Ethanol, Bread Dough, and Hops – Oh My!

By Lynn R. Hovda, DVM, MS, ACVIM
Director, Veterinary Services

The title of this article may cause you to wonder how these three items are related and why they are appearing together in a piece on animal poisoning, especially at this time of the year. The question is worthy of thought yet the answer is simple. The winter season brings holidays frequently filled with alcoholic beverages, baking, and gifts. It is easy to understand how dogs and cats can be poisoned from ethanol as it is found in mixed drinks, wine, and beer, but did you realize that bread dough, rotten apples, and even fermented food are other sources of ethanol. Home brewery beer starter kits are popular holiday presents and it is not unusual for people to use them in the colder winter months. Hops are sometimes added to these kits to provide bitter flavor and strong aroma to the beer. Any of these items can prove deadly to dogs and cats if ingested in large enough amounts.

ETHANOL

Small animals are primarily poisoned by drinking alcoholic beverages directly from glasses, containers, or punch left over after a party, although a few are poisoned from perfumes and medications where ethanol is used as a carrier. Other less frequent sources include fuel substitutes used in camping stoves, hand sanitizers and disinfectants, and other household products. Rarely, pet owners deliberately feed their animals ethanol just to see how they react. Most cases of ethanol toxicity occur in the home, especially in the kitchen, but dogs kept in the garage where ethanol or ethanol containing products are stored are also at risk.

The signs of poisoning in small animals generally occur within 30-45 minutes of ingestion as ethanol is readily absorbed from the gastrointestinal tract. The LD₅₀, the dose where 50% of animals die, for oral ethanol is 5-8 mL/kg so a 15 kg dog only needs to drink about 75 mLs or 2.5 ounces of 100% ethanol (200 proof) before it is in serious danger of developing respiratory depression and arrest. Ingestion of smaller amounts is often enough to cause a “drunken” stupor. Animals that reach this point or are so inebriated that they are unable to stand without assistance should be closely monitored in a veterinary facility.

The clinical signs are primarily related to the central nervous system and included depression, lethargy, ataxia, and stupor. Other commonly reported signs include retching, vomiting, respiratory depression, tachycardia, and hypothermia. Severely poisoned animals may develop seizures and a coma. The animal’s breath may smell like ethanol; as ethanol is metabolized to acetaldehyde an odor described as acidic or sweet may be found. Hypoglycemia and metabolic acidosis are often present on a serum chemical screen.

Blood ethanol concentrations in dogs and cats suspected of poisoning can generally be run at human hospitals. They are often a useful tool for measuring the severity and progression of toxicosis. Death, in humans and likely dogs, correlates with a blood ethanol concentration of 600 mg/dL, coma at 450-500 mg/dL, and respiratory depression at 400-500 mg/dL.

Treatment is limited to supportive care. The onset of clinical signs is so rapid that unless the ingestion occurred within 10-15 minutes emesis is not recommended. Activated charcoal is ineffective in binding ethanol and is not recommended. In affected dogs, intravenous fluids should be used to correct dehydration and abnormalities such as hypoglycemia and metabolic acidosis. The temperature should be monitored frequently and warming measures applied if hypothermia occurs. Yohimbine, an alpha₂-receptor antagonist, has been used successfully in some severely neurological dogs to block the effect of ethanol on these specific receptors in the brain.

The prognosis for a full recovery is generally good, but animals that develop severe respiratory signs and/or aspiration pneumonia have a less positive outcome, as do those with metabolic acidosis or nonresponsive neurological signs. Death is from respiratory failure and arrest.
BREAD DOUGH

Poisoning from bread dough occurs when animals ingest a live yeast containing bread product such as bread dough, pizza dough, sourdough, or bread starter before it has finished rising. This tends to happen more frequently in the winter when people are baking their own bread. Rising yeast produces ethanol and gas and in the warm, moist environment of the stomach the process accelerates and fermentation increases. The stomach essentially acts as the "oven" for uncooked dough. Rapid gas production causes stomach distension and vascular compromise similar to gastric dilatation/volvulus (GDV). In addition to ethanol and gas production and the potential for GDV in susceptible breeds, the large mass of rising bread dough may result in a foreign body obstruction.

The neurological signs are similar to ethanol. Gastrointestinal signs, however, are more severe with retching, vomiting, abdominal pain, and abdominal distention and bloat commonly reported. Hypoglycemia and metabolic acidosis may be severe. Abdominal radiographs often show the presence of bloat and gastric distension.

Emesis should be induced in asymptomatic animal with a known ingestion provided a GDV has been ruled out. Gastric lavage with a large bore tube should be used in those animals with nonproductive emesis or with large amounts of gas in the gastrointestinal tract although the sticky mass of dough may clog the tube. Cold-water lavage is often very effective in decreasing yeast fermentation as it lowers the gastric temperature and stops the "oven" effect. The remainder of the treatment is similar to ethanol poisoning.

The prognosis is generally very good for animals treated early and aggressively. Similar to ethanol poisoning, animals with severe respiratory depression, metabolic acidosis, and seizures have a poor prognosis. Surgery to correct a GDV often results in a less optimum outcome.

HOPS (Humulus lupulus)

Hops in the genus *Humulus* are used to provide the bitter flavor and strong aroma associated with brewing beer and may be found home beer brewery kits. Poisoning from hops occurs in households where these kits are used or less commonly in craft breweries where dogs are brought to work. Both fresh and used hops are toxic, but dogs seem to be at the highest risk when they have access to the spent or disposed hops, often in the garbage or compost pile.

Clinical signs appear anywhere from 30 minutes to 12 hours after ingestion; death at 6 hours was reported in one untreated dog. There is no known toxic amount or lethal dose, which makes guiding therapy difficult. The mechanism of action is unknown but may be related to uncoupling of oxidative phosphorylation by some of the biologically active compounds found in hops.

Dogs ingesting a presumed toxic amount of hops develop signs similar to malignant hyperthermia, a genetic mutation where the body temperature rises suddenly and uncontrollably. Canine breeds predisposed to this condition such as the Border collie, doberman, greyhound, Labrador retriever, Saint Bernard, and "cold weather" dogs such as Siberian huskies are at a higher risk of developing poisoning from hops. Common signs include hyperthermia, brick red mucous membranes, tachycardia, tachypnea, excessive panting, anxiety, and vomiting. Laboratory abnormalities include metabolic acidosis, an elevated creatine kinase and electrolyte alterations (increased potassium, calcium, magnesium, and phosphorous). Urine is often dark brown in color with myoglobin and other pigments present.

Treatment varies depending on the time of ingestion. Asymptomatic dogs should have emesis induced followed by the administration of activated charcoal. If more than an hour has passed from ingestion or if emesis was nonproductive, gastric lavage with a large bore tube should be performed and followed by a dose of activated charcoal. Similar to bread dough, lavage may be limited by the size and mass of the hops. Intravenous fluids are used to treat dehydration, correct electrolyte abnormalities, increase urine output and assist with body cooling. Cooling measures should be utilized, taking care not to drop the body temperature too low. While not an antidote, dantrolene sodium is a useful drug for reversing some of the effects of malignant hyperthermia.

The prognosis is variable even with aggressive therapy. Affected dogs should be monitored for 24-72 until signs subside. Death, while rare, may occur secondary to organ damage and the early onset of metabolic changes. Recovered dogs should be tested for a genetic mutation associated with malignant hyperthermia.

About Pet Poison Helpline: Pet Poison Helpline is a 24/7 animal poison control center for pet owners and veterinary professionals that require assistance treating a potentially poisoned pet. The staff provides treatment advice for poisoning cases of all species. Pet Poison Helpline is available in North America by calling 800-213-6680. Additional information can be found online at www.petpoisonhelpline.com.