

## Case Report: Complex Plant Poisoning in Heavily Pregnant Heifers in Germany

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### Abstract

On a pasture five heavily pregnant heifers out of 15 animals in total developed severe apathy, haemorrhagic enteritis as well as photodermatitis both at the mouth and vulva (mortality rate 80%). The vegetation of the 3-hectare pasture was recorded at species level. Both a botanical investigation of 500 g rumen content of one heifer and a quantitative analysis of cyanides in the blood of three animals were carried out. The sward consisted of fodder plants and reed sweet grass (*Glyceria maxima*), the latter a nutritious species containing cyanogenic glycosides. The blood samples contained up to 1.56 mg cyanide/l serum. Therefore, the heifers had eaten about 7 kg reed sweet grass, slightly less than the lethal amount. Marsh horsetail (*Equisetum palustre*) growing in between, was unintentionally ingested and caused haemorrhagic enteritis. As a possible post-ingestive effect this could have evoked a positive selection of caraway (*Carum carvi*) as a remedy for stomach disorders in ruminants. 45% of the caraway population on the pasture had been grazed, one fragment having been found in the rumen. Photosensitising substances in caraway resulted in photodermatitis in the heifers. The complex finding underlined the need for an interdisciplinary approach in cases of suspected poisoning in general.

**Keywords:** Photodermatitis; Haemorrhagic enteritis; Heifer; Marsh horsetail; Reed sweet grass; Caraway

### Introduction and Case History

Poisoning with reed sweet grass (*Glyceria maxima*) of the grass family (*Poaceae*) in cattle has been described in countries where the alien species was introduced as feed plant [1]. The first case report was reported in 1946 from Tasmania cited in [1], another one in 1967 in New Zealand [2], followed by further cases in 1978 in British Columbia [3], and in 1983 in New Zealand again [1].

Reed sweet grass is a native species in Europe, typical for wet sites like swards [4]. So far, in its natural area of distribution it has never produced any problems under grazing. However, in this first case reed sweet grass plays a key role in a multiple poisoning in cattle.

On 1<sup>st</sup> May 2012, 15 heifers (Fleckvieh breed) were brought to the pasture, and some 20 days afterwards five of them fell ill within a few days. They stopped feed intake and became apathetic. Further symptoms were haemorrhagic enteritis as well as photodermatitis both on mouth and vulva. One animal died during a few days, three individuals were euthanised finally, since they did not improve, one individual survived (mortality rate 80%).

Clostridiabacteria could be ruled out because of the lack of soil contamination of the vegetation. Endoparasites in clinically relevant amounts were absent and there was no additional feeding either. Any external causes could be eliminated as well.

Consulted agriculturists examined the pasture shortly afterwards and noted that marsh horsetail (*Equisetum palustre*) of the horsetail family (*Equisetaceae*) had been grazed by the young cows to a great extent. Since this plant species and its toxin palustrin is known to provoke diarrhoea in ruminants [5] the farmer assumed that the symptoms were due to the intake of horsetail and fenced the swamp off.

However, it remained unclear (1) why the animals had fed on a plant which they normally avoid [5], (2) why the symptoms included both severe apathy and photodermatitis, and (3) why heifers, all well advanced in pregnancy, were exclusively affected.

### Material and Methods

The 3 hectare pasture in the hilly countryside of southern Germany (State Hessen) was on a slope with a small swamp at the bottom.

Some three weeks after grazing, on 14<sup>th</sup> June 2012, estimation of the biomass of each plant species [%] in the whole vegetation [100%] on 1 m<sup>2</sup> took place. This selected square metre was supposed to be as representative as possible for the whole vegetation of the slope and swamp, respectively. In addition, the number of horsetail plants on 1 m<sup>2</sup> of the swamp were counted as well as the number of present and grazed plant species within a transect of 4 m width throughout the whole pasture.

The food examination covered both a Weender Analysis of fresh reed sweet grass and a botanical investigation of 500 g rumen content of one heifer. This individual had spent several days in the stable before it was put down.

Blood samples were taken from three out of the five ill heifers. The quantitative detection of cyanogenic compounds in the blood took place as a routine lab analysis.

### Results

#### Flora and vegetation

The slope of the pasture covered a species-rich vegetation with

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meadow foxtail (*Alopecurus pratensis*; 25%) and several other typical European fodder grasses of the grass family (Table 1). In contrast, the swamp at the bottom was dominated by reed sweet grass (70%), interspersed with 75 individuals/m<sup>2</sup> of marsh horsetail (5%; Figure 1).

### Grazing

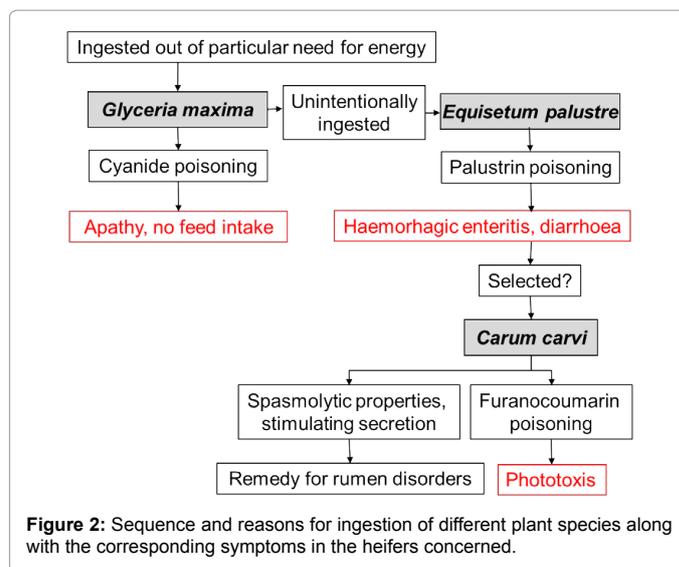
Grazing still continued during the field work (Figure 1). Except for meadow buttercup (*Ranunculus acris*) of the buttercup family (*Ranunculaceae*), all plant species on the slope were more or less heavily

Common name	Plant species	Slope	Swamp
Meadows foxtail	<i>Alopecurus pratensis</i>	25	
Common ryegrass	<i>Lolium perenne</i>	20	
Yorkshire fog	<i>Holcus lanatus</i>	10	
Cat's tail	<i>Phleum pratense</i>	10	
Meadow grass	<i>Poa pratensis</i>	5	
Caraway	<i>Carum carvi</i>	5	
Cock's foot	<i>Dactylis glomerata</i>	5	
Creeping bent	<i>Agrostis stolonifera</i>	10	
White clover	<i>Trifolium repens</i>	1	
Reed sweet grass	<i>Glyceria maxima</i>		70
Marsh horsetail	<i>Equisetum palustre</i>		
Common rush	<i>Juncus effusus</i>		
Marsh meadow grass	<i>Poa palustris</i>		
Tall fescue	<i>Festuca arundinacea</i>		2
Common yarrow	<i>Achillea millefolium</i>	1	1
Meadow fescue	<i>Festuca pratensis</i>	1	
English plantain ribwort	<i>Plantago lanceolata</i>	1	
Meadow buttercup	<i>Ranunculus acris</i>	1	
Bulbous buttercup	<i>Ranunculus bulbosus</i>	1	
Creeping buttercup	<i>Ranunculus repens</i>	1	
Curley dock	<i>Rutnax crispus</i>	1	
Dandelion	<i>Taraxacum officinale</i>	1	
Stinging nettle	<i>Urtica dioica</i>	1	
Meadow sweet	<i>Filipendula ulmaria</i>		1
Greater bird's foot trefoil	<i>Lotus uliginosus</i>		1
	<b>Yield [%]1</b>	<b>100</b>	<b>100</b>

**Table 1:** Estimated biomass (relative percentage [%] of the total biomass [100%]) in the two areas of the pasture (14.06.2012).



**Figure 1:** State of the vegetation on the wet area (left) and the slope (right) some three weeks after grazing. Between densely growing reed sweet grass some horsetail plants are growing (two examples marked with arrows; 14.06.2012).



**Figure 2:** Sequence and reasons for ingestion of different plant species along with the corresponding symptoms in the heifers concerned.

grazed. In detail, 46 out of 101 individuals of caraway (*Carum carvi*) of the umbel flower family (*Apiaceae*) had been eaten (45%). The cuts were already dried up, but clearly visible. In contrast, no evident signs of grazing on plant species in the swampy enclosure were apparent. At this spot the vegetation was already fully regenerated at the time of the survey.

### Rumen content

Except for some tissue (parenchyma) the rumen contained fibres of grasses and one fragment of the stem of caraway. Since these findings did not explain the multiple symptoms, we assumed another phytotoxin. From all plants at the site only reed sweet grass was known to be toxic due to its cyanogen glycosides [1-3,6]. Thus, if the heifers had ingested reed sweet grass (not visible any more in the regenerated grasses), then traces of cyanogenic compounds should have been detectable in the serum. This was checked, and indeed, all three blood samples turned out to be positive. They contained 0.17, 0.29, and 1.56 mg cyanide/l serum, respectively.

### Discussion

The case represents a sequence of single symptoms that appear at once due to the ingestion of three plant species (reed sweet grass, marsh horsetail, caraway) within a relatively short time (Figure 2).

### Reed sweet grass

Starting point was the intake of reed sweet grass by the heifers, ingested out of particular need for energy. Adapted to wet sites this grass species possesses broad, fleshy leaves and forms lush vegetation that reaches a height of some 200 cm [7]. Also due to its low fibre (3.89%) and high protein content (6.46%) with a dry matter content as low as 23.2% it represents an attractive food before flowering. However, the grass exhibits its highest concentration of cyanogenic glycosides up to 4.3 mg/g DM [6] at that time. The detoxification capacity of cyanide in ruminants [8] collapses when 7-9 kg of fresh grass is ingested [2]. Since the relative biomass on the swamp is about threefold higher than on the slope (cf. Figure 1, left and right), the heifers-in particular need of energy in their advanced state of pregnancy [9] - were able to consume a lot of fodder within a short time. Cyanide causes the cattle to stagger and to be unable to rise [3]. The lethal dose is >0.1 mg/l blood [3]. The figures between 0.17 and 1.56 mg/l presented here correspond to the

severe apathy with no regeneration as well as to the high mortality rate. The variables (1) particularly hungry animals, (2) lush vegetation, (3) fast consumption and (4) toxic contents made it plausible as to why only these five heifers fell ill, showing symptoms of cyanide poisoning, and none of the other ones.

### Marsh horsetail

Inevitably, the heifers ingested not only reed sweet grass but marsh horsetail, too, which was growing in between with a relative biomass of 5%. Thus, they had no choice to avoid a plant that cattle normally do otherwise. The haemorrhagic enteritis that the young cows developed, *i. e.* the symptoms of palustrin poisoning, is congruent to symptoms in a feeding trial: Cattle reacted to 34.7 g TS marsh horsetail/100 kg BM/d with diarrhoea [5].

The absence of marsh horsetail in the stomach goes back to the fact that its content was not equivalent to what the animal had been grazing. As mentioned, it had spent several days in the stable afterwards. Thus, it was surprising to have detected at least one piece of caraway.

### Caraway

Both the presence of caraway in the rumen and the significant grazing of this plant on the pasture (45%) in the past (no fresh cuts) proves the ingestion by the heifers. The plant contains traces of furanocoumarins like 5-methoxypsoralen that may act as photosensitising substances [10]. Additionally, caraway is the only ingested species in this vegetation capable of causing photodermatitis. In contrast, experimental data on grazing and hay feeding [11] show that caraway with its carminative, spasmolytic properties [10] “was found to be a protectant against stomach disorders” [11]. This suggests that the severe haemorrhagic enteritis due to the ingestion of marsh horsetail could have led to a kind of post-ingestive effect [12] which made the sick animals select caraway in large amounts. However, along with that they gathered large amounts of photosensitising substances, too, leading to furanocoumarin poisoning.

### Conclusion

The affected heifers started to feed on reed sweet grass after they had already spent more than three weeks on the site. Thus, animals can

live on a typical pasture given they receive enough energy from the vegetation. This had been so for years in this particular case. The farmer reported that he usually brought all heavily pregnant heifers back to the stable. However, in this instance he did not.

Luckily, the veterinarians doubted that marsh horsetail caused all of the aforementioned symptoms. In fact, multiple plant poisoning occurred. The initial ingestion of reed sweet grass led unintentionally to an ingestion of marsh horsetail that in turn could have evoked a deliberate ingestion of caraway. The complex finding of three distinct symptoms underlines the need for an interdisciplinary approach in cases of suspected poisoning in general.

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