

## Suspected Iron Toxicity in Dairy Cattle

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**Abstract:** Seven dairy cattle died in a farm in İvrindi, Balıkesir, Turkey. Local veterinary practitioner reported that all affected animals showed anorexia, depression, orange-yellow discoloration of buccal mucosa and lips, abdominal pain and dyspnoea. Postmortem lesions were orange-yellow discoloration of blood and all tissues, dark and degenerate liver, dark and oedematous kidneys.

All feed and feed materials of dairy cattle were analysed for iron. High level (1992 mg/kg) of iron was detected in commercial dairy feed additive. Iron toxicities in dairy cattle by oral route are very rare and we could not find any published report. In this case, historical and clinical signs, postmortem findings and the detection of high level of iron in the feed additive supported a diagnosis of subacute to/or chronic iron toxicity in dairy cattle by oral route.

**Key Words:** Dairy cattle, Feed additive, Oral route, Toxicity.

## Süt Sığırlarında Demirle Şüpheli Zehirlenme

**Özet:** Balıkesir İvrindi’de bir çiftlikte ölen 7 süt sığırında başlangıçta iştahsızlık, depresyon, dudak ve ağız içi mukozalarının portakal sarısı renkte olduğu, karın ağrısı, dispne ve sonrasında ölüm görüldüğü lokal veteriner hekim tarafından bildirildi. Nekropside, kan ve tüm dokuların portakal sarısı renkte, karaciğerin koyu renkte ve dejenere olduğu, böbreklerin koyu renkte ve ödemli oldukları belirtildi.

Süt sığırlarının tüm yem ve yem hammaddelerinin demir miktarları analiz edildi. Süt yemi katkısında yüksek düzeyde (1992 mg/kg) demir tespit edildi. Süt ineklerinde oral yolla ve demir ile zehirlenme çok nadir görülür ve bu konuda basılmış bir yayın bulunamadı. Bu olayda, anemnez ve klinik belirtiler, nekropsi bulguları ve süt yemi katkısında yüksek miktarda demir tespit edilmesi süt sığırlarında oral yolla subakut veya kronik bir zehirlenmeyi desteklemektedir.

**Anahtar Kelimeler:** Süt ineği, Süt Yemi Katkısı, Oral Yol, Zehirlenme.

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## Introduction

Iron poisoning is usually the result of excess iron being injected or given orally to the neonatal animal or accidental consumption of iron supplements<sup>6</sup>. About 70% of the iron in mammals is found in haemoglobin, and about 5% to 10% is found in myoglobin. When bound to haemoglobin and myoglobin, iron is in the ferrous ( $\text{Fe}^{+2}$ ) form. Up to 25% of iron in the body is in the ferric ( $\text{Fe}^{+3}$ ) form and is stored in hemosiderin, ferritin, and transferrin in the liver, spleen, and bone marrow<sup>1</sup>. Absorbed iron is carried in the serum by transferrin. When the dose is excessive then the binding capacity of the transferrin is exceeded and serum iron concentration rises rapidly. At the cellular level, excessive iron is a protoplasmic poison capable of inactivating metabolic oxidative enzymes. A severe metabolic acidosis occurs and the main clinical picture is profound shock<sup>6</sup>.

All animals are potentially susceptible to iron poisoning. Cattle and sheep have been killed by excessive dosing with ferric ammonium citrate and other iron preparations<sup>6</sup>. Apparently two syndromes are involved. Firstly, a peracute syndrome characterized by sudden death within a few minutes to hours after iron injection. This resembles an anaphylactic reaction, however the triggering mechanism is unknown. Secondly, a subacute syndrome is characterized by death accompanied by severe depression and coma. This syndrome is related to direct toxic effects of the iron resulting from overdosage. Oral dosages greater than 150 mg/kg, body weight (bw) are considered excessive and may lead to iron poisoning<sup>6</sup>.

In general, subacute and chronic iron poisoning by oral route is not clear, especially for cattle. In our case, appropriate history, clinical signs and some postmortem findings in affected and death cattle related to iron poisoning. These suspected deaths of seven cattle prompted us to investigate the causal agent in the cases. In the literature, to our best knowledge we could not find sufficient information about iron poisoning related deaths by oral route in cattle. Therefore, we aimed to describe suspected iron poisoning in cattle by oral route with the clinical signs, macroscopic postmortem and toxicological findings in this case.

## Materials and Methods

### Case Report

The farmer, who has a total of 25 Holstein cattle (13 dairy cows, 1 heifer, 8 calf and 3 un-

weaned calf) referred to the Faculty of Veterinary Medicine, Uludag University due to deaths of three dairy cattle (two dairy cows and one heifer) and four dairy cows on 17th July and 26th July 2007, respectively. The farm was in Ivrindi, Balikesir, Turkey.

The animals got dairy feed, a commercial feed additive to improve milk yield, wheat bran and corn silage, which were sampled by us for further investigation. All feed and feed materials had been purchased from same manufacturer except the commercial feed additive. The commercial feed additive had been changed by the farmer 2.5 months ago, and only the dairy cattle and heifers had been fed with it 150-200g per day.

Local veterinary practitioner reported that all affected animals showed anorexia (first three days animals were eating very little, and in the fourth and fifth days they could not eat anything and they began recumbent), and at those days depression, orange-yellow discoloration of buccal mucosa and lips, abdominal pain, dyspnoea and death occurred. Postmortem lesions were orange-yellow discoloration of blood and all tissues, dark and oedematous kidneys, dark and degenerate livers.

Appropriate history, clinical signs and postmortem findings in death cattle seemed to relate to iron poisoning, so all feed samples including dairy cattle concentrated feed, the commercial feed additive, wheat bran and corn silage were analysed by flame atomic absorption spectrometer (FAAS) (Perkin Elmer, Analyst 800, Shelton, USA) for iron content using manufacturer's method<sup>7</sup>.

Iron was detected in the commercial feed additive, dairy cattle feed (concentrate feed), wheat bran and corn silage, and detected iron concentrations were 1992 mg/kg, 143 mg/kg, 100 mg/kg and 64 mg/kg, wet weight, respectively. Iron analysis in blood and other organs is important for the diagnosis of iron poisoning. However, iron analysis in the dead animals was not completed because we could not take the samples at the time.

## Discussion

Iron poisoning generally occurs when excess iron is injected or given orally to the animal. There is scanty information on orally subacute and chronic iron poisoning in most domestic animals including cattle. Usually, in dogs, pigs and horses, clinical signs are vascular collapse, and they die rapidly within a few hours

in peracute shock syndrome<sup>1</sup>. In the subacute syndrome, clinical signs can include depression, vomiting<sup>2,3,6</sup>, orange-yellow discoloration of buccal mucosa and lips<sup>3,6</sup>, diarrhoea<sup>2,3</sup>, hematemesis, bloody stool, abdominal pain, muscle tremors<sup>2</sup> followed by a period of an apparent improvement. This is followed by cardiovascular collapse and death. In calves, clinical signs are trembling, vocalizing, bruxism, colic, and convulsions<sup>8</sup>. Postmortem findings can include dark and oedematous kidneys, dark and degenerate liver<sup>6,9</sup>, orange-yellow discoloration of blood and all tissues, oedema and erosions, progressing to ulceration of the stomach<sup>3,6</sup>, damaged vascular epithelium leads to the development of oedema, which can occur at any site<sup>2</sup>. Histological lesions can include cellular swelling and necrosis of the mucosal epithelial cells, myocardial cells, vascular epithelium, and hepatocytes. Vascular leaking and haemorrhage are also observed<sup>2</sup>.

Although iron poisoning in cattle are not clear, generally, clinical findings such as depression, orange-yellow discoloration of buccal mucosa and lips, abdominal pain in affected dairy cattle and macroscopic findings including orange-yellow discoloration of blood and all tissues, dark and oedematous kidneys, dark and degenerate livers observed. These findings in blood, all tissues, kidneys and livers could be attributed to iron poisoning<sup>2,3,6,8,9</sup>.

The deaths were observed only in dairy cattle (cows and heifers) on the farm. The commercial feed additive source had been changed 2.5 months ago, and only the dairy cattle had been fed with the changed commercial feed additive. Therefore, the iron level of this commercial feed additive was important to us and its iron level was found to be very high (1992 mg/kg). Additionally, when checked the quality of the feed additive, it was false and mislabelled.

The NRC<sup>5</sup> indicates the dietary iron level as 50 mg/kg, dry basis for dairy cattle diet. The dietary iron concentration we have found (approximately 350 mg/kg, dry matter (DM)) in cattle's diet was higher than this level, which may indicate that the additional iron consumed for 2.5 months (the time when the adulterated high iron feed additive was fed) may have lead to subacute to chronic iron poisoning in these cattle.

Osweiler et al.<sup>6</sup> reported that oral dosages greater than 150 mg/kg, bw of iron are considered excessive and may lead to acute poisoning. We can extrapolate from this report that approximately 7500 mg iron in diet may lead to poisoning in a 500 kg cattle. Also, our calcula-

tions indicated that the iron content in daily diet of dead cattle was approximately 2500 mg. Another perspective from National Research Council (NRC)<sup>4</sup> recommended that the dietary iron should not exceed 1000 mg/kg DM in feed of dairy cattle for iron poisoning. Based on this literature, we found that the dietary iron was approximately 350 mg/kg as DM in the feed of cattle in our case. In either of the information given by Osweiler et al.<sup>6</sup> and NRC<sup>4</sup>, in these levels, they indicate acute iron poisoning in dairy cattle. Although the iron level determined in this case seem to be approximately 1/3<sup>rd</sup> of the indicated values by Osweiler et al.<sup>6</sup> and NRC<sup>4</sup>. It should be kept in mind that our cases better fit for subacute to chronic iron poisoning.

In this case, appropriate history, clinical signs, postmortem findings, and demonstration of high levels of iron in the diet support a diagnosis of subacute to/ or chronic iron poisoning in the dairy cattle.

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