Twelve Common Causes of Stool Problems in Squirrels

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Abstract: Stool problems are very common in young squirrels in rehabilitation. Familiarity with common causes allows the rehabilitator to prevent or reduce the occurrence, severity and duration, and resolve problems quickly and easily, often without requiring medical treatment. This paper describes twelve frequent causes of such conditions.

Keywords: Squirrel digestive problems, digestive disorders, gastrointestinal disorders and upset, diarrhea, stool, feces, overfeeding, endoparasites, diet problems, rodent digestive disorders

Introduction

Stool problems are, unfortunately, a very common occurrence in squirrels in rehabilitation. Predictably, discussions of stool problems often jump immediately to treatment, with little if any discussion of cause. This paper focuses further upstream in the rehabilitation process, with an examination of common causes, since this knowledge can help prevent such problems or effectively resolve them in the very early stages, often without the squirrel needing any medical treatment. Effective and prompt prevention of more common causes means the squirrels stay healthier and recover faster, which is good for the squirrels. It also means less work, time, and stress for the caregiver working with ill animals, as well as reduced cost of medications.

Attention to Early Clues

Before considering problems, it is good to start with a review of what is healthy and normal in a squirrel (Casey and Goldthwait 2003). Squirrels that are consuming milk replacement formula produce firm, virtually odorless, small, round or slightly oblong, gold-colored pellets (Figures 1 and 2). Juveniles or adult squirrels eating solids also have round, odorless, firm stool, but dark brown or black in color (Figure 3).

Growth rates are another key clue to the health state in the digestive process (Casey and Casey 2003). While younger tree squirrels may gain one to two grams a day, juveniles with the eyes open should be gaining about three to five grams per day depending on species and age. If weight is not gained at this average rate, the rehabilitator needs to recognize this as a possible concern, identify the cause, and address the problem. Activity levels, size, and general health are also important considerations.

While some rehabilitators use the word diarrhea to describe any stool softer than normal, diarrhea actually refers to liquid, watery feces with few if any solids and defecation often is involuntary with a strong odor. Chronic diarrhea also can stress the immune system, especially for a very young animal. Squirrel stool that is softer than normal, such as formed and ‘soft’ or unformed but ‘paste-like’ is more accurately referred to as just that, ‘soft stool’—and not diarrhea!

It is extremely rare for squirrels with firm, round, normal color, and odorless stool to immediately develop involuntary liquid diarrhea. Squirrel stool is more likely to change gradually through several stages. The sequence commonly moves from normal stool described above, through the stages described below.
to softer, slightly sticky, and somewhat lighter in color; to much softer, but still formed, with some offensive odor present; to very soft paste-like solids that flatten quickly but are still voluntary; to a very liquid paste, may be either voluntary or involuntary, with prominent offensive odor; to finally, involuntary liquid with little solids, otherwise called diarrhea (Figure 4).

As mentioned above, soft stool is likely to have stronger odor than normal feces, which is often noticeable when entering the room where squirrels are confined. If a squirrel develops soft stool, prompt identification of the cause and immediate remedial action usually can reverse the problem quickly and prevent the problem from progressing into more serious diarrhea.

Squirrels with diarrhea are more compromised and are likely to dehydrate without extra hydration with isotonic fluids such as lactated Ringer’s solution. They need to be confined in a smaller cage and given supplemental heat to reduce energy expenditure.

Other conditions may develop as a result of severe and continuing diarrhea, such as prolapsed rectum, secondary infections (respiratory, renal, etc.), renal failure, and nutritional deficiencies.

**Common Causes**

Familiarity with common causes of squirrel stool problems can help rehabilitators prevent many of the possible causes and resolve them quickly and easily by adjusting rehabilitation practices, often without any medical treatments whatsoever! Extensive communication with rehabilitators and veterinarians has revealed frequent causes of squirrel stool problems. The following twelve causes begin with those that are very common, including overfeeding, endoparasites, inappropriate or inadequate diet, and improper preparation of milk replacement formulas.

**Overfeeding.** Most squirrels eat enthusiastically. Many will overeat unless the amount of formula, as well as solids, is controlled. Squirrels that overeat may develop digestive disturbances, including stool problems, when unable to fully digest the amount of food consumed.

![Figure 1. Normal stool of juvenile squirrel fed milk replacer formula and not yet eating solids tends to be a dark gold color. Photo by Allan Casey.](image1)

![Figure 2. Stool of a juvenile squirrel eating solids and milk replacer formula is darker brown or black. Photo by Allan Casey.](image2)
Until young squirrels are close to weaning age, the stomach capacity can comfortably and effectively digest a volume of formula measured in cubic centimeters (ccs) equal to about five percent of the body weight measured in grams (g) per feeding. In other words, a healthy 100 g squirrel can comfortably consume, digest, and utilize about 5 ccs of formula per feeding. Giving juvenile squirrels more than the stomach capacity (5% of weight) at a feeding likely will result in overfeeding, and they often will develop soft stool. If overfed frequently, they can develop diarrhea.

If the squirrel's stool becomes sticky, soft, and lighter yellow, but improves slightly when there is a longer period between feedings, overfeeding may be the reason. Weigh the squirrel every couple of days with an accurate gram scale to confirm the amount that should be fed. Ensure all caregivers feed the appropriate amount and do not overfeed.

Juvenile squirrels close to weaning (climbing well, jumping accurately, hanging from top of cage) may comfortably digest a larger volume approaching six to seven percent of body weight in formula per feeding, but may develop soft stool if fed more than this amount. If soft stool occurs, confirm squirrels are being fed an amount appropriate (based on weight) and then consider reducing daily feedings of milk replacer formula by one feeding a day, such as from four feedings a day to three, or possibly to feeding less per feeding, back to the five percent amount.

Overfeeding also can occur when the cumulative total amount of food per day exceeds the squirrels’ ability to digest the food as a result of too many feedings per day. Ideally squirrels should have time to digest most of the previous meal before being fed again. Check frequency of feeding to ensure they are receiving enough feedings, but not too many. If feeding frequency seems to be the problem, decrease daily feedings by a single milk replacer formula feeding to see if the stool firms.

In some cases, the number of feedings per day may be appropriate for the age of the squirrel, but if feedings are timed too frequently or too close together, it does not allow the squirrel to fully digest the previous meal. In such cases, the squirrel may have soft stool for some of the day and normal stool for the remainder. Feedings that are too close together are considered a type of 'overfeeding' and may be remedied by spacing the feedings more evenly over a day. For example, a squirrel that is fed formula five times a day should have feedings three to four hours apart, but no closer together than two and a half hours. A squirrel fed four times a day would have feedings no closer than three hours, preferably about four hours apart.

In addition to overeating formula, a squirrel old enough to chew and eat solid foods may eagerly consume and overeat more of those than can be easily digested, including rodent chow. It may develop bloat, pass lienteric (undigested) stool as well as diarrhea, and have rectal prolapse. Such overeating may occur if large amounts of food are placed in the cage.
at one time or if one or more of the squirrels in a
cage dominates another and consumes considerably
more food than cagemates. Placing a smaller amount
of solid foods in the cage two or three times per day
instead of a large amount once a day can reduce
such problems. Using a high quality, balanced and
fresh rodent chow helps ensure appropriate nutrition
(Casey and Casey 2003; Casey 2005). Ensure that an
appropriate amount of rodent chow is fed in order
to achieve good nutrition, growth, activity, size, and
health, but not so much as to cause gastrointestinal
disorders or inappropriate weight gain or loss.

A few rehabilitators concerned over a squirrel
smaller than others of the same age have tried to
increase weight by offering an extra feeding per day.
Unfortunately, this often results in overfeeding and
soft stool instead of weight gain. The rehabilitator
needs to consider the reason for the smaller size and
determine if that needs to be addressed. It is possible
that the squirrel arrived smaller due to being part of
a large litter or being without food for a longer time
and needs more time with a good diet to ‘catch up’
to others of the same age.

Recent changes in some milk replacement for-
mula products, recipes, and preparation methods
that allow more complete reconstituting and dissolv-
ing have affected the digestibility and utilization of
formulas. Some rehabilitators report that the squir-
rels are growing well and progressing slightly faster
in the weaning with formulas that seem to be more
digestible and better utilized. Consequently, rehabili-
tators following a feeding schedule previously used
concluded that they were overfeeding, and needed to
reduce by a single daily feeding slightly faster than in
the past, which resolved digestive issues.

Endoparasites. Squirrels are hosts to many differ-
ent endoparasites and there are some endoparasites
considered ‘normal’ residents in the squirrel gastro-
intestinal tract, which usually do not cause problems
at ‘low’ levels and while the squirrel is otherwise
healthy. However, an overgrowth of these endopara-
sites can develop and result in stool, growth, and
other problems when a squirrel is under stress from
injury, dehydration, shock, capture, or captivity. Thus
it is important to minimize stressors and reduce
potential for overgrowth of these endoparasites,
which can cause diarrhea. A heavy load of endopar-
asites in the feces of squirrels in rehabilitation
also increases the potential for transmission to other
squirrels confined in the same cage, and their developing
an overgrowth of the same endoparasites.

Coccidia is a common endoparasite in squirrel
gastrointestinal tracts. While not problematic at
low levels, it may cause problems at higher levels.
Squirrels with coccidiosis may alternate with normal
stool one day with soft, yellow stool the next day or
two, and then back to what appears normal. Squirrels
with coccidiosis may have stool that appears normal,
but a slower growth rate than normal. Coccidia and
endoparasites in general do not always show up on
a fecal exam. Coccidiosis is commonly treated with
sulfadimethoxine (Albon®, Pfizer Animal Health,
New York, NY). Since an overgrowth of coccidia is
extremely common in juvenile squirrels that arrive in
a compromised condition (dehydrated, debilitated),
some rehabilitators and veterinarians administer
sulfadimethoxine as standard rehabilitation practice
if squirrels show slow growth and intermittent soft
stool.

Giardia, another endoparasite, may cause squir-
rels to develop diarrhea that has mucus with green
color tint, and a particularly strong and distinctive
odor. Squirrels with giardia also tend to have slower
growth rates. Giardia has been treated with fen-
bendazole (Panacur®, Merial Ltd., a Sanofi Company,
Duluth, GA), as well as other products.

If rehabilitators follow initial quarantine proto-
cols and isolate affected squirrels, as well as follow
effective sanitation procedures, they can help prevent
other squirrels in care from getting endoparasites and
developing problems.

Inadequate or Inappropriate Diet. Most squir-
rels admitted to rehabilitation are juveniles of an age
that would still be suckling the mother. Since there
are no commercial sources of squirrel milk, rehabili-
tators prepare milk replacement formula based on
the nutritional needs of these young squirrels. Using
an effective and proven commercially available milk
replacement product, or combination, can prevent
many digestive and nutritional based disorders. If it
is suspected that the formula may be causing stool
problems, there are a number of actions a rehabilita-
tor can consider.

Research the milk replacement product and how
the wet matter composition, once mixed with water,
matches the needs of squirrels (Moore and Joosten
2002; Casey and Casey 2011a, 2011b). The com-
mercially available milk replacement products vary
widely by manufacturer and intended use. Do not
assume that just because the manufacturer says it is
for wildlife or displays a photo of a squirrel on the package label that the product fully meets the species nutritional needs. Consider the ingredients, such as preservatives that increase shelf life, or ‘filler’ ingredients that may increase calories or modify the composition, but may not be very nutritional or digestible. Recognize that, from time to time, manufacturers can and do change production methods, ingredients, sources of ingredients, recipes, and more. While some manufacturers may immediately reflect changes and accurately list ingredients on the label, US Food and Drug Administration allows pet food manufacturers a grace period of six months to update any new ingredients to be listed on the label.

Additionally, rehabilitators can review extensive milk replacement product research that includes independent test results and comparative analysis (Casey and Casey 2010; Casey and Casey 2011a, 2011b). An online nutrition calculator and video tutorials also allow rehabilitators to quickly and easily compare replacer formula recipes to published squirrel milk composition research (Casey 2011).

Talk with experienced rehabilitators who have a proven track record of raising healthy squirrels with consistently good growth rates, healthy digestion, and good stool. Ask detailed questions about the formula used, results (growth rate, activity, pelage), frequency and type of problems, number of squirrels rehabilitated, and so forth. Serious and thoughtful questions are a helpful way to learn and evaluate options, and should not be avoided due to concern that the questions could be considered intrusive or critical.

Rescuers often feed squirrels an inappropriate diet, such as cow’s milk. If the rescuer fed the squirrel a couple of inappropriate diet feedings, then rehydrating and gradually introducing the appropriate diet may allow the squirrel’s stool to normalize quickly. Gradual introduction suggests the first couple of feedings only be an isotonic fluid and then start dissolving powder until after the mixed formula is allowed to rest in a refrigerator for at least four and preferably eight hours after mixing. In addition, most of the powders reconstituted more effectively when water added to the powder was around 175° F (79.4° C) instead of just warm tap water, which is usually around 125° F (51.7° C). The water should not be boiling since that temperature may damage vitamins.

While inadequately reconstituted and dissolved formula may appear to be liquid milk, the dry particles can cause diarrhea in several ways. Young squirrels, like many other young mammals, have less efficient gastric acid and enzymes. If fed inadequately dissolved powder in a formula, the dry powder particles move through the stomach directly into the small intestine. The powder particles are unable to be fully digested by the animal resulting in inadequate nutrition even though fed the ‘correct’ calculated and measured amount. A squirrel with inadequate
nutrition may develop diarrhea, called ‘starvation stool.’ Additionally, the chemical properties of milk products are an excellent medium to grow bacteria, which may grow quickly in the poorly dissolved milk powders in the squirrel’s small intestine, resulting in inflammation and infection that causes bloat and diarrhea.

The squirrel that is fed inadequately reconstituted and dissolved powder in a formula multiple times per day, and over multiple days, is more likely to develop chronic diarrhea. Preparing milk replacement powders with hotter water and allowing a longer resting time before feeding the formula has been shown to improve digestibility and reduce the risk of problems.

**Inaccurate Measurement.** Inaccurate measurement of powdered milk replacers and water can result in formula with inappropriate proportions and cause digestive upset. Inaccurate measurement can occur due to inconsistent measurement by different people preparing formula and measuring in different ways (powder heaped in measuring implement vs. leveled, etc.), as well as inaccurate measurement such as confusing teaspoon with tablespoon.

Another much less obvious problem can be caused by milk replacement powder settling in the package container, resulting in compaction at the bottom and lighter particles at the top. This easily and adversely affects density of powder in a measuring utensil as the rehabilitator gradually uses and withdraws container contents over several days or weeks. A simple solution for this is to turn the milk replacer container over several times before using powder for formula preparation in order to reduce compaction and ensure even distribution of contents such as vitamin and mineral additives. Strive for accurate and consistent measurements.

**Unbalanced Gut Flora.** A normal, healthy gastrointestinal tract has a variety of healthy resident bacteria that support digestion. If the squirrel has soft or watery stool due to any cause or is taking antibiotics to destroy harmful bacteria for any purpose (cat bites, abscesses), the beneficial gut bacteria is also likely to be off–balance. Consider supplementing or replenishing with probiotics or an inoculant (made from the stool of a healthy adult squirrel that has been confirmed parasite free). Probiotics only should be provided twice a day (Casey and Fedchak 2010).

Saccharomyces boulardii, a nonpathogenic yeast strain classified as a probiotic, has proven highly effective in both preventing and treating unbalanced gut flora in humans—as well as in squirrels—and is available online, in pharmacies, and health food stores. The cost of Saccharomyces boulardii varies based on brand name, with one of the most well–known names, Florastor® (Biocodex, Beauvais, France), significantly more expensive than other labels, such as Jarrow (Los Angeles, CA). Saccharomyces boulardii comes in capsule form, does not need refrigeration, and like other probiotics is administered in liquid only twice daily. Rehabilitators open a capsule, sprinkle a few ‘grains’ into warmed formula, and stir to dissolve.

**Not Using Water to Mix Formula.** Commercial milk replacement powders are formulated to be mixed with water—period. Unfortunately, a popular practice of mixing commercial milk replacers with other products that include sodium, such as lactated Ringer’s solution, Normasol–R® (Abbott Animal Health, Abbott Park, IL), and Pedialyte® (Abbott Laboratories, Columbus, OH), inadvertently increases the level of sodium and other electrolytes in the formula. This higher sodium level in formula can pull fluids into the intestine from surrounding tissue, resulting in more water in the stool, and actually cause dehydration.

**Feeding When Dehydrated.** Many squirrels are admitted into rehabilitation with mild or moderate dehydration. An animal must be fully hydrated in order to effectively digest and absorb nutrients in formula or other foods. Feeding a squirrel any food, whether formula or solids, before it is hydrated causes it to pull body fluids into the gastrointestinal tract as it attempts to digest the food. This can result in more watery stool—and possibly further dehydration.

Generally, the first step in rehydrating a squirrel is to provide one or two feedings consisting solely of an isotonic fluid such as lactated Ringer’s solution or Normasol–R®. Then the squirrel is started on milk replacement formula that is more dilute than normal, achieving full strength over four to six feedings as the animal reaches normal hydration. This allows the squirrel to rehydrate while starting to get some nutrients and adjust to the new diet. Experienced squirrel rehabilitators report that young squirrels often can and need to be on full strength formula within about 24 hours after admission, especially infants.
**Rapid Diet Change.** The composition of milk provided by a lactating mother changes gradually over lactation—not drastically over only a couple of feedings. Juvenile squirrels eating solids generally are eating tree cambium and buds, and some other plant materials. Since these almost weaned squirrels are not going far from the nest, they may nibble on these solids from only a couple of different sources and eat pretty much the same basic foods each day with very little change.

When the diet for juvenile squirrels is changed significantly over a very short time, stool problems often result. The solution is to add new items to the diet very gradually and only one item at a time. If problems occur, remove the new item and introduce it much slower the next time, or do not add it at all. Adding new items to the diet or making other diet changes when the squirrel’s stool has not been normal for several days generally causes a mild problem to become more severe. Rapid and large increases in the amount of formula or other foods may cause stool problems even though these foods were previously tolerated in small amounts.

**Indigestible Fat.** Formulas made with milk replacement powders provide a good base for formulas, but do not by themselves fully meet the nutritional composition needs of juvenile squirrels. Rehabilitators must add a small amount of supplemental fats to adjust the milk replacer to more fully match the mother squirrel’s milk. It is essential to select fats that are more easily digestible, such as heavy whipping cream.

Some supplemental fats added to milk replacement formulas contain lard (rendered pork fat), such as PetAg’s MultiMilk® (Hampshire, IL), which is more difficult to digest. Additionally, since lard has a melting point of 109° F (42.8° C), if formula is not mixed and maintained while being fed at a temperature above that level, the lard quickly solidifies in the formula. Since feeding a formula that is 109° F (42.8° C) is too hot for a squirrel to eat, rehabilitators feed at a lower temperature. However, the lard will not be in liquid form at the lower temperature. If a rehabilitator chooses to use a product that contains lard, it is not added to the formula until the squirrel is older and the digestive system has developed enough to digest it (i.e., after a juvenile squirrel has fur on the abdomen).

Some solids also have high percentages of fat and can cause gastrointestinal upset especially when fed in large quantities, including some nuts and even some of the rodent chows. The ‘breeder’ rodent chows have a higher fat content designed for rapid growth and weight gain, and should be avoided in favor of a complete life cycle or balanced rodent chow.

**Formula Storage.** Unopened commercial milk replacement powders should be stored in a cool environment, generally 70° F (21° C) or less, to prevent both degradation of vitamin potency and onset of rancidity. Shelf life of unopened containers also can be extended if refrigerated or frozen. Once opened for use, the container or product must be kept refrigerated or frozen until completely used.

Manufacturers’ instructions indicate milk replacement powder should be used within 24–hours of preparation into formula and the liquid should be kept refrigerated during that time. Other dairy experts suggest that formulas made with milk replacement powders may be refrigerated and used over a two- or three–day period, which allows for a more fully reconstituted powder in the formula (Wisconsin Center for Dairy Research, Madison, WI).

When preparing a feeding, the required amount of prepared formula should be removed quickly from the refrigerated storage container without contaminating milk in the container. Formula that has been withdrawn is then warmed to about 98° to 102° F (37°–39° C) before feeding the squirrels. Do not chill and reheat formula previously warmed for feeding since that can result in bacteria development.

Milk powders can become rancid when exposed to air or heat. Rancid powders often have a distinctively strong odor. Rancid or spoiled milk replacement formulas or spoiled food can cause stool problems. If an unusual odor is detected when first opening a container of milk powder, the manufacturer or distributor should be contacted immediately (with product name and lot number) for possible return of the product and to request a fresh replacement.

**Stress.** Squirrels, like other wild species, can develop gastrointestinal disorders and other health problems due to stress induced by the captive environment. Squirrels have very sensitive hearing, so noises that may not seem loud to humans may be major stressors, including normal conversation, ringing telephones, rattling cages, and other animals (a room full of baby birds begging for food).
Since squirrels have an acute sense of smell, odors, however strong or faint, are serious stressors. Examples of stressful odors include cleaning agents, perfumed soaps or lotions, scented laundry detergent on bedding, odors from predators, or even the odor of urine or feces in dirty cages.

Movement and activity by humans or other animals can be stressors. This includes sound, sight, odor, and proximity to any possible predator, wild or domestic. Frequent handling, examinations, capture, escape and chase in a rehabilitation room, pain, and more can cause stress. It is critical to understand what factors are stressors and work to prevent or minimize them for the animal.

**Conclusion**

In summary, the factors described above are common and often preventable causes of soft stool and diarrhea in juvenile squirrels. Paying close attention to these factors helps prevent health problems, allows more normal growth and development, and provides a higher quality of life for squirrels in rehabilitation. This reduces the need for medical care, including medications, fluids, and more intensive monitoring. This helps the rehabilitator minimize costs, time, and effort spent working with debilitated animals. Plus, preventing health problems caused by rehabilitation practices helps the animal and reduces rehabilitator stress and burnout.

**Literature Cited**


**Resources**


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