# Feeding practice in Warmblood mares and foals and the incidence to osteochondrosis

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## Introduction

Osteochondrosis is a developmental orthopedic disease in growing foals. Beside hereditary predisposition there are several suspected aetiological factors (growth, body size, nutrition, endocrinology, and biomechanical stress) which are associated with the onset of equine osteochondrosis (*Jeffcott* and *Henson* 1998). Overnutrition or imbalances in mineral homeostasis are nutritional aspects which have to be considered as contributory factors in equine osteochondrosis. The aim of the present study was to investigate the typical feeding practice in German Hanoverian stud farms and the incidence to osteochondrosis.

## Material and methods

Totally 629 Hanoverian warmblood foals born between December 26, 2000 and July 01, 2001 (308 males, 321 females) and their dams from 83 farms in Germany were included in this study. Over a period of six month foals were weighed monthly on a portable electronic scale. Simultaneously feed samples were obtained and the nutrient intake of the rations was recorded during stable period and pasture time. Feed samples were analyzed for crude nutrients, macro and trace elements. For the mares, amount of feed and the analysed nutrients in the feed samples were used to estimate nutrient intake during stable period. During pasture time nutrient intake by grass regarding dry matter intake (dry matter intake: 2.2% of BW) was calculated for the mares. As the foals were not fed separately from their dams during stable period and pasture time, the energy to nutrient ratio (stable ration for the mares, milk and grass) was calculated to assess the supposed nutrient intake in foals. This proceeding implied an adequate energy intake by the foals (BW development and daily BW gain). X-ray controls for osteochondrosis (OC) were done between the fifth and tenth month after birth. Radiographic diagnosis showed 226 foals with signs of osteochondrotic lesions.

## Results and discussion

*Energy and nutrient intake of the pregnant and lactating mare*

The nutrient intake for the pregnant mares during stable period in winter was mainly limited by an insufficient supply of Zn and Cu (Table 1). Cu deficiency has been implicated in equine osteochondrosis by several studies in foals (*Knight* et al. 1990, *Hurtig* et al. 1993, *Pearce* et al. 1998). During pregnancy copper will be stored in the foetal liver and is used as Cu source during the first months of foals´ life (*van Weeren* et al. 2003). However, in our study there was no significant relationship between Cu intake of the pregnant mare and osteochondrosis in the foals.

**Table 1** Deviations of nutrient intake [%] of the pregnant mare [600 kg BW] with regard to requirement during stable period [N =298].

| Nutrient | Deviations of nutrient intake [%] of the pregnant mare with regard to recommendation | | | | | *Requirement** | |
|---|---|---|---|---|---|---|---|
| | <-30 | -30/-10 | -10/10** | 10/30 | >30 | | |
| vRp | - | 6.8 | 30.4 (627-697 g) | 11.1 | 51.7 | *640* | *g* |
| DE | 4.7 | 13.5 | 38.5 (93-109 MJ) | 37.5 | 5.7 | *101* | *MJ* |
| Ca, g | 4.7 | 1.7 | 32.4 (41-49 g) | 18.9 | 42.2 | *45* | *g* |
| P, g | 1.7 | 24.0 | 3.0 (29 g) | 18.6 | 52.7 | *30* | *g* |
| Zn, mg | 42.6 | 20.3 | 3.4 (550-562 mg) | - | 33.8 | *600* | *mg* |
| Cu, mg | 35.8 | 12.5 | 11.5 (112-125 mg) | 6.4 | 33.8 | *120* | *mg* |

*Requirement/day: 11th months of pregnancy, BW 600 kg
**-10/10% of requirement is estimated as adequate, in brackets nutrient intake in g, mg or MJ/day

During lactation considerable deficiencies in nutrient intake during winter time were noticed (Table 2). The intake of energy and digestible crude protein (DCP) were insufficient in most of the mares which was mainly related to an inadequate intake of compound feeds for lactating mares and the misjudgement of protein levels of the provided feedstuffs. Consequences of a low protein intake might be body weight losses or subfertility.

**Table 2** Deviations of nutrient intake [%] of the lactating mare [1./2. months of lactation, 600 kg BW] with regard to requirement during stable period [N = 671].

| Nutrient | Deviations of nutrient intake [%] of the pregnant mare with regard to recommendation | | | | | *Requirement** | |
|---|---|---|---|---|---|---|---|
| | <-30 | -30/-10 | -10/10** | 10/30 | >30 | | |
| vRp | 35.2 | 31.2 | 23.6 (1150-1379 g) | 6.0 | 4.0 | 1275 | *g* |
| DE | 10.7 | 42.4 | 35.5 (122-149 MJ) | 9.3 | 2.1 | 135 | *MJ* |
| Ca, g | 10.4 | 16.6 | 23.9 (55-67 g) | 14.6 | 34.5 | 61 | *g* |
| P, g | 8.5 | 28.1 | 37.0 (42-50 g) | 13.9 | 12.5 | 46 | *g* |
| Zn, mg | 15.2 | 23.0 | 7.6 (547-640 mg) | 6.1 | 48.1 | 600 | *mg* |
| Cu, mg | 9.7 | 20.7 | 9.0 (108-131 mg) | 11.2 | 49.4 | 120 | *mg* |

*Requirement/day: 1./2. months of pregnancy, BW 600 kg
**-10/10% of requirement is estimated as adequate, in brackets nutrient intake in g, mg or MJ/day

Furthermore mineral supply was not well balanced in the lactating mare as both a high and a deficient intake for several minerals was observed. In comparison to the pregnant mares, the Cu intake was above requirement in more than 50 % of the lactating mares. The shift from a low Cu intake in the pregnant mare to a high Cu intake in the lactating mare showed the awareness that Cu deficiency might play a role in osteochondrosis. However, a high Cu intake in the lactating mare does not provide more Cu for the foal as the mares´ milk will not be enriched with Cu.

In general, lactating mares did not receive any compound feed during pasturing period and therefore nutrient intake was mainly covered by pasture grass (Table 3). Grass intake provided sufficient energy, crude protein and P, but Ca, Zn, Cu and Se intake was marginal. However, symptoms of deficiency like hypocalcaemia were not monitored, and it is suggested that enough Ca could be mobilized from bones to balance Ca homeostasis. The nutrient intake of the lactating mares was not correlated with osteochondrosis in the foals.

**Table 3** Deviations of nutrient intake [%] of the lactating mare [3./4. months of lactation, 600 kg BW] with regard to requirement during pasture period [N = 671].

| Nutrient | Deviations of nutrient intake [%] of the pregnant mare with regard to recommendation | | | | | *Requirement** | |
|---|---|---|---|---|---|---|---|
| | <-30 | -30/-10 | -10/10** | 10/30 | >30 | | |
| vRp | - | 3.0 | 7.2 (1106-1302 g) | 21.9 | 67.9 | 1185 | *g* |
| DE | - | 7.0 | 82.8 (130-156 MJ) | 10.2 | - | 142 | *MJ* |
| Ca, g | 38.4 | 38.1 | 12.2 (54-67 g) | 5.5 | 5.8 | 61 | *g* |
| P, g | - | 2.4 | 20.3 (41-51 g) | 33.3 | 44.0 | 46 | *g* |
| Zn, mg | 35.9 | 32.9 | 15.5 (538-660 mg) | 8.1 | 7.6 | 600 | *mg* |
| Cu, mg | 15.7 | 13.5 | 40.5 (108-131 mg) | 12.3 | 18.1 | 120 | *mg* |

*Requirement/day: 1./2. months of pregnancy, BW 600 kg
**-10/10% of requirement is estimated as adequate, in brackets nutrient intake in g, mg or MJ/day

*Energy and nutrient intake of the foal*

During stable period there was no separate feeding of the suckling foals, but foals were supposed to participate in the meals for their dams as body weight development and daily body weight gain was adequate (*Vervuert* et al. 2005). Energy density in the provided concentrates for the mares was above 8 MJ DE/kg (Figure 1) and digestible protein density

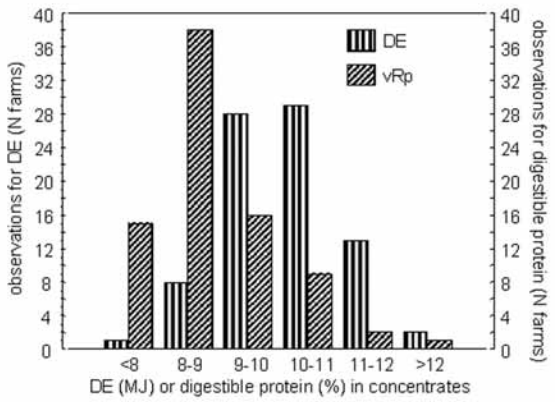


**Fig 1** Distribution of digestible energy (MJ DE/kg) and digestible protein (%) in concentrates for mares and foals.

was mainly below 100 g/kg. Because of the low protein levels in the concentrates and roughages, an insufficient protein and amino acids intake was supposed for the suckling foals from the third month of life. Similar to protein, Ca, P (Figure 2) and Cu supply was marginal as composition of the concentrates was not well balanced.

The foals were on pasture at the latest from the third month of life and the precise nutrient intake was unknown. Almost all foals were fed with milk and grass with no other supplementation during this time. Similar to stable period, the development of body weight for foals was within the normal range (GEH 1994) and an adequate energy and protein intake by milk and grass intake was supposed for the suckling foals. The energy requirement for the foals was used to estimate DM intake for grass and milk and the energy to nutrient ratio was calculated to assess the supposed nutrient intake in the foals. Protein intake met the requirements for the suckling foals, but mineral intake, especially Ca (Figure 3), P (~0.26-0.28 g P/MJ DE, requirement: 0.55 g P/MJ DE) and Cu (0.24-0.3 mg Cu/MJ DE, requirement: 0.5-0.6 mg Cu/MJ DE) were marginal. There was no clear relationship to mineral intake and the incidence to ostechondrosis in the foals. However, as all foals revealed an insufficient mineral intake, a final conclusion regarding osteochondrosis and mineral intake remained open.

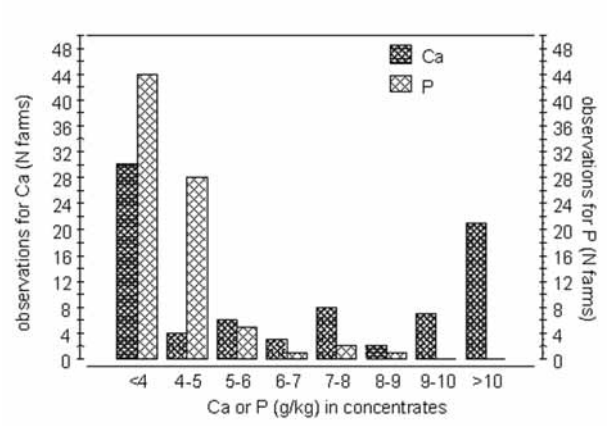


**Fig 2** Distribution of Ca and P (g/kg) in concentrates for mares and foals.

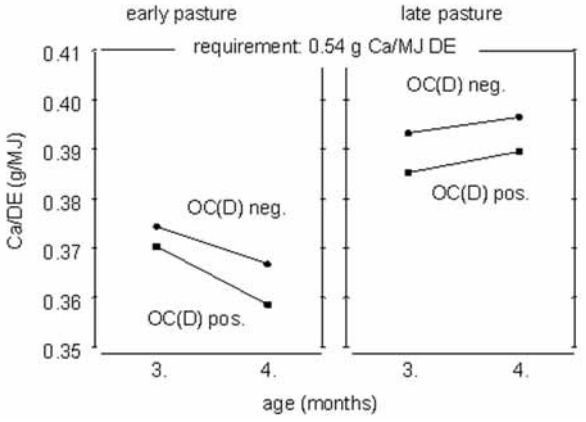


**Fig 3** Ca to energy ratio in milk + grass in the diet for foals for different time points and the incidence to osteochondrosis.

## Conclusions

The growth rates of the Hanoverian warmblood foals showed a normal development (*Vervuert* et al. 2005) which leads to

the conclusion that excessive energy intake is not a single and simple factor in the aetiology of osteochondrosis in foals. Although the present study did not clearly show that imbalances in nutrition have a negative impact on the development of osteochondrosis, more attention should be given to correct the considerable imbalanced energy and nutrient intake of the mares and foals to optimize breeding and to enhance longevity of the horses. In general, the nutrient supply of the broodmare and foal should be corrected by compound feeds which consider the special needs. During pasture time the mineral intake of the mares and foals should be balanced by supplements according to grassland conditions.

## References

Gesellschaft für Ernährungsphysiologie (GEH) (1994): Empfehlungen zur Energie- und Nährstoffversorgung der Pferde. 2. Auflage, DLG-Verlag, Frankfurt/Main

*Hurtig M. B., Green S. L., Dobson H., Mikuni-Taaki Y.* and *Choi J.* (1993): Correlative study of defective cartilage and bone growth in foals fed a low copper diet. Equine Veterinary Journal 16, 66-73

*Jeffcott L. B.* and *Henson F. M. D.* (1998): Studies on growth cartilage in the horse and their applications to aetiopathogenesis of dyschondroplasia (Osteochondrosis). Veterinary Journal 156, 177-192

*Knight D. A., Weisbrode S. E., Schmall L. M., Reed S. M., Gabel A. A., Bramlage L. R.* and *Tyznik W. I.* (1990): The effect of copper supplementation on the prevalence of cartilage lesions in foals. Equine Veterinary Journal 22, 426-432

*Pearce S. G., Firth E. C., Grace N. D.* and *Fennessy P. F.* (1998): Effect of copper supplementation on the evidence of developmental orthopaedic disease in pasture-fed New Zealand Thoroughbreds. Equine Veterinary Journal 98, 211-218

*Van Weeren P. R., Knaap J.* and *Firth E. C.* (2003): The influence of liver copper status of mare and newborn foal on the development of osteochondrotic lesions. Equine Veterinary Journal 35, 67-71

*Vervuert I., Coenen M., Borchers A., Granel M., Winkelsett S., Christmann L., Distl O., Bruns E.* and *Hertsch B.* (2005): Growth rates in Hanoverian Warmblood foals and the development of osteochondrosis. In: *Juliand V.* and *Martin-Rosset W.* (edit.): The growing horse: nutrition and prevention of growth disorders. EAAP publication 114, 85-87

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