterns of movement, control of surroundings, security, safety, occupation, resting and eating pattern.
4. The animal–human interaction must be considered.

The specific needs of the species

Mice

Mice are social animals that need to live in stable, harmonious groups. They prefer to be with conspecifics. It might be necessary to keep adult male mice separated due to aggression. Mice need to be able to rest, hide and build nests. Appropriate and sufficient nesting and bedding material must therefore be available. They also have a need for complex and challenging surroundings, e.g. to work for getting access to the feed, and for new and unpredictable things to happen. Mice are nocturnal animals and have a need for darkness.

Rats

Rats are social animals that need a structured and enriched environment with access to both hiding places and viewing places, as well as opportunities for rearing, gnawing, digging and grooming. Furthermore, it is difficult to estimate the exact basic needs of rats because of their strong adaptability to the actual environment and the difficulty of assessing how they actually feel.

Guinea-pigs

Guinea-pigs are social animals that should be housed socially in small groups. Guinea-pigs are “surface animals” and relatively anxious. It is therefore important for all individuals in a group to be able to hide at the same time. Another important need is the access to hay used for occupation and feed, as well as for hiding. It is also important for guinea-pigs to be able to walk on a solid, non-skid floor. They must have access to a feed containing extra vitamin C, and are generally very conservative in their choice of feed.

Rabbits

Rabbits are social animals. Female rabbits, castrated males and young animals can be housed socially, but

sexually mature male rabbits should be housed separately as violent fights might occur, during which the mature males try to castrate each other. To ensure social contact with conspecifics, it is therefore recommended that males be castrated. A basic need for rabbits is the ability to exercise, which requires sufficient space. Ideally, it should be possible for them to run, jump and make quick changes of direction. Rabbits also need to visually control the environment, e.g. by rearing, and to withdraw and seek shelter. In connection with food seeking or exploration of the environment, it is very important for rabbits to gnaw. According to the experts, the behaviour of digging is connected to the need for seeking shelter. If shelter is available, the possibility of digging is considered less important to the rabbit. Rabbits use the available space functionally, and they demonstrate ownership and make scent markings.

Dogs

Dogs are social animals that need to live in harmonious groups. It is important that early socialisation takes place, both with regard to the dog–dog interaction and the dog–human interaction. Dogs need predictability; therefore, training for daily routines, as well as for future experimental procedures should be performed. Dogs have a need for an enriched, functionally divided environment with opportunities for playing, resting and exercising. They need to be given various challenges and occupations, including searching for feed.

Fulfillment of the needs of experimental animals

To evaluate how the welfare of the experimental animals at Novo Nordisk could be improved, Environmental Enrichment Committees for dogs, rabbits and rodents were established, consisting of personnel from the animal facilities. Based on this work, and combined with the results of the workshop, the animal technicians made specific suggestions for prototypes for new housing systems, as well as management initiatives, satisfying the most important basic needs of the animals. In addition, the housing systems have been developed to ensure that the working conditions of the employees can be satisfied. In collaboration with a commercial company, some of the prototypes have been put into production. The principles of animal welfare today at Novo Nordisk can be seen in Table 1.

Mice

The needs of the mice can, to a certain extent, be covered in the existing type III and type IV macrolon

Table 1: The animal welfare principles employed at Novo Nordisk**General**

The housing of experimental animals at Novo Nordisk must ensure:

- Group housing wherever possible
- Housing and enrichment strategies that take into account the species-specific needs of the species housed. To ensure this, these needs should be established and evaluated regularly by Environmental Enrichment Committees focusing on each species
- That handling and observation of animals is facilitated with the least possible induction of stress to the animals. Appropriate socialisation of the animals should be provided
- That incompatible species or species requiring different housing conditions are not housed together

Contact with other animals

- Animals, except those that are naturally solitary, should be housed in harmonious groups of compatible individuals
- Single housing can be necessary if justified on veterinary or welfare grounds
- Single housing on experimental grounds should only happen after consultation with the responsible laboratory animal veterinarian
- If single housing is necessary, additional resources should be targeted to the welfare and care of these animals, and the duration of single housing should be limited to the minimum period necessary
- All singly housed animals must be allowed visual, auditory, olfactory and tactile contact with other animals whenever possible

Enrichment

- All animals must be allowed sufficient space of adequate complexity, and all animals must have a degree of control and choice over their environment to reduce stress-induced behaviours
- Environmental enrichment in animal enclosures must be appropriate to the species-specific and individual needs of the animals concerned
- The enrichment programme must be regularly reviewed and updated
- Animal care staff must understand the natural behaviour and biology of the species, so that they can make sensible and informed choices on enrichment

cages (800cm² and 1800cm², respectively). The optimal cage size will depend on the size of the mice, the group size and the extent of environmental enrichment. Further improvement of the cage may be obtained by using a commercially available 7cm extra elevated lid.

Rats

It is presently being investigated whether the existing type IV macrolon cage system can be further enriched by replacing the traditional lids with specially designed elevated lids that will increase the height of the cages from 18cm to 30cm. This will give the rats the opportunity to visually control the environment, rear and perform grooming in this position (Figure 1).

A shelf is supplied to give the rats more possibilities for exploring, exercise, jumping and having observation opportunities. Furthermore, the shelf provides better hiding possibilities for the rats. The possibilities of connecting the cages with tunnels, and thereby extending the space and increasing the complexity of the environment, are presently being evaluated.

Guinea-pigs

In the new prototypes for housing of guinea-pigs, the flooring area is, depending on group size, 75 or 150cm × 200cm and covered with a thick layer of bedding and plenty of hay and wood wool (Figure 2). Multiple shelters in various shapes are available, all of them big enough to shelter several animals. The guinea-pigs are provided with wooden blocks for biting and are fed apples, carrots, and/or cucumbers daily as a part of their standard diet. The housing system can, with flexible partition walls, be divided into smaller units in order to keep appropriate group sizes. Some of the partition walls have pop holes, allowing passage of the animals and giving the animals a sense of security by walking along a wall. In most of the prototypes, the partition walls are, in addition, smoke-coloured to increase the feeling of security, meaning that this system covers all the prioritised needs of the guinea-pigs.

Rabbits

The new prototype for housing of up to eight rabbits is designed with a flooring area of 150cm ×

200cm, with a flexible partition in the middle and pop holes allowing the rabbits to freely run through. If housing of smaller groups of rabbits is needed, or if the rabbits must be handled, the pop holes can be closed (Figure 3). A shelter is placed on each side of the partition, allowing the rabbits to hide or hop on top. The shelters are open at both ends, allowing the rabbits to run through. The floor is solid and non-skid (vinyl cover with a rough

surface) and covered with a thick layer of bedding and cut straw or hay. In addition, hayracks where straw or hay is supplied are installed to cover the need of searching for food. The rabbits are occupied with pulling the straw or hay out of the hayracks. The rabbits are also provided with wooden blocks for gnawing. The housing system slopes toward the rear end, allowing urine and water from nipples to be drained into an outlet. The housing system can

Figure 1: Prototype for new rat cage compared to conventional type IV macrolon cage



a) The new lid of the prototype (left) increases the total height of the cage from 18cm to approximately 30cm. This allows the rats to rear and groom. A conventional type IV macrolon cage is shown on the right.

b) Provision of a shelf gives the rats more choices. Hiding and nesting opportunities are provided under the shelf and the rats use it extensively to lie on.

Figure 2: A pen for group housing of guinea-pigs

Traditionally, guinea-pigs are housed in type IV macrolon cages (see right side of Figure 1a). The pen system not only gives more space but also allows group housing and provision of shelters. The flexible system can be divided into smaller sections, depending on group size.

Figure 3: A pen for group housing of up to eight rabbits

The floor area of the pen is 200cm × 150cm. On each side of the middle partition, a shelter has been placed where the rabbits can either hide or sit on top. The shelters are open at both ends and divided in two, giving the opportunity for two rabbits to rest at the same time. The rabbits are provided with wooden blocks for gnawing, and they are given carrots. Hayracks are installed so the rabbits can use time to pull out the hay themselves.

Table 2: The rabbit pen model gives optimal conditions for execution of normal behaviour**Social behaviour**

An opportunity for social interaction and establishment of a hierarchic group. Behaviour such as allo-grooming, snuggling against each other, olfactory control, threat, chase, biting, fighting, etc. are allowed

Physical displays

The pen gives the rabbits opportunity for activity and for resting. They can hop, run, jump and make quick direction changes, and because of the free height they can move in more than one level

Need for security, safety, resting place and nest building

The shelters (“Stauffacher tables”) are covering all these needs and are very important as hiding places, as group housing will cause some hierarchical fights. The construction of the pens in two parts allows even more hiding opportunities

Control of environment

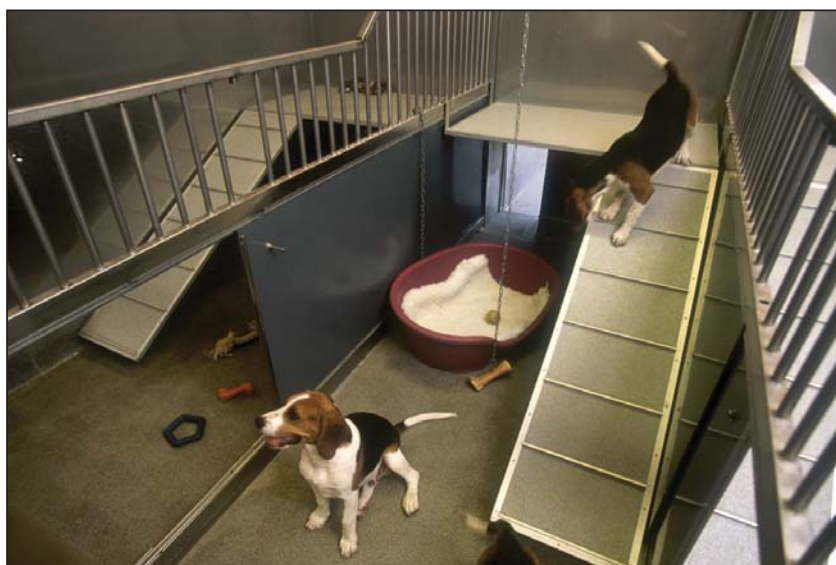
The rabbits can sit upright, rear, sniff, do locomotion and stamp. They can scent mark the “Stauffacher tables” and jump on them to obtain a clear view of the surroundings

Occupation & challenging environment

An opportunity for gnawing (wood blocks/carrots), playing, manipulation of resources, searching and exploring of the pen, and they can build a nest (straw)

be divided into four sections by adding one more partition across the system. In this housing model, all the prioritised needs of the rabbits are covered, apart from the need for free reproduction, as male and female rabbits will not be housed together. It is not advisable to keep sexually mature male rabbits together, while castrated male rabbits can be kept in the same kind of housing system as the females. If it is necessary to use uncastrated male rabbits

for experiments, these rabbits can be housed separately in sections of the housing systems. The pen is raised from the floor to table height, giving better working conditions for the employees, and it is presently being evaluated how to minimise the allergen exposure as much as possible. Table 2 highlights the optimal conditions for execution of normal behaviour that the rabbit pen model provides.

Figure 4: The enriched indoor pens for group housing of dogs

One dog is on the floor and another dog is on its way down from the platforms that are often used for resting or observation. All pens are equipped with dog beds, cushions, and various kinds of toys for playing, biting and amusement.

Figure 5: Outdoor grass enclosure for dogs

All dogs have access to a 2000m² outdoor exercise area 5–7 days a week for a minimum of 1–2 hours. The exercise area is equipped with “pig huts” with flat roofs and chutes, hills with drain pipes, stone formations and trees.

Dogs

The dogs are housed in pens, each consisting of an indoor area of 3.5m², permanently connected through a hatch to an outdoor pen of approximately 2m². The individual pens can be connected in a flexible way, allowing dogs to be standard group housed, but still fed individually. All mature dogs are typically housed in harmonious groups consisting of 2–4 animals each.

All the indoor pens are enriched with platforms and ramps, which provide a choice of resting place and observation opportunities, offering the dogs visibility across the room (Figure 4).

The pens are equipped with dog beds and changeable cushions, and spring chains hanging from the ceiling allow for provision of changeable bones and toys for playing and chewing. The dogs are given various other types of toys for playing and biting, as well.

To fulfil the need of adequate space for exercise and recreation, all dogs have daily access, in harmonious groups, to a 2000m² outdoor enclosure for a minimum of 1–2 hours (Figure 5).

The outdoor grass enclosure includes: a) pig huts with flat roofs that provide resting and observation opportunities, b) huge banks with underground tunnels, c) small stone formations used for observation, and d) trees and big logs for playing and marking.

To further fulfil the need of various challenges and activities, the dogs are now individually fed

directly on the floor in the pen — and once weekly in groups by spreading the food in the outdoor enclosure. In addition, they are offered bones and dried fish for chewing and amusement, and they are taken for walks on a leash either alone or in small groups in the surrounding farmland.

A three-step, age-divided socialisation programme has been introduced to fulfil the need of early socialisation and on-going training, as well as to fulfil the need of close social interaction with humans. The early socialisation programme is applied to puppies from three to ten weeks of age in collaboration with the Novo Nordisk dog supplier and includes: a) daily physical contact with humans while cleaning and feeding, b) weekly play and close physical contact with humans within the litter, and individually, according to age of the puppies, and c) familiarity with normal sounds and disturbances. The mid-socialisation is applied to young dogs from the day of arrival (ten weeks of age) until maturity and includes: a) daily physical contact with humans while cleaning and feeding, b) either play with the whole housing group or other close physical activities with humans five times (mid-socialisation) or twice (adult socialisation) a week for 15–30 minutes, and c) individual playing, going for a walk or training for the future (mid-socialisation) or on-going training for experimental procedures at least twice a week for 15–30 minutes. The adult socialisation programme is, with minor modifications, as mentioned above, identical to the mid-socialisation programme.

Conclusions

The Three Cs, Common sense, Commitment and Communication, should be drivers for the implementation of the Three Rs (2). This paper is one way to deal with the last “C”, and without Commitment from all involved in this project, it would never have resulted in new housing conditions. Scientific proof is often mentioned as a prerequisite for introducing new environmental enrichment ideas, and unfortunately, this often stops further progress. We have tried to use common sense when translating the experts’ view of the animals needs into new housing conditions. However, we will now also evaluate the systems using the traditional testing of scientific hypotheses.

We believe that the new prototypes will cover the basic needs of the animals to a much higher degree than the traditional cage systems, and we therefore recommend that these prototypes should be evaluated as possible new standards for housing of experimental animals. Beyond ensuring much better welfare of the animals, the new systems are much more pleasant and inviting, and therefore, contribute to a better occupational health of the

animal technicians, as well as contributing to a broader acceptance by the public of experimental animal use.

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