

Animal Lab Environment for Better Research: A Short Communication

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ABSTRACT

Animals offer experimental models that would be impossible to replicate using human subjects. Humans clearly reap the benefits derived from animal research, but adequate care and maintenance of animals is given less importance. Animal living conditions, such as housing and food, have a great influence on the lifespan on the laboratory animal and are directly related to the success of animal experiments. Hence, the laboratory conditions of the laboratory animals have to be enhanced for better animal welfare, the validity of research data, health, and safety of animal care personnel.

Keywords: Anesthesia, Animal research, Contact bedding, Environmental enrichment, Euthanasia, Laboratory animals

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INTRODUCTION

The use of animals in experimental research coincides with the development of medicine, which started in ancient Greece. Today, around 100 million vertebrates are used annually worldwide in research and testing for a wide range of purposes. Mice and rats are the most frequently used animal species.¹ The majority of laboratory animals taking part in various experiments are used as a model replacing human body in the studies on the safety of pharmaceutical and biologically-derived products, active dermatological preparations used in cosmetology as well as in the studies of neoplasia, toxicological, genetic research, and experimental surgery. Therefore, ethical considerations suggesting the withdrawal of animals from experimental studies and replacing them by tissue cultures fall through the fact that no tissue culture can replace a living organism.^{2,3}

The term "laboratory animal" denotes a creature which is to be used in laboratory research. The animal is born, bred, and reproduced in certain conditions; it has a close characteristics determining its suitability for appropriate tests, and it remains in certain conditions required for the experiment all the time.⁴

The rodents form the main species (80% all vertebrates) in animal lab experiments. Rodents are favored because

of their easy adaptability to new conditions, higher reproductive rates and low nutritional-environmental requirements. Rabbits are frequently favored for scientific experiments. Other animals, such as dogs, cats, pigs, sheep, goats, and apes, are not often used, but their role is considered important due to the considerable resemblance between them and humans. Apes substitute humans as models for studies on behaviorism and for diseases affecting humans. Food product safety is experimented on pigs. For experimental surgery, animals such as dog, cats, sheep, and goat are considered.¹

ANIMAL PROCUREMENT

All animals should be acquired lawfully; a health surveillance program for screening incoming animals should be carried out to assess animal quality.

Quarantine

The animals should be quarantined and stabilized according to procedures appropriate for the species and circumstances. For small lab animals, the period of quarantine is one week and six weeks for larger animals.⁵

The newly acquired lab animals are stabilized physiologically, psychologically, and nutritionally before they are being utilized for research experiments.

Separation

Physical separation of animals by species is done to prevent interspecies disease transmission, eliminate anxiety and physiological and behavioral changes due to interspecies conflict. Cubicles, laminar-flow units, cages with filtered air, and isolators can be used for separation.⁵

Transportation

The main considerations for transport of animals are the mode of transport, containers, animal density in cages, food and water during transit, protection from transit infections, injuries, and stress. The transport containers should be of appropriate size accommodating fewer animals to avoid overcrowding and infighting.⁶

ENVIRONMENTAL CONDITIONS⁷

Temperature	25±2°C throughout the year
Relative humidity	45-55% throughout the year
Ventilation (number of air changes)	16-20 fresh air changes/hour (recirculation of air from animal rooms is not recommended)
Light-dark cycle	12 h light and 12 h dark or 14 h light and 10 h dark
Light intensity	350-400 lux one meter above the floor level
Light source	Fluorescent tube lights fixed in such a way to facilitate uniform distribution of light
Noise level	Should be <65 decibels (should avoid all high-frequency sound)

CAGING OR HOUSING SYSTEM

Good husbandry program should provide animals with warm, clean, dry environment, sufficient space to move around, access to chow and water, i.e., the conditions allowing for their growth, reproduction, and maintaining good health status.⁸ The following things should be considered for adequate animal living conditions.

- The housing system should provide a comfortable environment
- Provide an escape-proof enclosure that confines animal safety
- Easy accessibility to nutritional needs
- Adequate space for freedom of movement, normal postural adjustments, and comfortable resting place favoring the species
- Adequate light and aeration
- The biological needs of the animals should be well taken care of, for example, maintaining body temperature, defecation, reproduction, etc.
- Cleanliness and wellness of the animals, in accordance with species needs
- Well-being of the animals to facilitate research experiments.⁸

Cages should be big enough to enable the animals move around freely. The cages should be made of nontoxic, easily cleaned material (plastic and macrolon), and they

must be strong enough to withstand escape attempts and be fit for sterilization.

FOOD

Food served to lab animals should be of high nutritive value ensuring normal growth pattern in immature animals, sustaining biological needs such as proper body weight, reproduction, and lactation in adult animals. The formulation and preparation of nutritive food, nontoxicity, absence of microbial contaminants, should be given prior importance. The nutrient food should meet the nutritional requirement of the lab animal under study. The farm feeds or any other food products containing rodenticides, insecticides, antibiotics, fumigants, and other toxins should not be in contact with laboratory animal diet. There should be a separate facility for manufacturing and storing animal lab food products. The animal feed should contain moisture, crude fiber, crude protein, essential vitamins, minerals crude fat, and carbohydrate for providing appropriate nutrition.^{5,8}

WATER

Animals should have continuous access to fresh, potable, uncontaminated drinking water, according to their particular requirements. Periodic monitoring of microbial contamination in water is necessary. Watering devices, such as drinking tubes and automatic waterer if used should be examined routinely to ensure their proper operation.^{5,9}

CONTACT BEDDING

The term “bedding” refers to any substances used as an absorbent in waste collection pans beneath wire floors of a cage as well as the actual bedding material that comes into direct contact with the animals. Bedding must not contain nutrients or be treated with deodorizers, disinfectants which could affect the animals. Bedding must be dust free, non-irritant to animal’s lungs and eyes. There is no ideal bedding material for all species in all applications. Ground corn cob, wood shavings, compressed paper, and straw are the most common type of bedding.¹⁰

SANITATION AND CLEANLINESS

In a laboratory animal facility, there are generally four definable and achievable levels of sanitation:

1. Cleanliness: Involves complete removal of all visible soil from a surface
2. Sanitization: Prevention of diseases by a reduction in the microbial growth, living on inanimate surfaces. This is aimed at reducing total numbers

- of organisms but not necessarily total elimination of microorganisms
3. Disinfection: A more intense form of sanitation which is designed to reduce to a harmless level the number of a specific type of organism, specifically pathogenic organisms (but not necessarily spores), on an object
 4. Sterilization: The object is made totally free of all living organisms including spores.^{4,5}

Cages should be sanitized before animals are placed in them. Animal cages, racks, and accessory equipment, such as feeders and watering devices, should be washed and sanitized frequently to keep them clean and contamination free. Disinfection is done with proper chemicals, the equipment utilized should be rinsed thoroughly to make them chemical free prior to usage. The efficacy of disinfection procedures is evaluated using periodic microbiological monitoring. When pathogenic organisms are prevalent, sterilizing of equipment, and supplies is done using autoclave or gas sterilizer.^{7,8}

ANESTHESIA AND EUTHANASIA

General anesthetics are used in the form of inhalants, intravenous, or intra-muscular injections such as barbiturates. Species characteristics, variation, and side effects must be kept in mind while using anesthetic. The animal should remain under veterinary care till it completely recovers from anesthesia and postoperative stress.⁵

Euthanasia

Euthanasia is defined as an act of killing an animal, preceded by its loss of consciousness. It is done when an animal is to be sacrificed on termination of an experiment or for ethical reasons. Euthanasia is determined by the following factors:^{11,12}

- Painless death
- Rapid loss of consciousness
- Proper technique so that the process is irreversible
- The animal should be under minimal stress
- Safety of the person performing euthanasia
- Simplicity of the employed method and easy availability of necessary equipment.¹¹⁻¹³

Regulations to Ensure Animal Welfare

Animals used in research are covered by several laws and regulations:^{14,15}

- 28-h law (1873)
- Animal welfare act (1966)
- Health Research Extension Act of 1985
- Public health service policy on Humane care and use of laboratory animals

- ILAR Guide for the Care and Use of Laboratory Animals,
- Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC)
- State Certification For Animal Research
- Institutional Animal Care And Use Committee
- Good Lab Practices Act
- AVMA panel reports on euthanasia
- 2008 National Institutes of Health (NIH) Design Requirements Manual for Biomedical Laboratories and Animal Research Facilities
- NASA Principles for the Ethical Care and Use of Animals.

THE CONCEPT OF 3R'S:¹⁰

The principle of the Three R's (Reduction, Refinement and Replacement), given by William Russell and Rex Burch in 1959, provides the foundation for a rational and stepwise strategy for the minimization of animal use and of the suffering caused by that use without compromising the quality of the scientific work being done.

Reduction: To reduce the number of animals used in the study, neither too small nor larger but sufficient enough to satisfy statistical norms.

Refinement: Is to list out the latest approach to reducing pain and distress in experimental laboratory animals?

Replacement: Is to use of alternatives to painful procedures in animal research such as cell cultures and computer generated models?

CONCLUSION

The importance given to the well-being of lab animals is a very old concept, which has been drawing immense attention and is revitalized in the recent years. Researchers have realized the fact that catering to the humane treatment of lab animals could enhance their research abilities while promoting the welfare of lab animals. Every research field using animal lab animals for research purpose should value the importance of these selfless beings and promote quality research for the betterment of mankind.

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