Many recent articles on reptile husbandry note the importance of quarantining newly acquired animals. Most of those same articles also suggest the importance of cleanliness in the proper care of captive reptiles. These points can not be stressed too much, but cleaning and quarantining can be sources of problems for the chameleon keeper if improperly conducted.

While commonly assumed (even by some in the medical and veterinary professions), cleaning is not disinfecting. Cleaners/detergents, disinfectants and antiseptics are not the same. Cleaning is a process (vacuuming, washing, etc.) by which debris (including some disease-causing agents) is removed and must precede disinfection and antiseptic procedures. Disinfection and antiseptics are processes by which fungi, bacteria, viruses, or other pathogenic microorganisms are reduced, killed, or rendered harmless. If the microorganisms to be killed are in or on a living animal (including humans), the process is called antiseptic and the product (antiseptic) is considered to be a drug. Antiseptics are regulated in the U.S.A. by the Food and Drug Administration. Disinfectants are to be used in or on inanimate objects and are legally defined as antimicrobial pesticides. They are regulated by the U.S. Environmental Protection Agency.

Disinfectants and antiseptics are not interchangeable. An antiseptic should not be used to "disinfect" a cage and a disinfectant should not be used as a rinse or soak for a lizard. While it is true some disinfectants and antiseptics have the same active ingredients, they are generally not in the same concentration or associated with the same inert or other active ingredients. Because disinfectants generally have not been tested for skin contact, health risks are unknown when they are used in such a fashion. Likewise, because of the misuse of the product, the level of disinfection (i.e., type and numbers of microorganisms killed) is uncertain when an antiseptic is used as a disinfectant.

Common sense and careful reading of a product label/literature will aid the keeper in the selection and use of germicidal products. If a label reports that a particular product is an irritant and should not be inhaled or allowed to contact human skin, do not use it on or near your plants or chameleons. Likewise, a product that has a label listing special safety equipment (gloves, goggles, respirator, etc.) for correct application is an indicator that this material should not be used on a living plant or animal. This does not mean that it is not suitable for cages, but rather that the inhabitants must be removed from the cage during application. Following the application, the cage surfaces which were in contact with the disinfectant should be rinsed thoroughly and air-dried before returning living plants and animals.

Disinfection

Disinfectants are available in a variety of products, each with its own special uses and abilities to control microorganisms. As part of the registration of these products, the manufacturer performs specific microbiological and human toxicity experiments. Data from these experiments are used to formulate the labels of the products, which include application rates, temperatures, and contact times. While these tests are generally aimed at microorganisms affecting human health, they can serve as guides for chameleon care.

There are many disinfectants available for use around chameleons. The choice of products is influenced by the conditions under which the cages and other inanimate objects will be treated. All objects must be thoroughly cleaned before being disinfected unless the label of the product being used states the product is a disinfectant-detergent. Household detergents are cleaners, but do not assume that they can be used as a disinfectant. If the product is a disinfectant, the label will list the organisms that it will control. Read the label of the product carefully noting such things as: method of application, dilutions, contact times, contact temperatures, and precautions. As with any pesticide, these use directions should be strictly followed. Doubling the concentration will not halve the time the product should remain in contact with the cage surface. In fact, increased concentrations of some pesticides result in an increase in the required contact
time. The use directions are established from laboratory tests and are the only certain way of achieving the level of disinfection stated on the label.

Every disinfectant should list the organisms for which it has been found to control. Some will simply list the product as a bactericide; meaning it kills some, but not all, bacteria. If the keeper knows that his animals harbor no infectious agents a general disinfectant will be fine, but a more stringent product should be sought if pathogens or parasites are possible. A product listing bacteria, fungi, and viruses would be better than a simple bactericide. A product labeled as being effective against tuberculosis (tuberculocide) or Mycobacterium is the strongest disinfectant available and should therefore control all but the most resistant bacterial endospores (Favero and Bond, 1991). If endospores of Bacillus or Clostridium bacteria might be a problem (as on surgical or injection instruments), sterilization should be considered.

When selecting a disinfectant, it is important to note that some leave a toxic residue which can be ingested by chameleons. Any residue will eventually end up in the chameleon as they obtain their water by licking droplets found on cage surfaces. The denaturants in rubbing alcohols are bitter and very difficult to rinse from a surface. Likewise, disinfectants containing phenolic compounds (such as Lysol Disinfectant) are difficult to rinse and should not be used. Even though not stated on all product labels, a good practice is to rinse all objects with potable water after disinfection. Even products which are not known to cause problems in humans might do so in a lizard. Because of the lizard's smaller size and different metabolism, trace amounts of antimicrobial pesticides might be hazardous to them. Like disinfectants, many detergents and cleaners leave residues and should be rinsed thoroughly before disinfecting or returning animals to their cages.

Probably the best disinfectant available to all chameleon keepers is household bleach (5.25% sodium hypochlorite). It is (1) a proven and powerful disinfectant controlling a wide spectrum of microorganisms, (2) free of poisonous residuals [degrades into sodium chloride (table salt) and water], (3) deodorizes, (4) non-poisonous to humans at use concentrations [Dychdala (1991) reported that a 10 ppm sodium hypochlorite solution at room temperature killed Rana pipiens in four days], (5) colorless and non-staining, (6) easy to handle, and (7) most economical to use. Bleach solutions are recorded as being effective against both gram positive and gram negative bacteria (including Mycobacterium spp.), viruses (both lipid and non-lipid), fungi, algae, protozoa, and nematodes.

Unfortunately, bleach is not specifically labeled for use as a tuberculocidal disinfectant. Therefore, use directions are not listed on the label. A 1:10 (1 part bleach in 9 parts water) dilution (5,000 ppm free available chlorine) is appropriate for porous surfaces (wood, cloth, concrete, etc.) that cannot effectively be pre-cleaned of organic matter. The 1:10 dilution is typically considered too corrosive for many surfaces. A 1:100 dilution can be used on smooth pre-cleaned surfaces (glass, plastic, metal, etc.). The object to be disinfected should be thoroughly moistened with the solution (spray or sponged) for not less than 10 minutes at room temperatures. After the appropriate time, the cage can be rinsed with potable water or air dried. While the CDC (1987) and Hoffman, et al. (1981) recommend a fresh bleach solution should be mixed daily, Rutala et al. (1987) and Rutala (1990) stated that diluted solutions last much longer than one day. Up to 30 days when stored in brown opaque containers without air or light contact. Elevated temperatures, presence of organic matter or metals, and ultraviolet irradiation greatly lower the stability of the bleach solution. Dark, sealed, plastic or glass containers that are kept cool are best for time extending storage.

Heat stable objects can be effectively treated by immersing them in boiling water for 20 minutes or in an oven at 170 C (340 F) for 1 hour [160 C (320 C) for 2 hours, 141 C (285 C) for 3 hours]. These times and temperatures are for sterilization (Hurst, 1991; Soule, 1983) and can be used to treat surgical or injection instruments.

Antisepsis
Because antiseptics are considered drugs, they are best discussed in context of disease or injury therapy. Several books are available on this topic, with Frye's 2-volume set topping the list (Frye, 1991). Antiseptics are used on skin surfaces prior to injections or in wound cleansing/irrigation. Rubbing alcohols appear to be the standard for reducing microbial populations at injection sites. In order for the alcohols to be most effective, the site should be rubbed thoroughly with a cotton swab and the alcohol should remain in contact with the skin for at least a minute. Wound cleansing/irrigation should be conducted under a veterinarian's consultation and will not be detailed here. Further information is also available in Frye (1991).

Antimicrobial agents are also present in hand rinses. These rinses (generally with alcohol and emollients) are used to reduce cross-contamination. While some of these rinses will greatly reduce microbial levels, a thorough wash with water and soap is almost effective. The advantages and disadvantages of the various product types are discussed by Larson (1988).

Cleaning

From the point of view of infection control, it is fortunate that most chameleons are solitary. Separate housing reduces contact with potentially infective sources.

Isolating a newly acquired animal, but not its excreta or other body fluids, does little good in halting the spread of pathogens or parasites. At worst, the pseudo-isolation gives the keeper a false sense of accomplishment and might slow the early detection of infection or infestation. Universal precautions in human and veterinary health dictate that a potential source of infection (blood or body fluids) be treated as infective and appropriate precautions be taken. Taking a cue from this health strategy, a potentially infectious source (newly acquired chameleon) should be treated as an infectious source. Thus, quarantine should not just be a period in which the new animal is observed but a period in which the animal is treated as if verified to be infectious.

The new chameleon, the contents of its cage, and any refuse must not come into contact with other lizards. Airborne pathogens are difficult to control in a room with many caged chameleons. Fortunately, this type of infection does not appear to be common. Furthermore, UV light which is found in sunlight and full-spectrum lighting is microbiocidal and should help reduce the numbers of infectious agents in the air. Because UV light does not penetrate well, it can not kill microorganisms which are covered with a film of body fluids or other detritus.

Cleaning can be a source of great stress in chameleons. Moving substrates, branches, or other cage "furniture" has been reported to cause stress leading to death in some wild caught chameleons. None-the-less, some form of cleaning is required. Water dishes, if present, should be cleaned routinely and at the appearance of any excreta or dead food items. At least one article on chameleons suggests that water dripped onto plants can be collected and reused. This can lead to problems if any infectious agent is present on areas over which the water runs. Since live foods crawl through/over any excreta on the floor or in the food dish it is important to attempt to keep these items separate (often a difficult task). Likewise, leaves and other substrates used as watering sources should be free of excreta or dead food items. As stressed is some articles, "musical" foods should not be practiced; i.e., foods offered but not eaten by one animal should not be offered to another animal, especially if the food was mouthed but rejected by the previous animal.

If cleaned cages can be exposed to unfiltered sunlight (UV light does not pass through glass and some plastics well), this will be beneficial as the rich source of UV light will kill or irrevocably alter many microorganisms.

Experience will show how much stress an animal will tolerate at any setting. Some animals can be removed while the entire cage is cleaned, whereas others will crawl from branch to branch as the cleaning proceeds. Cages of easily stressed animals can be cleaned in sections over a period of time: i.e., dishes, floor, and branches on separate days. While it is often convenient to clean as one feeds, be careful not to contaminate the food items.
While the use of wet/dry vacuum cleaners can be very useful, care should be exercised. The noise can be stressful to some animals and should be monitored. Filters on vacuum cleaners are not fine enough to remove viruses or bacterial spores. The use of a vacuum cleaner could potentially produce an airborne spread of these agents.

Acknowledgments

I thank Jill F. Haukos (Antimicrobial Complaint System, National Pesticide Telecommunication Network, Texas Tech University, Lubbock, Texas) and Dr. Fredric L. Frye (Fund for Clinical Research) for their comments on the manuscript. Most of the literature was provided by the Antimicrobial Complaint System. Access to copies of Frye's books was kindly provided by Joe Bill Rogers (Flyers Specialty Pets, Lubbock).

Literature Cited


