

NITRATE AND NITRITE POISONING

- Nitrates and nitrites are composed of nitrogen and oxygen that occur naturally in the environment as part of the nitrogen cycle.
- Nitrates are non-toxic. But in the feedstuff or in the alimentary tract they are converted into nitrites, which are toxic.
- Nitrite is 6-10 times more toxic than nitrates.
- In normal circumstances this nitrite is further broken down to ammonia in the rumen and is then used by the rumen microbes to make protein. However, when large amounts of nitrate are eaten over a short period of time, the nitrite accumulates in the rumen and is absorbed.

Sources of Nitrite Poisoning

- Whey, preserved feed, fertilizers containing sodium, phosphorus or ammonia, well water and plants that contain more nitrates.
- Plants that accumulate nitrate when they grow on soils containing excess of nitrates include *Amaranthus retroflexus*, *Brassica napobrassica*, *Chenopodium album*, *Datura* sp., *Tribulus* sp., *Beta vulgaris*, *Curcubita maxima*, *Ipomoea* sp. and *Solanaum* sp.
- Due to the lowered activity of nitrate reductase, the nitrate content of plants will be higher on dull days and at night.
- During periods of draught, the amount of nitrate in the soil can increase greatly because of lack of leaching, reduced uptake of nitrate by plants and decomposition of organic matter.
- When draught breaks, nitrate uptake by the plants may be high especially in the first week after rain. If hungry animals are allowed access to such plants nitrate poisoning may occur.
- Water run off from fertilized fields, decaying manure and silage juices may lead to nitrate poisoning through water.

Factors Affecting Toxicity

- Nitrates from plants are converted into nitrites in the rumen. These excessive nitrites are absorbed into circulation.
- Pigs are more susceptible than cattle and sheep.
- Fasting increases toxicity.

- Rate of intake, variations in gastrointestinal nitrate reduction, diet, metabolic state of the animal, pregnancy are some factors affecting toxicity.
- The amount of preformed nitrite influences toxicity in monogastric animals.
- Foetuses and neonates are more susceptible.

Mechanism of Toxicity

- Nitrite is the actual toxic compounds.
- Ruminants are more susceptible to nitrates than monogastric animals.
- Rumen microorganisms reduce nitrate ion to nitrite ion.
- Nitrites induce toxicity by two mechanisms.
- In the first mechanism, circulatory haemoglobin is converted to methaemoglobin.
- One mole of absorbed nitrite reacts excessively with two moles of haemoglobin and in this process there is loss of an electron and ferrous form of iron in haemoglobin is converted to ferric form resulting in methaemoglobin formation.
- When 20% of haemoglobin is converted to methaemoglobin, toxic symptoms are noticed.
- When 80% of haemoglobin is converted, anoxia and clinical signs are noticed and death occurs.
- Relaxation of vascular smooth muscle and consequent vasodilatation are considered to be the other mechanisms of toxicity.
- The vasodilatation due to nitrites results in systemic arterial hypotension and decreased cardiac output.
- Nitrates have a direct caustic effect on the lining of the gut, if consumed in large quantities.

Clinical Symptoms and Postmortem Lesions

Clinical symptoms

- Abdominal pain, diarrhoea, muscular weakness, incoordination, accelerated heart rate, dyspnoea and in severe cases progressive cyanosis which is first visible as bluish discolouration of the mucous membrane and unpigmented areas of the body, coma and death.
- Rapid noisy and difficult breathing.
- Abortion in pregnant animals.

- In acute poisoning dyspnoea with violent respiratory efforts or gasping are noticed.

Postmortem Lesions

- Dark brown or coffee coloured blood which clots improperly, brown staining of tissues, congestion of the intra-abdominal organs, petechial haemorrhages on the serous surface, dilatation of the blood vessels, generalised cyanosis and blood stained pericardial fluid are common postmortem changes.

Diagnosis and Treatment

Diagnosis

- Dark chocolate coloured blood or coffee coloured blood indicates poisoning due to nitrites.
- Analysis of stomach and intestinal contents for nitrites gives a conclusive diagnosis.

Treatment

- Methylene blue intravenously at the rate of 4-8 mg/kg in cattle and sheep as a 1% solution.
- Methylene blue is an oxidising agent which is reduced to leucomethylene blue by the action of NADPH₂ - reductase.
- This leucomethylene blue converts methaemoglobin to haemoglobin.

A second dose of methylene blue is recommended after 6-8 hours. Ascorbic acid is also found to be useful.

Large doses of antibiotics can be administered orally to reduce conversion of nitrate to nitrite by the microflora of the rumen.