

Suspected nitrite poisoning in pigs caused by *Capsella bursa-pastoris* (L.) Medik. ('herderstassie', shepherd's purse)

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ABSTRACT

Nitrite poisoning in pigs was suspected when 4 of 18 pigs died in a piggery near Ellisras in the Northern Province. The pigs showed typical brownish discolouration of the blood at autopsy. It was established that they ingested vegetable tops and weeds from the adjacent garden as part of their daily ration. Of the available plants, only *Capsella bursa-pastoris* contained nitrites. The drinking water and some of the other plants tested positive for nitrates but not for nitrites. This is the first report of suspected nitrite poisoning in pigs caused by *Capsella bursa-pastoris*.

Key words: *Capsella bursa-pastoris*, nitrite poisoning, pigs.

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INTRODUCTION

Monogastric animals such as pigs do not readily succumb to nitrate poisoning, but are very susceptible to nitrite poisoning, which results from oxidation of the iron in haemoglobin to the ferric state to produce methaemoglobin. Death occurs when methaemoglobin, which has compromised oxygen-carrying capacity, reaches 80–90 % of total haemoglobin in blood⁴.

Nitrates are converted to nitrites by reductases of bacteria (for instance ruminal bacteria) or those in plants. Many plants may contain dangerous levels of nitrate. Some of the more common examples are *Amaranthus* spp., *Brassica* spp. (*Brassica rapa* L.), *Sorghum* spp. (grain sorghum), *Avena sativa* L. (oats), *Triticum aestivum* (wheat) and *Zea mays* (maize)³. However, a much wider range of species may become toxic under conditions that favour high nitrate levels and conversion of nitrates to nitrites.

Nitrate levels in plants increase under wet conditions combined with a good supply of nitrogenous fertiliser or compost. Acid soil favours nitrogen uptake and the use of phenoxy-acetic herbicides enhances the accumulation of nitrates. Plants contain their highest concentration of nitrates in the pre-flowering stage. Reductase activity in plants is favoured by

molybdenum, sulphur and phosphorus in adequate quantities. Nitrates can be reduced to nitrites when the plant material undergoes anaerobic fermentation⁴.

Suspected nitrite poisoning of pigs after

ingestion of *Capsella bursa-pastoris* (Fig. 1) is described below.

CASE HISTORY

At a small piggery near Ellisras in the Northern Province, 4 of 18 pigs died suddenly within a period of 24 h. The pigs were kept in open, brick-walled sties with a corrugated iron overhang roof providing shade and shelter.

The caretaker maintained that, although they were not in good condition, the pigs were eating well and appeared healthy the day before this incident.

The pigs received a dry feed made up of chicken litter and yellow maize with a little salt added to it. This was supplemented with green feed consisting of weeds and vegetable tops from the garden, which was fertilised with the dung and slurry washed from the pig-

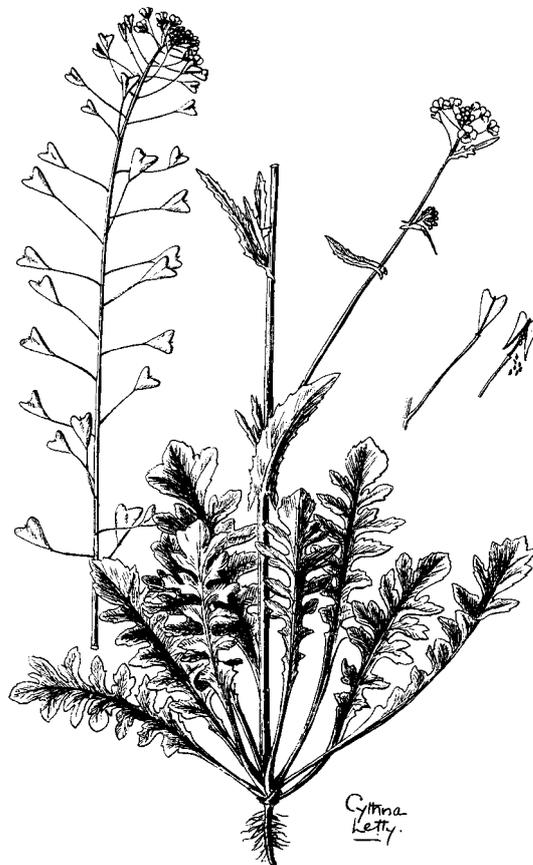


Fig. 1: A sketch of *Capsella bursa-pastoris* by Cythna Letty (courtesy National Botanical Institute)².

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Table 1: Results of tests for nitrates and nitrites.

Specimen	Nitrates	Quantity (ppm*)	Nitrites	Quantity (ppm)
Water	Positive	12760	Negative	–
<i>Spinacea oleracea</i>	Negative	–	Negative	–
<i>Brassica oleracea</i>	Negative	–	Negative	–
<i>Amaranthus</i> sp.	Positive	–	Negative	–
<i>Brassica rapa</i>	Positive	–	Negative	–
<i>Capsella bursa-pastoris</i>	Positive	8020	Positive	4630
Onderstepoort <i>Capsella</i>	Positive	100	Negative	–

*ppm = parts per million.

sties. Borehole water was used as drinking water for livestock and to irrigate the garden, while the owner and labourers obtained drinking water from the neighbours, as the borehole water had an unpleasant taste.

Post mortem examination revealed a distinct brownish discolouration of the blood, suggestive of methaemoglobinaemia. Connective tissues and muscles were also stained brown with the blood. There were no other notable macroscopical changes.

A provisional diagnosis of nitrate or nitrite poisoning was made.

Various specimens were taken for histopathology in 10 % buffered formalin. These specimens were routinely processed and stained with haematoxylin and eosin.

Specimens of the weeds and vegetables, representing the pigs' last meal, and a sample of the borehole water, were collected. The plants and water sample were tested for nitrate and nitrite content. For comparison, a *Capsella bursa-pastoris* specimen growing as a weed at the toxicology laboratory at the ARC - Onderstepoort Veterinary Institute was collected and tested for the presence of nitrates and nitrites. Nitrate and nitrite levels were determined at the ARC - Institute for Soil, Climate and Water by means of an ion chromatograph with an electrical conductivity detector.

RESULTS

Histopathology

No specific lesions were observed

during histopathological examination of sections of the liver, kidney, brain, lung and skeletal muscular tissues.

Identification of plants

Plants were identified as follows at the National Herbarium of the National Botanical Institute, Pretoria: *Amaranthus* sp. (pigweed), *Capsella bursa-pastoris* (shepherd's purse or herderstassie), *Brassica rapa* (turnip), *Spinacia oleracea* (spinach) and *Brassica oleracea* (broccoli).

Nitrate and nitrite levels in plants

Nitrate and nitrite levels in the plants are reflected in Table 1. The only plant that contained significant nitrite levels was *Capsella bursa-pastoris*. The sample of this plant from Onderstepoort, by contrast, had high nitrate levels but, like the other plants, tested negative for nitrite.

DESCRIPTION OF *C. BURSA-PASTORIS*

Shepherd's purse (Fig. 1) is indigenous to Europe. It was introduced into South Africa at the beginning of the 19th century and is now a common weed, particularly of vegetable gardens and waste ground. It is a member of the family *Brassicaceae* and grows as an annual, erect herb about 15 cm tall, branching from the base, with a thin taproot and rosettes of leaves. Stems are angled and striate, pale green to straw-coloured. Flowers are white, borne in long terminal racemes. Fruits are obcordate, emarginate, 2-valved capsules (shepherd's purse). Seeds are tiny, yel-

lowish-brown, 1 mm long, ellipsoid and grooved on each side².

DISCUSSION

The results of the analysis indicate that the pigs probably died of nitrite poisoning caused by ingestion of *Capsella bursa-pastoris*. According to Clarke *et al.*¹, pigs are more susceptible to nitrite poisoning than cattle and sheep, the minimum lethal dose of sodium nitrite being 70–75 mg per kg body mass. Ruminal bacteria that can convert nitrites to ammonia by means of a nitrite reductase enzyme enable ruminants to safely digest feeds or drinking water with higher levels of nitrates³.

This is the first report of suspected nitrite poisoning caused by *Capsella bursa-pastoris*. The rather unusual circumstances under which the plant grew, namely nitrate-rich water for irrigation, nitrogen-rich manure and slurry used as fertiliser, and probably some bacterial decomposition of the plant material, must have contributed to the concentration of nitrites in this common weed. The negative nitrite test and only 100 parts per million of nitrates in the Onderstepoort specimen of this plant, indicate that unusual circumstances are required for this plant to become toxic.

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