

## Biotin deficiencies can cause hoof problems

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**M**any nutritionists claim that biotin is a vitamin they don't need to worry about, because it is believed to be present in most common feedstuffs in more than adequate amounts. This belief is reinforced in the discussion of biotin requirements included in the *1998 NRC Nutrient Requirements of Swine* guidelines.<sup>1</sup> However, the *NRC Guidelines* reiterate some conclusions shown to be invalid many years ago. Many North American nutritionists have told me that biotin supplementation is never needed in the United States and that biotin-responsive conditions are a European phenomenon. Experience has shown me that this is not true and that biotin-responsive conditions can and do occur in the United States, and in fact in every country with high-producing breeding stock around the world.

One major difficulty in determining biotin requirements has been the inherent variability in feedstuffs. Indeed, the NRC review acknowledges that “biotin bioavailability varies greatly among ingredients” (p. 75). All yellow corn is not the same. Growing conditions, the extent of post-harvest drying, and the presence/absence of mycotoxins can all affect the availability of biotin. Mycotoxins have been observed to reduce circulating levels of biotin (as well as other b-group vitamins).<sup>2</sup> This would suggest that the presence of mycotoxins in feed would increase the demand for a range of vitamins (including biotin). However, to my knowledge no one has directly investigated the relationship between mycotoxin and vitamin requirements in the pig.

The NRC also states that “A considerable portion of the pig's requirement is *presumed* to come from bacterial synthesis in the gut” (my emphasis) (p. 75).<sup>1</sup> However, it has been demonstrated that a pig can void more biotin in its feces than it consumed in its feed and still be biotin-deficient.<sup>3–6</sup> The problem is that biotin is absorbed in the ileum and synthesized in the colon—thus, gut synthesis is not an adequate source of biotin. Even where coprophagy can occur, we found that the pig did not pick up enough biotin to meet its needs.

The NRC suggests that “biotin is present in most common feedstuffs in more-than-adequate amounts” (p. 75). However, there are problems with the supply of biotin to the pig. Several investigators have observed problems with digestibility of biotin from natural sources.<sup>7,8</sup>

There is no doubt that biotin affects skin as well as feet (since both are keratin-based tissues). Although the evidence in the literature all involves other species, biotin probably also effects skin histology/cytology<sup>9</sup> and disease resistance,<sup>10</sup> and is involved with wound healing.<sup>11</sup>

Biotin has also been observed to affect the fat composition of exudates.<sup>12</sup>

It is not surprising that the literature should be equivocal on the need for biotin supplementation. It is a vitamin that is only marginally inadequate in diets. Where animals are fed generously and not expected to perform particularly well, you are unlikely to see many conditions that can be resolved by supplementing with biotin. However, if the supply is marginal and the demand on the animal is high, you will see biotin-responsive conditions.

There are always arguments about whether or not to include certain nutrients in diets. A review of the literature will reveal 10 studies that suggest that supplementation is beneficial, and 10 saying it produces no response. Unless able to find some explanations for the differences, one is faced with a difficult choice. The scientist will generally err on the side of caution and want to undertake more studies before pronouncing a feed deficient. For the nutritionist, the choice may depend upon how fierce the competition for the feed order is. In the United Kingdom, feed orders are amazingly price sensitive and a producer's choice of supplier can be influenced by a few pence per tonne.

Nor are statistics always helpful. I am against relying too much on coincidence and correlation. However, slavish conformity to the 5% probability level is also wrong. When we worked on biotin some years ago, we performed one study in which a number of factors (litter size, weaning weight, remating interval) all showed a slight, nonsignificant improvement. However, if we forgot the experimental niceties and pulled those factors together as they would be in the real world and looked at a single measure (weight of pigs weaned per sow per year) the result was very significant.<sup>13</sup> More importantly, we predicted a 1:15 cost:benefit ratio when we performed an economic analysis. What we need to do is relate probability with potential cost benefit so that we make more informed decisions.

We will always end up with fierce debate when we are considering supplementation of nutrients that are in marginal supply and that are multifunctional. In the current economic climate, there are few research units that can perform experiments involving sufficient animals, treatments, and dose responses to resolve these issues. For this reason, we are working to develop new research strategies that are sufficiently robust to deal with this type of problem.

We found in field interventions that supplementing biotin at very high concentration (2000–3000 µg per kg for 3–6 months) resolved skin and hoof problems.<sup>14,15</sup> A lower concentration gives a slower response. However, our repeated experiences on farms have demonstrated that you must be very careful to gradually decrease back to a supportive concentration

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**Practice tips are not refereed**

of supplementation over a 6-month interval, or you'll get a bounce-back deficiency and end up worse off than you were before.

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