XIV. MONGOLIAN GERBILS*

A. INTRODUCTION

1. General Characteristics

The Mongolian gerbil (*Meriones unguiculatus*) is a small rodent of from 70-100 g adult body weight. A member of the family Cricetidae, it is indigenous to the desert regions of North Eastern China and Mongolia.

This is a nearly odourless, burrowing animal that is mostly nocturnal in its habits. Concise reviews of its origin and development as a laboratory animal, as well as of its natural history, habitat, and behavior, are available (Marston, 1976; Harkness and Wagner, 1983).

The gerbil's capacity to conserve water is unique among laboratory animals, its average intake being only about 4 ml/day. Similarly, it eliminates only a few drops of urine daily which, in part, accounts for its relative odourlessness when confined. The gerbil can, if necessary, meets its water requirements for considerable periods of time from moisture obtainable from fresh greens. This is, however, definitely not an acceptable way of providing for the water needs of these animals under laboratory conditions.

Some other notable characteristics of this species are: a) monogamy—they normally pair by 10 to 12 weeks of age, shortly after weaning, and stay together for life; b) friendly disposition—they are not given to either fighting or biting; c) temperature adaptability—they show no discomfort between 0^{o} and $32^{o}C$ (32^{o}-$90^{o}F$) and can manage adequately at considerably greater extremes, given the appropriate bedding, feed and ventilation. The biological characteristics and husbandry of the Mongolian gerbil have recently been reviewed and summarized (Harkness and Wagner, 1983) and a comprehensive bibliography of gerbil behavioral studies is also available (Tumblebrook Farm, 1978).

2. Use in Research

Gerbils have been increasingly used as research animals in laboratories since their introduction to North America and the establishment of the first commercial colony (Schwentker, 1963). They have proven to be a particularly useful research animal in radiation studies and experimental atherosclerosis. The effects of hormones on sebaceous glands (the abdominal sebaceous gland pad in the gerbil is androgen dependent and readily observable) and the gerbil's capacity for temperature regulation are examples of characteristics that suit these animals to particular areas of research.

Several species of gerbil have been used as experimental animals in biomedical studies; however, by far the most commonly used is the Mongolian gerbil.

B. HOUSING

1. Environment

Gerbils can readily adapt to a wide range of environmental conditions without apparent stress. Normally, room temperatures of 20-22°C (68-72°F) will be satisfactory, although they can tolerate variations ranging from well over 38°C (100°F) to near or below—18°C (0°F), provided the humidity is low and there is adequate bedding. Relative humidity should be somewhat lower than for most laboratory animals; however, a level of over 30% is recommended (Harkness and Wagner, 1983). When the humidity is over 50% the gerbils' fur, instead of lying smoothly and sleekly against their bodies, stands out and appears matted. This would seem to be their only reaction to high humidity and therefore should be considered an environmental bioindicator and need not in itself be a cause for alarm (Schwentker, 1968). Gerbils have no special light requirements; however, controlled lighting providing a 12-14 hour day is recommended.

2. Caging

Gerbils, which are burrowing animals by nature, will fare much better in bedded cages than on wire. They may be caged singly, in pairs or groups. Males caged singly show a greater weight gain than the males of mated pairs over the same period of time (Loew, 1968).

As noted, gerbils are natural burrowers. They will make covered nests if suitable bedding material is available, regardless of whether or not the female is pregnant. Their instinct to hide in a dark nest and sleep much of the day will be greatly facilitated if a small nest box is provided (Harkness and Wagner, 1983).

C. FEEDING

The nutrient requirements of the gerbil have been outlined in a U.S. National Research Council bulletin (NRC, U.S. 1978). Their requirement for dietary water is very modest and, if their feed contains much water, consumption from bottles appears to be negligible (Loew, 1971). Despite this, they should be provided with a constant supply of clean water when caged in the laboratory.

Gerbils are extraordinarily fond of sunflower seeds and will eat them to the exclusion of all other food if they are available. This characteristic has been made use of in psychological research when food-motivated tests are required (Schwentker, 1968). Sunflower seeds are, however, low in calcium and high in fat and do not constitute a complete diet.

Good quality, pelleted feed for gerbils may be obtained commercially and should be provided ad lib. Adult males will eat about 8 g of feed daily (Harkness and Wagner, 1983).

D. REPRODUCTION

1. Physiology

The estrous cycle is about four days' duration and is comparable to those of other small laboratory rodents. Sexual maturity is achieved at nine to 12 weeks. The estrous phase (period of heat) lasts less than 24 hours (Barfield and Beeman, 1968). Gestation lasts about 25 days. Post-partum ovulation occurs within 18 hours and the male will breed the female at this time unless removed. If a fertile post-partum mating does occur, a delayed implantation usually ensues, particularly if the female is nursing a large litter. Delayed implantation may lengthen the period of gestation up to 42 days.

2. Breeding

Gerbils are usually monogamous and if a mature gerbil loses its mate for any reason, it may not accept another. The male gerbil aids in caring for its young. Isosexual pairs also form strong bonds. Gerbils breed readily in the laboratory environment. Litters will average four to six young with a range of from one to 10. Very small litters are often destroyed by the mother; however, cannibalism as a vice, is not of common occurrence among laboratory gerbils (Harkness and Wagner, 1983). If paired gerbils are separated to avoid post-partum mating, they must not be kept apart for more than two weeks or fighting may occur when they are reunited.

Groups of two females and a male that are set up before sexual maturity (by about seven weeks) will usually prove compatible and breed successfully.

Weanling gerbils may be sexed at any time after birth on the basis of ano-genital papilla distance, which is approximately double in the male to that in the female.

Further information on breeding methods, rearing, and details of reproduction in gerbils may be found in the literature (Harkness and Wagner, 1983; Marston and Chang, 1965).

E. RESTRAINT

1. Handling and Specimen Collection

Gerbils can be handled quite freely and there is usually no danger and very little difficulty in handling pregnant females either with young litters or even newborn pups. In picking the animal up, the base of the tail should be grasped and the body supported in the other hand. Care must be taken to maintain a gentle but firm grip, as the gerbil is very agile and may wiggle free quite easily and thus fall to the floor.

Alternatively, the animal may be more firmly restrained by a tail-base hold with one hand and over-back hold with the other, such that two fingers are over the neck, with the thumb and the third finger under the belly. Gerbils resent being turned onto their backs and will struggle when held that way.

Procedures for the collection of blood, urine, and fecal samples are essentially the same as those described in the chapter on Hamsters.

2. Chemical Restraint and Anesthesia

Chemical restraint, anesthetic recommendations, routes of administration and dosages have been briefly summarized in the appendices of Volume 1 of this Guide and should be referred to.

Chemical restraint and a level of anesthesia sufficient for most manipulative procedures and minor surgery may readily be achieved in this species by injecting ketamine at 40-45 mg/kg, i.m. or diazepam 5 to 10 mg/kg (Harkness and Wagner, 1983; Green, 1972).

Injectable anesthetics undergo very rapid metabolic degradation in small rodents. Consequently, surgical anesthesia with these agents alone requires relatively high doses with a concomitant increase in risk (Sawyer, 1982).

Surgical anesthesia may be induced by using ketamine (see above), with subsequent maintenance with 0.5 to 1% methoxyflurane in O_2 to effect (Green, 1979).

However, probably the safest and least complicated procedure is by chamber induction with methoxyflurane, followed by maintenance, using a mask and the same anesthetic. A simple chamber for small rodents is often improvised in the laboratory by using a bell jar and a pledget of cotton soaked in a volatile liquid anesthetic. A perforated platform must be placed between this and the animal. Halothane should never be used in this way due to its high vapour pressure and potency; methoxyflurane and diethylether are, however, commonly used for this purpose (Sawyer, 1982).

Methoxyflurane may be the agent of choice for chamber induction, as it has been suggested that diethylether is not a suitable anesthetic for gerbils, although no data were given to support this contention (Marston and Chang, 1965).

F. HEALTH CARE

1. General Problems

The gerbil generally presents very few health care problems. A commonly encountered condition in these animals is an overgrowth of the incisors which results from malalignment or breakage of teeth (Loew, 1967).

A localized hair loss, particularly over the dorsum of the tail, is sometimes associated with overcrowding and results from chewing and clipping each others' hair. This habit may lead to fighting, in which case the resultant alopecia will be combined with scratches and abrasions. Another type of alopecia, in which there is a mild inflammation of the skin and the external nares due to staphylococcus, occurs rather less frequently (Peckham, Cole, Chapman *et al.* 1974). This condition may respond to topical anti-bacterial therapy.

A generalized sign of poor health is weight loss (check for incisor malocclusion and neoplasms). A rapid, severe weight loss will result from food and water deprivation, although this should not be a problem in a research animal facility. A rough, dull and somewhat damp hair coat may be indicative of fighting, malnutrition or incipient disease. (Check that the relative humidity is not over 50%.)

Zoonoses are rarely attributable to gerbils and the only risks in that regard would appear to be the *Hymenolepis* tapeworm and *Salmonella* infections.

2. **Specific Diseases**

Gerbils appear to be remarkably resistant to infectious diseases, particularly to the several respiratory infections, pneumonia and otitis media that plague most rodents. It is possible that this is, at least in some part, attributable to their relatively short history and limited use as research animals; it would seem, however, to be more likely due to their innate hardiness.

The few reports of systemic infections in these animals mostly concern gastrointestinal disease. Tyzzer's Disease, caused by *Bacillus piliformis*, is now known to affect gerbils and is perhaps more frequently a cause of diarrhea than was formerly realized (Carter, Whitnack and Julius, 1969; White and Waldron, 1969).

Gerbils also have a natural susceptibility to acute infection with *Salmonella* organisms (Olson, Shields and Gasken, 1977).

Intestinal parasites reported include the zoonotic tapeworm *Hymenolepis nana* (Loew, 1971; Lussier and Loew, 1970). Occasional cross infection from other laboratory species with *Entamoeba muris*, and pinworms (*Enterobius vermicularis*) probably also occur. Naturally occurring infestations with ectoparasites are rarely seen, although cross infection is a possibility (Marston, 1976).

Gerbils live for three and to four years and spontaneous neoplasms have been reported to occur with an increasing frequency in aging animals (Lussier and Loew, 1970). Malignancies involving the ovaries, ventral sebaceous glands, kidney, adrenal glands and skin have been described (Marston, 1976; Harkness and Wagner, 1983; Ringler, Lay and Abrams, 1972; Vincent, Rodrick and Sodeman, 1979; Benitz and Kramer, 1965). The high incidence of tumours that may be expected in the gerbil after about two years of age (Vincent, Rodrick and Sodeman, 1979) makes them unsuitable for chronic toxicity studies.

G. SPECIAL CONSIDERATIONS

1. Behavior

The gerbil is a very friendly animal with a natural curiosity. It will tolerate considerable gentle handling and seems to seek it. Gerbils appear to have a cyclic activity consisting of brief periods of intense activity alternating with brief periods of rest or deep sleep. They rarely show aggressive behavior, although, under certain conditions, individuals in a group of adult gerbils may become pugnacious. Fighting can also be a problem when setting up mating groups, although once the group is established there does not seem to be any recurrence of fighting. It is quite safe to assemble large groups of gerbils by sex at the time of weaning and to continue to rear them together up to and beyond the onset of sexual maturity. It is possible to minimize the likelihood of fighting by selecting experimental groups from such large groups of animals (Marston and Chang, 1965).

2. Inherited Characteristics

Several apparently inherited characteristics of the gerbil are of interest and may provide useful experimental models. Some of these have already been referred to above; others include:

a. Spontaneous epileptiform seizures, occurring in certain genetic lines with a high incidence, while being essentially absent from others. Occurrence is in response to perceived threat, particularly when in an unfamiliar environment. Recovery is spontaneous, with no ill effects and the seizures are not cause for alarm.

b. High serum cholesterol and lipemia from standard rodent diets with 1% cholesterol added, leading to the development of hepatic lipidosis and gallstones, but not atherosclerosis (Harkness and Wagner, 1983).

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