

Developing a black rhino diet for Zurich Zoo

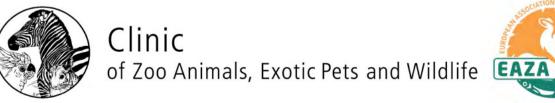
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EAZA Acadmey Liberec 2017









Iron storage disease a problem in black rhinos

Journal of Zoo and Wildlife Medicine 43(3): S92-S104, 2012 Copyright 2012 by American Association of Zoo Veterinarians

REVIEW OF LABORATORY AND NECROPSY EVIDENCE FOR IRON STORAGE DISEASE ACQUIRED BY BROWSER RHINOCEROSES

Donald E. Paglia, M.D., and I-Hsien Tsu, M.S.



- Iron storage disease a problem in black rhinos
- Zoo diets differ from natural diets (less fibre, more iron, less tannins, less PUFA)

Comparison of the chemical composition of the diet of three free-ranging black rhinoceros (*Diceros bicornis*) populations with zoo diets

S. F. Helary¹, N. Owen-Smith¹, J. A. Shaw¹, D. Brown, D. Hattas²



- Iron storage disease a problem in black rhinos
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Comparison of the chemical composition of the diet

Journal of Zoo and Wildlife Medicine 43(3): S48-S54, 2012 Copyright 2012 by American Association of Zoo Veterinarians

S. F. BLACK RHINOCEROS (DICEROS BICORNIS) NATURAL DIETS:
COMPARING IRON LEVELS ACROSS SEASONS AND
GEOGRAPHICAL LOCATIONS

Stephane F. Helary, med.vet., M.Sc., Joanne A. Shaw, Ph.D., Derek Brown, Marcus Clauss, M.Sc., Dr.med.vet., Dipl. E.C.V.C.N., and Norman Owen-Smith, Ph.D.



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Of three free-ranging black rhinoceros (Diceros Journal of Zoo and Wildlife

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S. F. BLACK RHINOCEROS (DICEROS BICORNIS) NATURAL DIETS:
COMPARING IRON LEVELS ACROSS SEASONS AND
GEOGRAPHICAL LOCATIONS

Stephane F Dr.med.vet

ORIGINAL ARTICLE

Mineral absorption in the black rhinoceros (*Diceros bicornis*) as compared with the domestic horse

M. Clauss¹, J. C. Castell², E. Kienzle², P. Schramel³, E. S. Dierenfeld⁴, E. J. Flach⁵, O. Behlert⁶, W. J. Streich⁷, J. Hummel^{6,8} and J-M. Hatt¹



- Iron storage disease a problem in black rhinos
- Zoo diets differ from natural diets (less fibre, more iron, less tannins, less PUFA)





- Iron storage disease a problem in black rhinos
- Zoo diets differ from natural diets (less fibre, more iron, less tannins, less PUFA)
- Tannins (as in natural diet) act as iron chelators

Journal of Zoo and Wildlife Medicine 43(3): S74-S82, 2012 Copyright 2012 by American Association of Zoo Veterinarians

PLANT PHENOLICS AND THEIR POTENTIAL ROLE IN MITIGATING IRON OVERLOAD DISORDER IN WILD ANIMALS

Shana R. Lavin, M.S., Ph.D.



- Iron storage disease a problem in black rhinos
- Zoo diets differ from natural diets (less fibre, more iron, less tannins, less PUFA)
- Tannins (as in natural diet) act as iron chelators
- Tannins without apparent adverse (but some positive) effects in feeding trials

DOI: 10.1111/j.1439-0396.2006.00673.x

ORIGINAL ARTICLE

The influence of dietary tannin supplementation on digestive performance in captive black rhinoceros (*Diceros bicornis*)

M. Clauss¹, J. C. Castell², E. Kienzle², E. S. Dierenfeld³, E. J. Flach⁴, O. Behlert⁵, S. Ortmann⁶, W. J. Streich⁶, J. Hummel^{5,7} and J.-M. Hatt¹



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ORIGINAL A

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M. Clauss¹, J. W. J. Streich⁶ J. Vet. Med. A **53**, 319–322 (2006) © 2006 The Authors Journal compilation © 2006 Blackwell Verlag, Berlin ISSN 0931–184X

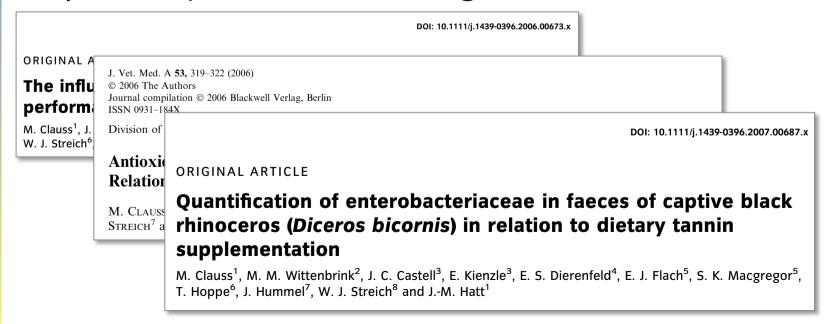
Division of Zoo Animals, Exotic Pets and Wildlife, Vetsuisse Faculty, University of Zurich, Switzerland

Antioxidant Status of Faeces of Captive Black Rhinoceros (*Diceros bicornis*) in Relation to Dietary Tannin Supplementation

M. Clauss^{1,8}, N. Pellegrini², J. C. Castell³, E. Kienzle³, E. S. Dierenfeld⁴, J. Hummel⁵, E. J. Flach⁶, W. J. Streich⁷ and J.-M. Hatt¹

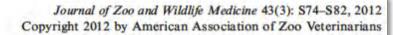


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- Zoo diets differ from natural diets (less fibre, more iron, less tannins, less PUFA)
- Tannins (as in natural diet) act as iron chelators
- Tannins without apparent adverse (but some positive) effects in feeding trials
- => what tannin source should we use?





PLANT PHENOLICS AND THEIR POTENTIAL ROLE IN MITIGATING IRON OVERLOAD DISORDER IN WILD ANIMALS

Shana R. Lavin, M.S., Ph.D.

Specifically,

it is recommended to compare palatable, 14,16 low-cost, and commercially available products in terms of relative affinities for iron to determine if an appropriate dietary supplement exists for minimizing iron absorption in wild animals sensitive to IOD. Potential sources of phenolic supplements include grape pomace



Animal Physiology and Animal Nutrition

DOI: 10.1111/jpn.12587

ORIGINAL ARTICLE

Black rhinoceros (Diceros bicornis) and domestic horse (Equus caballus) hindgut microflora demonstrate similar fermentation responses to grape seed extract supplementation in vitro

N. F. Huntley¹, H. D. Naumann², A. L. Kenny¹ and M. S. Kerley¹

Grape seed extract was found to be an effective iron chelator, and supplementation in black rhinoceros diets up to 4% of DM is unlikely to adversely affect macronutrient hindgut digestibility or microbial viability and fermentation. In vivo trials are needed to determine supplementation levels necessary to limit iron absorption and tissue accumulation in captive black rhinoceros.



Aims

- Readily available source of tannins -> red grape pomace
- forage base (also good for PUFA) -> lucerne meal or grass meal
- low iron components -> excludes grass meal
- use fermentable fibre rather than starch -> beet pulp
- no iron added





Nashorn und andere Pflanzenfresser Rhinocéros et autres herbovores Rhinoceros and other herbivores

Ergänzung Complément Supplement

Zoo-Nashornpellets | Pellets pour rhinocéros de zoos | Pellets for rhinoceros in zoos

Inhaltsstoffe Substances Major Nutrients		Rohstoffe Ingrédients Ingredients
rockensubstanz Matière sèche Dry matter	90.0 %	Luzernemehl, Traubentrester, Rübenschnitzel, Melasse, Weizenkleie
Rohprotein Protéines brutes Crude protein	13.5 %	Hafer, Sojaextraktionsschrot (NGVO), Mais (NGVO), Mineralstoffe, Vita-
Rohfett Graisses brutes Crude fat	2.8 %	mine
Rohfaser Fibres brutes Crude fiber	21.0 %	
Rohasche Cendres brutes Crude ash	10.0 %	Farine de luzerne, marc de raisins, pulpe de betterave, mélasse, sor
NFE ENA NFE	42.7 %	de blé, avoine, tourteau d'extraction de soja (sans OGM), maïs (sans
Bruttoenergie Energie brute Gross energy	14.8 MJ/kg	OGM), substances minérales, vitamines
Verdaubare Energie Energie digestible Digestible		Alfalfa, grape pomace, beet pulp, molasses, wheat middlings, oats
Stärke Amidon Starch	2.0 %	soybean meal (NGMO), corn (NGMO), minerals, vitamins
Aminosäuren Acides aminés Amino acids		Bemerkungen Remarques Remarks
		- Eisenreduziertes Ergänzungsfuttermittel für Dickdarmverdauer und
Arginin Arginine Arginine	0.65 %	andere Pflanzenfresser
Lysin Lysine Lysine	0.60 % 0.18 %	- Angegebene Gehalte sind berechnete Mittelwerte bezogen auf luft-
Methionin Méthionine Methionine		trockene Substanz
Methionin + Cystin Méthionine + cystine Methioni		- NDF: 33.8 %
Tryptophan Tryptophane Tryptophan Threonin Thréonine Threonine	0.15 % 0.46 %	- ADF: 24.7 %
	X50000000	- Aliment complémentaire, pauvre en fer, pour animaux, dont la fer-
Mengenelemente Macro-éléments Major	mineral elements	mentation se fait dans le gros intestin et autres herbivores
Calcium Calcium Calcium	0.85 %	- Les teneurs indiquées sont des valeurs moyennes se rapportant à la
Phosphor Phosphore Phosphorus	0.65 %	matière séchée à l'air
Magnesium Magnésium Magnesium	0.25 %	- NDF: 33.8 %
Natrium Sodium Sodium	0.95 %	- ADF: 24.7 %
Kalium Potassium Potassium	1.45 %	
Chlor Chlore Chlorine	1.15 %	 Low iron supplementary animal feed for hindgut fermenters and other herbivores
Spurenelemente Oligo-éléments Trace el	ements	- Given values are calculated averages in air-dry feed
Eisen Fer Iron	400 mg/kg	- NDF: 33.8 %
Zink Zinc Zinc	175 mg/kg	- ADF: 24.7 %
Kupfer Cuivre Copper	34 mg/kg	Bestellform Conditionnements Delivery form
Jod lode lodine	1.20 mg/kg	
Mangan Manganèse Manganese	42 mg/kg	Pellets 8 mm rund Pellets ronds 8 mm Pellets 8 mm round
Selen Sélénium Selenium	0.35 mg/kg	3695.PD.S25:
Wa		25 kg in Papiersäcken
Vitamine Vitamines Vitamins		25 kg en sacs en papier
Vitamin A Vitamine A Vitamin A	29'000 IE UI IU/kg	25 kg in paper bags
Vitamin D ₃ Vitamine D ₃ Vitamin D ₃	1'000 E U IU/kg	
Vitamin E Vitamine E Vitamin E	850 mg/kg	
Vitamin K ₃ Vitamine K ₃ Vitamin K ₃	5 mg/kg	
Vitamin B ₁ Vitamine B ₁ Vitamin B ₁	5 mg/kg	
Vitamin B2 Vitamine B2 Vitamin B2	14.5 mg/kg	
Vitamin B6 Vitamine B6 Vitamin B6	9.5 mg/kg	
Vitamin B12 Vitamine B12 Vitamin B12	0.03 mg/kg	
Nicotinsäure Acide nicotinique Nicotinic acid	105 mg/kg	
Pantothensäure Acide pantothénique Pantothe	enic acid 45 mg/kg	
Folsäure Acide folique Folic acid	3 mg/kg	
Biotin Biotine Biotin	0.75 mg/kg	
Cholin Choline Choline	740 mg/kg	Cy
Vitamin C Vitamine C Vitamin C	15 mg/kg	3

16/200

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Nashorn und andere Pflanzenfresser Rhinocéros et autres herbovores Rhinoceros and other herbivores Ergänzung Complément Supplement

Zoo-Nashornpellets | Pellets pour rhinocéros de zoos | Pellets for rhinoceros in zoos

- Low iron supplementary animal feed for hindgut fermenters and other herbivores
- Given values are calculated averages in air-dry feed
- NDF: 33.8 %
- ADF: 24.7 %





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Zoo-Nashornpellets | Pellets pour rhinocéros de zoos | Pellets for rhinoceros in zoos

Rohstoffe | Ingrédients | Ingredients

Luzernemehl, Traubentrester, Rübenschnitzel, Melasse, Weizenkleie, Hafer, Sojaextraktionsschrot (NGVO), Mais (NGVO), Mineralstoffe, Vitamine

Farine de luzerne, marc de raisins, pulpe de betterave, mélasse, son de blé, avoine, tourteau d'extraction de soja (sans OGM), maïs (sans OGM), substances minérales, vitamines

Alfalfa, grape pomace, beet pulp, molasses, wheat middlings, oats, soybean meal (NGMO), corn (NGMO), minerals, vitamins





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Inhaltsstoffe | Substances | Major Nutrients

Trockensubstanz Matière sèche Dry matter	90.0 %
Rohprotein Protéines brutes Crude protein	13.5 %
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NfE ENA NFE	42.7 %
Bruttoenergie Energie brute Gross energy	14.8 MJ/kg
Verdaubare Energie Energie digestible Digestible energy	10.3 MJ/kg
Stärke Amidon Starch	2.0 %





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Spurenelemente | Oligo-éléments | Trace elements

Eisen Fer Iron	400 mg/kg
Zink Zinc Zinc	175 mg/kg
Kupfer Cuivre Copper	34 mg/kg
Jod lode lodine	1.20 mg/kg
Mangan Manganèse Manganese	42 mg/kg
Selen Sélénium Selenium	0.35 mg/kg





HERBIVORES

Rhino and tapir

Suitable for: Rhino and tapir

YOUR BENEFITS

- A recipe low in iron with naturally low-iron raw materials and manufactured without additional iron supplementation for black rhinos and tapirs
- Also a suitable recipe for white rhinos
- High content of pectins through beet pulp and grape marc
- ♦ Supplemented with vitamin E and selenium

We are happy to work with you to create an individual feeding recommendation



TYPE OF FEED, FORM, DELIVERY QUANTITY

- supplementary feed
- Form: pellet 8 mm round
- Delivery quantity: 25 kg paper bag pallets of 750kg

FEED SPECIFICATIONS

Maior nutrients (%)

1114,01 11401101100 (10)		11446 01011101100 (
Dry matter	90	Iron	400
Crude protein	13.5	Zinc	175
Crude fat	2.8	Copper	34
Crude fiber	18	Iodine	1.2
Crude ash	10	Manganese	42
NFE	42.7	Selenium	0.4
NDF	31.6	Cobalt	0.3
ADF	22.6		
Starch	2.4		
Sugar	5.1	Vitamins (added, mg/kg)	
		Vitamin A (IU/KG)	6500
Energy (MJ/kg)		Vitamin D3 (IU/KG)	1000
Elici Sy (MJ/Kg)		Vitamin E	850
Gross energy	16	Vitamin K3	5
Digestible energy	10.2	Vitamin B1	5
3		Vitamin B2	14.5
		Vitamin B6	9.5
Macrominerals (%)		Vitamin B12	0.03
Calcium	0.0	Nicotinic acid	105
	0.9	Pantothenic acid	45
Phosphorus	0.7	Folic acid	3
Magnesium	0.3	Biotin	0.8
Sodium	1	Cholino	7/.0

Trace elements (mg/kg)

Amino acids (%)

Arginine	0.65
Lysine	0.6
Methionine	0.18
Methionine + Cystine	0.37
Tryptophan	0.15
Threonine	0.46

Ingredients

Alfalfa, grape marc, beet pulp, wheat bran, molasses, minerals, soybean meal (NGMO), vitamins.

Remarks

- ♦ Given values are calculated averages in air-dry feed.
- Gross energy calculated according to Kamphues et al. 2009
- Digestible energy calculated according to NRC Horses 2007
- Nutrients are subject to natural variation of the raw materials and their production process.

OUR FEED RECOMMENDATION

• The feed is suitable for supplementing a balanced basic diet in terms of protein and energy.

Choline

Vitamin C

- Always provide free access to fresh drinking water.
- ♦ Benchmark: 0.3% -1% of body weight per day

We are happy to work with you to create individual feeding recommendations for the respective species

ources:

Potassium

Chlorine

Clauss, M. et al. (2005). A contribution to the trace element nutrition of captive black rhinoceroses (Diceros bicornis). Nutrition Advisory Groups Proceedings.

Castell, J. (2005). Dissertation. Untersuchungen zu Fütterung und Verdauungsphysiologie am Spitzmaulnashorn (Diceros bicornis). Institut für Physiologie, Physiologische Chemie und Tierernährung der Tierärztlichen Fakultät der Ludwig-Maximillans-Universität München (Institute for Physiology, Physiological Chemistry and Animal Nutrition at the Veterinary Faculty of the Ludwig-Maximillan University of Munich).

Kamphues, J. et al. (2009). Supplemente zu Vorlesungen und Übungen in der Tierernährung, 11. Auflage, M.&H. Schaper, Hannover Litzenich, B. A., Ward, A. M. (September 1997). Hay and Pellet Rations: Considerations in Feeding Ungulates. Nutrition Advisory Group Handbook, Fact Sheet 006.

National Research Council (2007). Nutrient Requirements of Horses, 6th rev. edition, National Academies Press, Washington DC, S. 4



Experiences

- no formal assessment by digestion study or (the really important) long-term study
- no acceptance problems
- no clinical problems observed in black rhinos
- black rhino husbandry at Zurich Zoo discontinued for other reasons
- nutritional logic should apply for tapirs as well