Nutritional and energetic studies on captive Eurasian otters (*Lutra lutra*)

Papers of Ph.D.:

- **Energy requirement:** **„Energy and digestive efficiency of captive Eurasian otters (*Lutra lutra*)"**
- **Digestibility:** **„Digestive efficiency in Eurasian otters (*Lutra lutra*) and investigation on chromium oxide as marker"**
- **Mink as model:** **„Comparison of digestibility and passage rate of diets in Eurasian otters (*Lutra lutra*) and mink (*Mustela vison*)"**
- **comparison ex-situ / in-situ:** **„Comparison of the nutrient content of ex-situ and in-situ diets of Eurasian otters (*Lutra lutra*)"**
- **Reference values:** **„Dietary influence on urinary minerals, metabolites and amino acid concentrations in Eurasian otters (*Lutra lutra*)"**
- **Renal calculi:** **"Dietary risk factors for urate urolithiasis in Eurasian otters (*Lutra lutra*)"**

Energy: „Energy and digestive efficiency of captive Eurasian otters (*Lutra lutra*)"

Objective:

- optimal supply with energy on the basis of digestible energy

➡ determining the apparent digestibility (AD) of energy for various diets

➡ Kilojoule per kg metabolic body mass per day (kJ/kg BM ^{0,75}/ day) on AD basis

➡ considering season and gender

Results:

- mean AD of energy of all diets: 81% (68% for chicken to 86% for fish)
  ➡ differed between diets and must be considered for diet calculation!!

- the digestible energy intake was in average 720 kJ/ kg BM ^{0,75}/ day
  ➡ high energy demand

- during summer only a light decrease in comparison to winter season (691 to 721 kJ/ kg BM 0,75/ day on AD basis)

- females have higher energy demands than males (738 and 698 kJ/ kg BM 0,75/ day on AD basis)

Digestibility:

„Digestive efficiency in Eurasian otters (*Lutra lutra*) and investigation on chromium oxide as marker"

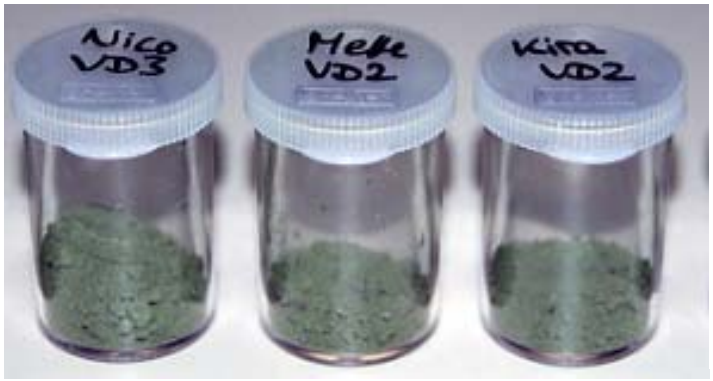
OBJECTIVES:

- Testing the suitability of chromium oxide as marker for *Lutra lutra*
- Digestibility coefficients (AD) for different diets for dry matter, crude protein, crude fat and crude fiber to allow the adjustment of feeding stuff and ration composition to the requirements

RESULTS:

- chromium oxide is a suitable marker for *Lutra lutra*
- the mean AD for dry matter was 77%, for crude fiber 57%, protein 84%, fat 85%
  ADs differed within the diets ➡ this must be considered for diet calculation!!!

➡ Otters have low digestibility coefficients in comparison to other carnivores



marker chromium (III) oxide

Mink as model:

„Comparison of digestibility and passage rate of diets in Eurasian otters (*Lutra lutra*) and mink (*Mustela vison*)“

Mink (*Mustela vison*)

OBJECTIVES:

- Comparing digestive physiology to allow taking over the various scientifically based dietary recommendations of mink for the otter

RESULTS:

- passage rates: are little bit shorter in otters than in mink
- digestibility: are little bit lower in otters than in mink

➡ in comparison to other species:

both species show low digestibility values as well as short passage rates

➡ by keeping the small differences in mind, the dietary recommendations for mink (NRC recommendations) can be taken over for the otter!

comparing ex-situ / in-situ: „Comparison of the nutrient content of ex-situ and in-situ diets of Eurasian otters (*Lutra lutra*)“

OBJECTIVES:

- Receiving manifestations on feeding mistakes in the keeping of otters through comparing the nutrient intake in the wild and in zoos

RESULTS:

- used feeding stuffs in zoos are very different from the prey spectrum in the wild
- nutrient concentrations of zoo diets are significantly different for many nutrients as otters absorb in the wild:

  -> nutrient levels in the zoo diet exceeded the in-situ dietary fat content and vitamin A and B1. The in-situ diet was higher in protein, zinc and vitamin E

  ➡ Caution with the supplementation of vitamin A in zoos is proposed as well as the deficiency of vitamin E

Example of a zoo diet in Europe

Reference values for urine:

„Dietary influence on urinary minerals, metabolites and amino acid concentrations in Eurasian otters (*Lutra lutra*)“

Values measured in the urine:

+ uric acid
+ allantoine
+ ammonium
+ phosphate
- citrate
- oxalate
+ calcium
+ magnesium
+ potassium
+ sodium

amino acids

+ = influenced from diet
- = not influenced from diet

Renal calculi: "Dietary risk factors for urate urolithiasis in Eurasian otters (*Lutra lutra*)"

- Renal calculi almost exclusively from ammonium urate in *Lutra lutra*

- Occurence of renal calculi in the wild: up to 23%
  Occurence of renal calculi in zoos: up to 69%

OBJECTIVES:

➡ finding reasons for the high occurence of renal calculi

➡ give recommendations for minimizing the risk for calculi in captivity

- How strong depends uric acid excretion on exogen purine intake?
- Exists a hyperuricemia?
- How high are urine pH values?
- How high is urine ammonium concentration?

➡ Urine was collected quantitatively in metabolic boxes (marker: chloride) for 7 diet trials with different purine contents and tested for pH, uric acid, ammonium, allantoin

RESULTS:

- concentration of uric acid in urine: 3,28 mmol/l urine -> high values
- urine pH: in average 6,14 -> very low
- ammonium concentrations: in average 103 mmol/l urine -> high values

➡ equivalent to the 3 main risk factors known for ammonium urate calculi from other species (Dalmatian dogs and humans)

- purine is metabolized to uric acid and purine content strongly correlates with uric acid excretion

➡ uric acid excretion - as one of the main factors for uric acid calculi – is controllable through the purine content in the diet

Feeding RECOMMENDATIONS for keeping institutions to avoid calculi:

- avoidance of feeding stuff with high purine content (e.g. herring, yeast, innards)
- proteine feeding should be close to the demand to control ammonium production
- (increase of urine pH e.g. through potassium citrate or calcium carbonate)

Results with values and descriptions for calculation of rations:

- **Optimizing the nutrition of captive Eurasian otters (*Lutra lutra*)**
  (parts of PhD-thesis: Ruff, K. (2007)

  Free download: http://otterspecialistgroup.org/Library/TaskForces/OCT/Ruff_Lutra_Lutra_diet_study.pdf

- **"Nutritional and energetic studies on captive Eurasian otters (Lutra lutra)“**
  (complete PhD)

  Free download: http://edok01.tib.uni-hannover.de/edoks/e01dh07/541491776.pdf

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