Euthanasia of livestock using magnesium sulphate

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A method of euthanasia for farm animals where gunshot, barbiturates or bleeding out are not an option, is intravenous administration of a saturated solution of magnesium sulphate (SS-MgSO4).

Magnesium sulphate (aka Epsom salts) in solution was one of the first anaesthetics and euthanasiates for large animals (1) before more modern drugs were developed. It does not present the carcass disposal problems of barbiturates, and is safer for the operator and more humane than intravenous potassium chloride, which causes a heart attack without first diminishing consciousness.

Prior sedation with xylazine is used (0.4 mg/kg bodyweight intramuscularly). Once the animal is recumbent, the SS-MgSO4 is administered intravenously until the animal is dead. Death is achieved consistently with dose rates of 2mL/kg bodyweight of SS-MgSO4, although half this dose rate will kill most livestock. When the SS-MgSO4 is gravity administered via an elevated bag or bottle, the transition to death is smooth, within 3-5 minutes. There is little or no leg, body or head movement and no outward signs the animal is distressed.

Saturated solutions of KCl do not work as well as $MgSO_4$ and are not recommended unless ketamine is used to potentiate the xylazine. With saturated solutions of KCl there are often arching of the back and neck, kicking of front and hind legs, and vocalisation. These don't tend to occur with saturated solutions of $MgSO_4$.

Saturated $MgSO_4$ solutions are prepared by adding the salt to a container of water until it no longer dissolves. The saturation point is reached when vigorous stirring does not remove the salt crystals on the bottom of the container, or simply add 2 kg of Epsom salts to an empty 5 L container and top up with water. Solubility in water of $MgSO_4$ is between 300 to 400 gm/L over the 10-30^{o}C temperature range (Table 1).

Table 1: Solubility of $MgSO_4$ in water at different temperatures. Source: https://en.wikipedia.org/wiki/Solubility_table

Temp	0 °C	10 °C	20 °C	30 °C	40 °C
$MgSO_4$ solubility (g/100 mL water)	25.5	30.4	35.1	39.7	44.7

The volume required to kill an animal will vary depending on the ambient temperature, the depth of anaesthesia and how sick it is. The commercial bags of 25% $MgSO_4$ solution used to treat hypomagnesaemia (grass tetany) in cattle are usually not concentrated enough to consistently kill cattle.

Volumes as small as 500 mL of $MgSO_4$ may kill a 500 kg xylazine-sedated cow, however, sometimes 50% more volume is required. Therefore, the recommendation is to be prepared to administer 2mL/kg of the $MgSO_4$ solution. In practice, the solution is administered until death occurs.

In large animals, the solutions can be administered rapidly into the jugular vein via a 14 g needle, a flutter valve and 1 L bottle (Figure 1). A long length of flutter valve tubing enables the bottle to be held high to increase rate of flow.

Figure 1: Flutter valve attached to bottle being used to administer intravenous medication to a cow

An alternative delivery vehicle is the collapsible plastic bag and tubing of a used commercial 4 in 1 solution. Cut a corner from the top of the bag to create an opening to pour in the saturated solution. Once filled, fold the opening closed and squeeze the bag to force the solution in as fast as possible.

The advantage of the xylazine + $MgS0_4$ method over barbiturate is that it is cheaper, and safer for scavengers. At dose rates of 0.4 mg/kg xylazine administered IM to cattle, sheep and goats it is likely that dogs could consume the meat at rates up to 0.5kg per 10kg of dog per day without them becoming affected. Meat from around the injection site and the liver and kidney are likely to contain higher concentrations of xylazine and pose more of a risk if eaten.

Risks would be reduced if lower doses of xylazine were used such as when xylazine is administered IV and if the animal was bled immediately after death to drain the carcass of circulating xylazine. If higher dose rates of xylazine and salt were used, the worst that could happen would be the carcass being rendered distasteful and scavengers eating the carcass would be unaffected other than perhaps by temporary vomiting, diarrhoea and drowsiness.

The infused saturated $MgSO_4$ salt solution is unlikely to affect palatability of the meat ($MgS0_4$ is slightly bitter) as there would be in the order of 2 to 3 g of salt per kg of meat at the most. At this low level, palatability is unlikely to be affected or the laxative affects felt. When any method involving anaesthetics, sedatives or saturated salt solutions has been used, and a knackery service is to be used to remove the carcass, ensure that they are advised that the carcass is not to be used for pet food.

1. Riebold T, Goble D, Geiser D. *Large animal anesthesia : principles and techniques*. Iowa State University Press, Iowa, USA, 1982.

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