Stiftung Tierärztliche Hochschule Hannover
University of Veterinary Medicine Hannover, Foundation

Suspected iron overload syndrome in a black rhino – how to approach the case?

Residency Class

15th – 16th September 2020

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Preliminary report:

Black Rhinoceros (Diceros bicornis)

♂,~1500 kg, at the time of request 10 years old , kept in an European Zoo

Keeping: indoor area (rubber flooring) and outdoor enclosure (floor covering: sand)

Diet:

- alfalfa hay (20 kg), pellets for browsing species (6 kg), vegetables and fruits (6 kg), mineral supplement for cattle
- free access to water, a salt-lick-stone and mineral licks (NaCl, Cu, I)
- if available supplemented with branches
- offered mainly in the indoor area, but fruits and vegetables are also offered in the outdoor enclosure from the floor during commented feeding

Symptoms: without any clinical sign

Blood test: hemolytic anemia, serum bilirubin, iron and liver enzymes elevated

Suspected diagnosis: hemosiderosis/hemochromatosis?

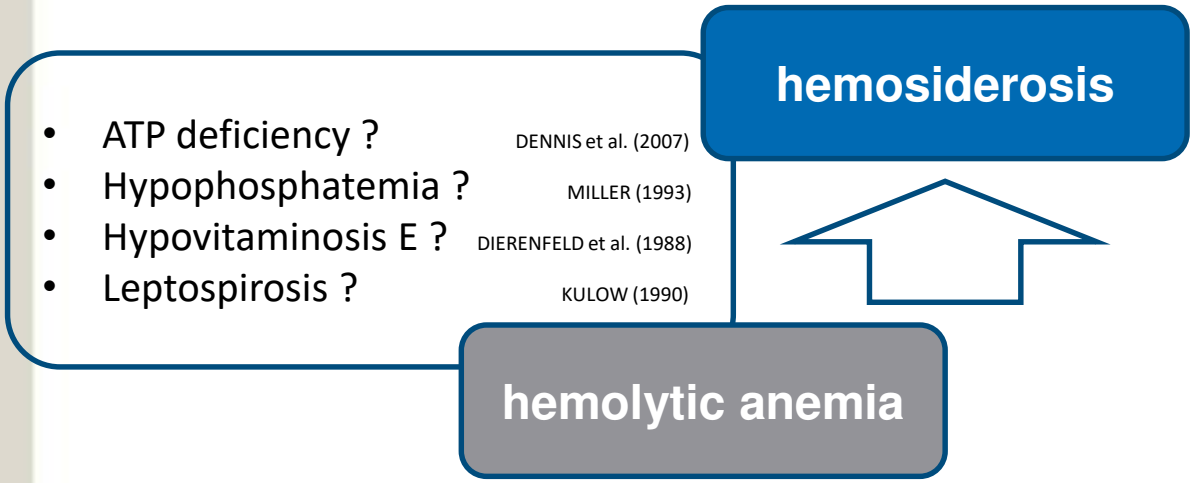
Backround

Necropsy reports of black rhinoceroses dying in captivity have frequently cited **hemosiderosis** as residual **evidence of hemolytic anemia**, a disorder of high morbidity and mortality in this species.

PAGLIA a. DENNIS (1999)

Cause of hemolytic anemia syndrome in captive black rhinos **is not known**.

DENNIS et al. (2007)



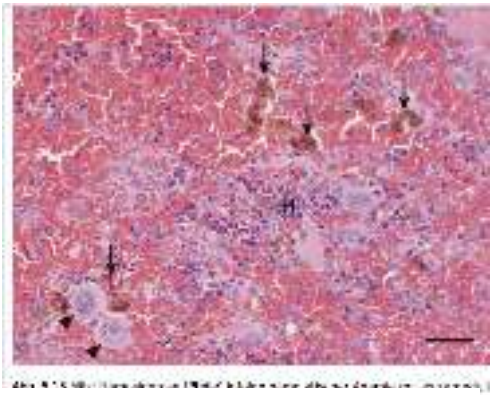
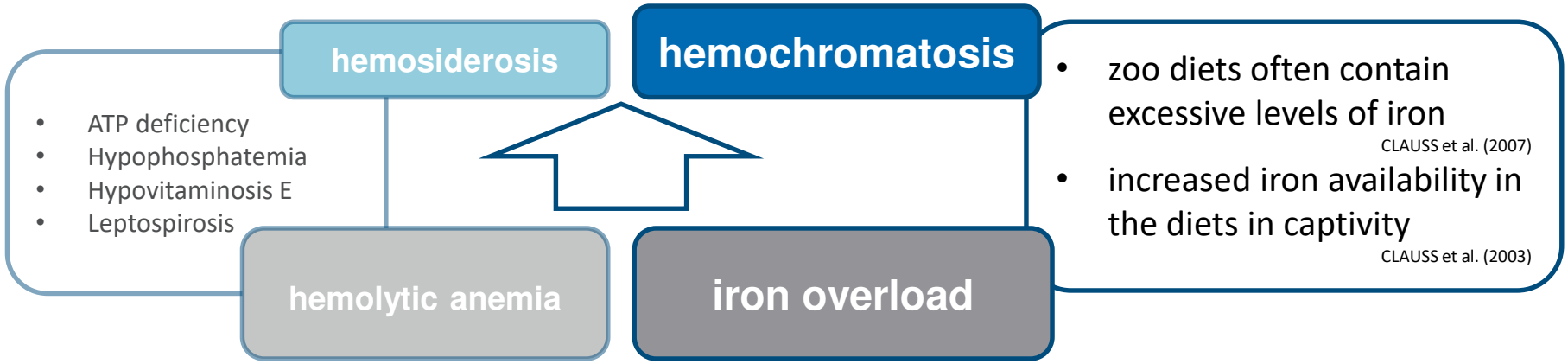


Figure: Allgemeine Pathologie für die Tiermedizin

Backround

Iron accumulates as a consequence of captive conditions and in direct relation to time in captivity, producing an acquired **hemochromatosis**. Species that normally forage predominantly on **browse are most at risk** for development of hemochromatosis in captivity.

PAGLIA a. DENNIS (1999)



Preliminary report:

A zoo diet with a high iron content might explain a case of hemochromatosis.

⇩

Request to the Institute of Animal Nutrition:

1. detection of the main source of iron intake (evaluation of the iron content in the present diet, etc.),
2. if necessary: correction via a new dietary concept

Demands:

Alfalfa hay should remain the main component of the diet fed to the black rhinoceros (high palatability, welcome protein and Ca source).

Examinations/Analysis

Table: Iron content of the present diet offered to the black rhinoceros

	ME (MJ/kg diet)	Fe (mg/kg DM)	Offered amount (kg)		Fe (mg)
				in DM	
Pellets for Browser[1] (DM= 883g/kg diet)	10.1[2]	333	6.00	5.30	1765
Alfalfa hay[1] (DM= 878g/kg diet)	7.20[3]	322	18.0*	16.8	5410
Vegetables (carrots[3], fennel, iceberg lettuce, celery, chicory) (DM= 110g/kg diet)	1.62	35.4	6.00	0.660	23.4
Fruits (apple[3], banana) (DM= 160g/kg diet)	2.23	15.6	6.00	0.960	15.0
Sum	213 MJ		36.0	22.7	7213
Intended	193 MJ (0,8 MJ/kg $BW^{0,75}$)[4]	50-100[5]		22.5 (1,5 % of BW in kg)[4]	1135-2270

Diet is supplemented with Mineral Supplement for Cattle, salt-lick-stone, mineral licks (NaCl, Cu, I) frequently and branches irregulary;
[1] measured values in the Institute of Animal Nutrition; [2]quoted from declaration; [3] Kamphues et al. (2014); [4]Castell (2005); [5]Clauss et al. (2012)
*calculated value with the help of dry matter intake of *Diceros bicornis*, see footnote 4

Table: Iron content of hazel branches and sandy soil in the outdoor enclosure

	DM (g/kg diet)	**Fe** (mg/kg DM)
Hazel branches	837	113
Floor covering: sandy soil	845	12412

Amount of adhering sand particles on sliced fruits and vegetables ?

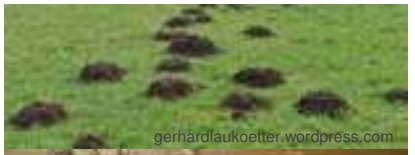
Amount of sand intake during feeding from the sandy soil ?

Availability of mineral iron from different sources (sand) ?

Approaches to reduce iron intake with the offered diet

feedstuffs for fattening calves (iron) ↓

harvesting technology (avoiding cont. by soil)



Iron source in feedstuffs/water

- original iron content
- contamination with soil rich in iron !
- iron abrasion of used equipment during feed processing
- relative content of iron raises with decreasing organic matter during ensiling
- Water (mg/kg only)?

Table: Iron content of dried beet pulp and pelleted dried beet pulp

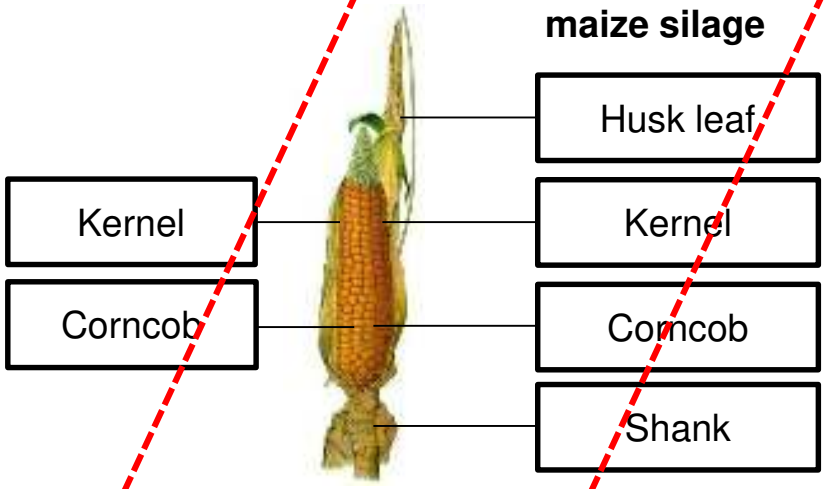
	DM (g/kg diet)	Fe (mg/kg DM)
dried beet pulp	894	49.8
pelleted dried beet pulp[1]	951	374

[1] Warzecha (2006)

Iron overload syndrome in a black rhino – how to deal with cases like that ?

Corn-Cob-Mix (CCM)

ear and husk meal maize silage



whole maize plant as silage or as dried, pelleted ingredient

straw (dedusted)

CF (g/kg DM)	54[2]	110[3]	220[1, 2]	434[2]
starch + sugar (g/kg DM)	630[2]	480[3]	295[1, 2]	-
iron (mg/kg DM)	32[4]	46[3]	102[3]	67[3]

[1] milk ripeness stage, amount of ears < 25 %; [2] Kamphues et al. (2014); [3] measured values in the Institute of Animal Nutrition; [4] Deutsches Maiskomitee e.V.

„concentrate“

silages are not accepted by zoo employees

pelleted entire maize plant

maximum intake by the Rhino	**-**	**1.5 kg**	**2.0 kg**

Artificially dried alfalfa hay ≠ field dried alfalfa hay

- Lower desintegration losses
- Independence of the weather

➢ Hypothesis: no hay tedding = less contamination with soil and therefore lower iron content in the dried product **?**

Table: Iron content of alfalfa hays produced differently

Alfalfa hay	DM (g/kg diet)	Fe (mg/kg DM)
field dried	878	322
art. dried, product 1	890	74.3
art. dried, product 2	877	65.9
remind iron content of the pelleted entire maize plant		102

Approaches to reduce iron intake with the offered diet

1. **feedstuffs for fattening calves (iron ↓)**

2. **harvesting technology (avoiding cont. by soil)**

dedusted straw
artificially dried alfalfa hay

Table: Iron content of the adjusted diet, 200 g commercial, iron free horse mineral added

	ME (MJ/kg diet)	Fe (mg/kg DM)	Offered amount (kg)		Fe (mg)
				in DM	
Pellets for Browser[1] (DM= 883g/kg diet)	10.1[2]	333	3.00	2.60	866
Alfalfa hay[1] **(artificially dried)** (DM= 878g/kg diet)	7.20[1]	74.2	19.0*	16.7	1239
Dedusted straw[1] (DM = 901/kg diet)	3.80[1]	47.3	2.00	1.80	85.1
Vegetables (carrots[3]) (DM= 110g/kg diet)	1.62	35.4	6.00	0.660	23.4
Fruits (apple[3], banana) (DM= 160g/kg diet)	2.23	15.6	6.00	0.960	15.0
Sum	198 MJ		36.0	22.7	2229
Intended	193 MJ (0,8 MJ/kg $BW^{0,75}$)[4]	50-100[5]		22.5 (1,5 % of BW in kg)[4]	1135-2270

[1] measured values in the Institute of Animal Nutrition; [2]quoted from declaration; [3] Kamphues et al. (2014); [4]Castell (2005); [5] Clauss et al. (2012)
*calculated value with the help of dry matter intake of *Diceros bicornis*, see footnote 4

Conclusions and Recommendations

Iron contents in the ingredients/ diets/ the whole ration is of primary interest due to the species-specific high susceptibility of black rhinos regarding hemosiderosis/hemochromatosis.

1. Use of artificially dried alfalfa hay instead of field dried alfalfa hay
2. Don‘t offer feed from sandy floor?
3. Look for browser pellets with adequate iron content

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