GV-SOLAS
Gesellschaft für Versuchstierkunde
Society for Laboratory Animal Science

Specialist information

from the Committee for Humane Laboratory Animal Housing

Species-specific housing of laboratory hamster

November 2020

Authors: Max Busch, Sabine Chourbaji, Philipp Dammann, Karin Finger-Baier, Susanne Gerold, Andreas Haemisch, Paulin Jirkof, Anja Osterkamp, Sybille Ott, Saskia Peters, Karin Spekl, Angelika Richter, Franziska Richter-Assencio, Elke Scheibler, Christine Spröte

Contents

1. Biology

Hamsters range in distribution from East Asia through Eurasia to Central Europe. Four genera with 12 species are known (Weiss et al. 2014).

The Syrian or golden hamster (*Mesocricetus auratus*) is the species most commonly used as a laboratory animal. In the early 1930s, the Syrian hamster was first used as an animal model for the diagnosis and experimental research of visceral Leishmaniasis (GV SOLAS 2009). In 1931, Saul Adler published the first scientific article on the golden hamster as a laboratory animal (Adler 1931). A large number of outbred and inbred strains are used for research purposes today (Weiss et al. 2014).

The Chinese hamster (*Cricetulus griseus*), the European hamster (*Cricetus cricetus*), the Roborovski hamster (*Phodopus roborovskii*), the Campbell's dwarf hamster (*Phodopus campbelli*) and the winter white dwarf hamster or Djungarian hamster (*Phodopus sungorus*) are of minor importance in research.

This information focuses in particular on the Syrian hamster because of its relatively frequent use; however, special aspects relevant to the housing of other hamster species will be considered in the appropriate chapters.

With the exception of *Phodopus*, hamsters are solitary animals, unlike other laboratory rodents. For this reason, they can only be housed in groups until they reach sexual maturity. Adult hamsters react aggressively to conspecifics outside the mating season (Vivien-Roels 1992, Weiss et al 2014). Hamster species of the socially tolerant genus *Phodopus* may be housed in permanent mating pairs, and housing with littermates of the same sex is also possible.

Hamsters have poor vision, but their good sense of smell and hearing enables them to explore their environment (Wolfensohn 2013). Syrian golden hamsters have a hearing range from 32 Hz to 50 kHz (96 Hz - 46.5 kHz at 60 dB SPL) with the greatest sensitivity (1 dB SPL) at 10 Hz (Heffner et al 2001). Since hamsters are long-day breeders, it is important to maintain a daily light period of 12-14 hours for an optimum reproduction rate. Hamsters cannot perceive the long-wave red region of the light spectrum (> 580 nm) and, like mice, are crepuscular and nocturnal animals. Golden hamsters are so-called facultative hibernators, i.e. under certain environmental conditions they fall into hibernation (hibernation). This may be induced by low ambient temperatures, short periods of daylight, seclusion, nesting material and appropriate food supplies (Hubrecht 2012).

Table 1: Morphological, physiological and reproduction biology data, Syrian hamster (Weiss et al. 2014)

	Hamster
Body weight	W: 165 – 180 g M: 130 – 150 g
Body temperature	37 – 39°C
Head-trunk length	15 – 17 cm
Tail length	1.2 cm
Respiratory rate	50 – 120 breaths/min
Heart rate	250 – 500 beats/min
Blood pressure	170 / 120 mmHg
Sexual maturity	M: 7 – 9 weeks W: 4 – 6 weeks
Breeding maturity	56 (W) – 70 (M) days
Oestrus cycle	every 4 – 5 days for approx. 6 h (4 – 23 h)
Gestation period	15 – 18 days
Litter size	3 – 16 young
Weaning age	18 – 21 days
Weaning weight	20 – 55 g
Daily food intake	Growth phase: 6 –12 g / animal Maintenance phase: 8 –12 g / animal Breeding phase (heavily pregnant, lactating dams): approx. 15 g / animal
Daily water intake (water to be provided *ad libitum*)	8 – 10 mL/ 100 g b.w.
Daily urine volume	6 – 12 mL / animal
Chromosome number (2n)	44
Life expectancy (depending on strain, gender and nutrition)	2-3 years, max. 4

2. Housing type and space requirement

The minimum cage size requirements in the case of hamsters used for scientific purposes are specified in ETS 123 (Council of Europe 2006) and Directive 2010/63/EU (Council of European Union 2010). The Type III cage (800 cm²) is the smallest permissible housing unit (see Tables 2 and 3). For the installation of feed stores and latrines, the cage area offered should provide for appropriate compartmentalization.

When it comes to group housing, the maximum stocking density of the cage must be observed. For example, if the animals have a body weight of more than 100 g, each animal should be provided with at least 250 cm² of floor space, so a maximum of three adult hamsters may be housed in a Type III cage. In this context, the differences in body weight of various hamster species must be taken into account (European hamster up to approx. 500 g, Syrian hamster up to approx. 150 g and dwarf hamster species up to approx. 60 g (Weiss et al. 2014)).

Table 2: Minimum dimensions and space requirements in the case of hamsters used for scientific purposes (Council of Europe 2006, Council of European Union 2010).

	Body weight (in g)	Minimum cage size (in cm^2)	Floor space per animal (in cm^2)	Minimum cage height (in cm)
In feed storage and in experiments	≤ 60 60 – 100 > 100	800 800 800	150 200 250	14 14 14
Reproduction		800 Mother or monogamous pair with litter		14
Feed storage at the breeders[1]	< 60	1500	100	14

[1] Hamsters may be housed at these higher stocking densities for the short period between weaning and handover. Housing conditions must not compromise animal welfare, e.g. by causing increased aggression, morbidity or mortality, stereotypic behaviour and other behavioural deficits, weight loss, or other physiological or behavioural stress responses.

2.1. Single or group housing

Littermates can be housed together until they reach sexual maturity. Keeping them in groups beyond this point is only advisable if the group is stable and harmonious. It should be borne in mind, however, that 1.) within a few hours aggression can lead to serious injuries and even the death of individual group members and 2.) this usually happens during the activity time of the animals, i.e. in the dark phase when no staff are present. For sexually mature solitary species,

single housing is advisable (Skirrow 1976). Socially tolerant species, such as *Phodopus roborovskii* or *Phodopus campbelli*, can be housed permanently as breeding pairs or in groups of same-sex littermates. Nevertheless, watch for signs of non-harmonious groups, such as separate sleeping nests, weight loss or increased activity during the light phase.

2.2. Handling and moving animals

As hamsters are nocturnal, they usually sleep during the light phase. They should not be suddenly disturbed in their sleep.

Hamsters can be restrained relatively calmly when gripped around the neck. A more species-appropriate means of moving an animal to another cage is to use a bowl. Other techniques are to pick up the animal in the palm of the hand or to put the open hand over the animal, grasping it with the fingers around the abdomen and thorax, with its head resting in the wrist. This restraint is suitable for sexing the animals. For oral administration, intraperitoneal injection and other manipulations, hamsters may be restrained by holding them firmly by the scruff of the neck and the dorsal skin so that the freedom of movement is briefly restricted and injuries can be prevented.

Hamsters can inflict serious bite injuries. It may be advisable to wear protective gloves (Hubrecht 2012).

2.3. Housing during the rearing phase

Hamster-specific data regarding reproduction biology can be found in Table 1.

In nature, male and female golden hamsters only come together for copulation. It has proved advantageous to put the females together with the males and leave them there for a short time (if compatible, then up to 3 days for older animals, but at least 4 days for young animals). Type IV cages are recommended. The animals that mate should be observed carefully to prevent possible bite injuries. Alternatively, a mating box with escape facilities can be provided. This offers the advantage that the males can usually be housed with the female for 7-10 days without major problems. The mating box (area 2.50 m x 1.20 m) is also well-suited to field hamsters.

With the so-called hand-mating technique, the female is paired with the male at the end of the light phase/beginning of the dark phase under observation and removed again after the copulation phase of about 30 minutes to reduce the risk of bite injuries.

The time-consuming cytodiagnostic assessment of the cycle stages can be dispensed with, since a cloudy white discharge can be detected after ovulation, indicating the end of oestrus. Occasionally, permanent monogamous mating after weaning is also suitable. (Hubrecht 2012).

With a gestation period of 15 to 18 days (in older animals), the hamster has the shortest gestation period among laboratory rodents (see Table 1). Once the litter is weaned after 21 days, a new oestrus already occurs within 4 to 5 days, so a period of 6 weeks between litters is both possible and practicable (Weiss et al. 2014).

3. Cage equipment

3.1. Bedding and nesting material

Bedding and nesting material and also shelters are essential for hamsters and not only during gestation, so they should always be available, unless contraindicated for experimental reasons.

Bedding fulfils various purposes. For rodents in particular the satisfaction of species-specific digging and burrowing behaviour must be taken into account. In addition, building a nest from bedding and nesting material offers the possibility of creating a micro-environment for resting and reproduction. Deep bedding is popular, but tubes should also be used at the same time for stabilization. Nesting material is required both for hamsters and for other rodents according to ETS 123 (Council of Europe 2006).

Moving the animals to a new cage has the advantage not only of removing them from contaminants, but also of allowing them to be thoroughly assessed on a regular basis in addition to daily checks on their general condition. As a rule, animals are moved to clean cages with fresh bedding once a week. Extending the transfer intervals to two weeks is hygienically justifiable under certain circumstances (e.g. singly housed golden hamsters or dwarf hamster breeding pairs in Type IV cages), but the daily visual inspection check should not be neglected here (GV SOLAS 2007).

Animals immediately before the litter date and females with a fresh litter should not be moved, as this may lead to the young being rejected or cannibalized (Weiss et al. 2014). The lactating mother should not be disturbed up to at least 7 days post partum (Wolfensohn 2013).

3.2. Enrichment in the hamster cage

Environmental enrichment, i.e. the provision of an environment enriched with retreats (e.g. tubes, houses), stimuli for exercise (e.g. climbing frames, running wheels) and/or the satisfaction of gnawing and nest-building needs (e.g. pulp, straw, hay, pieces of wood), should enable the animals to enjoy their natural behavioural repertoire and thus serve to satisfy physiological and ethological needs. A low-stimulus environment can cause behavioural changes and physiological disturbances and compromise not only the welfare of the animals but also the validity of the scientific data collected. The advantages and disadvantages must be careful weighed for each individual enrichment measure. The same applies to potential impairment of hygiene through non-standard forms of enrichment, e.g. hay. Figure 1 shows an example of an enriched Type IV cage.

Hamsters in bedding depths of 10 cm (compared to a depth of 40 cm and 80 cm) show significantly more frequent wheel running and gnawing of cage wire. Since the gnawing of cage wire in particular is seen as a sign of inadequate husbandry, deep bedding may be recommended for golden hamsters (Hauzenberger 2006).

Fig. 1: Type IV cage with two little huts for temporarily paired breeding animals (Syrian hamsters), for example with various suitable types of enrichment and sunflower seeds

It remains unclear whether running in the wheel is to be interpreted as a stereotypy, as a natural compensation of the need for physical activity or as exploratory behaviour (Mather 1981, Sherwin 1998). The more structures that are offered to the animals, the less pronounced the wheel-running behaviour (Reebs 2003).

Nest-building materials and retreats are standard features of hamster cages (Council of Europe 2006). In breeding cages of temporarily paired golden hamsters, both animals must have their own shelter in order to provide a refuge from possible aggression by the other sex. (Weiss et al. 2014). Our own observations show, in contrast, that offering further shelters to socially tolerant dwarf hamsters in group housing induces territorial aggression. A second shelter is only advisable if there is already a new litter in addition to an older one.

Additional structures such as tunnels or gnawing sticks of wood to satisfy the need for gnawing are recommended. A sand bath may be provided and is used extensively by some hamster species.

To give the animals the opportunity to forage, sunflower seeds or the like may occasionally be distributed in the cage, subject to hygiene and dietary requirements permit. However, sunflower seeds are high in calories and can lead to obesity, which has a negative effect on fertility (Rousseau 2003). Millet is a possible alternative (Wolfensohn 2013).

4. Physical environment

Table 3: Reference values for environmental factors in animal rooms (Balk 1987, Council of Europe 2006).

	Hamster
Temperature in animal room	22 (± 1)°C
Humidity in animal room	45 – 65%
Air changes	10 – 20 ACH
Lighting	150 – 225 lux in the room (in the case of albinos < 60 lux in the cage) Low-intensity fluorescent tubes at 486 nm
Light-dark rhythm	Light phase between 12 and 14 hours (no change in summer and winter time)

4.1. Lighting

Hamsters are long-day breeders, a light period of 12-14 h per day is required for breeding (Hubrecht 2012).

During the dark phase, red light should be used, if need be, to avoid disturbing the circadian rhythm (see chapter 2). In the literature, there is no specific information on light intensities for hamsters, so the values for rats are used here.

4.2. Temperature

The room temperature should be maintained at 20-24°C as specified in ETS 123 (see also Hubrecht 2012). These values only apply to healthy adult animals. Newborn, young, sick or injured animals or animals that have recently undergone a surgical procedure require correspondingly higher temperatures, at least in the nest. Deviations of more than 2-4°C affect physiological parameters such as blood flow, calorie consumption, feed intake and metabolic rate as well as the resting behaviour and spontaneous motor activity of the animals (GV SOLAS 2004).

4.3. Humidity

The relative humidity in rodent facilities should be between 45% and 65% (Council of Europe 2006). Values that fall below 40% and values that exceed 70% are acceptable for a short period if need be (Balk 1987).

4.4. Air change rates

An air change rate of 15 to 20 ACH is the required standard. However, under certain conditions, e.g. when the stocking density is low, as is usually the case in hamster facilities, an ACH of 10 may also be sufficient (Council of Europe 2006).

4.5. Noise

EU legislation as laid down in Directive 2010/63/EU (Council of European Union 2010) stipulates that the wellbeing of laboratory animal must not be impaired by noise levels, including ultrasound. Hamsters hear up to 50 kHz, so measurements should occasionally be made in the ultrasonic range. The noise level should be kept continuously below 60 dB, with noise peaks below 80 dB (GV SOLAS 2017). The measurement of noise intensity in the individual cages is recommended (Council of Europe 2006).

5. Feeding and watering

A detailed set of information on feeding and watering is given in *Fütterungskonzepte und -methoden in der Versuchstierhaltung und im Tierversuch: Hamster* (Feeding concepts and methods in laboratory animal facilities and animal experiments: hamsters) published by the GV SOLAS Committee for Nutrition (GV SOLAS 2009). Hamsters typically hoard their food: occasionally they transport whole pellets in their cheek pouches to a “food store”. This results food losses, because the stored food must always be removed when the animals are moved to a new cage (contamination with urine and faeces). Before weighing, the cheek pouches must be emptied, e.g. so that anaesthetics can be precisely dosed.

Hamsters belong to the predominantly granivorous species, but also feed on insects to meet their protein requirements. Feeding hamsters a complete diet of mice/rats is possible and sometimes practised, but this has been reported to result in reproductive problems. Feeding with special hamster food is recommended. An oversupply of calcium must be avoided at all costs (see chapter 6, Diseases). Drinking water must be provided *ad libitum*.

6. Diseases

The most common diseases in laboratory animal facilities are listed here in bullet-point form. A detailed overview can be found in Van Hoosier (Van Hoosier 1987).

Nutritional diseases:

- *Wet tail*: is an idiopathic enteritis; it may be caused by an insufficient supply of complex carbohydrates and roughage (Wolfensohn 2013)
- Injury to the mucous membranes and/or blockage of the cheek pouches: e.g. as a result of markedly swelling or sharp-edged woody structures in the feed (GV SOLAS 2009)
- Predisposition to the formation of calcite stones due to a peculiarity of calcium metabolism: with increased oral calcium intake, more calcium is excreted via the kidneys (and not absorbed less as in other animals, GV SOLAS 2009)

- Vitamin E deficiency in the dam can lead to spontaneous haemorrhagic necrosis of the foetal or neonatal central nervous system (Hubrecht 2012)

Pain and stress-related reactions:

- Weight loss, prolonged sleep periods, increased aggression or depression-like behaviour, eye discharge, diarrhoea (Wolfensohn 2013)
- Cannibalism is not uncommon in stressed hamsters, especially in primiparous females (Hubrecht 2012)
- Bite wounds, especially in the neck, genital and tail area; females react aggressively to males after mating, which can lead to fatal injuries. Pairs should therefore be separated in good time and litters separated by gender before reaching sexual maturity; noise and other stressors must be avoided (Van Hoosier 1987)

Viral infections:

- Hamsters are potential carriers of the Sendai virus (respiratory disease)
- As carriers of zoonoses, hamsters may be affected by lymphocytic choriomeningitis (LCM)

Bacterial infections:

- There is a wide range of opportunistic or pathogenic bacteria that lead to disease under certain circumstances (e.g. stress, immunosuppression)
- The most common infection is proliferative ileitis (transmissible hyperplasia of the ileum). It is characterized by high morbidity and mortality; as regards aetiology, *E. coli*, *Campylobacter*, *Cryptosporidium* and Chlamydia should be considered
- Other forms of enteritis are caused by e.g. salmonellae, clostridia, etc. (*C. piliformis*: Tyzzer`s Disease) (Hubrecht 2012)

Other diseases:

- Arteriolar nephrosclerosis = hamster nephrosis. This is a non-neoplastic, age-related, degenerative disease (Hubrecht 2012).
- Liver cirrhosis: spontaneously occurring, sporadically up to an incidence of 20% in some colonies (Hubrecht 2012)
- Neoplasia: quite rare, more common in older animals, varies markedly between strains, is mostly benign, predominantly in endocrine system or digestive tract.

Table 4: Recommended pathogen controls for the Syrian hamster according to FELASA (Mähler et al. 2014.

	quarterly	**annually**
Viruses		
Lymphocytic choriomeningitis virus	x	
Sendai virus	x	
Bacteria		
Pasteurella pneumotropica	x	
Clostridium piliforme		x
Corynebacterium kutscheri		x
Helicobacter spp.		x
Salmonella spp.		x
Parasites		
Endoparasites and ectoparasites	x	
Other pathogens[1]		
Viruses: Hamster polyoma virus Pneumonia virus of mice		
Bacteria and fungi: Encephalitozoon cuniculi Lawsonia intracellularis other Pasteurellaceae		
Others if necessary		

[1] A test for these pathogens is optional and should be considered where necessary. The frequency of testing depends on local circumstances.

7. References

Adler S, Theodor O.1931. Investigations on Mediterranean kala azar. II. *Leishmania infantum*. Proc Roy Soc B 108(759):453-463.

Balk MW, Slater GM. 1987. Care and Management. In Hoosier GL, McPherson CW (eds): Laboratory hamsters. Academic Press, Orlando, Fl, pp 61-67.

Council of Europe. 2006. European Convention 123, Appendix A revised 2006, European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes - Guidelines for accommodation and care of animals.

Council of European Union. 2010. Directive 2010/63/EU of the European Parliament and of the Council on the protection of animals used for scientific purposes https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:276:0033:0079:en:PDF

GV Solas. Ausschuss für Ernährung der Versuchstiere. 2009. Fütterungskonzepte und -methoden in der Versuchstierhaltung und im Tierversuch Hamster (am Beispiel des Syrischen Goldhamsters, *Mesocricetus auratus*) http://www.gv-solas.de/fileadmin/user_upload/pdf_publikation/Ernaerung/ern_fuetterung_hamster.pdf

GV Solas. Ausschuss für Tiergerechte Labortierhaltung. 2014. Tiergerechte Haltung von Labormäusen. http://www.gv-solas.de/fileadmin/user_upload/pdf_publikation/Tierhaltung/hal_201408Tiergerechte-Haltung-Maus.pdf

GV Solas. Ausschuss für Tiergerechte Labortierhaltung. 2017. Tiergerechte Haltung von Laborratten. http://www.gv-solas.de/fileadmin/user_upload/pdf_publikation/Tierhaltung/2017Rattenhaltung.pdf

Hauzenberger A, Gebhardt-Henrich SG, Steiger A. 2006. The influence of bedding depth on behaviour in golden hamsters (*Mesocricetus auratus*), Appl Anim Behav Sci 100:280-294.

Heffner RS, Koay G, Heffner HE. 2001. Audiograms of five species of rodents: implications for the evolution of hearing and the perception of pitch. Hearing Res 157: 138-152.

Hubrecht R, Kirkwood J. (editors) 2012. The Care and Management of Laboratory and Other Research Animals, 8th edition, Wiley-Blackwell, West Sussex / Oxford (UK), p. 147-162, pp.348-358, (ISBN 978-1-4051-7523-4).

Mähler M, Berard M, Feinstein R, Gallagher A, Illgen-Wilcke B, Pritchett-Conring K, Raspa, M. 2014. FELASA recommendations for the health monitoring of mouse, rat, hamster, guinea pig and rabbit colonies in breeding and experimental units, Lab Anim. 48:178, DOI: 10.1177/0023677213516312.

Mather JG. 1981. Wheel-running activity: a new interpretation. Mamm Rev 11:41–51. DOI: 10.1111/j.1365-2907.1981.tb00246.x

Reebs S, Maillet D. 2003. Effect of cage enrichment on the daily use of running wheels by Syrian hamsters. Chronobiol Int. 20(1):9-20, PMID: 12638687.

Rousseau K, Atcha Z, Loudon, AS. 2003. Leptin and seasonal mammals, J Neuroendocrinol 15(4):409-14, PMID: 12622842.

Ruf T, Stieglitz A, Steinlechner S, Blank JL, Heldmaier G. 1993. Cold exposure and food restriction facilitate physiological responses to short photoperiod in Djungarian hamsters (*Phodopus sungorus*). J Exp Zool. 267(2):104-112, PMID: 8409896.

Sherwin CM. 1998. Voluntary wheel-running: a review and novel interpretation. Anim Behav 56:11-27, PMID: 9710457.

Skirrow MH, Ryšan M. 1976. Observations on the social behaviour of the Chinese hamster, *Cricetulus griseus*. Can J Zool 54.3: 361-368.

Van Hoosier GL Jr, Mc Pherson W (eds). 1987. Laboratory Hamsters; Academic Press, Orlando, Fl, (ISBN 0-12-714165-0).

Vivien-Roels B, Pevet P, Masson-Pevet M, Canguilhem B. 1992. Seasonal variations in the daily rhythm of pineal gland and/or circulating melatonin and 5-methoxytryptophol concentrations in the European hamster, *Cricetus*. Gen Comp Endocrinol 86(2):239-247, PMID: 1601273.

Weiss J, Becker K, Bernsman E, Chourbaji S, Dietrich H (eds). 2014. Versuchstierkunde, 4th revised edition, Enke Verlag, Stuttgart, p. 233, 237, 239-241, ISBN 978-3-8304-1253-3.

Wolfensohn S, Lloyd M (editors). 2013. Laboratory Animal Management and Welfare, 4th edition, Wiley-Blackwell, West Sussex / Oxford (UK), p. 223-227 (ISBN 978-0-4706-5549-8)

Disclaimer

The use and application of the publications (technical information, statements, booklets, recommendations, etc.) of the Gesellschaft für Versuchstierkunde GV-SOLAS and the implementation of the information and content contained therein is expressly at the user's own risk.

GV-SOLAS and the authors cannot accept any liability for any accidents or damage of any kind resulting from the use of the publication.

GV-SOLAS accepts no liability for damages of any kind arising from the use of the website and the downloading of templates. GV-SOLAS is also not liable for direct or indirect consequential damages, loss of data, loss of profit, system or production losses.

Liability claims against GV-SOLAS and the authors for material or immaterial damage caused by the use or non-use of the information or by the use of incorrect and/or incomplete information are fundamentally excluded.

Claims for damages against the Gesellschaft für Versuchstierkunde GV-SOLAS as well as against the authors are therefore excluded.

The works, including all content, have been compiled with the greatest scientific care. Nevertheless, GV-SOLAS and the authors do not assume any guarantee or liability for the topicality, correctness, completeness and quality of the information provided, nor for printing errors.

No legal responsibility or liability in any form can be assumed by GV-SOLAS and the authors for incorrect information and any resulting consequences.

Furthermore, the operators of the respective websites are solely responsible for the content of the websites printed in these publications.

GV-SOLAS and the authors have no influence on the design and content of third-party websites and therefore distance themselves from all third-party content.