Chapter 2

Care and Management

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I. HOUSING

The general design criteria used in buildings to hold rats, mice, and hamsters are applicable for the guinea pig. Design and construction of facilities must not only conform to local building codes, but should also comply with the recommendations of the Institute of Laboratory Animal Resources (1972), published in the "Guide for the Care and Use of Laboratory Animals."

In planning individual animal rooms, one must consider the nature of the activity to be performed, such as maintenance of animals for quarantine, long-term holding, breeding, or research requiring special facilities. The functional and spatial requirements for each of these activities will vary; therefore, the room dimensions, spatial relation of rooms to each other, and the designation of space within the room for servicing both animals and equipment will likewise vary.

Control of infectious disease is best accomplished by use of several small rooms, as contrasted with one large room, because the former design minimizes transfer of disease and is a useful form of isolation. It is advisable that each small room be confined to one activity and at no time should healthy animals be housed in the same room as animals undergoing experimental procedures with infectious agents or with animals of another species. Ideally, animals on experiment should be in a different building with its own sterilizing equipment, feed, bedding, and animal attendants. If guinea pigs are procured from an outside source, they should be quarantined in a room remote from all other guinea pigs.

The arrangement of caging within each room depends on the activity and the unit of animal accommodation chosen (see caging requirements, Table I). Maximum use of space is an important factor in design, and caging equipment within the

Table I
Space Recommendations for the Guinea Pig[a]

Weight (gm)	Floor area per animal (cm^2)	Height (cm)
Up to 250	277 (43 inches)	17.8 (7 inches)
250–350	374 (58 inches)	17.8 (7 inches)
Over 350	652 (101 inches)	17.8 (7 inches)

[a]Institute of Laboratory Animal Resources (1972) space recommendations for the guinea pig published in the "Guide for the Care and Use of Laboratory Animals."

room should be arranged to allow easy access to all animals for both observation and handling. Portable racks with tiered caging are popular and increase the capacity of the room; however, there is a loss of efficiency in servicing tiered caging which exceeds the reach of a person of average height. In addition to floor space allotted for holding animals, sufficient space must be reserved for servicing the room, handling animals, tattooing, weighing, experimental manipulations, and for maintenance and storage of records.

A. Temperature, Ventilation, and Humidity Control

Special attention should be given to ventilation systems to control temperature, humidity, air velocity, and air pressure within the animal room. Guinea pigs are extremely susceptible to respiratory disease, and a well-designed, efficiently operating system provides the environmental stability requisite for respiratory disease control.

There should be 10–15 changes of air per hour and no air should be recirculated unless it has been filtered to remove airborne contaminants. Care must be taken to control velocity and direction of air flow to produce a draftless and even distribution of air to all areas of a room. An ideal state of mass air displacement is, in some instances, difficult to achieve in a room filled with animals and cages, and in these circumstances cages can be designed or arranged to minimize drafts.

The compact body of the guinea pig conserves heat well but dissipates it poorly. Thus the guinea pig is more likely to tolerate cold than heat. The average heat production from 350- to 410-gm guinea pigs is 5.0 to 5.7 BTU per animal per hour (Dick and Hanel, 1970; Hill, 1971). Maximum or peak heat production from an animal of similar size is approximately 47 BTU per animal per hour (Brewer, 1964). Therefore, factors such as the number of animals per room and especially the type of caging affect optimal temperature requirements. Guinea pigs kept singly in wire cages with wire bottoms obviously require a higher room temperature than those maintained several to a cage with solid sides and bottom and 2 inches of bedding. My experience has been with a system about midway between the two cage examples just given. Our animals are on bedding, but the sides of their cages are woven wire or perforated panels which provide added ventilation.

Reported optimal temperatures for maintenance and breeding of guinea pigs vary; however, most references indicate an ideal temperature range is 65°–75°F. If allowed to exceed 90°F, heat prostration and death may occur, particularly in sows in advanced pregnancy. Young (1927) reported sterile matings when testicles of male guinea pigs were exposed to high temperatures. In my experience rooms maintained at 72°±2°F were very satisfactory for all age groups. Relative humidity should be maintained at about 50%. One of the strongest reasons for adopting this level is that the survival of airborne microorganisms is lowest at this point (Weihe, 1971).

To maintain an ideal room environment each room or group of rooms serving a common purpose should have individual controls for room temperature and humidity. The sensing element should be located at the level of the animal cages. There should be an alarm system to indicate whenever temperature or humidity deviate from an acceptable range, and the environmental control system should have a "standby" capability to supply auxiliary power if necessary.

B. Caging and Space Requirements

Paterson (1967) described different types of indoor guinea pig caging as (1) floor pens, (2) tiered compartments, fixed or portable, and (3) cages either mobile on trolleys or portable on racking. Portable racks with plastic or metal cages have a distinct advantage over floor pens and other types of permanent caging either single or tiered because permanent caging is generally difficult to disinfect satisfactorily and wasteful of both labor and space. When considering cages of metal or plastic on portable racks, there are many different cage designs from which to choose and the choice must be based primarily on the intended use of the guinea pigs. If they are to be held in a laboratory environment, one determines the number of animals and the size of the animals to be held per cage. The cage size should comply with the Institute of Laboratory Animal Resource's (1972) space recommendations for guinea pigs published in the "Guide for the Care and Use of Laboratory Animals," and with Public Law 89-544 as amended by Public Law 91-579, The Animal Welfare Act of 1970. Attached accessory equipment, such as watering devices and feeders, must take into consideration anatomy as well as the eating and drinking habits of the guinea pig. After 6 months of age females of heavier strains commonly weigh over 800 gm and males over 1000 gm. Provide space accordingly.

Caging for a production colony is more complex and depends on the the breeding system. There may be several animals per cage and provisions must be made for accommodating young. The Tumblebrook cage, a solid floor cage, modeled after those used at Brant Laboratory, New York, has been used for over 20 years with reasonable success at the Fort Detrick production colony (Fig. 1). Each cage is 30 × 30 × 10 inches, made of stainless steel, and has both a solid bottom and front panel. The other three panels are solid 4 inches from the bottom and have ¼ inch mesh, woven wire, or ½ inch perforated holes in the top 6 inches. In both designs, the openings are equivalent to 40% of the panel. Except for the top drawer no cover is necessary. For the top cage a 4-inch removable guard around the perimeter of the cage (Fig. 2) prevents escape by jumping. Each rack is portable on four 5-inch locking casters and holds five cages, which rest on side runners 1.25 inches wide.

Bedding is provided in the solid bottom cages. Numerous materials have been used as bedding, such as peat moss, dried corn cobs, cedar shavings, and a flax by-product. The product most satisfactory in my experience is seasoned ponderosa pine shavings. It consists of large, thin curls of pine, generally obtained from planing mills. In our colony we cover the bottom of the cage with about 2 inches of pine bedding. It is constantly aerated as pigs move through it, and the feces tend to work through the shavings to the floor of the cage. It does not pack as readily as small-particle bedding, such as sawdust. Plank and Irwin (1966) reported that sawdust caused infertility in guinea pigs. They concluded that sawdust particles adhere to the genital mucosa and interfere with copulation. Care must be exercised in procurement of all bedding. It must be free of dust, sharp particles, and excreta of other animals. Although several bedding products are highly satisfactory without sterilization, the only way to be sure that bedding is free of infectious agents is to sterilize the product prior to use and then to prevent poststerilization contamination.

Fig. 1. The Tumblebrook cage.

Fig. 2. Four-inch removable guard for prevention of escape by jumping.

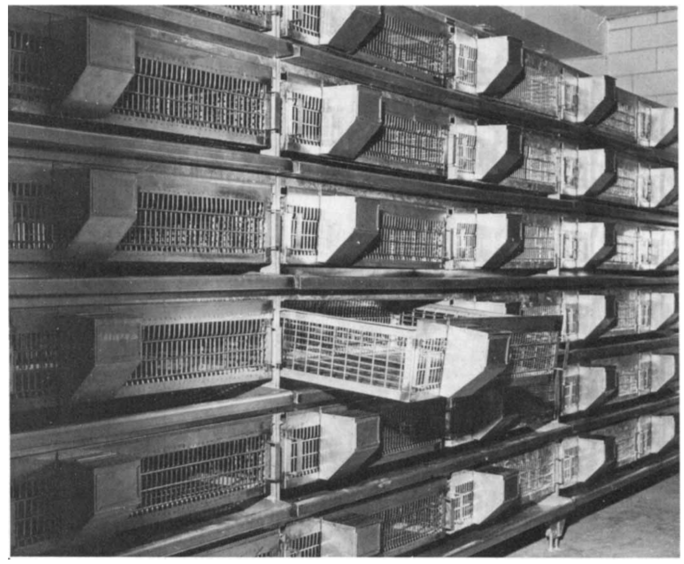

Fig. 3. Wire-bottom cages.

There is a great difference of opinion about whether guinea pig cages should have solid or wire floors. Cages with wire floors have been used by a number of competent breeders and researchers. Some claim excellent breeding and rearing results; others have been less successful. The advantage of cages with wire floors is that bedding is not needed, and there are substantial savings in labor in the washing process. The pigs should stay cleaner and drier because water passes through the wire floor to the pan below, and there is no contact with wet or soggy bedding. These cages need not be changed as frequently as those with bedding. The most important feature of wire flooring is the size of the wire mesh. It must be large enough to let the droppings fall through, but not of a size to catch and break legs. Various sizes of wire mesh flooring have been used. Paterson (1962) and Porter (1962) used wire floors with mesh size 76.2 × 12.7 mm. Lane-Petter and Porter (1963) indicated that a mesh of about 18 × 18 mm is satisfactory but that a mesh size of about 75 × 12 is best. They stated that in the case of oblong mesh, longitudinal wires (those at 12 mm intervals) should be on top. In all cases the wires should be straight, not crinkled, and welded at their intersections. Wire floors must be designed to offer no lodgment for droppings at corners, along edges, or at intersections of reinforcing wires.

Several articles, particularly in the British literature, describe the successful use of wire floor cages in guinea pig breeding colonies. Therefore a room of wire-bottom cages (Fig. 3) was designed and installed in the Fort Detrick breeding colony to test the desirability of wire floor cages versus solid floor cages. Two hundred females were maintained in this room for 3 years of testing. From almost every aspect, the use of wire-bottom cages in this breeding colony was unsatisfactory. The production rate was 22% below that of the colony on solid-bottom cages and the young weighed 25% less at weaning. Bacterial pneumonia was the principle cause of a higher mortality rate among both adults and offspring. Other guinea pigs had to be eliminated because of emaciation and debility. The wire mesh floor was essentially devoid of sharp projections yet many animals had to be culled because of pododermatitis. Hairlessness increased significantly in this colony, and guinea pigs turned a dirty rust color on their ventral surfaces. Many young were caught in the wire mesh, suffered fractured legs, and had to be destroyed. The dimensions of the stainless steel wire mesh used was 12.7 × 38.1 mm.

In conclusion, it appears that wire floor cages may have advantages for short-term holding and rearing of guinea pigs provided the wire mesh is of the dimensions necessary to minimize the catching and breaking of legs. Solid floor cages with bedding, on the other hand, appear to have a decided advantage for studies where animals are maintained for an extended period of time and in breeding colonies where each cage usually contains animals of various sizes, from newborn to adults.

Points which must be emphasized when considering caging requirements include: the cage should be designed after consideration of the use to which the animal will be put, such as aging, holding, breeding, quarantine, and the length of holding time required. At all times the comfort of the animal should be considered. The cage should have adequate ventilation without drafts. Either plastic or metal is preferable in cage construction, and joints should be seamless for ease of cleaning and sanitizing. Sufficient space must be provided.

For convenience in identification and record keeping, a card holder, either permanently attached or removable, should be on each cage. Mobile racks, with shelves and removable cages, are popular. These racks are versatile, save labor, and lend themselves to maximal use of space. They should be constructed with a minimum of crevices or joints where dirt might accumulate.

C. Sanitation Procedures

Attention to details of thorough cleaning is an integral part of the success of maintaining guinea pigs. Obnoxious odors, accumulation of mineral scale from the high concentration of mineral salts in guinea pig urine, and spread of infectious diseases between animals and cages are minimized with proper sanitation of cages and racks.

Cages in which bedding is used should be cleaned and sanitized often enough to prevent an accumulation of excreta or debris. In our experience these cages should be sanitized at least once each week, and all new bedding should be added each time the cage is sanitized. Although wire floor cages do not have to be cleaned as frequently, they should be sanitized at least once every 2 weeks. The pan under the cage however must be cleaned frequently to prevent the accumulation of excreta. If large numbers of animals are maintained in each cage, daily cleaning of the pans may be necessary to maintain a high level of sanitation. Soiled bedding should be disposed of promptly either by incineration or in a way that will not contaminate other animal areas or areas of human inhabitation.

Mechanical equipment for cleaning and sanitizing cages and accessory equipment is usually located in a central area which has been specifically designed for this purpose. A cage-washing machine is highly recommended and where the size of the facility warrants the investment, a large washing machine for racks is useful. For thorough cleaning and destruction of most pathogenic organisms, the wash cycle of the machine should use water heated to not less than 180°F. When using cages made of stainless steel, weekly rotation of acid and alkaline detergents has proved to be effective in removal of urinary salt accumulations. Care must be exercised when using acid detergents to wash cages of plastic or metal, other than stainless steel, as they may corrode the cage material. Following the wash cycle, a rinse cycle is necessary to remove residue left on the cage during washing. Periodically, several randomly chosen sanitized cages should be swabbed, and the swab cultured in an effort to isolate and identify microorganisms that may have been left by the sanitation routine. The latter procedure is a valuable quality control method for determining the efficacy of the washing and sanitization cycle.

Routine sterilization of cages and bedding is not considered necessary if care is taken to assure that the washing equipment is sanitizing properly and that clean bedding is used. Where pathogenic organisms are under investigation, autoclaving animal cages and accessory equipment from the holding area is essential to prevent spread of infectious agents to man or other animals.

When washing equipment is not available, the task of cleaning cages is greatly increased. Cleaning can be done by vigorous scrubbing with appropriate detergents followed by thorough rinsing; however, in the case of the large harem-size cage, this operation would not only be cumbersome but time consuming. Cages washed in this manner should not be hand dried, but allowed to air dry in a clean area. Rinsing the cages in hot water will hasten drying.

In conclusion, all activities to acquire, breed, and house guinea pigs free of pathogenic organisms are in vain if a sanitary program is not instituted and adhered to. The "Guide for the Care and Use of Laboratory Animals" (Institute of Laboratory Animal Resources, 1972) has sections dealing specifically with personal hygiene, cleanliness, and sanitation of equipment and facilities. The well-indoctrinated animal care technician who adheres rigorously to the tenets of sanitation is an equal partner in the effort to maintain a colony of high quality guinea pigs.

II. BREEDING

The age at which sexual maturity is attained varies with sex differentiation, environment, and genetic background. Puberty in the female guinea pig may occur as early as 4–5 weeks of age. Wright (1922) found that many young females were mated by their sires before weaning at 33 days of age. Males are slower to reach maturity and although they demonstrate sexual activity at an early age, fertile matings are unusual before 8–10 weeks of age.

Guinea pigs are best mated when they are approximately 2.5 to 3 months old or when they weigh 450–600 gm, depending on the strain in question. If the female is bred before 6 months of age, there is less likelihood of the animal becoming excessively fat or having firm fusion of the symphysis pubis. For normal parturition in the guinea pig, the symphysis pubis must separate approximately the width of the index finger to permit passage of the fetus. Fusion of the symphysis pubis may lead to failure of the fetus to pass, and dystocia results.

The reproductive potential of the guinea pig is high. Generally, a litter of 3–4 young and a reproductive index of 1.0 weanling per female per month is considered standard in outbred colonies whereas in the commercial inbred guinea pig colony the standard reproductive index is 0.7 weanling per female per month. The decline in reproductive potential of inbred guinea pigs has been attributed to a decline in vigor and fertility as displayed by a reduced frequency of littering and smaller litter size.

Unless interrupted by pregnancy, pseudopregnancy, or other disturbances of the reproductive tract, the guinea pig displays signs of estrus every 13–20 days. The average interval between ovulations in unmated animals is about 16 days. The estrous cycle in the guinea pig was described by Bacsich and Wyburn (1939) as having four stages: diestrus, proestrus, estrus, and metestrus. The duration of estrus is approximately 50 hours. The female will accept the male for up to 15 hours of this period, generally between 5:00 PM and 5:00 AM (Lane-Petter and Porter, 1963). Ovulation is spontaneous and occurs approximately 10 hours after the beginning of estrus and also within 2–3 hours postpartum.

Mating in the guinea pig is normally detected by either presence of sperm in the vagina or by the presence of a vaginal plug. The plug consists of a central core formed by a mixture of secretions from the male's vesicular and coagulating glands and is enclosed by a mass of flat epithelial cells apparently derived from the vaginal wall (Stockard and Papanicolaou, 1919). The plug usually fills the vagina from cervix to vulva. A few hours after its formation the plug falls out of the vagina and can often be observed as a waxy mass on the cage floor. The efficiency of utilizing plugs to predict pregnancy is usually high. Live sperm, on the other hand, can be found routinely in vaginal smears for only a few hours after copulation.

When not in estrus the vagina of the sexually immature as well as the multiparous female is closed by a cellular membrane which Stockard and Papanicolaou (1919) called the vaginal closure membrane. The epithelial membrane unites the labia of the vulva so that the vaginal opening is completely closed. This membrane is formed shortly after estrus in females that have not copulated and following expulsion of the vaginal plug in those that have copulated. It persists in pregnant animals throughout pregnancy and ruptures when the vulva swells shortly before parturition.

In colonies where intensive or continuous breeding is practiced, the male and female remain together as a static group. With this practice, maximum advantage is taken of the postpartum estrus. Our experience is similar to Rowlands (1949) in that 80% of mated guinea pigs conceived in postpartum estrus; consequently, gestation and lactation proceed simultaneously. This method reduces the time interval between litters and allows for maximum production per female.

The gestation period of the guinea pig is 59–72 days; the average is 63 days. The length of the pregnancy decreases as the litter size increases (McKeown and Macmahon, 1956). In many instances, it has been shown that the female guinea pig doubles her weight during pregnancy.

In 277 genetically heterogeneous females observed daily by Goy *et al.* (1957), 23 or 8.3% of the pregnancies were terminated by abortion. McKeown and Macmahon (1956) concluded that abortions were independent of litter size, but the stillbirth rate was directly proportional to litter size. High stillbirth rates are frequently observed in primaparous animals. Embryonic resorption, uterine hemorrhage, pregnancy toxemia, dystocias, and exhaustion from prolonged labor are common causes of death in a breeding colony.

Individual birth weights depend on nutrition, genetics, and litter size. The average individual body weight in a litter of 3 to 4 is 85 to 95 gm. Young weighing less than 50 gm at birth usually die. Young should be weaned when about 21 days old when they weigh 165 to 240 gm. Development is rapid and young should gain 2.5 to 3.5 gm per day during the first 2 months; at the end of which they should weigh 370 to 475 gm. After 2 months, growth slows and they reach maturity at 5 months; however, weight gain continues until 12 to 15 months of age, when it levels off at 700 to 850 gm for females and 950 to 1200 gm for males.

The art of breeding high quality guinea pigs has been discussed in many texts. Success has been claimed for several breeding systems; however, the system selected by a breeder will be based on the type of equipment, housing, and caretaker personnel available and the purposes for which the animals are required.

Breeding systems may be divided into two groups, each with several variations; these are (1) monogamous pairs and (2) polygamous groups.

1. Monogamous Pairs

With this system a paired male and female of breeding age are mated in a single cage. Monogamous pair breeding is used widely in inbreeding, which requires brother X sister matings, for the issue of littermates, or for selection of stock most suitable for intensive breeding in polygamous groups. Record keeping is simple; however, this system requires maintaining a large number of boars, is less efficient, and requires more space and labor. If the pair is maintained together continually, there is the advantage of the postpartum mating, and it is generally believed that there is a greater number of young weaned per female.

2. Polygamous Groups

This system consists of mating a select number of sows to one boar. Opinions vary regarding the optimum number of sows for a polygamous group; however, the most important factor appears not to be the number of sows which a boar can successfully service, but rather the space available per sow. It is recommended that each sow be provided with 180 square inches of floor space. Due to the aggressive nature of males, when using this system, best results are obtained when there is not more than one boar per pen.

Polygamous groups may be handled several ways: (a) They may be maintained as a static colony and held intact throughout their useful breeding life. This maximizes the advantage of postpartum breeding and communal rearing of young. (b) Sows in advanced pregnancy may be isolated individually for farrowing. After the young are weaned, the sow is again returned to the mating pen and the cycle continues. (c) In the communal farrowing and rearing method, advanced pregnant sows are removed from mating pens and allowed to litter in groups, young are reared communally, and after weaning, the sows are returned to the mating pens.

Monogamous pairs produce the greatest number of offspring per female, but considering the saving in space and the number of animals required, the ratio of 1 male to 4 or 5 females is usually a more efficient housing method. The efficient breeding life of guinea pigs varies and is dependent on many factors including the number of animals per cage as well as genetic and environmental variables. Under ideal management, most guinea pigs reproduce efficiently until 27–30 months of age.

III. WATERING

Most facilities supply water by means of a water bottle and sipper tube. Theoretically, a 32-oz bottle filled daily should supply sufficient water to a breeding cage of 5 adults. However, guinea pigs have a tendency to play with the sipper tube and rapidly empty the bottles. Most of the water ends up in the bedding or on the floor. Collins (1972) reported wastage of water can be reduced by fitting drinking bottles with ball-bearing equipped drinking tubes instead of standard valveless tubes. Presently, the Fort Detrick colony uses automatic water devices mounted about ¾ inch outside the cage thus allowing excess water to drop to the floor and exit through a centrally located floor drain. This system was installed in 1965 and has functioned very satisfactorily. Most important, water is available 24 hours a day. Automatic watering is not recommended for use in guinea pigs housed in solid-bottom cages, unless it is of the design to prevent drippage and leakage into the cage.

The "Nutritive Requirement of Laboratory Animals," second edition (1972), published by the National Academy of Sciences, indicates that adult guinea pigs receiving a green food supplement (usually kale or lettuce) require 50 to 100 ml of water per day. Without a supply of green food, 250 to 1000 ml per day are required because of spillage. As the amount of "greens" in the diet increases, the amount of water required decreases. The reverse is true as well; however, Bruce (1950) indicated that guinea pigs whose water was supplied wholly by green food were less thrifty than those having access to water. She indicated that the amount of water they consumed in green food was below their optimum needs. Mortality rates increase significantly when animals are deprived water. Pregnant and lactating females are affected first followed by young, rapidly growing animals.

IV. NUTRITION

Among the commonly used laboratory species, only guinea pigs and primates require a dietary source of vitamin C (ascorbic acid). Collins and Elvehjem (1958) reported the ascorbic acid requirement for growth of immature guinea pigs is 0.5 mg per 100 gm body weight per day. Nungester and Ames (1948) indicated that a 300-gm guinea pig requires a daily intake of approximately 6 mg of vitamin C to provide adequate protection against infection. Under intensive breeding conditions, the requirement of the adult female that is pregnant or lactating during most of her breeding life is at least 20 mg per day (Bruce and Parker, 1947).

Commercial pelleted diets are manufactured to meet the requirements of the guinea pig for ascorbic acid. Additionally, they are usually fortified to compensate for ascorbic acid losses in storage. In general, most commercial guinea pig feeds are satisfactory in regard to vitamin C content. Laboratory animal feeds must not be maintained too long in storage and must be fresh when used. This is not a pious platitude when referring to guinea pig feed. Ideally, guinea pig feeds should be stored in rooms where the temperature is 50°F or less, and should not be stored in the animal room. The date of manufacture is commonly given or coded on each feed bag, and a strong effort should be made to store feed for no longer than 4 to 6 weeks from the date of manufacture. This is especially important where no green vegetable supplement is offered. Feeders should be designed to prevent guinea pigs from climbing into them. For this purpose the standard "J" type feeder works very well.

Feeding guinea pigs green vegetables in addition to the pelleted diet has been a subject of continuing controversy. A "green" supplement on a regular basis may provide insurance against vitamin C deficiency; however, its benefits go beyond this one advantage. These benefits are most apparent in a production colony under an intensive breeding system where there is heavy stress on the pregnant or lactating female. We have concluded that such supplements enhance the ability of breeding animals to maintain body weight. Based on the results of feeding experiments in which four different commercially prepared diets were compared using large numbers of animals held for breeding periods of 18–24 months, we have observed that the feeding of green supplement resulted in an average increase of 10 to 44% in weaned offspring over the same pelleted feeds without green supplement. Dean and Duell (1963) compared several pelletted diets with and without supplementation. They reinforce our belief that in comparison of diets for breeding guinea pigs, tests for nutrient adequacy must involve long-term studies of breeding animals, preferably for several subsequent generations.

Guinea pigs on short-term experiments can be maintained on fresh pelleted feed and water without provision of green supplement, but care must be taken to provide an adequate water supply.

Maintenance and therapeutic levels of ascorbic acid can be given through the water supply. Ascorbic acid given in this manner is effective at 0.2 gm/liter when added to distilled or resin column deionized water (Paterson, 1962). Ascorbic acid undergoes rapid oxidation, which is enhanced by heat and catalyzed by copper; therefore, if vitamin C is to be given at an effective level in the water supply, a non-copper water system and frequent preparation of the drinking solution are required. Paterson (1962) indicated that approximately 50% of the vitamin activity was present after 24 hours when glass or plastic bottles were employed.

Although a number of vegetable supplements such as carrots, cabbage, sprouted grain, chicory, and mangolds have been used, kale is routinely fed in our colony because it has one of the highest vitamin C levels of all commonly available vegetables. One hundred grams of kale contains 115 mg of ascorbic acid (Heinz and Co., 1959). Also, kale is totally edible, eagerly accepted by guinea pigs, and is available all year in our area. The supplier is required to maintain on his premises automatic equipment for washing the kale in a chlorinated solution in order to provide a product free of chemical residue and minimal surface bacteria. After washing the kale it is immediately iced in disposable plastic bags and delivered daily. Kale has not been implicated at any time as a source of contamination in our colony. Colony contamination by way of the feed, however, is of considerable concern. *Salmonella* species or chemical residues used to control crop insects could be introduced into a colony via the feed. Fluorosis (Hard and Atkinson, 1967), estrogens (Wright and Seibold, 1958), *Pasteurella pseudotuberculosis* (Paterson *et al.*, 1962), *Histoplasma capsulatum* (Correa and Pacheco, 1967), and *Aspergillus flavus* (Paterson *et al.*, 1962) have also been introduced by contaminated feed. These reports illustrate that feed contamination can and does occur in dry pelleted feeds as well as vegetable supplements. Although many of the more intricate quality control tests are beyond the capability of most colonies, maximal effort must be made to ensure that the feed is of highest quality.

Guinea pigs have unusually high requirement for certain amino acids and this is usually met by providing a diet of 20% protein (cf. Chapter 17), usually of plant origin (Reid, 1958). In England, animal protein in fish meal or meat meal is often used quite successfully in guinea pig feeds.

Guinea pigs appear to have definite taste preferences and alterations in the composition of a feed or the introduction of a new feed may result in a sharp decline in feed consumption to the point of starvation or where clinical symptoms of vitamin deficiency rapidly appear. In one instance in our experience the animals refused to eat pelleted feed from our usual supplier. Within 10 days the death rate increased in younger animals with some showing signs of lameness and paralysis. These pigs were found to be suffering from a form of muscular dystrophy. Since we were able to reverse the process with injection of α-tocopherol, we attributed the condition to hypovitaminosis E due to drastically reduced food intake. We later determined that the feed in question contained about five times the amount of NaCl called for in the formula and was thus unpalatable.

V. QUALITY CONTROL

In surveillance of colony health, access to a diagnostic laboratory capable of bacteriological and parasitological tests is an important part of colony management. It allows one to readily confirm or disprove the presence or absence of disease which may adversely affect colony health. Grossly, guinea pigs should be observed daily for signs of disease or any abnormality. Gross observation is not sufficient to detect all diseases, so it is advisable in production colonies to remove representative guinea pigs periodically for necropsy. This can be done by examining approximately 10% of retired breeders. Dead and sick animals should be similarly evaluated. To confirm the cause of disease in select cases, it may be necessary for affected tissues to be examined histologically by a pathologist familiar with laboratory animal diseases.

Guinea pig sera have been tested against many of the latent viruses affecting rats, mice, and hamsters. There is little work which substantiates actual infection by these viruses, and it is quite obvious that much work will be necessary to define the viral flora of the guinea pig and the role which each virus plays.

Cesarian derivation of the guinea pig is a relatively easy surgical procedure. The primary need for this operation, however, is not for production of germfree animals, but rather for obtaining animals aseptically derived and reared in an environment free of pathogenic contamination of parents, thus breaking disease cycles. Although transplacental transfer of disease and mycoplasma infection of the uterus (Juhr and Obi, 1970) are possible sources for contamination of cesarian-derived young, successful derivations and gnotobiotic rearing of guinea pigs have established nucleus colonies free of disease. From these nuclei, new foundation colonies free of communicable diseases can be populated.

To assure that the disease-free status is maintained and that the introduction of pathogenic organisms has not occurred, there must be continuous monitoring of holding and production colonies, as described previously. The entry of new animals with undefined flora into such a colony is considered a great risk. If animals are introduced from an outside source, diagnostic monitoring and a quarantine period of at least 2 weeks are recommended.

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