

## Can broodmare nutrition predispose foals to disease?

**Dr C E Foote**  
**Equine Consulting Services**



The provision of adequate levels of nutrients in broodmare diets is already well known to be essential for optimal foal health and development. Deficiencies and imbalances of minerals have been associated with developmental orthopaedic disease. Calcium, phosphorus, copper and zinc are well known to be essential in bone and cartilage formation and the incidence of skeletal diseases in offspring has been shown to decrease significantly when these four minerals, particularly copper, were increased in the diet. Feeding gestating and lactating mares becomes something of a balancing act and ensuring adequate nutrient intake while maintaining appropriate body weight can be a challenge. This becomes even more challenging when an abundance of pasture (typically low in these minerals) is available. More recently, new research indicates that it is not just the level of nutrients, but also the method of feeding broodmares that may have a significant effect on foal health and ultimately performance.



Research suggests that nutrition of the dam and stress on the dam during gestation and lactation could ultimately have an impact on the foal's metabolism and may predispose the foal to various diseases. In a recent article published by researchers in the United States, it was found that feeding mares high starch diets during late gestation resulted in higher glucose levels in their foals compared to levels from foals of mares fed low starch diets [1]. A trend for lower insulin sensitivity was also observed in this group of foals. This study therefore suggests that feeding mares high starch diets during late gestation may result in decreased insulin sensitivity (or "insulin resistance") in foals. Insulin resistance has been shown in horses to be associated with obesity and laminitis [2, 3] and may play a role in colic [4], exertional rhabdomyolysis (often referred to as tying-up) [5] and developmental orthopaedic disease [6].

This idea of "foetal programming" has been already well documented in humans and other species. In one paper newborns of diabetic mothers were shown to be larger in all body measurements than babies with nondiabetic parents and had an altered glucose/insulin metabolism [7]. Obesity in offspring was shown to be directly related to maternal diabetes and findings strongly suggest that the prenatal environment of the offspring of diabetic women results in the development of obesity in childhood and early adulthood [8].

We are currently involved in a large Rural Industries Research and Development Corporation project which is looking at the effect of insulin sensitivity in mares and their foals and how this might affect skeletal disease. Many of the mares are kept on pasture improved paddocks, and on a scale of 0 (very poor) to 5 (very fat) [9], we are finding that approximately 75% of mares have a body condition score of 4 or above [10]. Equine researchers have found that obese horses are more likely to be insulin resistant and that horses fed grain meals rich in starch with a high glycaemic index may have a higher risk of developing insulin resistance [11, 12].

While much of the research quoted here is in its very early stages, taken together the studies suggest that:

- A) A high proportion of Australian mares have a body condition score of 4 or above (on a scale of 0 – 5);
- B) There appears to be a relationship between obesity in horses and insulin resistance;
- C) Feeding high starch diets to pregnant mares might affect the insulin sensitivity of foals;
- D) Insulin resistance in horses may be associated with diseases such as laminitis, obesity, exertional rhabdomyolysis and developmental orthopaedic disease.

While a direct link between insulin resistance in mares and foals is yet to be established, maintenance of optimal body condition and avoidance of unnecessary grain-based meals rich in sugar and starch may not just be beneficial for pregnant mares but also may have a positive effect on foal metabolism. If a solid relationship is found between mare intake and foal health, it will potentially have implications for farms with lush pastures and those that use high starch feed sources in mare feeding programs.

## References:

1. George, L.A., et al., *Insulin sensitivity and glucose dynamics during pre-weaning foal development and in response to maternal diet composition*. Domestic Animal Endocrinology, 2009. **37**: p. 23-29.
2. Jeffcott, L.B., et al., *Glucose tolerance and insulin sensitivity in ponies and standardbred horses*. Equine Veterinary Journal, 1986. **18**: p. 97-101.
3. Pass, M.A., S. Pollitt, and C.C. Pollitt, *Decreased glucose metabolism causes separation of hoof lamellae in vitro: A trigger for laminitis?* Equine Veterinary Journal, 1998. **26**: p. 133-138.
4. Hudson, J.M., et al., *Feeding practices associated with colic in horses*. Journal of American Veterinary Medical Association, 2001. **219**: p. 1419-1425.
5. Valentine, B.A., et al., *Role of dietary carbohydrate and fat in horses with equine polysaccharide storage myopathy*. Journal of American Veterinary Medical Association, 2001. **219**: p. 1537-1544.
6. Ralston, S.L., *Hyperglycaemia/hyperinsulinemia after feeding a meal of grain to young horses with osteochondritis dissecans (OCD) lesions*. Pferdeheilkunde, 1996. **12**: p. 320-322.
7. Krishnaveni, G.V., et al., *Anthropometry, glucose tolerance, and insulin concentrations in Indian children: relationships to maternal glucose and insulin concentrations during pregnancy*. Diabetes Care, 2005. **28**: p. 2919-2925.
8. Pettitt, D.J., et al., *Excessive obesity in offspring of Pima Indian women with diabetes during pregnancy*. The New England Journal of Medicine, 1983. **308**: p. 242-245.
9. Huntington, P.J., *Field Estimation of Body Condition and Weight*. Proc 181 Post. Grad. Comm. Vet. Science Uni of Sydney, Sydney, Aust. p.15-29, 1991.
10. Dobbs, T., pers comm.
11. Hoffman, R.M., et al., *Glucose clearance in grazing mares is affected by diet, pregnancy, and lactation*. Journal of Animal Science, 2003. **81**: p. 1764-1771.
12. Williams, C.A., et al., *Plasma glucose and insulin responses of Thoroughbred mares fed a meal high in starch and sugar or fat and fiber*. Journal of Animal Science, 2001. **79**: p. 2196-2201.