

Is phosphorus still a concern for reproductive performance?

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With the constant challenge to improve performance, dairy producers, veterinarians, nutritionists and AI personnel continually look for factors that may adversely affect reproduction. Nutrition is frequently implicated as a potential cause for less than desirable performance. A traditional view is that phosphorus is very important to reproductive performance. In recent years, this has become an issue because of the concern that the new recommendations to reduce dietary phosphorus for environmental reasons may affect reproduction. However, an increasing amount of evidence suggests that supplementation of phosphorus does not make a difference in reproductive performance of modern dairy cows fed moderate to high quality diets.

The 2001 Nutrient Requirements of Dairy Cattle (NRC) reviewed the literature from 1923 through 1999 to assess the effects of dietary phosphorus on reproductive performance. Some studies showed that severe phosphorus deficiency caused infertility or reduced reproductive performance. However, the typical phosphorus concentration was less than 0.20% of dietary dry matter, the diets were fed for extended periods of time (1 to 4 years) and when measured, feed intake was depressed due to other dietary reasons, causing coincidental deficiencies of energy, protein, and other nutrients.

The study that seems to establish the linkage between phosphorus and reproductive performance in dairy cows is a survey conducted in Scotland in 1951. According to the survey, supplemental phosphorus was shown to improve conception rate. However, before basing conclusions on this information, several important points should be identified. Dairy cows at that time were fed much differently than cows fed today in North America. Little or no grain would have been fed and the forage would have consisted of badly weathered grass hay. It is conceivable that the phosphorus content of badly weathered hay could be low and phosphorus availability reduced. This study has been widely quoted and seems to be the source of the current dogma that dietary supplementation with phosphorus is important to reproductive performance. Few people have noted that the investigators estimated 30 grams of phosphorus per day as being sufficient to meet the lactating cow's requirement for phosphorus. This is much less than the 80 grams per day that the 2001 NRC recommends.

There is significant evidence suggesting that dietary phosphorus is not a factor that can change the reproductive performance of lactating dairy cows fed moderate to high quality diets. A recent review by researchers outlines 13 studies evaluating the effect of dietary phosphorus on reproductive performance (Table 1). These experiments used a total of 785 cows, half of which were fed phosphorus ranging from 0.32 to 0.40% of the diet and the other half ranging from 0.39 to 0.61% of the diet. The average of several

reproductive measures from these studies indicate no effect of increasing dietary phosphorus on reproductive performance. Reproductive performance in dairy cows is unlikely to be impaired unless dietary phosphorus is extremely deficient. There is no data available suggesting that the 2001 NRC recommendations for phosphorus are inadequate for optimal reproductive performance.

There are more important nutritional factors than phosphorous that can adversely affect reproductive performance. Numerous studies have documented that maintaining adequate dry matter intake and minimizing negative energy balance in early lactation are important to timely initiation of ovarian function. There is a relationship between body condition loss and negative energy balance. Monitoring body condition loss in early lactation is helpful in determining the extent of the energy deficiency. Cows with a severe change in body condition (loss of one point or greater on a scale of 1 to 5) between calving and first service tend to have an extended interval to first ovulation, days to first estrus, days open and reduced conception rate compared to herdmates with only minor or moderate change in body condition. Feeding an appropriate transition ration is also critical to maintaining appetite and minimizing periparturient problems in early lactation. Such problems delay onset of estrous cycles or reduce conception rate.

Feeding excessive levels of protein or more specifically degradable protein has been shown to lower reproductive performance. Evaluation of the amounts of rumen-degradable protein and undegradable protein is important to determining possible problems related to reproduction. Excesses or deficiencies of certain vitamins and minerals can adversely affect reproductive performance, but these are observed less frequently and should be of lower priority than energy and protein balance.

There are simple tools available to help monitor these nutritional factors. If a total mixed ration (TMR) is being fed, consider a TMR analysis to check the nutritional specifications. This helps determine how close the formulated ration is to the one being fed. Analyze forages routinely and update rations accordingly. Monitor dry matters on high moisture feeds and evaluate dry matter intakes on a regular basis. Analyze milk samples for milk urea nitrogen to evaluate protein and carbohydrate utilization. These basic practices can help ascertain how nutrition may be affecting reproduction.

There is no doubt that improper nutrition and feeding practices can affect reproductive performance. However, focusing on one mineral such as phosphorous and feeding excessive amounts could be costly and unlikely to correct poor reproductive performance. Inefficient and inaccurate heat detection, improper procedures associated with artificial insemination, poor cow comfort, and inadequate vaccination and biosecurity programs are usually the major factors contributing to poor reproductive performance.

More information on phosphorus is available on the web at <http://nutrient.psu.edu>. The publication titled “Nutritional Concerns for Optimal Reproduction” is located on the nutrient management web site under dairy cattle, nutrition.

Table 1. Reproductive measures of lactating dairy cows fed low or high dietary phosphorus diets (summary of 13 trials).

Item	Low Dietary P	High Dietary P
	(% of diet dry matter)	
	0.32-0.40	0.39-0.61
Number of cows	393	392
	Mean \pm standard deviation ¹	Mean \pm standard deviation ¹
Days to first estrus	46.8 \pm 10.9	51.6 \pm 13.8
Days to first breeding	71.7 \pm 16.2	74.3 \pm 10.6
Days open	103.5 \pm 21.4	102.1 \pm 13.0
Services per conception	2.2 \pm 0.9	2.0 \pm 0.5
Pregnancy rate	92% \pm 6%	85% \pm 5%

Source: Satter and Wu, 1999. Cornell Nutrition Conference for Feed Manufacturers, Rochester, NY.

¹Differences between means were not statistically significant for any measured parameter.