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Raising Healthy Rabbits Under Primitive Conditions

By: Dr. Sheldon Bivin, Dr. Kathleen A. Murray &
Dr. Glenn H. Olsen

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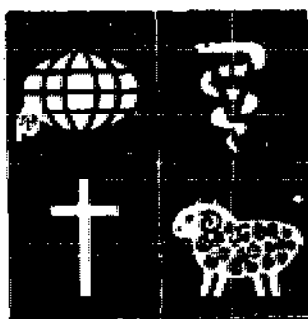
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A Publication of Christian Veterinary Missions

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Box 33000
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Thank you for your help.

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Section I

Acknowledgements

Introduction



ACKNOWLEDGEMENTS

The authors wish to thank the Christian Veterinary Mission for taking the initiative to seek authorship and publish this type of material. We sincerely believe that this information will allow many people to provide a cheap source of high quality protein, and we are very proud to have been asked to participate. Obviously, the information for such a text comes from many sources; however, the authors wish to express special acknowledgements and thanks to two organizations: The Oregon State Rabbit Research Center, Oregon State University, Corvallis, Oregon, 97331; and the Agricultural Research Service, U. S. Department of Agriculture.

The authors also wish to express deep appreciation to these secretaries, Jan Townsley and Beth Wilson, for their assistance in editing and typing this text.

INTRODUCTION

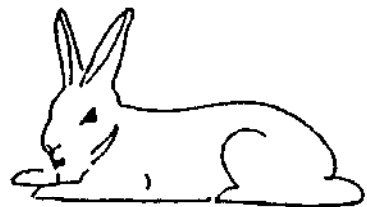
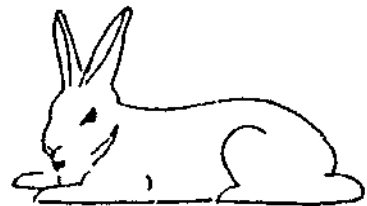
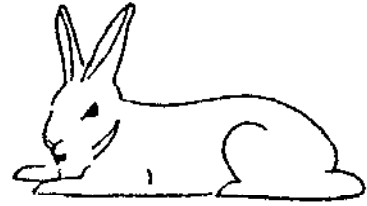
Many developing countries have populations which are suffering from protein deficiencies. As a means of alleviating this need for protein, government agricultural research centers and Christian Veterinary Missions are encouraging the production of fish, poultry, swine, some rodents such as capybara and guinea pigs, and rabbits by small family units or villages.

This text will outline essential information required for rabbit production. Some of the specific advantages for raising rabbits are: They do not compete for grains used for human consumption, since they can reproduce and grow on low-grain, high-forage diets; unlike chickens, they can be successfully raised on a diet consisting largely of forage, plants, grasses and shrubs; and because they are small animals, these food substances can be easily collected by a small family or village unit. Another advantage is that rabbits can use these sources of protein more efficiently than most other animals and they have a high feed conversion ratio. Weanling rabbits can gain one kilogram of body weight for each 2.5-4.0 kilograms of plants they eat. For beef cattle on a similar diet, 12-15 kilograms of feed are required per kilogram of body weight. This means that a hectare of alfalfa can produce at least five times more rabbit meat as compared to cattle raised under similar circumstances. In many areas of the world the keeping of large animals for meat is not feasible. This is primarily due to their large feed and space requirements, the long time taken to reach slaughter weight, and the problem of using a large amount of meat at once when refrigeration and electricity are lacking. In these instances, the rabbit has the distinct advantage of serving as a 'biological refrigerator', since the meat from one animal can be quickly consumed without the need for storage. Another advantage of the rabbit is its high reproductive rate and its ability to thrive on weeds, tropical forages, vegetables leaves and tops, and table scraps. Twelve good does, producing five litters each year, and raising seven fryers to the litter, will produce 420 fryers per year for the table. At a 50% average dress out, they will produce somewhere between 385 and 475 kilograms of high quality white meat, which is enough to satisfy the needs of an entire village for a year.

Because there is a pressing need for protein in millions of people living in predominantly rural environments where forages are plentiful, Christian Veterinary Missions (CVM) highly recommends following the outlines presented in this text regarding raising healthy rabbits. As competition for grain intensifies between humans and livestock, it is possible that rabbits will assume an increasingly important role as a source of food.

Section 2

Housing, Equipment And Furniture



HOUSING, EQUIPMENT AND FURNITURE

Permanent rabbit caging should be constructed before the arrival of the first rabbits. This avoids the situation where temporary housing becomes, by default, the permanent housing for the rabbitry.

The site of the rabbit hutches should have fresh air circulation and good drainage. Outdoor hutches can be the best means of meeting the fresh air requirement and, if located properly, even dirt floors can be adequately drained. Outdoor hutches with free air flow and dirt under the cage flooring also cuts down on fly problems.

EQUIPMENT:

Rabbits are housed in hutches made of a variety of materials. A simple house can be built using a wood frame with a solid wood roof and floor. The sides of the cage may be covered with a chicken wire mesh and the floor can be covered with hay for bedding. If welded wire is available in a fine mesh, this is preferred over wood as a flooring material (Figures 1 and 2).

Commercial rabbitries often use hanging, or quonset-style cages in an open sided building with a solid floor (Figure 3). Cages should be constructed of 14-16 gauge wire. The sides and top can be 2.5cm x 5.0cm mesh and the floor wire should be 1cm x 2cm. The average height for all cages is 51cm; whereas, the floor area should be 75cm x 75cm if the young are removed at four weeks of age, and 75cm x 91cm if the young are removed at six weeks of age. Young does, prior to their first breeding, can be kept in a floor space of 38cm x 75cm cages. Individual breeding bucks should be housed in 75cm x 75cm cages with a floor space of 75cm x 75cm. Wire bottom cages which allow the feces to fall through are superior to solid bottom cages as they help control coccidiosis (Figure 4).

The rabbit building, which is required for larger operations can be open sided in warmer climates. The side toward the prevailing winds should be closed. Even in areas with some cool or cold weather, a one sided building with curtains made of plastic or some other material can be used. In a completely enclosed building, a ventilating system delivering 14 to 20 air changes per hour is required and can defeat the economics of rabbit raising. In either case, abundant ventilation is of tremendous value in controlling snuffles (see disease section).

In many areas of the world bamboo can be used to construct the flooring, sides and roof on a wood frame rabbit hutch (Figure 5). Although not as effective as wire, split bamboo can be used to form slatted floors and walls. Because rabbits like to chew, the rounded sides of split bamboo should be placed on the inside of the hutch. It is also important

to place the split bamboo slats close enough together to prevent injury to the feet. Usually a 1-2cm spacing is adequate.

A more permanent hutch can be made with a wooden frame and wire mesh (Figure 6). The wire between should be 2.5cm x 5 cm wire mesh or 1cm hardware cloth. The hutch dimensions can vary, but the depth should be no longer than the owner's arm length. Generally, 75cm wide and 91-122cm deep is the ideal size. The roof should provide at least 15cm of overhang. Roof construction can be a solid sheet of plywood, metal, several boards or straw thatch. If wood is used, the roof should be covered with some type of shingle material. Also note that multiple cages can be built, with two adjoining cages sharing a common wall (Figure 7).

If materials such as hinges are not available for a cage door, cages can be built with removable tops (Figure 8). Some method, such as hook-and-eyes, should be used to secure the top in position. Scrap lumber and 2.5cm poultry wire mesh are useful for hutch construction. Wood-framed hutches should be built with the wire mesh covering placed on the inside of the wood frame to help prevent the rabbit from chewing up the caging (Figure 9).

All-wire cages can be used in any covered type of building, such as a pole barn or open pole shed. The all-wire indoor cage is ideal for large operations, as it helps reduce disease problems. All-wire cages can be easily sanitized by using a propane hand torch plus a brush. If this equipment is not available, a thorough scrubbing with soap and water followed by a chlorine bleach or weak lye rinse is adequate. Periodically, following cleansing, the cages should be set in the sun for 2-3 days.

In order to construct a wire cage you need 5.5 meters of 60cm wide wire. Roof and floors are cut out to be 60cm x 90cm (Figure 10). Next remove one piece 60cm x 60cm for a door. The remaining wire (300cm x 60cm) can be shaped into a rectangle (60cm x 90cm and 60cm high). The top and bottom are then attached using J-clips, or other small metal or wire fasteners. Finally cut a 45cm square hole along one of the long sides. Attach the 60cm x 60cm piece as a door over the 45cm square hole. This provides 5400 square centimeters of floor space. A doe with young rabbits requires more floor space (6500-7500 square centimeters), especially if the young rabbits are to be left with the doe until they reach butchering size (2 to 2.5 kilograms).

Keep outdoor cages raised off the ground and note the placement of buckets of oil around the base of each leg and/or metal cones, which can be attached around the legs (Figure 5). These tips help prevent access by rats, mice, or other rodents and snakes. In warm areas, an open sided pole barn is best to allow adequate air circulation around the rabbit cages (Figure 11). If other livestock are housed near the rab-

bitry, the rabbits should be screened from the livestock. A pig or goat may frighten a nervous doe and cause her to abandon her litter.

In hot areas it is important to control the temperature. When the temperature in the hutch exceeds 30°C it is essential to provide additional cooling measures. One simple method of shading the rabbitry is to make an awning framework covered with thatched material, moistened cotton, or burlap feed bags. Of course, trees and vines should be used whenever possible to shade the rabbitry. Large rabbitries in enclosed buildings often require roof sprinklers and electric fans; however, these techniques are often expensive.

Gravel or sand floors under the caging is recommended. Loose dirt will also work to help reduce humidity and ammonia levels. Concrete under caging is not recommended unless it is to be cleaned several times daily. However, concrete can be effectively used for alley ways between the rows of cages in the larger rabbitry.

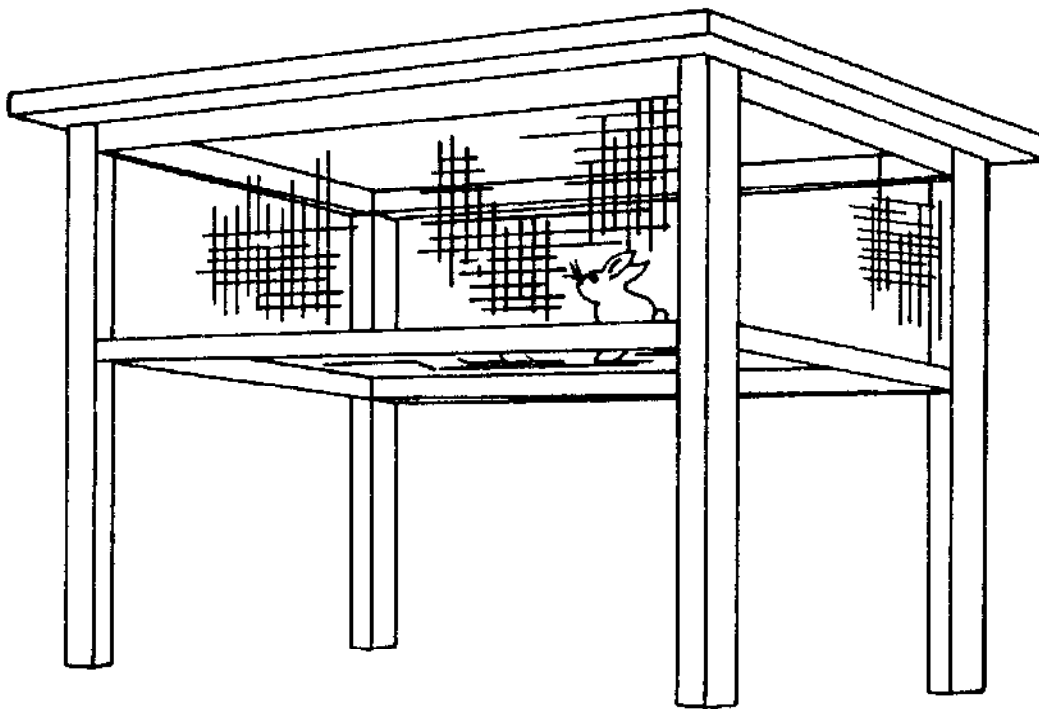


Figure 1. Wood frame hutch with wire sides and floor
(Redrawn from Kanable, Raising Rabbits)

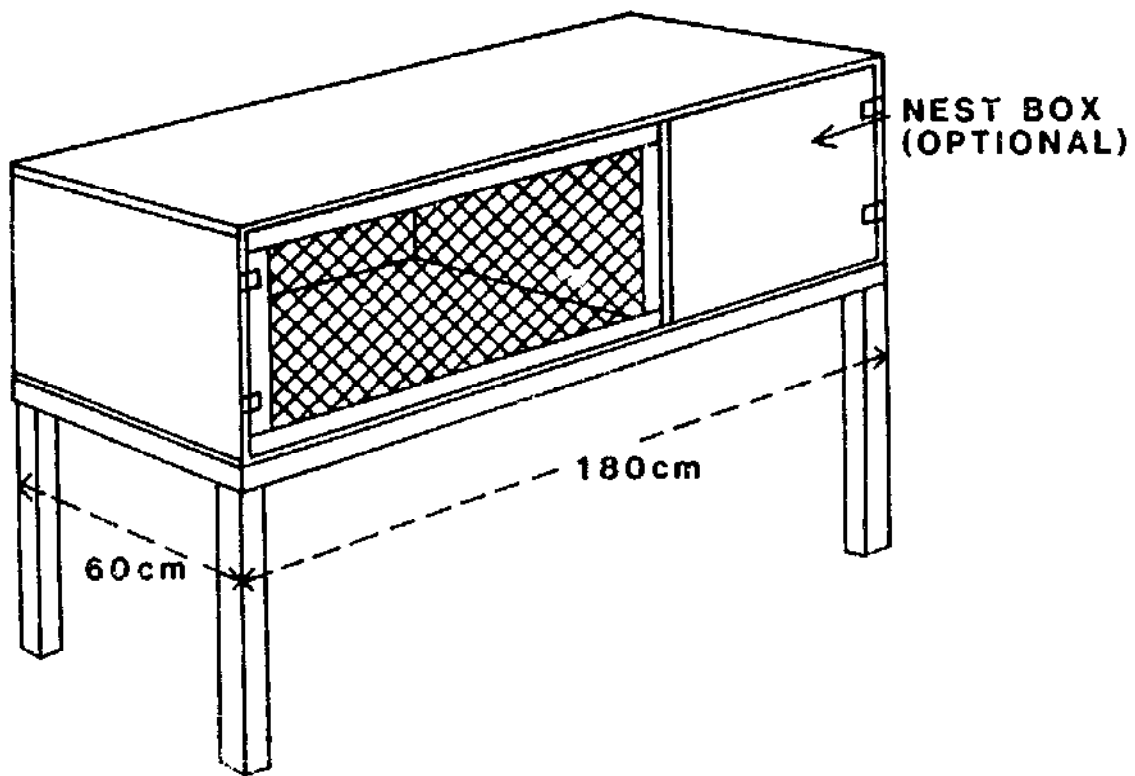


Figure 2. Wood frame hutch with solid floor and nest box

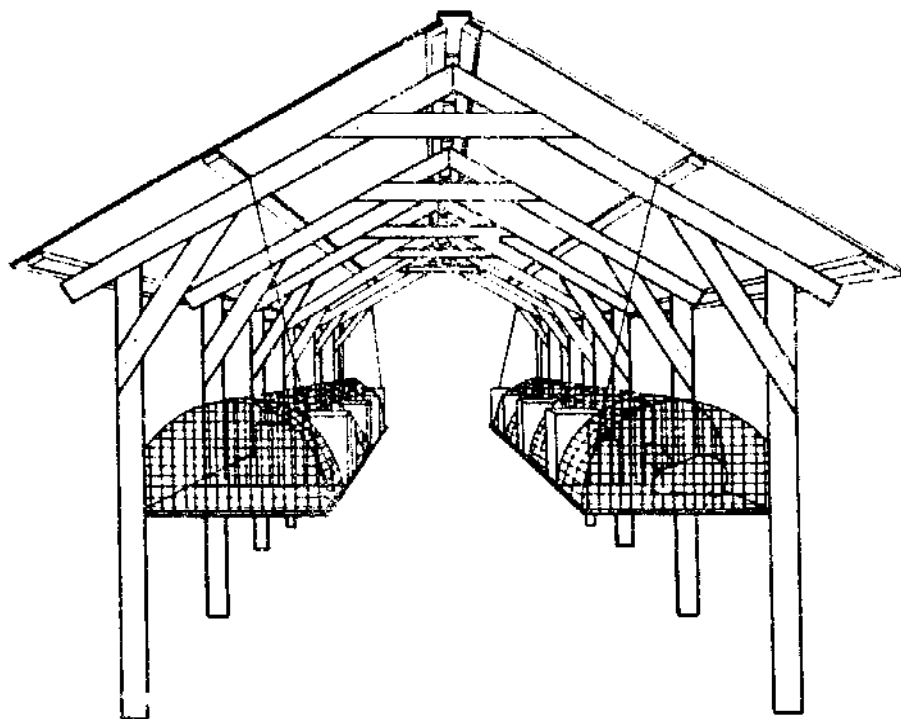


Figure 3. Hanging wire quonset style cages in open building

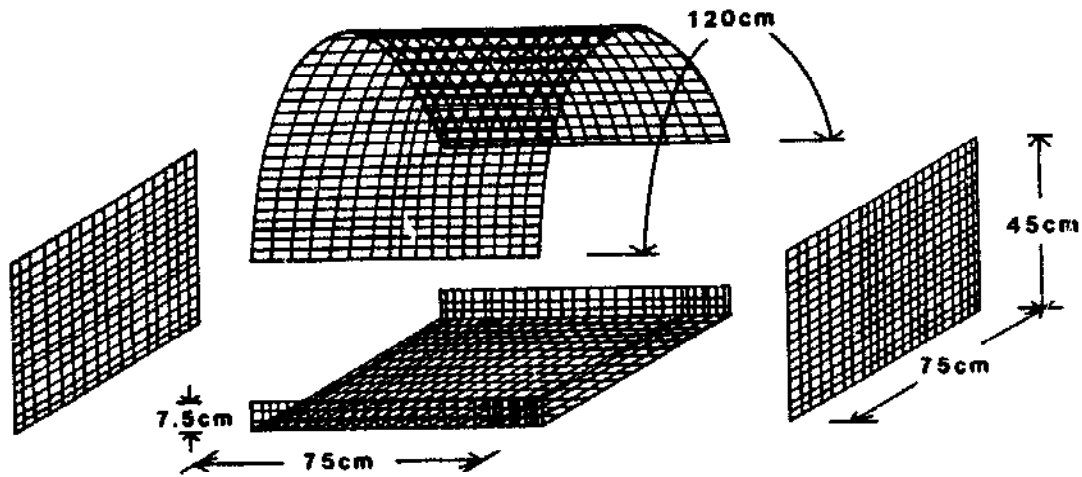


Figure 4. Construction of Quonset style rabbit cages
(Redrawn from D.J. Harris)

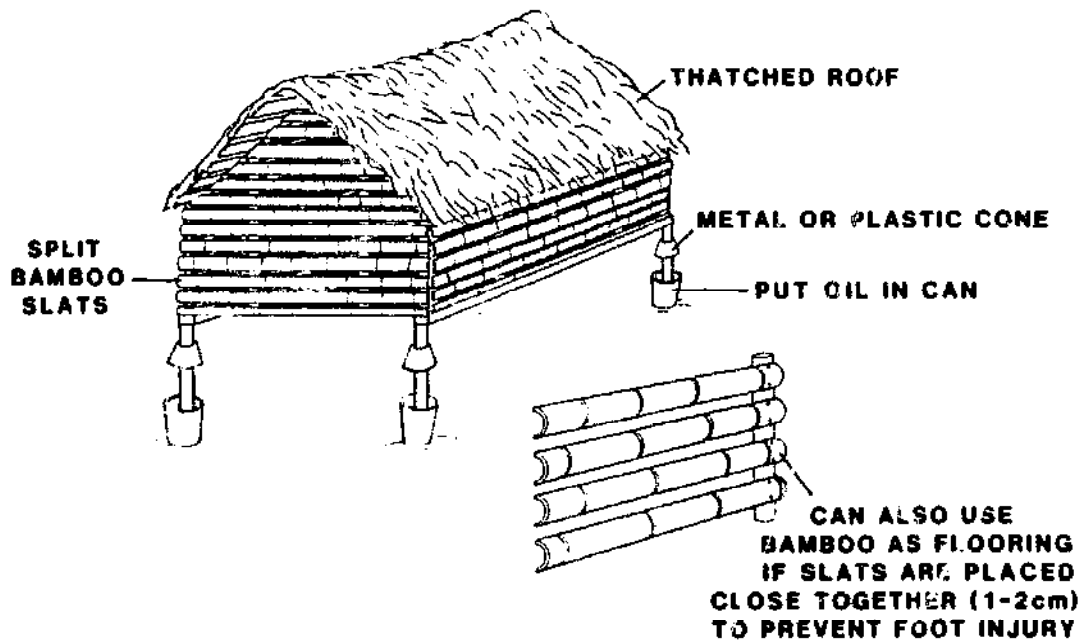


Figure 5. Bamboo hutch with a thatched roof.
Note the protective barriers on the legs to keep out rodents and snakes.

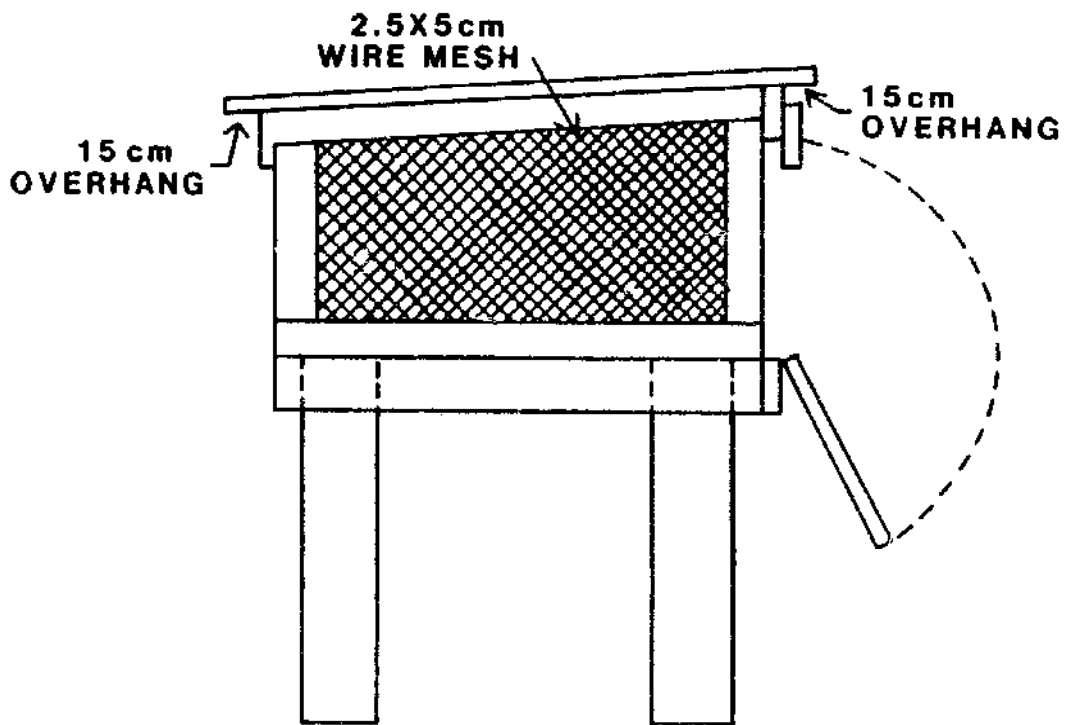


Figure 6. Wood frame hutch with wire mesh sides and roof overhang (Redrawn from Kanable Raising Rabbits)

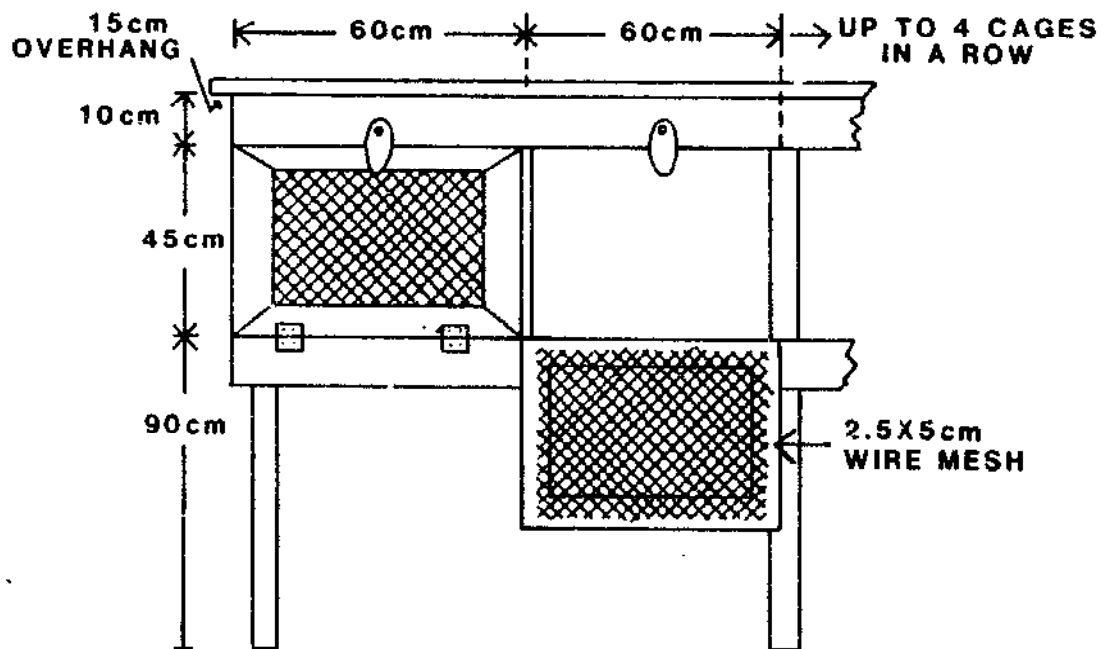


Figure 7. Model illustrates multiple hutch construction (Redrawn from Kanable, Raising Rabbits)

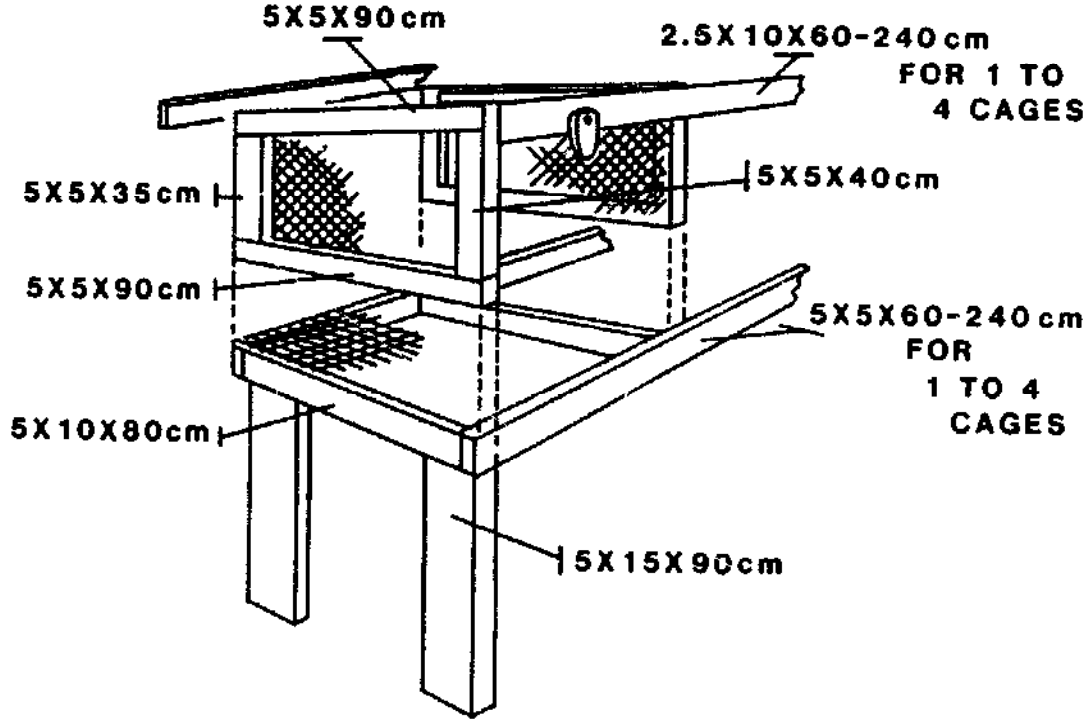


Figure 8. Model illustrates hutch construction with removable top
(Redrawn from Kanable Raising Rabbits)

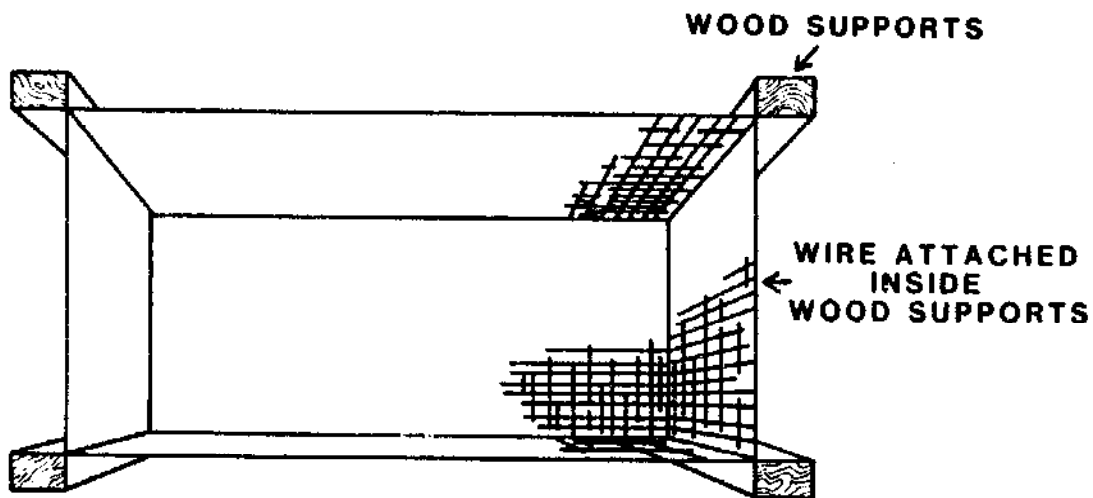
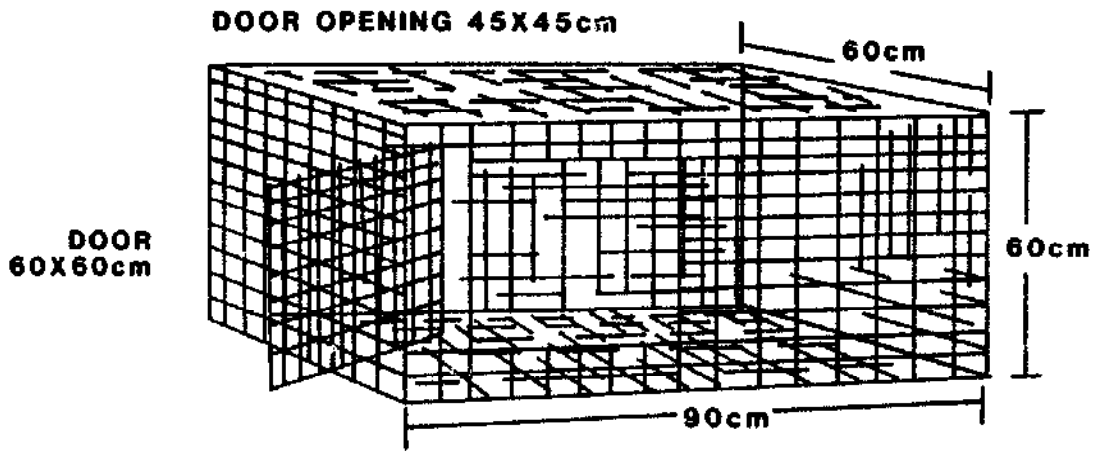


Figure 9. Overhead view of cage showing position of wire



ENLARGED VIEW OF J-CLIP USED TO FASTEN WIRE TOGETHER

Figure 10. All wire cage construction

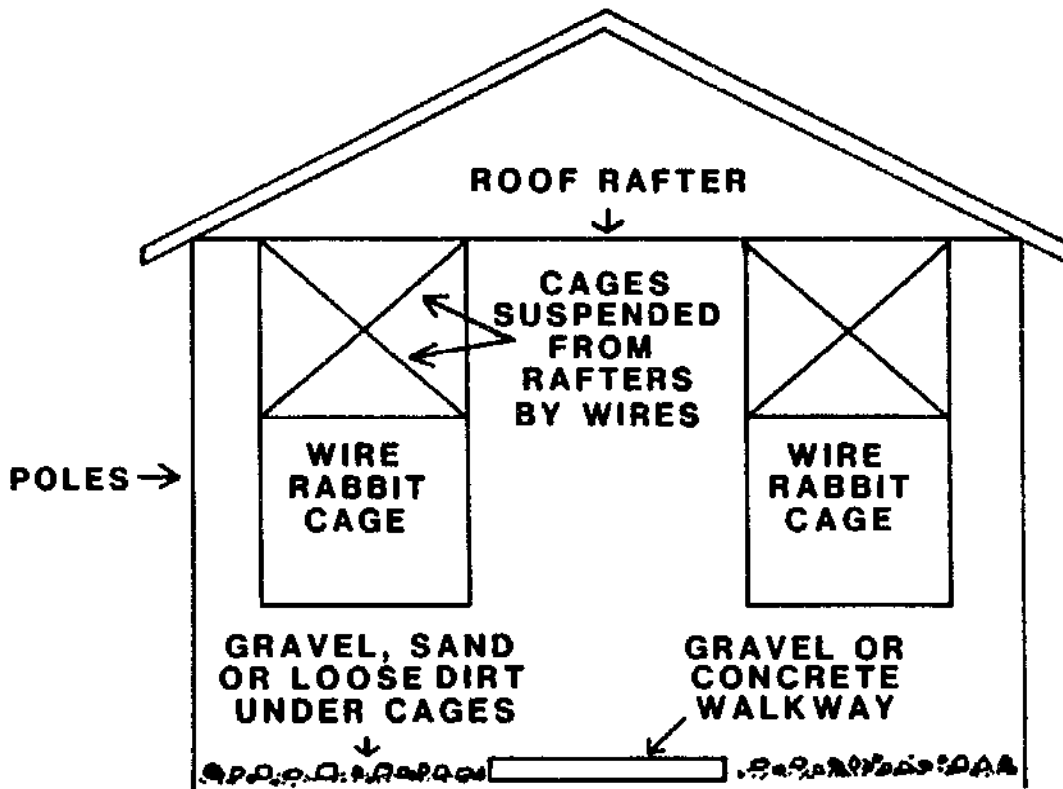


Figure 11. Open-sided pole barn with hanging cages

FURNITURE:

Nest Box:

There are a number of nest box designs, but basically all designs try to provide the doe with some seclusion for kindling (giving birth to the young) and to provide protection for the young rabbits. The nest box should be large enough to prevent crowding, but not too large to prevent the young from remaining close together. Good ventilation is required in warmer climates, while some protection from wind is required in cooler climates.

Box-type: The box-type nest box can be constructed of a variety of scrap wood materials such as shipping crates, etc. The corners should be covered with metal to prevent the doe from gnawing on these areas. Basic dimensions shown in Figure 12 are for a 3.5-5.5kg doe. Adjustments in the size can be made for larger or smaller does. A good doe should provide a warm nest of wool groomed from her body or from nesting material provided (such as straw), so that her young rabbits can survive temperatures as low as -25 °C. Lids and floors should be screwed in place to allow nest box to be removed and cleaned between litters (Figure 13). Extra insulation can be provided by placing corrugated cardboard as a liner along the inside of the nest box. An alternate method is to place the nest box within a corrugated cardboard box and use straw to line the space between the nest box and the cardboard box.

Nail-keg: The nail-keg nest boxes can make use of an item sometimes available for free in the community. A 30cm diameter keg is required for a doe weighing over 5.5kg, while a 25cm diameter keg is adequate for a 3.5kg doe. The required drain holes, ventilation holes and door are shown in Figures 14 and 15. Boards nailed to the front and rear of the keg will prevent it from rolling.

Open-box type: When plywood is available a more open wood nest can be built for use in warmer climates (Figure 16). The bottom can be either solid or wire window screen material. The screen bottom has the advantage of keeping both the babies and the doe cooler by providing more ventilation. If a solid bottom is used, 3-4 holes should be drilled in the bottom to provide drainage. The sitting board at the back of the box provides the doe with a place to rest and observe her young without having to be in among them.

Wire nest box: In some warm tropical areas the sides and bottom of the nest box can be constructed entirely of wire and the top is left open. The purpose of this type of nest box is to provide adequate ventilation while confining the young to one small part of the cage.

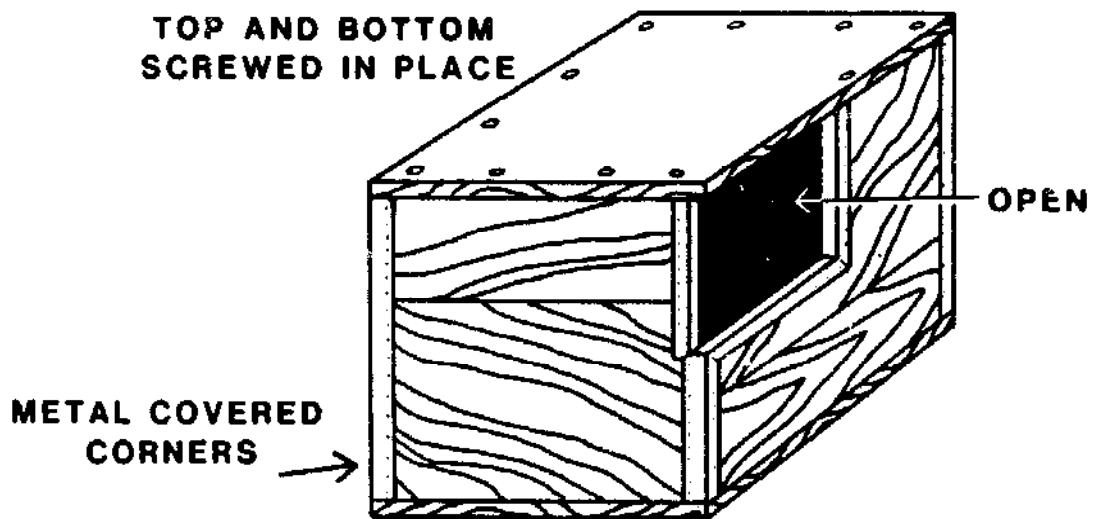


Figure 12. Nest box construction using wood with metal covered corners
(Redrawn from Farmers' Bulletin 1730, USDA)

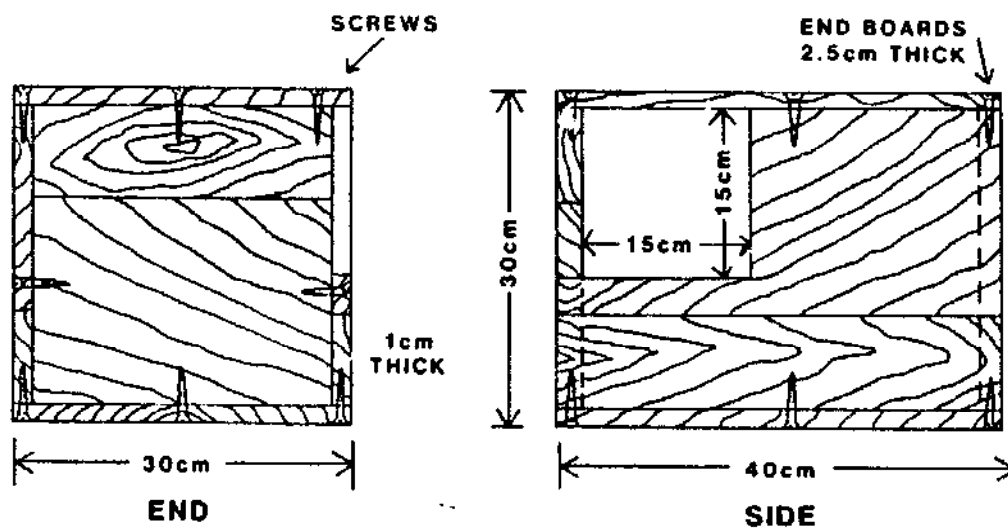


Figure 13. Nest box construction detailed for ease in cleaning
(Redrawn from Farmers' Bulletin 1730, USDA)

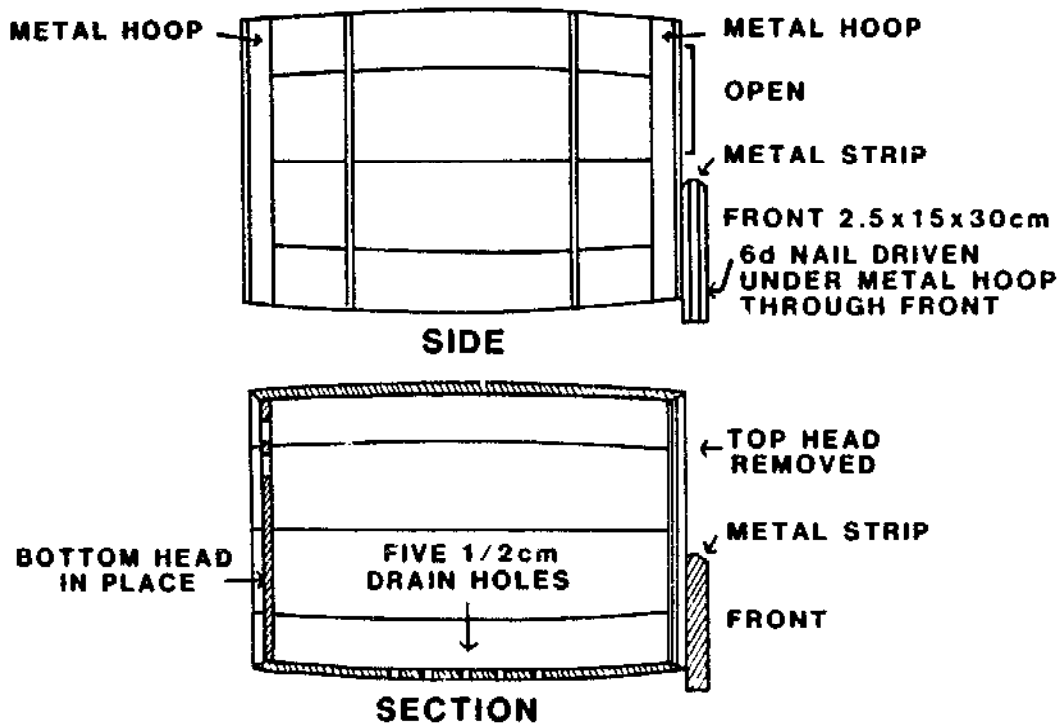


Figure 14. Nail-keg hutch
 (Redrawn from Templeton, Ashbrook and Kellogg, Rabbit Raising, Conservation Bulletin 25, USDI)

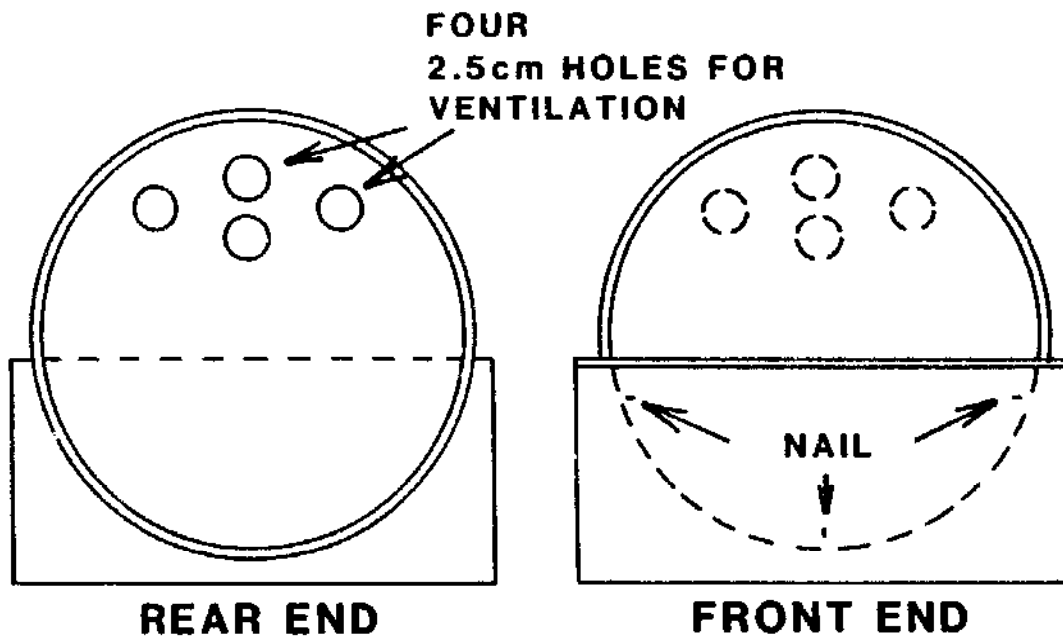


Figure 15. Nail-keg hutch with wood supports to prevent it from rolling
 (Redrawn from Templeton, Ashbrook and Kellogg, Rabbit Raising, Conservation Bulletin 25, USDI)

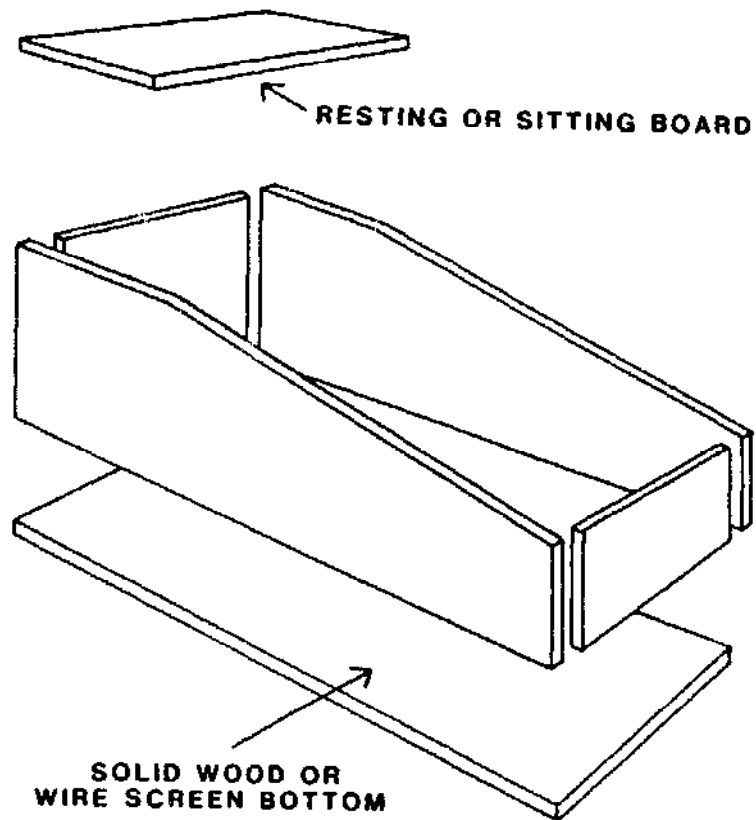


Figure 16. Open wood nest box
(Redrawn from Kanable, Raising Rabbits)

WATERING DEVICES:

Rabbits require clean water at all times. A doe and her offspring can drink four liters of water daily. Several watering systems, from simple equipment for small farmers to automatic systems for larger operations, can be used.

Crocks:

Two liter pottery crocks are still one of the easiest and least expensive ways for watering rabbits. The crock needs to be fastened to the front of the hutch with part of the crock extending into the hutch. Fasten the crock so that the rabbits will not tip it over. Clean and disinfect the crocks at least weekly.

Coffee Cans:

Cut-down coffee cans or other types of large cans will work in place of crocks, but are tipped over more easily by the rabbits. Therefore, it is necessary to securely fasten them to a board or the cage. Again, if part of the can extends out beyond the cage it can be refilled easily. Cans should be cleaned and disinfected weekly, and replaced as soon as they begin to show rust.

Soda Bottle and Cans:

A further modification of the can watering device is to wire the can inside the hutch. Then wire a large soda bottle on the outside of the hutch with the bottle neck extending into the water in the can (Figure 17).

Plastic Jugs:

A simple watering device can be made from a four liter plastic jug such as those used for various cleaning agents (bleach or soap). Be sure to rinse the container thoroughly, then mount a drinking valve in the heavy plastic material near the bottom of the jug (Figure 18). The jug is then placed on a tray attached to the cage. A wire loop helps secure the jug in place. By retaining the jug's plastic screw-cap, the water supply can be protected from contamination by dust or vermin. This system is also useful for medicating a single rabbit. The medication is added to the water in a measured quantity and there is little waste as encountered in the more open systems described previously. The drinking valve would have to be purchased from a rabbit or poultry supply company.

Automatic-Watering Systems:

Automatic systems eliminate the need for washing and refilling of water containers daily and deliver a constant supply of clean, fresh water. The system starts with a pressure-reduction tank on the incoming water line. The tank is equipped with a float valve feeding into a supply pipe that leads to the watering unit for each hutch. The tank should be about 30cm higher than the highest point in the piping system

in order to maintain a good water flow. Tanks as small as four liters can be used where there is no problem with sediment in the water and no danger of freezing in cold weather. Small tanks have the advantage of maintaining a cool, fresh water supply due to the constant turnover. The tank should be connected to the watering pipes by a flexible hose in order to allow for adjustments in tank height. If the tank is too high, the system will be under too much pressure and the rabbit will not be able to trip the valves in their hutches; and, if the pressure is too low, the valves will leak or drip.

The water valve for the rabbit should be located 22.5cm above the hutch floor for large breeds and 18cm above the floor for smaller breeds. To minimize problems from dripping water valves, locate the valves just outside the hutch and cut a hole in the hutch wall large enough to allow the rabbit to stick its head through and drink.

The piping from the tank to the cages can be either a flexible rubber-type hose such as a garden hose or plastic (PVC) piping (except the first section near the tank as noted above). Drinking valves would have to be obtained from a commercial source of rabbit or poultry supplies. Additional valves for bleeding air from the system should be located at any high point in the piping. A valve to drain the system should be located at the system's lowest point (Figure 19).

Rabbits quickly learn to use the system. Even young rabbits readily adapt to the system providing they are large enough to reach the drinking valve. If young rabbits are not large enough to reach the drinking valve, be sure to supply their fresh water needs by adding a crock or other device they can reach. When a hutch has been unoccupied for a few days, make sure the drinking valve is working properly before introducing a new rabbit, as minerals and sediment in the water can cause the valve to stick.

In cold climates you must protect the system from freezing. If the hutch and all piping are in a heated enclosure there should be no freezing problem; otherwise, heating cables sold for wrapping house pipes can be used on the rabbit piping. Another alternative for short cold periods is to keep the water in the system moving by allowing water to dribble from the drain valve at the low end of the system.

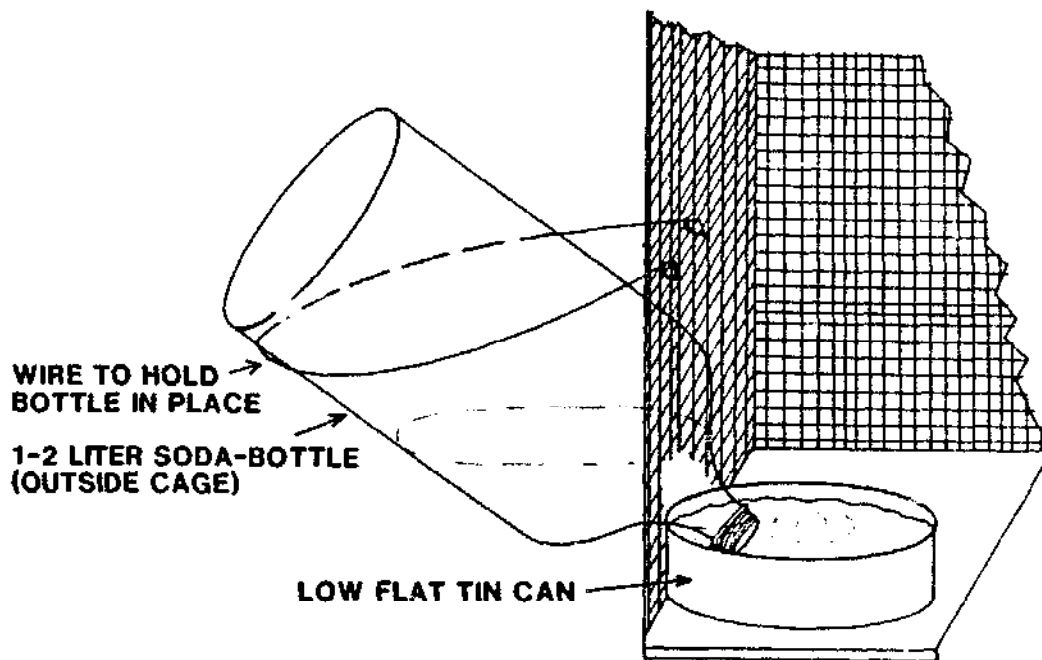


Figure 17. Cut-away view of soda-bottle waterer
(Redrawn from Kanable, p. 31)

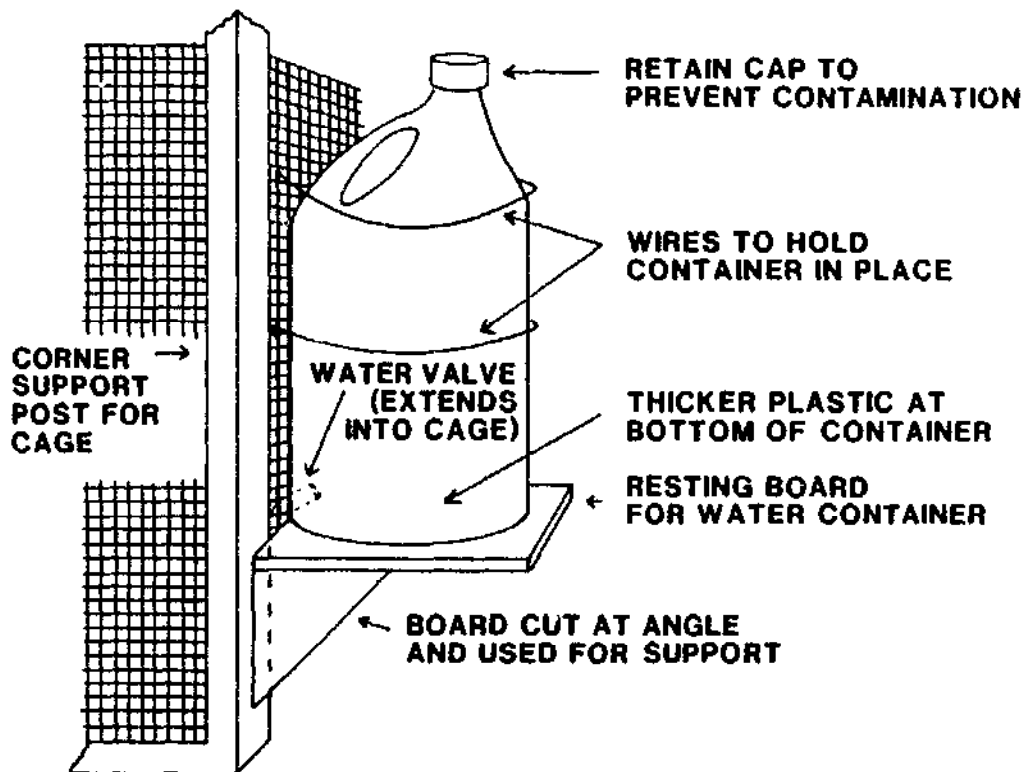


Figure 18. Plastic jug watering device
(Redrawn from Kanable, Raising Rabbits)

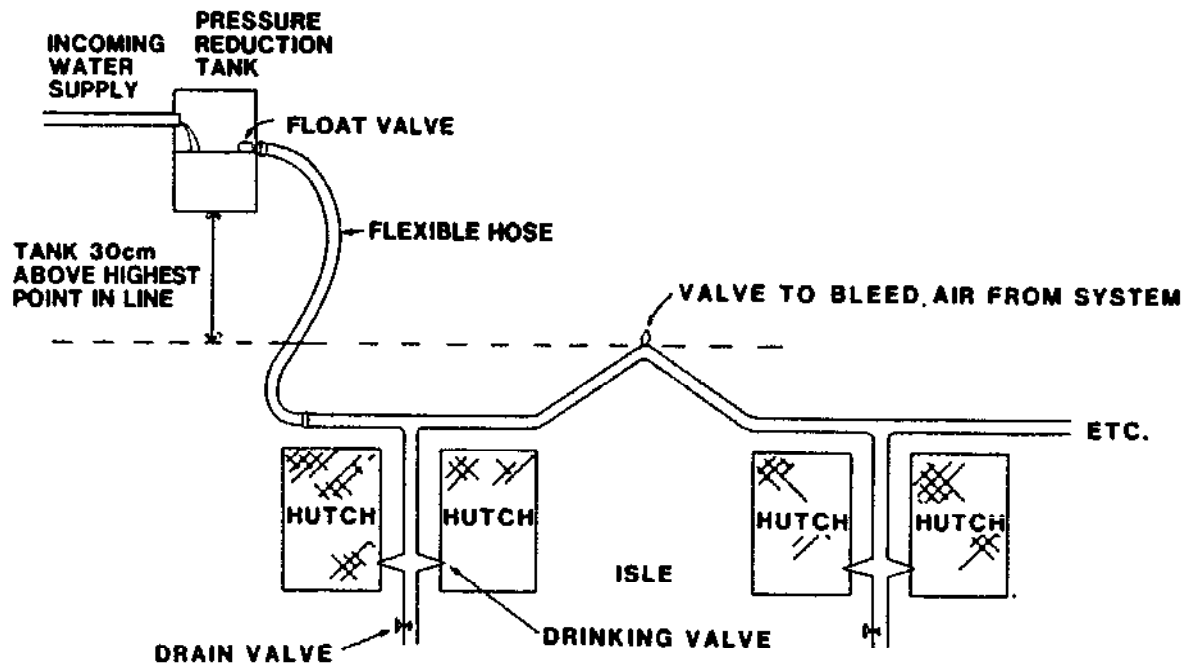


Figure 19. Automatic watering system for large rabbitry.

FEEDERS:

Feeders vary from small, homemade devices to manufactured hoppers for pelleted food. For the small rabbit farmer, homemade feeders are the most practical and least expensive alternative. The simplest feeders are those using a pottery crock or tin can similar to the equipment used to hold water.

Tin can feeder:

Take a one-pound coffee can or similar size tin can, and with tin snips cut down one side to within 5 cm of the bottom. Next, cut half-way around the can staying parallel with the bottom (Figure 20). Now flatten the cut section and fasten the overlap inside the remaining section of the can using rivets or solder. Bend the lower portion of the can over to reduce the possibility of the rabbit cutting itself on the can. The feeder can be wired to a cage wall to prevent tipping (either inside or outside the cage, Figure 21).

Feed troughs:

Hay mangers and feed troughs help keep food off the floor of the cage where it can be trampled and lost. Mangers and troughs also save time in feeding. A simple feed trough (Figure 22) can be built from wood and 24-gauge galvanized metal. The trough guide is made from two wood blocks approximately 2cm thick (9cm x 21cm in length and width) and covered on the flat surface with pieces of galvanized metal (to stop chewing). Next, cut two pieces of galvanized metal 11.75cm wide and 30cm long or longer. The length of these pieces can vary and will determine the length of the feeder, but both pieces should be the same length. Now cut five pieces of 2cm x 4cm boards to 30cm length (or the same length as the previous galvanized pieces). The 2cm x 4cm boards are attached at their end points to the galvanized covered 9cm x 21cm board using wood screws (Figure 22). Then the 11.75cm x 30cm galvanized pieces are formed into two half-circles and placed between the 2cm x 4cm x 30cm pieces (Figure 22). These two half-circles can be attached to the wood 2cm x 4cm supports with wood screws. A guard to prevent small rabbits from sitting in the feed trough can be constructed from a piece of iron 0.5cm x 2cm x 30cm to which 0.5cm iron rods are attached at 7.5cm intervals. The wire rods need to be 17cm long to cover the feed trough area, and are attached at their midpoint to the flat iron pieces (Figure 23). The flat iron piece is then attached with wood screws to the center 2cm x 4cm wood support for the two troughs.

Hay manger:

A manger can be constructed from 26-gauge galvanized metal and 16-gauge 2.5cm mesh wire (Figure 24). Galvanized metal sides and ends are attached to the 16-gauge 2.5cm mesh wire with 2.5cm long metal clips and rivets (pop rivets or similar devices). Hay can then be placed in the manger and not be contaminated by feces and urine, as it would be if just placed in the bottom of the cage. If the length and width dimensions used for the manger are the same as those used for the feeding trough, the manger can sit on top of the trough thus conserving cage space (Figure 25).

Oil-can feeder:

A four compartment feeder can be constructed out of a five gallon (20 liter) oil or gas can. The can should be cleaned thoroughly, then two openings are cut in the front and two in the rear. (Figure 26). The openings are 7.5cm x 10cm and are located 10cm from the bottom of the cage. Hem (turnover) a 0.5cm section around the edge of each hole to create a smooth surface. The inner partitions can be built of wood. Two partitions the same size as the inside dimensions of the can are needed (Figure 27). Notching these in their center for half their length will allow them to interlock. The four angled pieces can be made now, also taking their dimensions from the inside compartments. The cut-out portions of these pieces allow food to drop down to the feeding area inside the openings. A piece of 26-gauge galvanized metal can be used to build a top for the feeder. The corners are cut and turned down for 2-1/2cm (Figure 28). If an oil or gas can is not available, the feeder can be constructed entirely of galvanized metal.

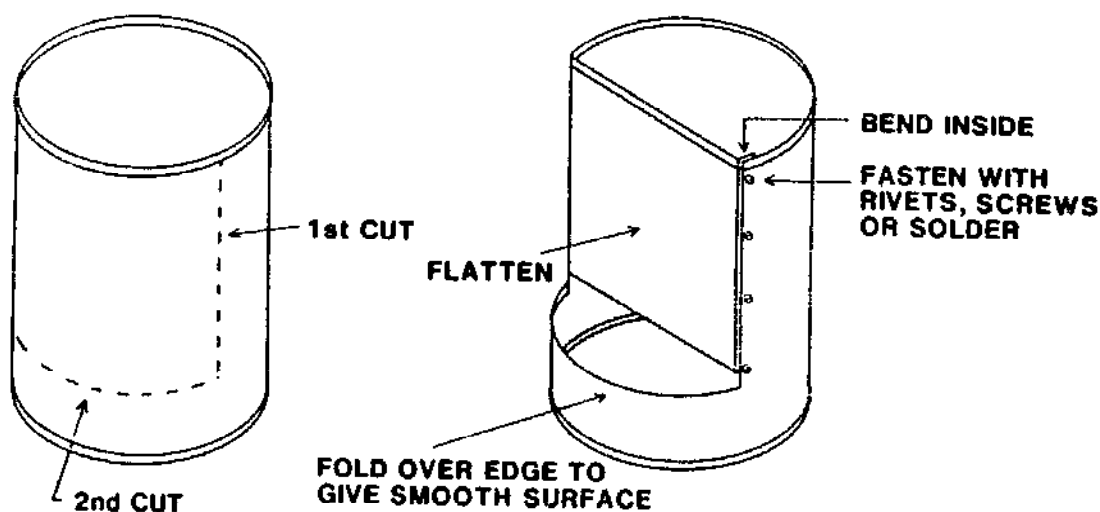


Figure 20. Tin-can feeder
(Redrawn from Kanable, Raising Rabbits)

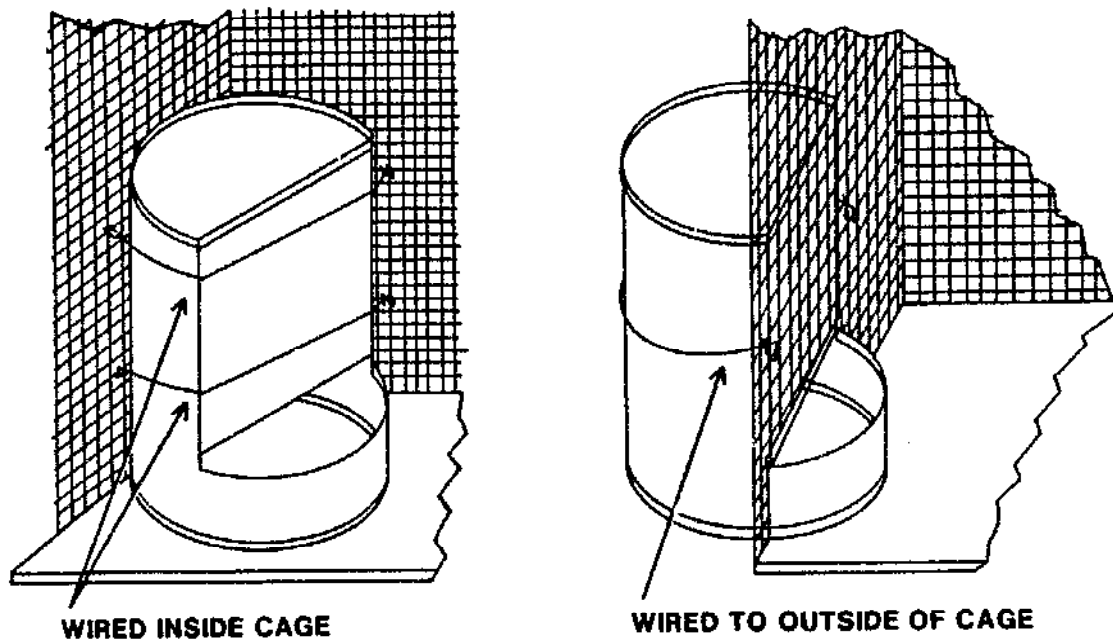


Figure 21. Tin-can feeder attached to cage or hutch

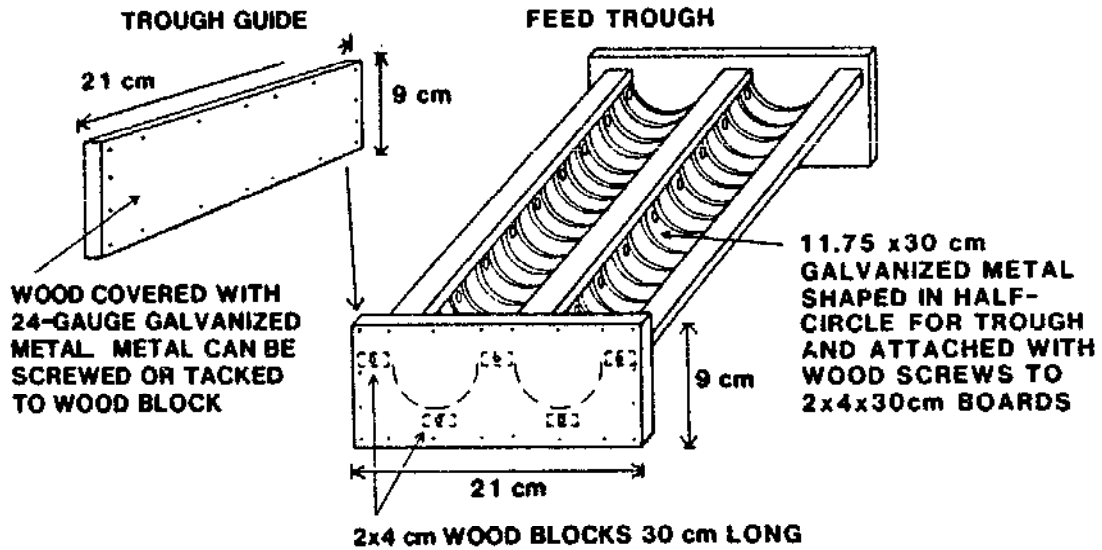


Figure 22. Wood and galvanized metal feed trough
(Redrawn from Farmers' Bulletin 1730, USDA)

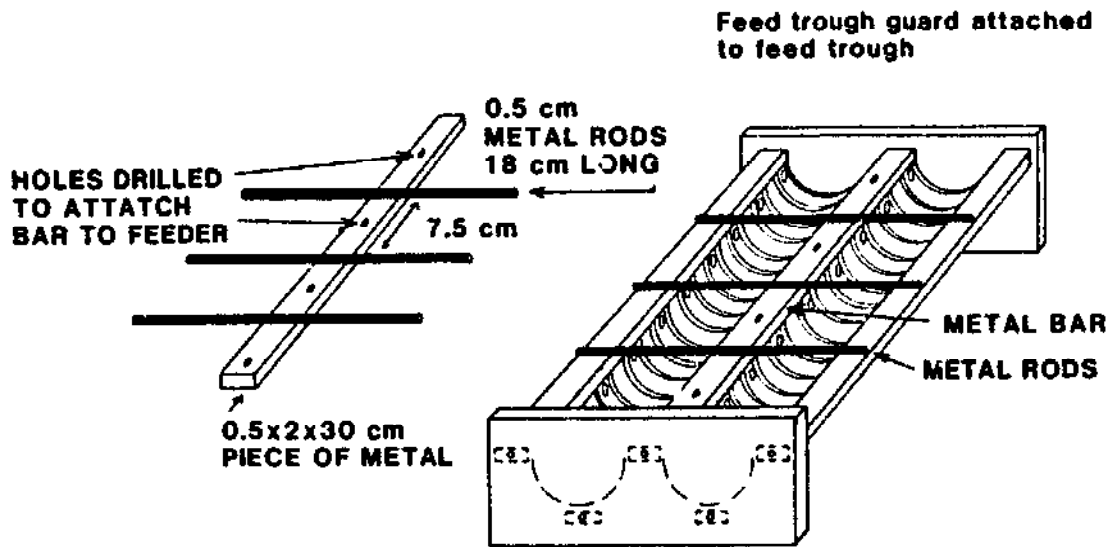


Figure 23. Feed trough guard
(Redrawn from Farmers' Bulletin 1730, USDA)

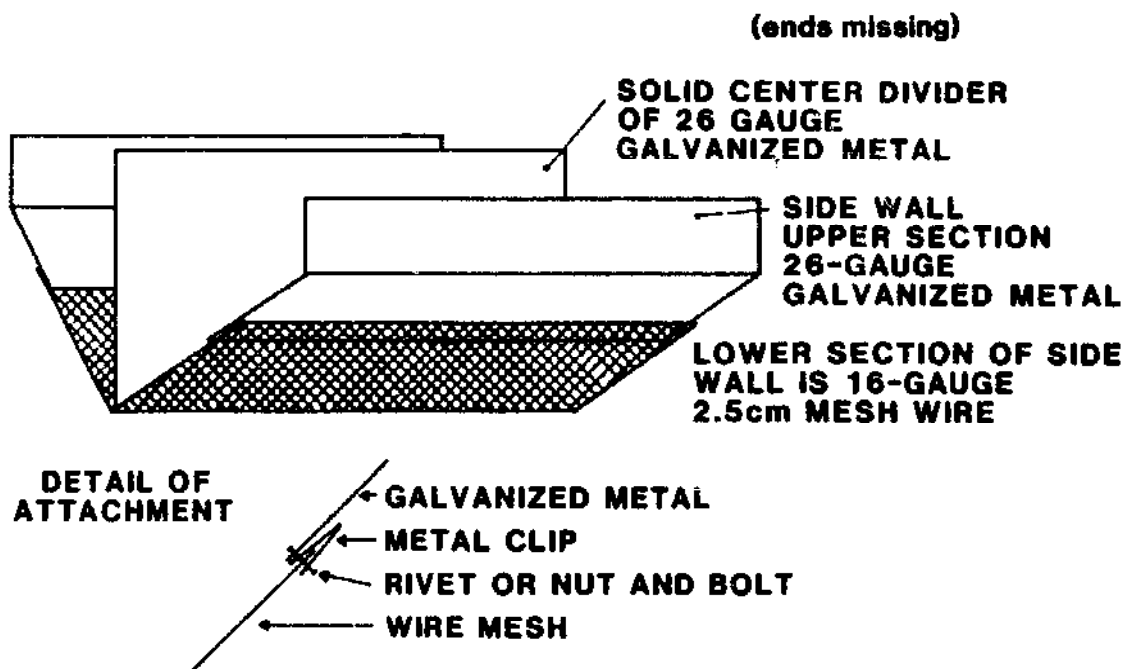


Figure 24. Cut-away view of hay manger (ends missing)
(Redrawn from Farmers' Bulletin 1730, USDA)

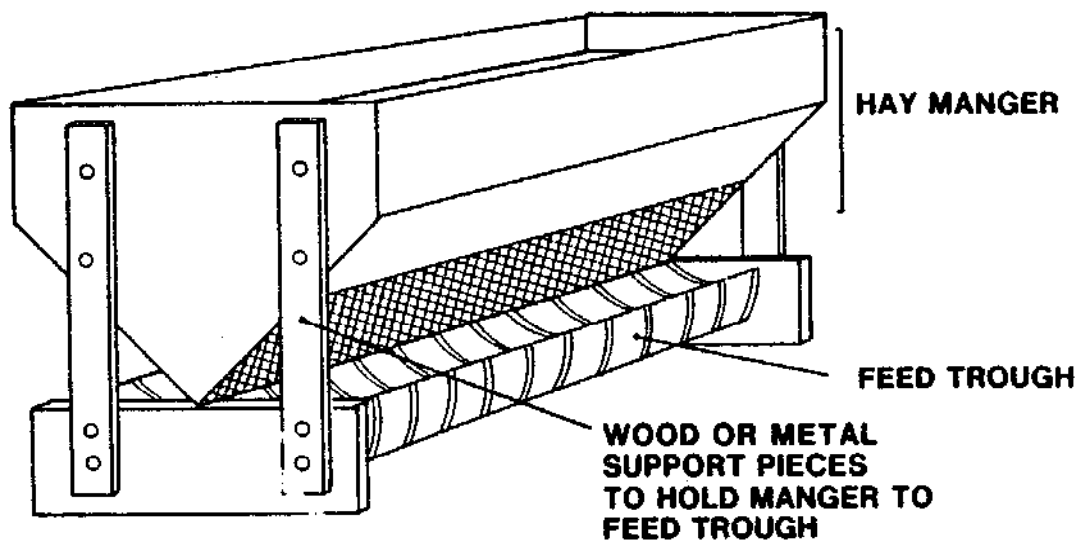


Figure 25. Hay manger on top of feed trough
(Redrawn from Farmers' Bulletin 1730, USDA)

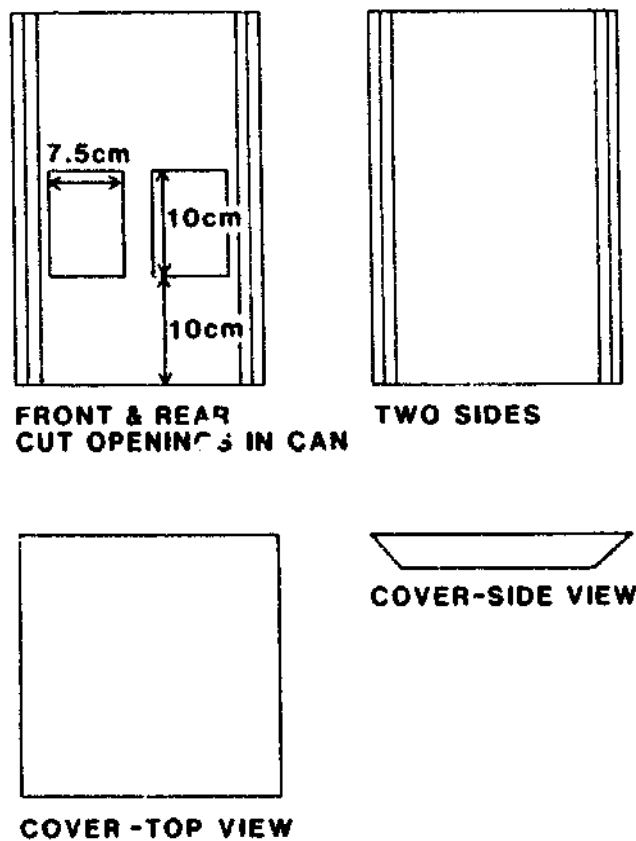
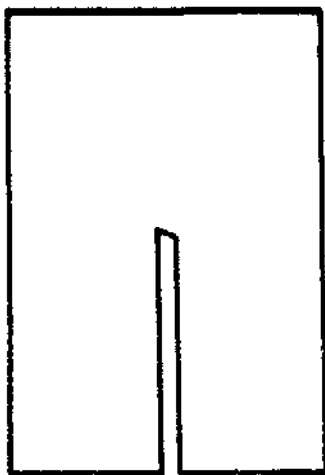
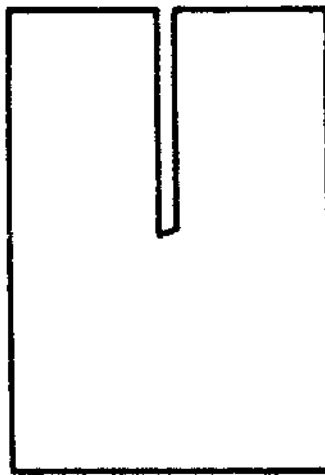


Figure 26. Self-feeder made from 5-gallon oil can
(Redrawn from Conservation Bulletin 25, USDA)



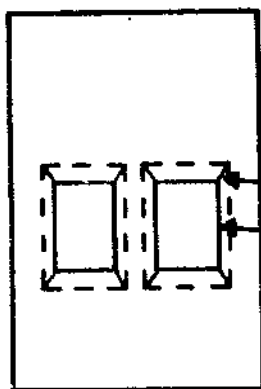
1. MAIN PARTITIONS



**2. HOPPER PARTITIONS
(MAKE 4)**

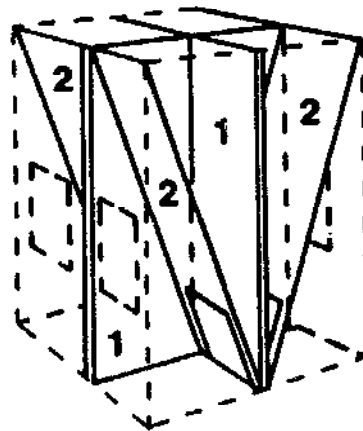


Figure 27. Partitions for 5-gallon self-feeder
(Redrawn from Conservation Bulletin 25, USDA)



HEM OPENINGS IN CAN

**CUT
TURN IN**



**CUT-AWAY SHOWING
ASSEMBLY OF PARTITIONS
1 AND 2**

Figure 28. Oil can feeder partitions and openings
(Redrawn from Conservation Bulletin 25, USD!)

CARE OF RABBITS DURING EXTREME HEAT

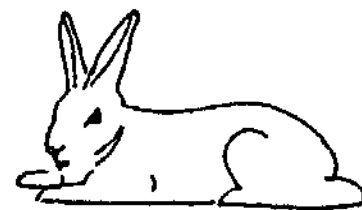
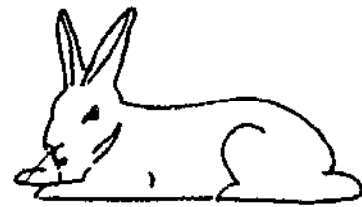
During unusually warm weather the two most important requirements for rabbits are shade and good air circulation. In addition, rabbits should have a good supply of fresh water.

Newborn litters and pregnant does, especially those near kindling, are most susceptible to heat stress. Signs of heat stress include extreme restlessness in early stages and, in young animals, rapid respiration, excessive moisture around the mouth, and small hemorrhages on nostrils. Place a rabbit suffering from heat stress in a quiet, cool, well-ventilated location. Wet the rabbit or give it a cloth soaked in wet water to lie on. When using an overhead sprinkler or another method, wet the tops and any solid sides of the hutch. The resulting evaporative cooling will reduce the temperature in the hutch by 3-8°C.

Section 3

Breed Selection

Rabbit Wool Production



BREED SELECTION

After the hutch is constructed, the rabbits can be obtained from another farmer or from a commercial breeder. Different breeds can be selected for various characteristics. Mature rabbits of the smaller breeds, such as the Netherlands dwarf, weigh 1.5kg to 2kg (3-4 pounds) and large breeds 6kg to 7kg (13-16 pounds). The medium and large breeds are most suited for meat and fur production. New Zealand, Californian, Champagne d'Argent, Chinchilla and Flemish Giant are excellent breeds for meat production (Table1). While the white breeds such as New Zealand and Californian are the most desirable for fur production, the New Zealand white is also the breed used most often for meat. The Californian is the second most common meat breed.

Often rabbit raisers will cross Californian bucks and New Zealand does. One buck can service 2 to 10 does, and the breeds or cross-breeds are not critical for the small backyard producers. Of more importance is trying to obtain healthy rabbits initially. Rabbits that come from different sources should be housed in separate quarters for 30 days before introducing them to other animals in the rabbitry.

Table 1. SOME COMMON BREEDS OF RABBITS USED FOR MEAT AND FUR PRODUCTION
(Farm Agriculture Handbooks No. 309, USDA)

| BREED | DESCRIPTION | WEIGHT (KG) | USES |
|--------------------|--|-------------|------------------------------------|
| Chinchilla | Rabbit that resembles the chinchilla in coloration | 4.5.5 | fur and meat |
| Californian | White body with darker nose, ears, feet and tail | 3.6-4.7 | fur and meat |
| Champagne d'Argent | Undercoat dark slate blue, surface coat blue-white or silver, long black guard hairs | 4-5.5 | meat |
| Flemish Giant | Gray, tan, black, white | 10+ | meat |
| New Zealand | White, reddish-brown, black | 4-5.5 | meat and fur (white color only) |

RABBIT WOOL PRODUCTION

Angora rabbits are raised primarily for their fur or wool. Wool on this variety of rabbit will grow at the rate of about 2.5cm per month. Usually the wool is trimmed from the rabbit at three month intervals with total production being about 450 grams per year. The wool is valued for its fluffiness, softness and warmth, but usually has to be blended with other fibers to give it a better strength and durability. The Angora rabbit can, of course, be used as a dual purpose animal for both meat and wool production in those areas with cooler temperatures favoring this type of rabbit.

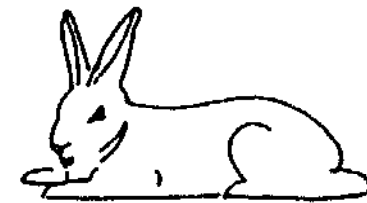
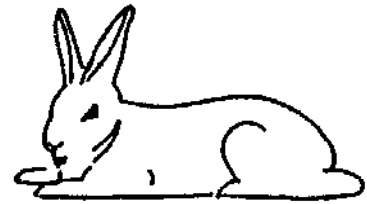
Herd bucks and does are kept in individual hutches, but extra rabbits can be kept in groups or colonies. Castration of bucks in the colony is necessary to prevent unwanted breeding and to help prevent fighting among the bucks.

Because of their thick coats, Angora rabbits should be handled periodically to determine how thin or plump they are, and adjust their feed accordingly. Self-cleaning types of floors for the hutches and colonies are recommended to keep the wool as clean as possible. Also, it is a good idea to shear animals just prior to mating to decrease matting and loss of wool during pregnancy.

Shearing can be accomplished with a hairbrush that has a single row of steel bristles and a pair of barber's scissors. Electric clippers can also be used if available.

Section 4

Reproduction



REPRODUCTION

INTRODUCTION

In planning a breeding program for rabbits, concepts that have been shown to work in the breeding of other domestic livestock should be applied in the rabbitry.

Gene Pool:

The initial foundation stock provides a pool or group of hereditary units commonly called genes. Genes are found on specific locations on the chromosomes (small thread-like bodies found in the center or nucleus of every cell). There are 22 pairs of chromosomes in the rabbit, one chromosome of each pair comes from each parent (via egg or sperm). Hereditary characteristics are transmitted from one generation to the next by this method.

Selection:

Selection is the process of a planned breeding to produce offspring with a desired trait or traits. Selection depends upon the initial quality of the gene pool and a proper environment to allow the animal to grow to its maximum potential (i.e. an environment that has adequate food and water plus adequate cage space, so that the young rabbits are not stunted).

Outbreeding or Crossbreeding:

Outbreeding or crossbreeding is the mating of unrelated rabbits.

Advantages: Offspring are usually more fertile and they display increased vigor and growth (desirable in animals for meat production). It produces a maximum number of unlike genes in one animal.

Disadvantages: Later generations show a great amount of variation and can have little commercial value.

Inbreeding:

Inbreeding is the mating of closely related individuals.

Advantages: It maintains uniformity of the rabbit population over several generations.

Disadvantages: It can result in undesirable recessive genes causing a decrease in viability and reproductive fitness of future generations of rabbits. Sterility, mortality and undesirable abnormal variations occur in greater numbers.

Generally, it is desirable that the initial stock of rabbits be of the highest quality and contain the maximum number of favorable genes.

If the size of the rabbitry is small, and especially if there is only one buck used, it would be highly desirable to bring new, unrelated females into the rabbitry to periodically increase the gene pool and avoid extensive inbreeding.

PHYSIOLOGY OF RABBIT REPRODUCTION:

Heat (estrus):

Rabbits do not have a regular estrus cycle as do some domestic animals. Rather the doe (female rabbit) remains in heat (estrus) for long periods unless she is bred. The follicles on the ovary remain active for 12 to 16 days before regressing. When these active follicles regress, others become active to take their place. There may be a short period (1 to 2 days) between regression of one set of follicles and the onset of activity of another set when the doe is sterile.

Ovulation:

Ovulation (the process of a large ovarian follicle breaking away to become an egg) occurs about ten hours after mating. The male's sperm have moved through the female's reproductive tract to a point where they will meet with and enter (fertilize) the egg.

Development of Fetus:

The fertilized egg grows and becomes the young fetus. In highly fertile strains an average of ten eggs are shed, while in the strains of lower fertility only 4-5 eggs may be shed. The average gestation period for the rabbit is 30 to 33 days (range of 28 to 35 days).

BREEDING METHODS:

Age to Breed:

Smaller breeds develop more rapidly and are sexually mature earlier. Normally bucks are one month older than does before the first breeding. In general, medium weight (4-6 kilograms) rabbits are first bred at 5-6 months and giant breeds (10 kilograms) at 8-10 months. A doe to be bred should always be placed in the bucks' cage. In order to prevent back injury, it is important to carry the rabbit in the correct manner (Figures 29 and 30). The rabbits should be observed for 15 to 20 minutes and if no breeding or fighting takes place it is best to try another buck or try again the next day.

Pregnancy Detection:

Pregnancy can be accurately determined by palpating the abdomen at 12-14 days after mating.

1. Hold the ears, fold of neck and shoulder skin in the left hand (or right hand for left-handed persons).

2. Place the right hand under the abdomen and in front of the pelvis; place the thumb on one side and the fingers on the other side of the abdomen.
3. Slip the tissues of the abdomen between thumb and fingers, feeling (gently) for several marble-size (2cm diameter) forms.
4. **CAUTION:** Do not palpate with too much pressure as the uterus can be damaged or a fetus torn loose from the uterine wall. This can result in a toxic abortion with loss of the fetuses and possibly the doe.
5. Experienced rabbit owners may be able to palpate pregnant does as early as seven days post mating. If by day sixteen no fetuses are palpated, the doe should be rebred.

Kindling (giving birth to young):

Place a nest box in the cage on day 27 (after mating). The doe will remove some hair and make a nest for the young with the hair and any bedding material provided. One to two days before kindling the doe will reduce her food consumption. Feeding a small amount of green plant material at this time is helpful. Kindling usually occurs at night, and afterwards the doe may be restless. Try not to disturb her until she quiets down.

Complications at Kindling: Complications are rare. Both anterior and posterior (or breach presentations are considered normal; however, if it is determined that the doe is not having strong contractions it may be necessary to give 0.2-3 U/kg of Oxytocin (Table 3). Because of the stress of kindling, does are more susceptible to diseases at this time. Pneumonia is the most frequently seen secondary problem in kindling does. Depending on the cause of the pneumonia, antibiotics may be effective in treating the condition (Table 3).

Caked Breasts: This condition develops in does if their milk is not removed. The tissues around the teats become enlarged and hard. Later the ends of the teats becomes tender. Treatment is to rub lanolin on the area and massage the teats, strip the milk from these teats, or allow the young to nurse on the teats affected.

Mastitis: The breast is congested and warm to the touch. Often the skin over the swollen breast is red or purple, and the teats are discolored. Usually mastitis is due to a bacterial infection and can be contagious causing illness in the nursing bunnies. Broad spectrum antibiotics can be used for treatment. Do not let bunnies nurse on infected breasts.

Large Litters: Does may care for 9-10 young, but litters of up to 18 are possible. If there is another doe with a small litter, it is possible

to take some of the young from the large litter and introduce the young to a doe with a small litter. Usually the litters should be within 3-4 days-of-age of each other.

Dry does: The young will starve in 2-3 days if the doe has no milk to nurse them. Using a foster mother may prove useful.

Cannibalism of Young: The doe normally severs the umbilicus and ingests the placenta. Cannibalism may be due to an inadequate diet, hereditary factors or a result of disturbance of a nervous doe.

Weaning:

Young rabbits can be weaned at eight weeks of age, and the weight of the young should average 2 kilograms/rabbit. Weaning as early as five weeks is possible.

SEX DETERMINATION IN YOUNG RABBITS

Hold the rabbit around the chest with your left hand and hold the front legs forward alongside the head. Turn the rabbit over on its back while holding the hind legs with the right hand. Now use the first two fingers of the right hand to depress the tail. Then move the thumb up to carefully depress the sex organs exposing the pink mucous membranes. The buck will have a penis with a rounded tip, while the female will have a membrane that protrudes and forms a slit with a small hole near the anus end (Figure 31). Young rabbits can sometimes be sexed as early as one week, but sexing rabbits at weaning is such more practical.

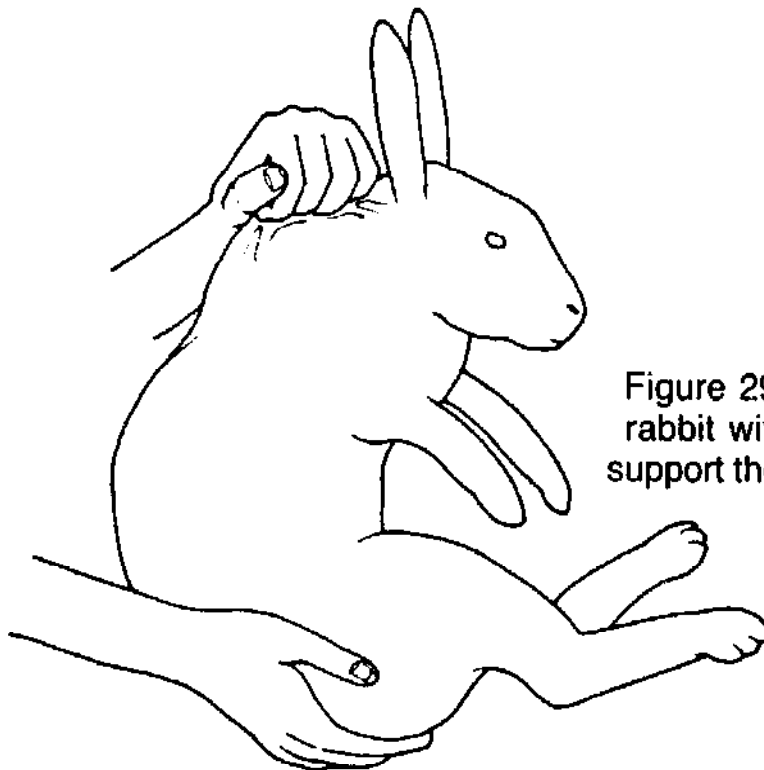


Figure 29. Rabbit restraint—Lift a rabbit with two hands and always support the posterior end of the body.

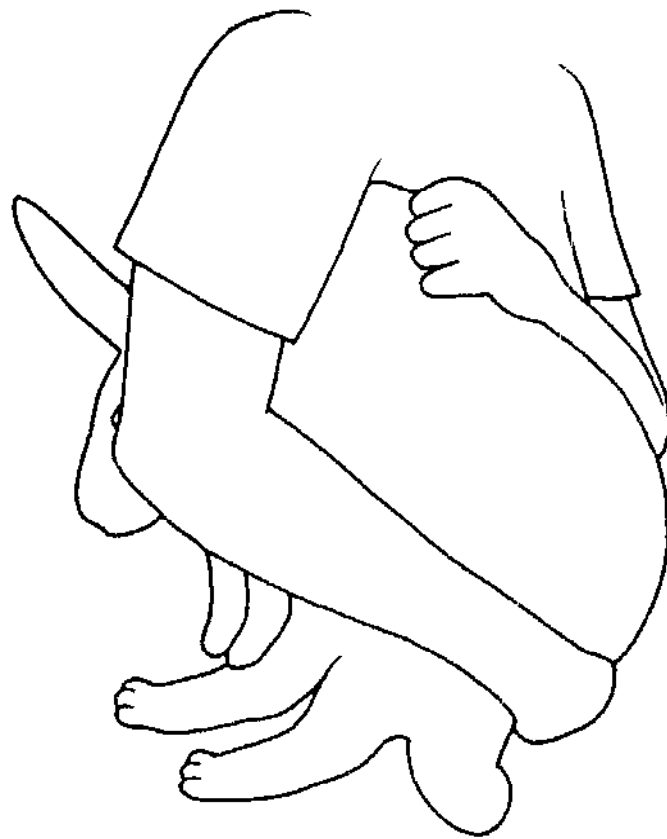


Figure 30. Proper method for carrying and supporting a rabbit to prevent injury

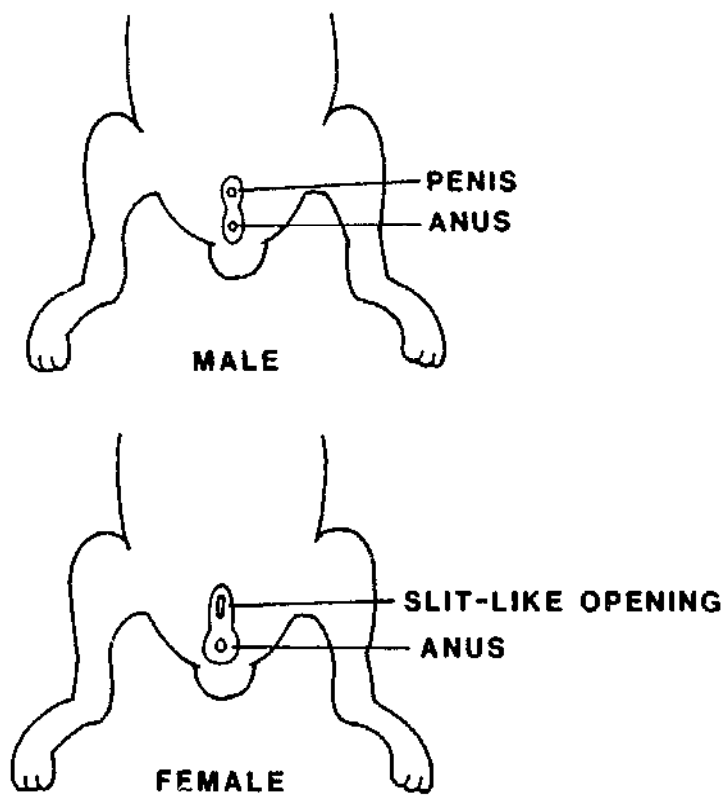


Figure 31. Sexing young rabbits

Table 2. NORMATIVE PHYSIOLOGICAL VALUES

| MEASUREMENT/ COMPONENT | RABBIT New Zealand Whites <i>Oryctolagus cuniculus</i> | | MEAN | MEAN |
|---|---|-------------------|--------|--------|
| | | MEAN | Male | Female |
| Humidity | 50% | | | |
| Recommended room temperature | 68°F. | | | |
| Begin consumption of dry feed | 21 days | | | |
| Daily food consumption (adult) | 5 oz. | | | |
| Water requirements | 200-850 ml/day | | | |
| Adult male, weight | 2000-7000 gms | 3000 gms | | |
| Adult female, weight | 2500-8000 gms | 3500 gms | | |
| Female breeding age | 5-6 months | | | |
| Male breeding age | 6-7 months | | | |
| Estrus cycle | Polyestrus | | | |
| Gestation, average | 31 (28-35) days | | | |
| Birth, weight | 80-120 grams | | | |
| Litter, size, average | 1-18 | 7-9 | | |
| Weaning age | 8 weeks | | | |
| Life expectancy (years) | 5-12 years | | | |
| Respiratory rate | | 51.0 | | |
| Tidal volume (ml) | | 21.0 | | |
| Minute volume (liter/min) | | 1.07 | | |
| Whole blood volume | | ---- | | |
| Plasma volume | | 38.8 | | |
| Erythrocyte volume | | ---- ^b | | |
| Whole blood pH | | 7.35 | | |
| Heart rate (beats/min) | | ---- ^b | | |
| Temperature | | 39.5° C | | |
| Erythrocytes (RBC) | 4-6.7 | | 6.7 | 6.31 |
| Hemoglobin (Hb) | | | 13.9 | 12.8 |
| Mean corpuscular volume | | | 62.5 | 63.1 |
| Mean corpuscular hemoglobin | | | 20.7 | 20.3 |
| Mean corpuscular hemoglobin concentration | | | 33.5 | 32.3 |
| Hematocrit (PCV) | 39-42 | | 41.5 | 39.8 |
| Sedimentation rate | | | 2.0 | 1.75 |
| Platelets | | | 480.00 | 450.00 |
| Leukocytes (WBC) | 5.2-12 | | 9.00 | 7.90 |
| Neutrophils | | | 46.0 | 43.4 |
| Eosinophils | | | 2.00 | 2.00 |
| Basophils | | | 5.00 | 4.30 |
| Lymphocytes | | | 39.00 | 41.80 |
| Monocytes | | | 8.00 | 9.00 |

Table 3. DRUGS AND DOSAGES

| DRUGS | DOSAGES |
|--|--|
| ANTIMICROBALS | |
| 1. Ampicillin | 10-25 mg/kg BW, I.M., b.i.d., 5-7 days. 22-44 mg/kg of body weight (B.W.) per os in divided doses for 10 days. |
| 2. Cephalothin | 12.5 mg/kg B.W., I.M. q.i.d. for 6-8 days. |
| 3. Chloromycetin palmitate | 50 mg/kg B.W. per os t.i.d. for 7-10 days |
| 4. Chloromycetin succinate | 30 mg/kg B.W., I.M. s.i.d. for 5-7 days. |
| 5. Gentamycin | 4 mg/kg B.W. s.i.d., I.M. for 5-7 days. |
| 6. Penicillin | 60,000 I.U. per kg B.W., b.i.d. I.M. for 7-10 days. |
| 7. Benzathine Penicillin G and Procaine Penicillin G | Flocillin (Bristol). 1 cc/2.25 kg B.W., I.M. or S.Q. every other days for 10 days or 42,000-84,000 I.U./kg B.W., S.Q. once each week. |
| 8. Tetracycline or Oxytetracycline | 30-100 mg/kg B.W. per os daily in divided doses, or 400-1,000 mg/liter of drinking water. Examples: -Cosa-terramycin (Pfizer) 2 teaspoons (500 mg) per pint. -Polyotic (American Cyanamid) 2.5 teaspoons (500 mg) per pint. -Panmycin Aquadeops (Upjohn) 50 mg per kg B.W. per os b.i.d. |
| 9. Sulfadimethoxine (Albon, Sulmet) | 75-100 mg/kg B.W., P.O. s.i.d. for 7 days. |
| 10. Sulfamethazine or Sulfamerizine | 100 mg per kg B.W., daily per os. Examples: (1) 40 ml (5 gm) of a 12½% solution per gallon of drinking water. (2) 5 ml of 12½% solution per pint of drinking water. (3) Dilute 1 ml of 12½% stock solution with 49 ml of water. Give 0.5 ml per 30 gms of B.W. (4) Dilute 10 ml of a 12½% stock solution with 40 ml of water. Give 10 ml b.i.d. to an adult 5 kg rabbit as an oral drench. Treat for 3-5 days, skip 3 days and repeat treatment. |

Table 3. DRUGS AND DOSAGES (continued)

| DRUGS | DOSAGES |
|-----------------------------|--|
| 11. Furazolidone (Furoxone) | Use -12 teaspoons (200 mg/tsp.) per pint of drinking water for 7-10 days, 2.5/100 lbs. of feed or 50g/ton of feed. |
| 12. Nitrofurazone (Furacin) | 100 mg/1,000 ml drinking water for long term therapy or 9 g/gal drinking water for 5-7 days. |
| 13. Sulfaquinoxaline | 225 gm/ton of feed or 0.05% in water for 10 days. |
| ANTIFUNGAL AGENTS: | |
| 1. Griseofulvin | Oral dosages: 2.5 mg/100 B.W., s.i.d. for 14 days or 25 mg/100 gm B.W. once every 10 days until lesions disappear. Fulvicin UF (Schering): Mix once 25 mg tablet with 10 ml of water and give 1 ml of suspension per kg B.W. s.i.d. until lesions disappear. |
| PARASITICIDES: | |
| 1. Fenbendazole | 50 ppm in the food for 5 days. |
| 2. Niclosamide (Yomesan) | 150 mg/kg B.W. P.O., repeat treatment in 14-21 days. |
| 3. Phenothiazine | 1 g/50 gm molasses-treated feed. |
| 4. Piperazine citrate | 100 mg/100 ml drinking water for 1 day, repeat treatment in 14-21 days. |
| 5. Piperazine powder | 25 mg/kg B.W. P.O. 1 ml/7 kg B.W. P.O. for 5 days. |
| 6. Amprolium 9.6% (Corid) | 309 ml in 20 liters of water and treat for 2 days, then use 15 ml in 20 liters of water for 4 days. Repeat in 2 weeks. |
| 7. Dimetridazole (Emtryl) | 0.025% solution prepared using 45g active ingredient /50 gallon of drinking water. |
| 8. Benzyl benzoate | Use as a 2-5% dust (dilute in talcum powder). |
| 9. Ivermectin | 0.1-0.2cc S.Q. of a 1 to 100 dilution in propylene glycol. |
| 10. 10% Ammonia solution | Used on caging following a thorough cleaning with hot water, a detergent to kill Coccidial oocysts. |
| 11. Mitox | Place 6-8 drops in each ear every 3 days for 2 weeks. Repeat as necessary. |

Table 3. DRUGS AND DOSAGES (continued)

| DRUGS | DOSAGES |
|------------------------------------|--|
| OTHER DRUGS: | |
| 1. Oxytocin | 0.2-3 u/Kg B.W., S.Q. |
| 2. Calcium gluconate 10% | 5-10 ml P.O. or 3-5 ml I.V. |
| 3. Chlorination of drinking water | Use 1.5 ml of 5.25% sodium hypochlorite solution (Chlorox) per 2 gallons of drinking water (200 ppm of free chlorine) use daily. |
| 4. Acidification of drinking water | Use 3.0 ml of 1.0N hydrochloric acid per pint of drinking water. Give a ph of 2.4. |

Key for Table 3: I.M.—intramuscular injection
I.V.—intravenous injection
S.Q.—subcutaneous
Per of or P.O.—oral dose
mg—milligrams
gm—gram
kg—kilogram
B.W.—body weight
s.i.d.—one daily dose
b.i.d.—two daily doses
t.i.d.—three daily doses
four daily doses

Section 5

Nutrition



NUTRITION

Although it has been said that rabbits can be fed any left-over food product, this is only true if specific nutritional levels are not met. Different foods contain different levels of those substances, which an animal uses to build its body, reproduce and produce energy. These substances are called nutrients, and there are basically five types of nutrients: Carbohydrates, proteins, vitamins, minerals and water.

Rabbits are herbivorous, monogastric animals with a unique large intestine. The potential of rabbits as meat producing animals is related in part to their ability to utilize fibrous feedstuffs that cannot be effectively consumed by man. In developing countries, rabbits can be raised to convert available forages and feed by-products into high quality human food. Rabbit meat is high in protein and low in fat, cholesterol and sodium.

The ability of the rabbit to gain weight on a small amount of feed is very good. Several studies have reported a feed to gain ratio of less than 4 to 1, on a high alfalfa diet. This is much lower than the feed to gain ratio of most other animals on a grain diet.

In the United States of America, the majority of rabbit feed utilized is pelleted. The use of pelleted feed has several advantages, including the reduction of dust, ease of handling, and prevention of animals from sorting through the feed and eating only the more palatable feedstuffs. Rabbits prefer a pelleted form or diet over the unpelleted form when given a choice. They have a higher growth rate compared to rabbits fed the same diet in an unpelleted form. Also, there is more feed spillage and wastage with the unpelleted diet. However, in situations where pelleted feed is impractical and/or too expensive, the feeding of unpelleted diets may be utilized with satisfactory results.

The rabbit's intestine is sensitive to many factors, such as pH, starch content and osmolarity. With this in mind, feed changes should be done gradually, over a four-to-five day period in order to allow growth of normal organisms required for digestion. This is especially important in the four-to-twelve-week old rabbit. During the diet change, old and new foods should be combined, gradually increasing the amount of new diet while decreasing the amount of old diet.

DIETARY REQUIREMENTS:

CARBOHYDRATES:

Carbohydrates (starch) are a major source of energy and are important for growing, reproduction, lactation, keeping warm and several other

body functions. Food sources which are high in starch include pasture grasses, bananas, cassava, potatoes, hay, and grains such as corn and cereals. Energy requirements for the rabbit have been estimated to be 2500 Kcal of digestible energy per kilogram of diet for growth, gestation and lactation. Approximately 2100 Kcal of digestible energy per kilogram of diet is required for maintenance.

One can divide carbohydrates into two main categories: 1) readily available carbohydrates (RAC) and 2) carbohydrates that are associated with fiber. The feeding of diets high in RAC can result in carbohydrate overload of the hindgut. The starch component in high energy grain diets such as corn and other cereal grains may pass through the small intestine relatively undigested and serve as a substrate for bacterial growth in the cecum, which is a large pouch off the large intestine. Finely ground ingredients predispose to the development of this situation. Starch in the cecum allows proliferation of **Clostridium spiroforme** which produces an iota toxin resulting in a fatal intestinal poisoning called enterotoxemia. Maintaining dietary crude fiber levels of at least 12-15% has been shown to minimize the occurrence of this disease.

Indigestible dietary fiber is also important for maximum growth rate and to prevent hair chewing. Rabbits fed low fiber, high energy diets have reduced grains and more pronounced fur chewing. Fur chewing may lead to increased problems from gastric trichobezoars (hair balls). Generally, a diet of 16 to 20% crude fiber is recommended for rabbits. Some evidence exists that particle size of the fiber is important (ie. finely ground alfalfa is less effective than coarsely ground or checked alfalfa). Diarrhea will be seen with dietary fiber levels that are less than 6%. Although fiber is an important component of a rabbit's diet, too much fiber may also cause problems. Digestion of fiber in the rabbit is much lower than in practically any other animal. It has been suggested that high dietary fiber levels, over 22%, may predispose a rabbit to develop cecal impaction.

FATS:

Fats, like carbohydrates, are also a major source of energy in a diet. Because fats are easily digested, rabbits like to eat fatty foods. A dietary fat content of 2% is generally thought to be adequate for rabbits, although dietary fat levels as high as 25% have been fed without adverse effects.

PROTEIN:

Proteins are important in maintenance, growth, reproduction and milk production. These dietary components are found in cereals, grains, by-products of oil crops such as coconuts, soybeans, peanuts and in young

green grass, green legumes and hay. Protein requirements for rabbits are 15 to 16% for growth and 18 to 20% for lactation. There is some evidence that bacterial synthesis of protein in the cecum contributes to the amino acid requirements of adult rabbits. It is thought that bacterial synthesis of protein makes only a minor contribution to the amino acid needs of growing rabbits. It is important to remember that the amino acids found in proteins are the building blocks of the body; therefore, protein quality of the diet is important in rabbit nutrition.

Even though 18-20% protein is necessary for optimal growth rate and performance for lactating does, lactating does can be fed diets containing 16-17% protein. At the lower dietary protein level, there is not a great deal of difference in doe productivity. The economic advantages, particularly in back-yard rabbitries, of the lower protein diet may offset the slightly reduced performance.

Protein deficient diets may result in inadequate milk production and poor growth of newborn rabbits, cannibalism and increased fur chewing.

VITAMINS:

Vitamins are substances that activate all body processes. Domestic rabbits require vitamins A, D, E, K and the B vitamins. Supplementation of the diet with vitamin C is not necessary. Generally speaking, a diet consisting of 30 to 60% good quality dried forage will meet the rabbit's requirements for the fat soluble vitamins (A, D, E and K). Vitamin D is also obtained from the sunlight.

Rabbits produce two kinds of feces, a soft, mucous form at night and a firm pellet during the day. The soft night feces are ingested directly from the anus. This practice is called coprophagy. The night feces may consist of 30 to 80% of the total daily excreta. Night feces have a similar protein, ash and fiber composition as day feces but have a much higher concentration of niacin, riboflavin, pantothenic acid and vitamin B₁₂. These B vitamins are synthesized by bacteria in the cecum. The practice of coprophagy provides sufficient B vitamins to meet the rabbit's daily requirements.

MINERALS:

Minerals are substances which must be presented in the diet for the proper building of bones and teeth. Like vitamins, mineral requirements of rabbits are easily satisfied by a good quality diet consisting of 30-60% dried forage. The major consideration regarding mineral nutrition is an adequate calcium: phosphorus ratio. Generally speaking, a calcium level of 0.40-0.45% and a phosphorus level of 0.22-.037% will be sufficient for growth and gestation. During lactation rabbits need higher levels, 0.775% calcium and 0.50% phosphorus. Most forages and feeds

contain minerals; however, salts are often added to the diet to supplement the needs for minerals.

WATER:

Clean, cool water should be provided for rabbits at all times. Water helps keep the animal cool in hot weather, but more important is the fact that water is essential for the animal to keep its body tissues alive and healthy. An animal's body is made up of 70% water and the rest is just minerals and ash.

DIETARY COMPONENTS:

GRAINS:

Except for a diet of barley, there is no real advantage to feeding diets consisting of grains over commercially available pelleted diets. However, if pelleted diets are not practical and/or affordable, grain may be a satisfactory component or supplement to a rabbit's diet. If home grown grains are available and are not needed for either human or other animal consumption, they may be used successfully as a component of the rabbit's diet.

Other grains that have been fed to rabbits include buckwheat (10% protein) and wheat (soft, 11-13% protein). It has been suggested that one can mix together equal parts of crushed wheat (or oats or corn) and barley, milo, rye, rice or other grain sorghums to feed dry does, young rabbits or herd bucks.

FORAGES:

While alfalfa is the most commonly used forage-addition to rabbit diets in the United States, research has also been done on the use of other forage materials. Forages are cheap and abundant year round in tropical countries. A recent study examined the use of woody legumes, non-woody legumes and grasses as dietary additions for the rabbit. Grasses were 6 weeks old, legumes were cut at the flowering stage and forages were hand-chopped to 1-1.5cm prior to feeding. Forages were wilted overnight and/or steam-pelleted. In general, the woody legumes had the highest nutrient composition, digestibility and palatability. Regardless of which type of forage, one must supplement with a concentrate diet to improve nutrient intake. This is especially true for grasses, as most tropical grasses have very little nutritional value except as a source of indigestible fiber. It is important to note that the digestibility values of calcium in most grasses, and phosphorus in most forages, are negative. The following is an alphabetical listing of forages that have been examined as components of rabbit diets.

Alfalfa - : The protein content of alfalfa deteriorates as the plant grows older. Prebloom alfalfa hay has approximately 19% protein content and early bloom alfalfa hay has approximately 16% protein content. Alfalfa hay, like other legume or grass hays, may be fed free choice in a hay manger or rack on the side of the cage. All hays (and other feeds) should be completely free of molds. Alfalfa is also available in pellet and meal forms. In fryer studies, the use of sun-cured alfalfa meal has yielded better performance when compared to dehydrated alfalfa meal. Sun-cured alfalfa meal is also more palatable than dehydrated alfalfa meal.

Bermuda grass - Bermuda grass is reportedly toxic to rabbits and therefore, is not recommended as a forage source.

Black Locust - Black locust, also called common acacia or false acacia, is a fast-growing, leguminous tree that is readily adaptable to a variety of soils and climates. The young trees can be repeatedly cut so that they grow in a shrubby form from which the leaves are easily harvested. The crude protein level in the leaves is 23%. One study compared the use of dried black locust leaves as the forage component (40% of the diet) of a pelleted diet to the use of alfalfa forage. Average daily gains with black locust leaves were approximately 12 g/day less than those obtained by rabbits fed alfalfa. Average daily gains were still in an acceptable range and no mortality, diarrhea or other adverse effects were reported following the feeding of black locust leaves. Black locust leaves may also be fed fresh to rabbits.

Butterfly pea - The crude protein level of butterfly pea, a tropical forage, is 17.2%. Average daily gains using butterfly pea as 40% of the diet are similar to those seen with alfalfa diets.

Calliandra sp - This has been used as a forage component of rabbit diets in Indonesia.

Cassava - The crude protein content of cassava is 24.7%. Average daily gains are approximately 10 g/day less than with similar diets utilizing alfalfa as the forage component. The cassava tuber is used as human food and rabbits may be fed with the leaves, a by-product of this human vegetable/crop production. Cassava leaves have been fed to rabbits in Indonesia. **Manihot utilissima**—grown in Nigeria, is another form of cassava, which has a crude protein of 32% and 18% crude fiber.

Cassia tora - This tropical forage has a 14.9% crude protein level, when fed to rabbits as 40% of the diet, average daily gains were 5-7 g/day less than those achieved by rabbits ingesting a similar diet of 40% alfalfa.

Comfrey - Comfrey, a leafy forage plant, may be fed as a fresh green during the growing months or dried and fed as as a hay during the winter months. Comfrey is a good protein source, comparable to alfalfa; however, the digestibility of the protein in comfrey is only about 70% of the digestibility of alfalfa protein because it is bound to fiber. Comfrey is lower in fiber compared to alfalfa and has about double the ash content. Comfrey also contains allantoin and has been reported to alleviate diarrhea in young rabbits.

Corn plant - Whole corn plant pellets, prepared by harvesting the entire corn plant, dehydrating it and pelletin_ it, have been fed to rabbits. The pellets are low in protein (6.2%), crude protein, and high in fiber.

Gliricidia sp. - This has been used as a forage component of rabbit diets in Indonesia.

Grass Hay - Various grass hays such as Prairie, Timothy, Johnson and Sudan may be fed to rabbits. Grass hays contain less protein than legume hays and the diet will probably need an added protein source.

Guinea grass - Guinea grass is a tropical forage with 13.1% crude protein level. Compared with a diet of 40% alfalfa, average daily gains with guinea grass were 5-7 g/day less.

Elephant grass - Elephant grass has a 13% crude protein level and a 30% crude fiber level.

Kentucky blue grass - Kentucky blue grass clippings were fed to rabbits, 10% of the diet, and average daily gains were similar to those seen with alfalfa. The grass clippings were obtained from a sod farm. The young, tender clippings proved to be a good high protein forage for rabbits.

Kudzu - Kudzu is a rapidly growing, coarse, hairy, stoloniferous vine that is native to China and Japan. It is best adapted to drained loam soils of good fertility. Kudzu can be used to prevent soil erosion, as a pasture plant, and also as a hay. Uncontrolled, it may overgrow other vegetation, and can become a pest. Compared to alfalfa, at 10% of the diet, average daily gains were about 8 g/day less but were still at an acceptable level. Kudzu, as a forage, is palatable and may be especially useful in tropical or warm countries where no alfalfa is available.

Leucaena - is a tropical leguminous tree producing high protein (greater than 30% crude protein) leaves. Trees can be kept in the shrubby form by repeated cutting. It has been fed successfully to rabbits at levels of 20-30% of the diet, in dried form, with

average daily gains of 37 g/day. The digestibility of dry matter and protein is reduced as the **Lecaena** level in the diet is increased, resulting in poor feed/gain ratios. Urine of rabbits fed **Leucaena** is deep red to black in color. The origin and significance of the urinary pigments is presently unknown. **Leucaena** may also be fed fresh, in the green form. It is important to note that **Leucaena** contains an amino acid, mimosine, which has been toxic for rabbits that were fed **Leucaena** as the sole forage. In this group of rabbits, various reproductive problems, poor growth and hair loss were seen.

Pawpaw leaves - Pawpaw leaves have a 35% crude protein level and 8.8% crude fiber.

Perennial peanut - Florigraze rhizoma is a warm-season, tropical, perennial forage legume, adapted to well-drained soils. The plant is a native of South Africa. When substituted for alfalfa, 40% of the diet, rabbits had similar rates of gain. Some rabbits had diarrhea for the first few weeks on this diet; however, this eventually resolved.

Red clover hay - Red clover hay, approximately 13% protein content, may be used to feed rabbits.

Rice straw - Rice straw has been fed to rabbits at either 20 or 20% of the diet. Growth rate is approximately 35 g/day.

Sesbania - is a forage plant that has been utilized to feed rabbits in Indonesia.

Spanish clover - Spanish clover contains 21.4% crude protein. When fed to rabbits, 40% of the diet, the average daily gains are equal to or slightly greater than gains seen with rabbits on a 40% alfalfa diet.

Styloanthes quinesis - is a tropical forage with 15.8% crude protein. Rabbits fed diets of 40% **S. quinesis** have average daily gains of approximately 33.5 g/day, which is 7-8 g/day less than gains of rabbits fed a 40% alfalfa diet. It should be noted that there is a 50% incidence of diarrhea and a 30% mortality rate in rabbits receiving **S. quinesis** compared with a 20% diarrhea and a 20% mortality in the alfalfa diet rabbits.

Sugarcane - Sugarcane has a 4.8% crude protein level and 21% crude fiber.

Sunflower leaves - Fed as 40% of the diet, sunflower leaves result in poor growth and hair loss problems. Sunflowers contain a phenolic substance, chlorogenic acid, which binds protein and reduces its availability. Hair loss in rabbits fed sunflower leaves is thought to be due to increased fur chewing caused by an in-

duced protein deficiency. Sunflower leaves appear to have poor potential as feedstuff for rabbits.

Sweet potato vines - have been used to feed rabbits in Indonesia.

Talfairia - Talfairia has a 22% crude protein level and 13% crude fiber.

Talinum - Talinum has a 22% crude protein level and 11% crude fiber.

Vetch - Common vetch, approximately 17% protein, may be used as a legume hay in rabbit diets.

Water peanut - In China, water peanut is grown along pond banks. It is collected in the morning, allowed to wilt on mats and then fed later in the day to rabbits. Approximately 70% of the rabbits' diet consist of water peanut, the remainder of the diet is composed of a variety of weeds and forages.

Wheat straw - Rabbits fed a diet of either 20 or 30% wheat straw had a growth rate of 35-40 g/day.

Winged bean - Winged bean, approximately 18.8% crude protein, fed to rabbits as 40% of the diet results in average daily gains of 10 g/day less than alfalfa. There is a high incidence of diarrhea when rabbits are fed winged bean. It is felt that the diarrhea plus low growth rate may suggest that winged bean contains compounds which interfere with nutrient utilization. Winged bean is a tropical forage. The bean pod has been used as human food, thus rabbits can be fed a by-product of vegetable/crop production.

SEEDS:

The following is an alphabetical list of seeds that have been examined as components of rabbit diets.

Amaranthus - Seed heads of both black and white species of amaranthus have been fed to rabbits. Both types resulted in poor average daily gains. Feeding of seed heads from the black-seeded amaranthus resulted in an 80% mortality rate due to a possible hepatotoxin.

Barley screening - Rabbits fed a diet of 20% barley screenings, as a fibre source, have average daily gains equal of superior to rabbits fed a similar diet with 22.5% dehydrated alfalfa.

Canola meal - Canola meal or low glucosinolate rapeseed meal is a good replacement for soybean in rabbit diets.

Cottonseed - Rabbits fed a diet of 43% cottonseed have no significant differences in gain compared with rabbits fed a soybean meal diet. Cottonseed meal, prepress solvent extracted, has been fed to fryers as 4, 8.2, 10 and 16.5% of the diet. No adverse

effects attributable to the cotton seed meal were noted as assessed by rate of gain, mortality or feed efficiency. No effects on the semen of bucks fed 20% cottonseed meal for 150 days were noted. At these levels cottonseed does not appear to have adverse effects on male rabbit fertility. Long term studies on does need to be done.

Flax - A diet of 30% flax seed has been fed to rabbits. No significant differences in gains are noted between rabbits fed flaxseed and a soybean meal diet.

Lupin grain - Diets of 7, 14, and 21% lupin grain, 40% crude protein, have been fed to rabbits. No significant differences in average daily gain or feed intake are seen in rabbits fed lupin grain as compared to soybean diet.

Maize (corn) bran - Maize bran has 11.2% crude protein and 7.8% crude fiber.

Peas - Peas, 26-27% crude protein, have been fed to rabbits as 30% of the diet. No significant differences in average daily gain or feed intake are seen in rabbits fed peas and those fed soybean meal.

Rice and wheat bran - Rice and wheat bran are excellent sources of protein and energy for rabbits. Wheat bran contains approximately 16% protein and 10% fiber plus vitamin E.

Safflower - Rabbits fed a 34% safflower diet have no significant differences in gain compared to rabbits fed soybean meal.

Soybeans - Soybean meal contains approximately 45 to 48% protein. It may be added to rabbit rations at a percentage of 5 to 7% of the total ration. Adding too much soybean meal can cause digestive problems in rabbits, especially young rabbits.

Soybean hulls - Rabbits fed a 10% soybean hull diet as a fiber source have average daily gains that are statistically equal or superior to a diet of dehydrated alfalfa.

MISCELLANECUS CATEGORY:

The following is an alphabetical list of various supplements and components of rabbit diets.

Banana and Plantain leaves - Mixtures of banana and plantain leaves have been fed to weanling rabbits. The leaves, comprising 30% of the diet, were fed either fresh, dry or half and half. No difference in performances were seen between fresh or dry leaves with average daily gains of about 20g. Banana leaves are 20% crude protein and 24% crude fiber. Plantain leaves are 18% crude protein and 20% crude fiber.

Beet pulp - Rabbits fed a 15% beet pulp diet, as a fiber source, have average daily gains that are statistically equal or superior to those of rabbits that are fed dehydrated alfalfa.

Blood meal - Blood meal has 24.3% crude protein and 24% crude fiber.

Brewers grains - Dried brewers grains contain 28% crude protein and 18% crude fiber.

Brewers yeast - Dried brewers yeast contain 46.3% protein and 12% crude fiber.

Cabbage - Fresh cabbage leaves have been fed into weanling rabbits in which 5, 15, and 25% levels replaced corn in the diet. Average daily gains were 13.2, 18.1 and 12.4 g/day respectively.

Citrus pulp - Dehydrated lemon and orange citrus pulps have been fed to weaning rabbits as 20% of the diet, replacing 20% corn in the diet. Digestibility of the citrus pulp is similar to the corn diet. Gains with the citrus pulp diet were about 20 g/day compared to 24 g/day with corn.

Corn husks - Corn husk contains 2.6% crude protein and 31.6% crude fiber.

Cottonseed cake - Cotton seed cake contains 22.4% crude protein and 25% crude fiber.

Copper - Conflicting literature reports exist on whether or not the addition of copper to rabbit diets is beneficial. One study examined the effects of 100, 150 and 200 ppm copper sulfate in diets that were low (14%), medium (18%) and high (22%) in protein. This study found that growth was significantly enhanced at 200 ppm copper sulfate for the low and medium protein levels, but not the high protein level diet. This suggests that as dietary protein levels increase, the effects of adding copper to the diet decreases. The mechanism of action is unknown; however, cupric ions activate pepsin, an enzyme involved in protein utilization, which may be part of the reason for the growth promoting effect of supplemental copper. Another study did not show any effect on weight gains when copper (250 ppm) was added to the diet. Some studies have also suggested that dietary supplementation with copper has some protective effect against diarrhea and mortality in 4 to 10 week old rabbits. Other studies have not supported this finding.

Goat's milk - One study gave rabbits free choice pellets and goat's milk. Rabbits given goat's milk consumed less than half the amount of pellets eaten by those control rabbits receiving water and pellets ad lib. When excess milk is available, the cost of feeding rabbits could be reduced by giving milk instead of water.

Palm Kernel Meal - Palm kernel meal contains 21% crude protein and 10% crude fiber.

Peanut Cake - Peanut cake contains 52% crude protein and 5% crude fiber.

Peanut hulls - Peanut hulls contain 5.7% crude protein and 31.8% crude fiber.

Poultry broiler finisher pellets - Poultry boiler finisher pellets (18% crude protein) can be fed in limited quantities along with free choice grass to produce rabbit meat at a cost comparable or less than that of fresh chicken and pork. A study in Trinidad fed each doe 80 g/day for day 1-23 of gestation and 100 g/day the last 8 days of gestation. The schedule for concentration feeding from kindling to weaning at 28 days was: 120 g/day first 7 days then 120 g + 10 g/kit/day for the next 21 days. Fryers are offered 30 g/day the first week post weaning and this amount was increased by 10 g every 7 days, until the animal was 9 weeks old. Animals 9 weeks of age and older received 80 g/day of the concentrate.

Poultry manure - Dried poultry manure contains 26% crude protein and 18.6% crude fiber.

Rabbit manure - Dried rabbit manure contains 36.7% crude protein and was fed in one study as 10-15% of the total diet. Average daily gains of rabbits fed manure were similar to those fed alfalfa. Rabbits fed manure had a decreased incidence of enteritis. If rabbit manure is treated with alkali, the crude protein level is 0.4% and the digestible content is 1970 Kcal/kg (vs. 772 Kcal/kg pre-treatment) which is similar to alfalfa.

Rice husks - Rice husks contain 5.2% crude protein and 43.2% crude fiber.

Urea - Urea has potential as an inexpensive substitute for low protein in rabbit diets. Experimental studies have reported somewhat variable results. Early studies, using weanling rabbits, showed no beneficial effects of the addition of urea to a low protein diet. More recent studies have shown that a urea diet does not support body weight gain and nitrogen retention as well as soybean meal diet in adult animals; however, fryers appear to utilize urea more efficiently than adult animals. With fryers, gain is actually slightly superior with a urea diet as compared to a soybean meal diet. Coprophagy is essential for normal utilization of dietary crude protein in both young and mature rabbits.

Vegetable leaves and tops - Various vegetables and vegetable leaves have been fed successfully to rabbits. These include collard leaves, carrots and carrot tops, dandelions, potatoes and potato peels, turnips, sweet potatoes, parsnips, English pea and green bean vines. Raw potato peels are high in Vitamin B₆.

Zeolite - Zeolite is a buffering compound, crystalline aluminosilicate, with ion exchange properties. Addition of zeolite to the

diet in either 1.5% or 3% has resulted in significant decreases in mortality due to enteritis.

TYPES OF DIETS:

Although many individual food products have been discussed in this section, there may be a commercial supplier of concentrated feeds in the area. If rabbit chow is not available, one may substitute a pelleted pig grower ration or even a pelleted chicken feed. It is especially helpful to use the commercial products as a supplement to the natural foods during the rapid growth periods of the young, during the last ten days of pregnancy, and during lactation. Some recommended rates for using the commercial supplements are: 90g per day for growing young; 90g per day during pregnancy; 150g per day during first 3-4 weeks of lactation; add 10g more per kg during the last few weeks of lactation (1-ounce = 28.25 grams).

Generally one diet is used for the entire herd. However, the protein and energy requirements for lactation are higher than for growth. If only one diet is used for all rabbits, for example, a diet suitable for a lactating rabbit, then fryers will receive excess protein and the high energy level may induce diarrhea. If a diet adequate for fryers is fed to all rabbits then one may see decreased productivity in does.

It has also been suggested that at least two diets could be advantageously used for fryers. One diet would be a high fiber weaning diet and the second diet would be a high energy finishing diet. More research needs to be done in order to develop optimal diets for various production phases.

Section 6

Rabbit Diseases



RABBIT DISEASES

Obviously, one of the most devastating and discouraging aspects of rabbit production is disease. The term disease is used here in the broad sense of various illnesses, disorders or ailments, which may cause poor performance, sickness, other abnormalities, or death. Disease states may result from infection by microorganisms and parasites (infectious diseases) or from injury, poison, and functional or metabolic disorders (noninfectious diseases). Rabbits may be affected by both classes, but the infectious diseases are of more concern.

The success or failure of a rabbit operation is probably dependent upon the owner's ability to keep disease at a minimum. Most diseases occur because of management mistakes or lack of knowledge. Mortality in many herds averages 20% or more of all animals born. The total loss of rabbits due to disease in the United States averages 20-25%; this includes kits born dead, nest box death, fryer deaths, and the loss of does and bucks. In other areas of the world it seems reasonable to expect that death losses would be at least this high. This section will discuss bacterial, viral, fungal, parasitic, hereditary and miscellaneous diseases often seen in the rabbitry.

When well fed and properly housed in draft free sanitary hutches, rabbits will live relatively free of disease; however, the best cure is always prevention. Because medications are not always available, the following paragraphs will discuss natural animal medicines and their reported uses in preventing and curing common rabbit ailments.

Many wild animals have an innate ability to choose what is needed to get well. Old time rabbit breeders have used this information to discover natural medications with which animals in the wild treat themselves.

Feeding the leaves of plantain, dandelion, or the leaves and bark from elm trees once or twice a week may help keep a rabbit herd from developing any need for more drastic chemical drugs. These natural materials appear to be effective in preventing common scours (diarrhea) that sometimes afflict the very young rabbit.

The bark and the limbs of the sassafras tree also appears to relieve digestive upsets in newborn rabbits. Once the bark is all eaten from the piece of sassafras, it is not uncommon to see the doe place the wood in her water bowl allowing the wood to seep into the water making tea. Breeders have felt that either the bark or the tea is helpful in preventing diarrhea.

It has also been shown that dry leaves of certain trees may have about the same effect as green leaves. The dry leaves may be gathered when they are fresh, clean and free of mold, decay and insects. Rabbits seem

to prefer the leaves of oak, elm, sassafras and willow trees. Apparently the bark of the willow tree also contains substances that are beneficial to rabbits.

Blackberry leaves have long been considered an excellent cure for scours. Because the rabbit is highly susceptible to chemical toxicities, it is very important to never use the leaves, bark, grass clippings or berries that have been sprayed with insecticides or herbicides.

Another natural remedy for diarrhea or scours in rabbit herds has been the use of apple cider vinegar. Apparently the apple cider contains large amounts of potassium, which may be the major beneficial ingredient for rabbits. The apple cider vinegar is diluted to 5% acidity, and one or two tablespoons are added to a gallon of fresh clean drinking water. The vinegar treated water is then given daily over a period of two to three months. Some breeders have claimed that giving rabbits this water vinegar daily will also control coccidiosis. Other breeders have actually reported that the apple cider vinegar in the drinking water will increase the reproductive rate of rabbits in a rabbitry.

Apple cider vinegar has also been shown to improve the rabbits' coats, giving them a healthier sheen even in hot months when rabbits are likely to be shedding at least some of their heavy fur. Improvement in rabbit coats is probably due to the acidity of the vinegar, which can effect the pH balance of the skin and give the hair follicles a healthier base in which to grow.

Another natural remedy which has been used to combat a lack of protein in the diet is feeding the product comfrey. Comfrey contains most of the amino acids that are the building blocks of protein, plus it contains the curative substance allantoin which is commonly used in many medications. Comfrey is fed as a fresh green plant during growing months or it may be dried and fed during the winter months. Like alfalfa, it should be fed as fresh as possible to have the greatest effect, but drying the summer crop for winter use is as practical as using other hays. It offers more extensive benefits with regular use. Many rabbit breeders have reported that their rabbits are very seldom sick with colds, numerous rabbits suffering from various types of diarrhea have cleared up, and those suffering from run down conditions due to a heavy breeding schedule and nursing, have all been shown to improve or disappear after the feeding of comfrey. Recent studies have indicated that comfrey may have some carcinogenic activity; therefore, it is recommended that this food source be used with discretion.

In raising rabbits you may come in contact with some unusual methods for treating diseases. One such medication is pekoe tea given in the drinking water. This substance has been shown to be effective against some bacterial diseases such as Tyzzer's disease. One large tea bag is diluted in one gallon of water, cooled and given to sick rab-

bits as drinking water. The tannic acid in the tea apparently is effective in killing many bacterial diseases. The weak tea has also been shown to clear up cases of ordinary diarrhea when given with clean, bright straw to eat.

As in many other animals, stress is known to produce or precipitate diseases in rabbits. Common stresses include such things as extreme heat in the summer, cold in the winter, and noises of various kinds. Perhaps the greatest stress placed upon the rabbit is lack of proper sanitation. Living in filthy quarters can stress any animal, including those much larger and stronger than the rabbit. Accumulation of manure and urine create an ammonia gas in the building. This in turn causes a severely oppressed air quality which has its effect on the respiratory system of the rabbit. As with heat, those carrying or nursing young and little rabbits are the most susceptible. When the rabbitry operator can smell ammonia gas in the rabbitry, damage has already been inflicted on the lungs, nasal passages, and bronchial tubes of the rabbit.

DISEASE DIAGNOSIS:

As a rabbit raiser, you should become very familiar with the normal appearance and physiological characteristics of a rabbit. Refer to Table 2 for physiological parameters. Rabbits suffering from a disease usually exhibit some characteristics which make them appear or act differently from healthy animals. The following clinical signs are indications of a disease or abnormality, and each should be evaluated carefully:

1. Failure to eat
2. Abnormal breathing
3. Discharges from the eye and nose
4. Loss of weight
5. Diarrhea
6. Listlessness
7. Blood in excretions
8. Skin lesions
9. Fever
10. Increased pulse rate
11. Increased respiratory rate
12. Change in color of mucous membranes

Close observation of clinical signs while the rabbit is living may allow for diagnosis. Other diseases cannot be diagnosed without a necropsy examination, and in some cases, special techniques. A necropsy should be performed by a veterinarian as soon as possible after death, since tissues degenerate rapidly and examinations several hours after death are of little value unless the carcasses are preserved. Refrigeration can be used to delay tissue decomposition if necropsies must be performed at a later date.

COMMON DISEASES:

The following diseases are grouped as: (a) miscellaneous and noninfectious diseases and ailments, (b) hereditary diseases, (c) viral diseases, (d) bacterial diseases, (e) fungal diseases and (f) parasitic diseases—external and internal parasites.

MISCELLANEOUS AND NONINFECTIOUS DISEASES:

Canibalism:

Most cases of canibalism, which is the act of one rabbit eating another rabbit, are the result of the diet being inadequate in either quality or quantity, or because the does are disturbed following kindling. In a breeding program it is essential that the doe be provided with adequate housing and diet in order to prevent this condition. Does which continue to destroy their litters should be culled from the breeding population.

Heat Prostration:

In tropical climates, care should be taken to prevent rabbits from getting too hot and collapsing. Adult animals suffering from heat may be relieved by spraying them with water or placing a wet burlap feed sack on the cage floor for the animals to rest on. Bedding and fur should be removed from the nest box to allow free circulation of air in boxes with infants. Other techniques which may be used in high temperature climates are: overhead water sprinklers to help reduce the air temperature by evaporation, aluminum roof sheds to help reduce the air temperature by evaporation, aluminum roof sheds to help reflect the heat, and burlap bags soaked in water may be hung from the edges of the roofs to shade and cool the air.

Clinical signs of heat prostration are increased respiratory rate, depression, and evidence of a bloody discharge from the mouth and the nose. Mortality rates can be high unless environmental temperatures can be reduced below 33°C (92°F). Pregnant does are most often affected, and young rabbits in the nest box are particularly susceptible when there is excessive bedding and little ventilation.

Broken Back:

Spinal fracture is an injury which may occur if the rabbit kicks excessively when the rear legs are not properly supported. Paralysis may extend from the middle of the back resulting in an animal that cannot use its back legs. The animal moves with its front legs and drags the hind quarters. Often times the urinary bladder may become greatly enlarged giving the animal a bloated appearance.

Other conditions which may produce spinal injury include using a tattoo short for the size of the animal or injuries which may occur at night

when predator animals invade the rabbitry. A rabbit with a dislocated spine usually cannot be treated and should be destroyed. Sometimes, if the spinal cord has not been too severely damaged partial recovery may occur.

Sore hocks:

Although the scientific name for this disease is Pododermatitis, the name sore hocks is much more descriptive of the inflamed bare spots, devoid of fur, which are found on the bottom surface of the hind legs. Severe cases will develop secondary infections with Staphylococcus organisms producing abscesses. If a rabbit walks with an unusual motion or of the rabbit sits with more weight on the front feet than normal, the disease sore hocks should be suspected. Although both front and hind feet may become involved, the animal usually throws more weight to the front feet due to the painful hocks of the infected hind feet.

A genetic predisposition for this disease occurs in certain strains of rabbits. If the animal is inherently nervous, excitable, and is active with excessive foot stomping, this may contribute to the development of sore hocks. Also, larger breeds seem to have a higher incidence compared to smaller breeds. Since there is an inherit predisposition to this disease, it is obvious that rabbits with a habitual tendency towards sore hocks should not be used as breeders. Environmental factors which may be involved in this disease include the type of wire on the cage floor, the cleanliness of the cage floor, and the condition of the cage floor. Filthy caging and improper housing can easily be corrected by proper management.

The use of ointments, sprays, and many other medications will produce temporary improvement in rabbits suffering with sore hocks. Placing the rabbit on a soft flooring such as sawdust may also help the feet to heal. Unfortunately when the rabbit is returned to its original housing or his treatment regime is discontinued, the condition will usually reappear. Most rabbitries believe it is more economical to cull the rabbit, and avoid using this animal for breeding stock.

Malocclusion:

Malocclusion and tooth overgrowth result when, (for genetic, dietary, infectious, or traumatic reasons) open rooted teeth do not meet properly and are therefore not worn down as they would normally. In the rabbit, the teeth commonly involved are the incisors, which, if not constantly worn down, will grow approximately 10 cm (4 inches) per year. Malocclusion in the rabbit is probably an autonomous recessive (inherited) trait involving an abnormally short upper jaw. Since buck teeth are also an inherited characteristic, the number of rabbits carrying the nose with the medial aspect of the fore feet resulting in a wetting and matting of fur on the feet.

undesirable gene will increase in a breeding colony unless specific culling is carried out to eliminate these animals. There is no cure for this condition other than culling. Temporary treatment involves cutting away the excessive growth using heavy scissors or wire cutters. This will allow the young to eat and obtain slaughter weight. The teeth will continue to grow during this period and repeated trimming may be required in two to three weeks.

Hairballs (Trichobezoars):

Many rabbits ingest small amounts of hair during the normal practice of grooming. Several rabbits in a hutch may eat body fur, eyelashes, and whiskers. Accumulation of hair within the stomach is thought to be attributed to the inability of the rabbit to vomit and the small pyloric lumen, which predisposes to hair accumulation in the stomach. In either case the fur mixes with the stomach contents and forms a firm ball which cannot pass through the pyloric valve between the stomach and the small intestine. Causes for this condition include hairloss; lack of dietary fiber; protein, copper, or a magnesium deficiency; abnormal grooming behavior; and excessive shedding of a naturally long hair coat.

Clinical signs for hairballs include anorexia, weight loss, agalactia, depression, absence of feces and eventually death in three to four weeks from starvation and metabolic abnormalities. Diagnosis is often times difficult but usually can be made using palpation and/or radiography.

Although routine treatment with mineral oil (10cc at a time) on a monthly basis may prevent hairballs, the formation of a ball too large to pass out of the stomach cannot be treated by this method. A wetting agent, dioctyl sodium sulfosuccinate 5% in propylene glycol or one of several flavored laxatives and lubricate preparations, can also be used. Of recent interest is the use of a digestive enzyme (papain) and/or pineapple juice, which may break down the fiber particles and allow for passage of the hairball. Surgical removal of the hairball can be used as a last resort. Postoperative care should include fluids, antibiotics, and hay or calf manna. Unfortunately, recurrences are common. Even though there is no effective method of treatment, many breeders feel that a 15% fiber level is probably the minimum that should be fed to either growing or producing rabbits. Apparently the increased fiber content in the diet helps prevent the formation of hair balls.

Coprophagy:

This is a normal characteristic of the rabbit in which it actually eats its own fecal pellets, and this usually occurs at night. Fermentation of feces in the large intestine supplies an abundance of certain B vitamins to the fecal pellets, probably improves the quality of the protein in the soft pellets, and improves fiber breakdown by bacterial action. The rabbit

actually takes three soft pellets from the vent as they are passed and reingests them. It is thought that this second passage of food through the digestive tract allows for increased nutritive values to be derived from the food. Coprophagia can occur during the day, although it is usually a night practice and should not be interpreted as a disease or an indication of a depraved appetite.

Yellow Fat:

Some rabbits develop a very dark yellow deposition of fat. This is a genetic trait determined by a recessive gene which prevents the reduction of the xanthophyll pigment to a colorless product. This is not a disease condition; however, it is often an objectionable trait because consumers prefer white fat in meat rabbits. The only solution is to cull those breeders producing this yellow fat syndrome.

Wet Dewlap:

The dewlap is a loose fold of skin under the neck, which is very large in female rabbits. During warm weather, rabbits will tend to drink large amounts of water and this may predispose this area to excessive moisture. If this dewlap remains damp, the fur will discolor and may develop a secondary bacterial infection. Usually the hair will turn green and the skin will become inflamed beneath the matted fur.

Treatment involves clipping away the matted fur and treatment of the skin with an antibiotic ointment. The removal of water crocks, fixing leaking sipper tubes and, in general, providing for a dry environment will usually prevent this condition.

Hutch Burn:

The reproductive organs and teats are very sensitive to urine and fecal contamination. These tissues are easily irritated and may have brownish crusts covering the area with a bloody exudate. This condition is often confused with rabbit syphilis or vent disease.

Treatment involves warm compresses, the application of camphor oil and massage to remove the milk. If the teat and its milk gland are severely caked it may be necessary to lance it and thoroughly irrigate the tissues with hydrogen peroxide. Topical and systemic antibiotics are also recommended. Often times this condition will predispose the female to subsequent mastitis, which is a severe disease of the milk glands.

HEREDITARY DISEASES:

Buphthalmia (Congenital or Infantile Galucomma):

This eye condition initially appears as an increase in the size of the eye with a gradual cloudiness and a bluish color on the surface of the eye. The eye soon becomes more milky white in color, enlarges and

there is increased blood supply to the surface of the eye. Eventually the eye is so opaque that blindness results. Because this is thought to be inherited, it is best to remove these animals from the breeding colony.

Hydrocephalus:

This is almost always a condition which is first noticed as an enlargement of the head at birth and then quickly worsens as the animal grows. Usually the young die within a short period of time. Although many reports describe this as an inherited trait, it has also been shown that a lack of vitamin A in the diet of the pregnant doe may be correlated with hydrocephalus.

Splay leg:

This condition is similar to the hip dysplasia found in certain breeds of dogs and it is thought to be an inherited condition. Affected rabbits cannot move the involved limb(s) toward the body resulting in a 'splay leg' appearance for the animal. Again, because of the potential genetic involvement, all affected animals should be removed from the breeding program.

VIRAL DISEASES:

Rabbit Pox:

Rabbit pox is a severe, highly fatal disease that can occur with or without clinical lesions. It is caused by a pox virus which is closely related to the vaccinia virus and it is transmitted through nasal secretions.

Clinically, animals are febrile and they have a profuse watery diarrhea, enlarged inguinal and popliteal lymph nodes and cutaneous skin lesions. The skin lesions are usually seen as a rash covered by a crusty exudate. Blepharitis, keratitis and a purulent conjunctivitis are often present. Mortality is highest in the unweaned young where it may approach 75% in epizootics.

Vaccination with vaccinia virus is recommended for susceptible colonies in the face of an outbreak.

Myxomatosis:

This is an infection of cottontails which can easily enter rabbitry colonies by means of mosquito transmission. Myxomatosis is also called 'Big Head Disease' because of the swelling produced around the eyes, ears, lips and nose. Clinically there is swelling around all body orifices and the ears may become so edematous that they become heavy and pendulous. Diagnosis is usually made on the basis of the clinical signs described and over 80% of the animals will die in 10-12 days.

Histological examination of the affected tissues is used to confirm this diagnosis. Some attempts have been made to vaccinate infected colonies with an attenuated rabbit fibroma virus or a modified-live myxomatosis virus.

Rabbit Papilloma:

This is a DNA virus belonging to the Papilloma virus group which usually causes papilloma type lesions in the cottontail but has also been isolated from domesticated rabbits. The most common sites for these well keratinized papillomas are the eyes and eyelids.

As these wart-like lesions increase in size they are easily scratched or knocked off leaving an open wound which heals without complications.

It is thought that transmission from the wild cottontail to the domestic rabbit is accomplished via insects such as mosquitos and ticks. The obvious measure is to protect the animals from these arthropod vectors.

BACTERIAL DISEASES:

Pasteurellosis:

One of the most serious problems observed in rabbitries is pasteurellosis caused by **Pasteurella multocida**. This disease results in economic losses through deaths, failure to gain weight, culling of sick animals, and in some cases failure of affected rabbits to reproduce. Rabbits are more susceptible to infection with **Pasteurella multocida** than most other laboratory animals, and several clinical forms of the disease occur. This disease can manifest itself in a number of different ways, such as metritis (infection of the uterus), orchitis (infection of the testicles), mastitis (infection of the mammary glands), conjunctivitis (infection of the eye), sinusitis (infection of the sinuses), and subcutaneous abscesses. Of all these conditions, sinusitis (snuffles), is by far the most common. Severe snuffle problems have forced many rabbitries out of business and cut the profits of most large rabbitries.

Snuffles is most often seen in rabbitries with poor ventilation. The rabbitry is usually over crowded and excessive manure build-up under the cages is common. The odor of ammonia from the breakdown of rabbit urine is often detected. All of these factors put a considerable amount of stress on the rabbit's respiratory system. The mucous membranes of the nasal sinus become infected by bacteria in the inspired air or by direct contact with infected animals or contaminated objects. The clinical disease is characterized by nasal discharge (mucous or pus); infection of the paranasal sinuses probably results in a lifelong infection in most cases. Infection may be clinically silent for varying periods of time with intermittent periods of mucopurulent nasal discharge. The discharge may be wiped from the

nose with the medial aspect of the fore feet resulting in a wetting and matting of fur on the feet.

Snuffles is extremely contagious to other animals in the herd. The other forms of pasteurellosis mentioned previously generally begin appearing after snuffles is noticed. The devastating aspect of **Pasteurella multocida** is that it has been shown to spread throughout the body by several routes including: a) the nasolacrimal duct to the conjunctival sac; b) via the trachea to the lungs; c) by the eustachian tube to the middle ear and subsequently to the inner ear, meninges, and brain; d) via blood to organs and tissues throughout the body; and e) by lymphatics to lymph nodes and the blood stream. Rabbit mortality surveys have shown that the greatest single cause of death in mature animals is pneumonia following an upper respiratory disease with snuffles. Signs of pneumonia are depression, labored breathing, bluish eye color in albinos, and a nasal discharge. The body temperature is usually above normal.

Many times infected females will not reproduce and are therefore culled from the herd and slaughtered. Necropsy usually reveals an infected uterus (**pyometra**) which can be traced back to a single buck with a chronic infection of testicles. **Orchitis** is an infection of the testicles. The testicle becomes enlarged and contains an abscess. Pus can be seen when the testicle is cut open. As described above, the infection is transmitted to does by infected bucks during breeding.

Pasteurella multocida is the causative organism found in the majority of abscesses seen in rabbits. Abscesses are usually seen in the subcutaneous areas and occur when the pasteurella organism invades a break in the skin due to a scratch, cut, or sore. Abscesses can also occur internally. Although abscesses can be lanced, drained and treated with a penicillin-streptomycin antibiotic, it is probably best to cull such rabbits from the herd immediately. Treated rabbits often show a recurrence of the problem and may well act as carriers of the pasteurella organism.

Middle ear infection of one or both ears causes filling of the tympanic cavity with a purulent exudate. If the process spreads to the inner ear, the equilibrium of the animal is disturbed and a head tilt or wryneck results. Again treatment is not effective and rabbits with this condition should be culled from the herd. There is nothing wrong with the meat from these rabbits, they can be safely eaten.

Conjunctivitis or weepy eyes is a condition which is often seen in rabbits in the nest box and sometimes in older does. It can be caused by several different bacteria; however, the usual cause is **Pasteurella multocida**. Infection of the eye usually occurs as a result of extension of the infection of the nasal cavity (snuffles). Antibiotic ophthalmic oint-

ment containing penicillin or chloromycetin are particularly effective in treating this disease (Table 3). If the infection persists or returns, a blocked tear duct can be anticipated which will require a veterinarian's care to correct.

When the organisms enter the blood stream, an overwhelming **septicemia** may develop. Tissue changes usually occur very rapidly in the heart, spleen, and upper digestive track resulting in the death of the animal within a very short time. A lack of clinical signs and the short duration do not allow time for suitable treatment of this condition.

Because nearly all of the pasteurilla isolates are sensitive to penicillin, individual cases can be treated with a daily injection of procaine penicillin 60,000 IU/kg of body weight for ten days. Although it is usually best to cull sick animals from the herd, in some instances it may be necessary to treat the condition on a herd basis. The addition of a broad-spectrum antibiotic to the water such as 300 mg/liter of tetracycline or the use of a feed additive sulfaquinoxaline, at 225 gm/ton of feed or furizolidone at 50 gm/ton of feed, may produce beneficial results. Other antibiotics which have been used include: Sulfamethazine, sulfamerazine, ampicillin, cephalothin, gentamycin and chloromycetin (Table 3). Recurrence of clinical signs frequently accompanies cessation of treatment. It is **recommended** that treated animals **should not** be used for human consumption for a period of at least 72 hours following treatment.

Because pasteurellosis is very difficult to treat and exists in a carrier state, the success of a rabbitry is dependent upon the prevention of pasteurellosis from entering the colony. A good preventive medicine program will rely on the following: 1) The purchase of breeding and replacement stock from healthy suppliers which are free of pasteurilla, 2) Providing a clean environment with adequate sanitation and the prevention of fecal contamination and ammonia buildup in the environment, 3) When the premises become severely contaminated it may be necessary to purchase pasteurilla-resistant rabbits, and experimental work is now being conducted to develop a streptomycin-dependent live **Pasteurella multocida** vaccine for the prevention of rabbit pasteurellosis. Further testing is necessary to determine the value of this vaccine.

Tyzer's Disease:

This disease is found in mice, rats, hamsters, gerbils, rabbits, guinea pigs, horses, cats, dogs and several wildlife species. **Bacillus piliformis** is the causative organism.

Transmission is usually by the fecal-oral route, although in-utero transmission has been demonstrated experimentally. A big problem with this disease is that infectious spore-like bodies may survive a year or more in bedding, soil, or contaminated feed. Some form of stress, such

as overcrowding or extremes in temperature, is usually needed to precipitate this disease.

The clinical signs for Tyzzer's disease can be either acute or chronic. Signs of the acute form in weaning or stressed animals are diarrhea, listlessness, anorexia, dehydration and death within 48 to 72 hours. Subclinical infections are very common resulting in carriers within a colony which continue to shed organisms. Chronically infected animals exhibit weight loss, rough hair coat and eventually death.

Pathological lesions include necrosis in the wall of the cecum and focal necrosis in the liver and heart. Acute deaths result in edema, congestion, hemorrhage and focal ulceration of the intestine. The intestine is often atonic and filled with a yellowish fluid. The hepatic, intestinal and myocardial foci, which are so characteristic for this disease, probably arise via an embolic shower of organisms from a primary infection in the intestine.

Diagnosis is usually made on the basis of clinical signs and demonstrations of the organisms in liver cells. Many times these organisms will give the appearance of a 'pile of sticks'. A complement fixation test has been effective in diagnosing this disease in Japan.

Treatment is usually not effective as the acute cases die before a therapeutic program can be initiated. Oxytetracycline in the drinking water at 0.1 g/l for 30 days has been effective in suppressing outbreaks (Table 3).

Tularemia:

This is an infectious disease of wild animals and man that is caused by **Francisella tularensis**. Tularemia is rare in domesticated rabbits unless they are exposed to wild animals, birds, rodents, deer flies and ticks. Transmission can be by direct contact, aerosol, or biting arthropods. Organisms can be found in the tissues, blood and feces of infected animals.

Tularemia produces an acute septicemia which usually results in death within one week. Necropsy lesions include pulmonary congestion and numerous small white necrotic foci in the liver and spleen. Diagnosis is based on these necropsy findings and isolation of the organism. This agent is extremely hazardous to man and must be handled with extreme caution in the laboratory. Treatment is not indicated due to the public health hazard. All infected animals should be euthanatized and their carcasses burned.

Spirochetosis:

This disease is caused by **Treponema cuniculi**. It has been erroneously called 'rabbit syphilis', although this disease is not the same as 'human syphilis'.

The accidental use of infected bucks will quickly spread this disease

through a colony. Lesions involve crusty, dry, scaly or edematous sores on the nose, mouth, ears and genitalia. Lesions around the vent easily become irritated from urine and poor sanitation and have resulted in the term 'Vent disease'. The organism is sensitive to arsenicals and penicillin. A single intramuscular injection of 100,000 units of penicillin is the recommended treatment (Table 3).

Listeriosis:

This disease is caused by *Listeria monocytogenes*. It exhibits three clinical forms: (1) a blood-born infection in young animals, (2) a brain infection in adults, and (3) a uterine infection and fetal mortality in pregnant does.

Clinical signs include loss of weight, incoordination, convulsions, nasal discharge, uterine discharge and abortion. The most consistent lesion at necropsy is liver necrosis which produces small pinpoint necrotic foci resembling Tyzzer's Disease and Tularemia. Pregnant does and does which have recently kindled are the most susceptible. Diagnosis is usually made at necropsy and so treatment is of little value. If a diagnosis is made, sick animals may be treated with tetracycline or penicillin. Females recovering from this disease are often sterile. This disease is transmissible to man and a positive diagnosis should be reported to the local health authority.

Enterotoxiemia, Rabbit Diarrhea Complex, Mucoid Enteropathy:

Young rabbits often show a variety of enteric conditions ranging from constipation to a profuse watery diarrhea. Although no one has clearly defined one cause for all these enteric disorders, a number of distinct infectious entities may be involved. These include a number of agents such as *Bacillus piliformis*, *Salmonella*, colibacillosis, intestinal coccidiosis and a clostridial enterotoxemia.

This disease complex usually occurs in 7-10 week old rabbits which have just been weaned and placed on a new diet. Clinical signs include loss of appetite, increased thirst, diarrhea, rapid weight loss, grinding of the teeth, bloated abdomen and a stained anus area with light green to brown feces and mucous. Diagnosis can only be confirmed on necropsy by finding goblet cell hyperplasia. There is no specific treatment due to the uncertainty of an etiology for this disease complex; however, increased roughage in the diet has been shown to reduce the incidence of this disease.

FUNGAL DISEASE:

Ringworm is produced by two main groups of fungi, *Trichophyton* and *Microsporum*. These fungi cause patchy areas of dry, crusty, thickened skin. Lesions are usually found on the nose, ears, eyelids and feet of nursing young where it can produce devastating results.

Single lesions are also found in the adult, but they are much less severe. Diagnosis is made by finding fungi in skin and hair scrapings and by culture. Treatment involves a thorough cleaning of all nest boxes and nesting materials with a strong detergent, hot water, chlorine bleach and/or a lye water rinse, cleaning up the nursing mothers with soap and water, and putting all diseased animals on griseofulvin at a dosage of 12 mg/lb/day for two weeks (Table 2). This disease is also transmissible to man and should be reported to the local health authority.

PARASITIC DISEASES:

External Parasites:

The most common external parasite of rabbits is **Psoroptes cuniculi**, which produces ear mange or canker. The mites live in the ear canal producing a brown, waxy material, which soon forms a dark crusty covering composed of mites, dried blood, and cellular debris. If not treated the ear may lose its vascular supply and actually slough or fall off the head. Contrary to some beliefs, external ear mites do not produce a middle ear infection.

Treatment for ear mites can involve commercial products such as Mitox (Norden Laboratories, P.O. Box 80809, Lincoln, Nebraska, 68501), or a 0.25% suspension of Lindane in mineral oil. Approximately 6-8 drops of this suspension or Mitox should be placed in the ear and massaged every third day for two weeks. Mineral oil by itself will tend to suffocate the mites and can provide a fairly effective treatment. The most effective treatment is to use Ivermectin injectable (Merk and Company, Inc., Rahway, New Jersey, 07065). This product has not been approved for rabbits in the United States, but it is very effective (Table 3).

Wild rabbits may have infestation with ticks of the genus **Haemophysalis**. Most housing facilities are sufficient to break the life cycle and so they are usually not a problem in domesticated rabbits. Another parasite of the wild rabbit is the Cuterebra fly. Grub worms hatch from fly eggs and burrow into the skin to form warbles. These larvae, sometimes three quarters of an inch long, can be removed by enlarging the opening in the skin and pulling them out with a tweezer. The wound is then cleaned with an antiseptic.

Internal Parasites:

Without a doubt, the most common parasitic disease in rabbits is coccidiosis. The most severe intestinal forms are **Eimeria magna** and **Eimeria irresidua**. These parasites produce diarrhea, poor appetite, weight loss and sometimes death. Diagnosis is dependent on finding the oocysts in the feces on microscopic examination. Control of intestinal coccidiosis is directly related to management practices which minimize

fecal contamination of feed, water and hutch floors. Most breeders use wire bottom floors and it has been shown that agitation of the floor on a daily basis will increase the flow of feces through the floor and thus greatly reduce the incidence of coccidiosis. Cages may also be soaked in a 10% ammonia solution, which will kill the oocysts (Table 3). In many cases this is all that is necessary to break the life cycle of the parasite; however, if further treatment is required amprolium, sulfaquinoxaline, sulfamerazine, and sulfadimethoxide have been proven to be effective (Table 3).

One species of coccidia, **Eimeria stiedae**, is known to attack the liver and is therefore very pathogenic. This parasite enters the body through the intestine, but it soon migrates to the bile ducts of the liver. On necropsy, the liver will have characteristic white, circular nodules on its serosal surface. Control measures are the same and are the most effective means of regulating this parasite. Medications will provide temporary relief as before, but the parasites will soon reinfect the colony if the life cycle is not broken.

Tapeworms:

The rabbit tapeworm, **Cittotaenia variabilis**, is a flat ribbon shaped parasite which usually causes little or no problem in low numbers. However, if excessive numbers are reached they can produce diarrhea and weight loss. Good sanitation will usually control this problem. Medications used have included Praziquante and Niclosamide (Table 3).

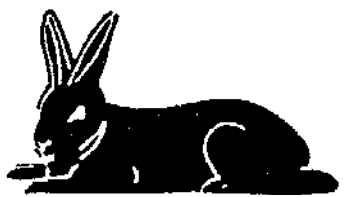
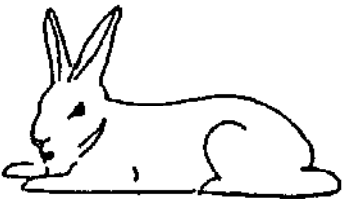
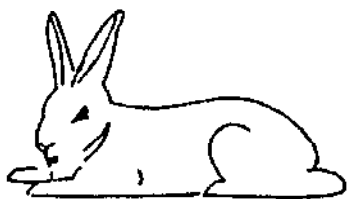
The dog releases eggs of the tapeworm **Taenia plisiformis** in its feces and is thus a source of infection for the rabbit. These larvae enter the digestive tract, migrate through the liver leaving white scars and eventually form small fluid-filled cysts (cysticerci) in the abdominal cavity. There is no treatment for the larval form and so control is accomplished through good management.

Roundworms:

Three roundworms are seen in the rabbit. **Obeliscoides** is a very slender, reddish colored stomach worm and **Trichostrongylus** is a similar parasite in the small intestine. These two parasites are usually not a problem and if they are present they can be easily controlled with good sanitation. The third roundworm is **Passalurus ambiguus**, a pinworm living primarily in the cecum. These parasites are glistening white, about one half inch long and they rarely cause any disease problems. Again, management practices will usually break the life cycle. All roundworms can be effectively treated with piperazine citrate at a dose of 100 mg/100 ml of drinking water for one day. This treatment must be repeated in 14-21 days. Other drugs which have been used include phenothiazine and fenbendazole (Table 3).

Section 7

Sanitation Program Slaughtering And Dressing



Sanitation Program

An essential part of disease prevention and reproduction is a good daily sanitation program. Environmental factors such as the proper type of hutch and shelter construction, and a routine program for cleaning and maintenance are particularly important. Ideally, cages should be cleaned daily with a wire brush to remove loose hair and manure. Following a thorough scrubbing, the cages should be brushed or sprayed with a chlorine bleach solution (one ounce of chlorine bleach per quart of water). The combination of scrubbing and using a bleach solution is an effective way to control coccidiosis and enteritis. The build-up of calcium carbonate deposits may be reduced by rinsing these areas with a weak acid solution, i.e. vinegar. Be sure to clean water and food bowls daily.

Avoid overcrowding of the rabbits. Build the hutches in an area which has good drainage, fresh clean water and adequate sunlight. Avoid damp, poorly ventilated areas as this will only reduce the animals resistance to disease and infection.

Because feed may act as a mechanical carrier for infection, be sure it is stored in a dry, vermin-proof container, such as a metal can with a sealed lid on it. Also, properly designed feed hoppers are necessary for any good sanitary program. Avoid scattered feed in the rabbitry, as this will only serve to attract insects, mice, rats and birds. Of course, all of these are potential carriers of disease.

Once a month, soiled hutches or cages should be removed from the rabbitry and thoroughly disinfected. In addition, pens or buildings housing infected animals should also be disinfected. One agent, which acts as both a cleaner and disinfectant, is lye or caustic soda. One 13-ounce can of lye can be dissolved in 15 gallons of water or one pound makes about 20 gallons of disinfectant. Care must be taken to avoid getting this lye solution on painted surfaces, clothing, aluminum or the skin of rabbits and man.

Sunlight is also an effective disinfectant; however, the exposed equipment must be thoroughly cleaned of all debris prior to exposure as the sun has very little penetrating power. When possible, a cement slab, exposed to the direct rays of the sun, provides a good place to disinfect movable equipment. Other methods which can be used include a variety of commercial chemical disinfectants, live steam and dry heat such as that produced by the direct flame of fire. Care must be taken when using any of these agents to avoid human injury.

In addition to maintaining the suggested sanitation and disinfection practices, the daily inspection and handling of sick animals is important. A good preventive medicine program would include:

- 1) Purchase only healthy animals. Never bring diseased animals into your rabbitry. Quarantine all new animals for thirty days before introducing them into your colony.
- 2) Isolate all sick animals in a completely separate area. If the animal cannot be readily cured, it is probably best to destroy these animals and bury or burn the carcasses.
- 3) Be sure to care for healthy animals prior to servicing the diseased animals. This will prevent carrying organisms into your healthy colony.
- 4) Mark all pens which contained diseased animals. Be sure to thoroughly clean and disinfect these cages with a 2% lye solution (one pound of lye in 5½ gallons of water) before placing new rabbits in them.

Slaughtering and Dressing

The rabbit that is ready for slaughter can be quickly and humanely killed by delivering a quick, sharp blow to the base of the skull. An alternate method is to dislocate the neck by holding the rabbit up by the hind feet, then pulling the head in a quick upward snap.

The carcass then can be suspended by the hind legs by slitting the skin between the tendon and the tibia. Hooks, nails or rope can be used to tie the legs and then suspend the rabbit from an overhead beam, tree limb, etc. (Figure 32).

Next, cut the neck to allow free bleeding or remove the head. The tail is removed and a cut is made from one hock to the other. The skin is cut completely around the hock area. Next cut through the skin around the anus and genital area extending this cut to the cut running from leg to leg (Figure 33).

The edge of the skin is now separated from the carcass and, starting at the legs, pull inside-out over the body. The front legs are removed at the carpus (wrist) before the skin from the body is pulled over this area. Likewise, the head should be removed from the body if not already done. Fat should be left on the carcass. The entire hide is then pulled off the rabbit and remains flesh side out (this is referred to as a cased skin). The cased skin can be stretched over a wood or wire form for drying (Figure 34).

Now remove the internal organs. First make a cut through the muscle on the midline of the abdomen from below the anus to the end of the sternum (breastbone). Then cut the cartilage alongside the breastbone, opening the chest area. Pull the intestines out of the body cavity, using your knife to cut any tough attachments.

Remove the liver, heart and lungs. The gallbladder will lie to one side of the center of the liver. It is necessary to remove the gallbladder from the liver if the liver is to be saved and eaten, as fluid leakage from the gallbladder can give the liver an unpleasant taste.

After removing the internal organs, the carcass should be rinsed in cold water for a short period not to exceed 15 minutes. This helps remove any hair or blood on the meat and cleanse the carcass.

Next, the carcass can be cut into sections (Figure 35). Remove the front legs by cutting from the underneath side of the legs, up through the shoulder. Likewise, cut the hind legs free at the hip. Now cut down to the vertebrae just behind the last ribs. Then bend the spine back to locate a space between the vertebrae and cut there to separate the carcass in two. Cut the ribs from the backbone (vertebrae) on each side to make two rib sections. The pelvic area can, likewise, be split in two or left as one large piece.

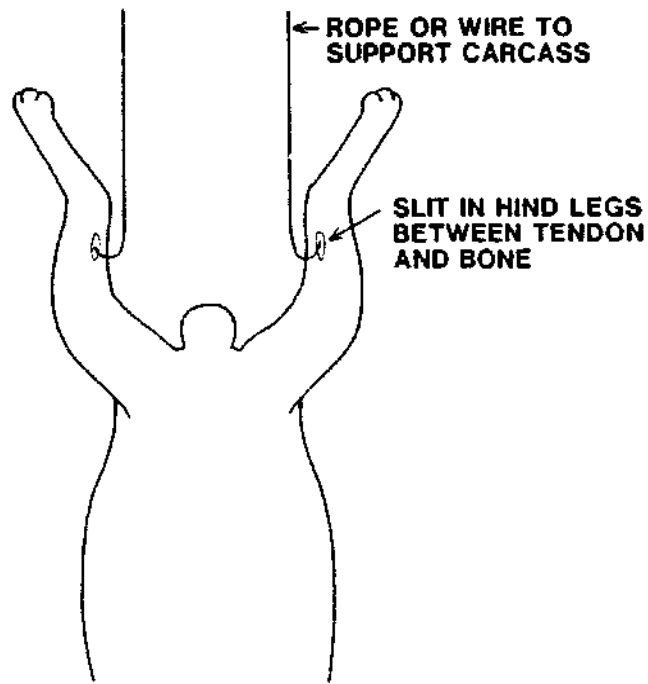


Figure 32. Suspending carcass by hind legs

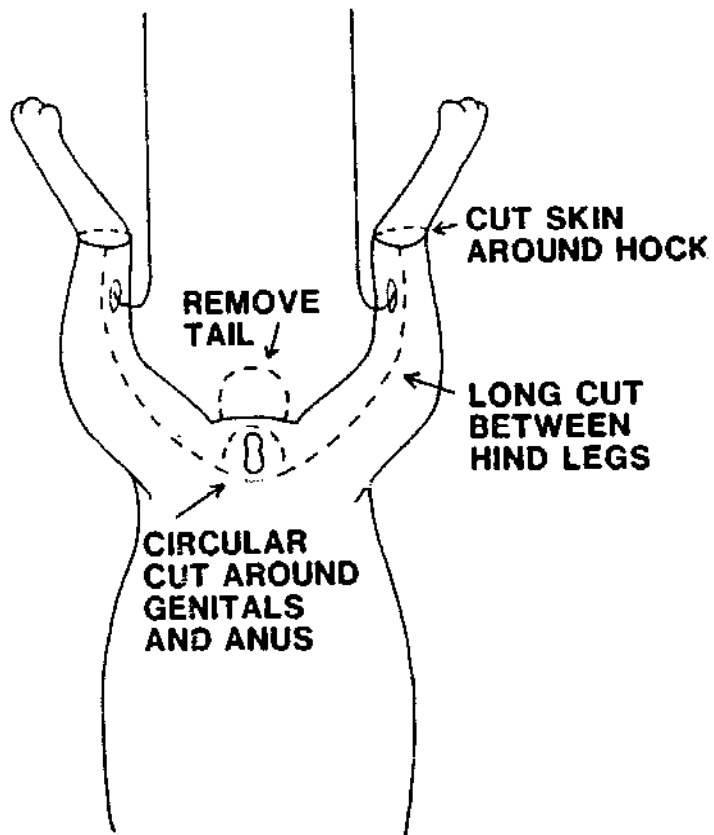


Figure 33. Dotted lines show proper cuts for hide removal

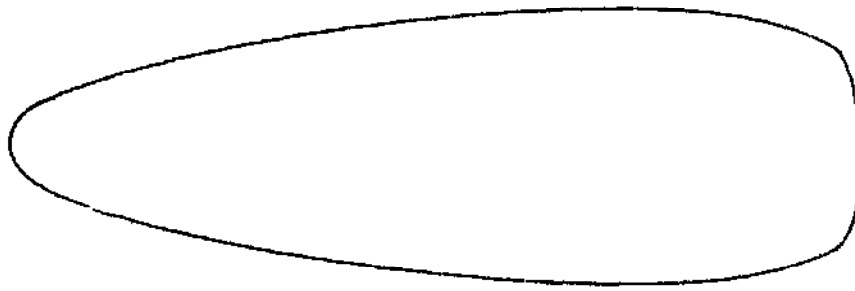


Figure 34. General shape for wood or wire form for drying cased pelt

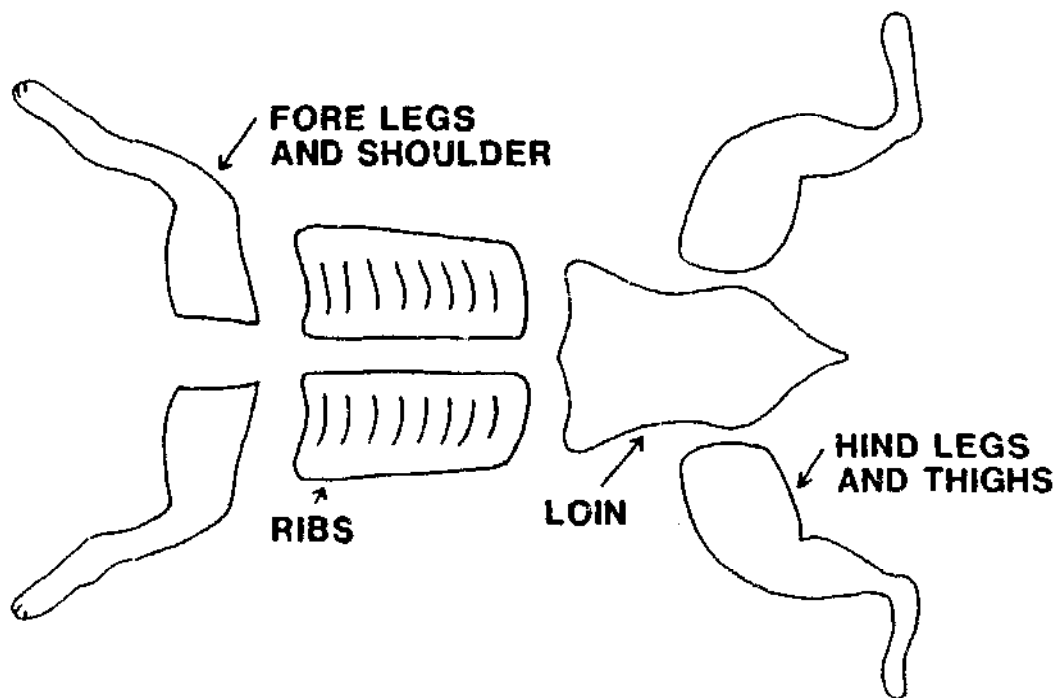


Figure 35. Method of dressing rabbits for marketing

THE AUTHORS

W. Sheldon Bivin

**Professor of Laboratory Animal Medicine
Chief, Laboratory Animal Resources
Head clinician for Laboratory, Zoo, Exotic and Marine Mammals
Director, Wildlife and Raptor Rehabilitation Unit
Louisiana State University
School of Veterinary Medicine
Baton Rouge, Louisiana 70803
Telephone number: (504) 346-3145**

**B.S., 1962, Kansas State University
D.V.M., 1964, Kansas State University
Ph.D., 1971, University of Missouri**

Diplomate-American College of Laboratory Animal Medicine

Dr. Bivin is a Professor in the Department of Veterinary Clinical Sciences. He serves as Chief of Laboratory Animal Resources in the School of Veterinary Medicine and is Director of Laboratory Animal Medicine for the Louisiana State University main campus. He is also Director of a state supported wildlife and Raptor Rehabilitation Unit housed at the School of Veterinary Medicine. His duties include teaching courses to veterinary students on the diagnosis, therapy and control of diseases of laboratory, zoo, exotic and marine mammals. He and his staff of four veterinarians also provide all of the clinical expertise required to care for several thousand research animals used on the L.S.U. campus.

Kathleen A. Murray

**Clinical Veterinarian
Merck, Sharp and Dohme Research
W42-2
West Point, Pennsylvania 19486
Telephone number: (215) 661-6984**

**B.S., 1977, University of Rochester
D.V.M., 1982, Purdue University
M.S., 1984, Pennsylvania State University**

Diplomate-American College of Laboratory Animal Medicine

Dr. Murray was a clinical veterinarian at Louisiana State University at

the time this text was written. She is now a clinical veterinarian with Merck, Sharpe and Dohme. In this capacity she is responsible for the health care and surgical expertise required to manage several thousand research animals.

Glenn H. Olsen

**Clinical Veterinarian and Researcher
Patuxent Wildlife Research Center
United States Federal Wildlife Service
Laurel, Maryland 20708
Telephone number: (301) 498-0264**

**B.S., 1969, University of Illinois
D.V.M., 1971, University of Illinois
M.S., 1980, University of Massachusetts
Ph.D., 1983, University of Massachusetts**

Dr. Olsen was a clinical veterinarian at Louisiana State University at the time this text was written. He is now doing basic research on Wildlife and providing veterinary care for a wide variety of wildlife housed at the Center.

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