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Does MUN affect reproduction?

Phytoestrogens can have significant effects on reproductive performance in dairy cows. Since soybean products can contain high levels of phytoestrogens, it might be possible to relax the milk urea nitrogen constraints if alternative proteins are used in diets.

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CORRELATIONS between variables provide a valuable means for researchers to predict the effects of changes in diet upon animal performance. Occasionally, however, coincidental findings skew perceptions and can lead to the misinterpretation of events.

For example, for many years, feeding legume forages to dry cows was associated with milk fever, and therefore, prepartum calcium intakes were positively correlated to milk fever.

Overlooked was the fact that the same forages also contributed significant amounts of potassium and that prepartum potassium feeding was a major culprit in the etiology of milk fever. The concern regarding dietary prepartum calcium could be eased.

This may be the case with regard to the relationship between milk urea nitrogen (MUN) and fertility in cows.

History of MUN

In many studies, providing dairy cows with high levels of protein has been shown to reduce conception rate by increasing days to first estrus and increasing services per conception.

In an in-depth, groundbreaking review, Ferguson and Chalupa (1989) analyzed results from nine published studies. These researchers determined that excess rumen degraded and/or excess escape protein had a negative impact on conception rate. These researchers proposed three modes of action of excess protein upon fertility:

(1) Production of ammonia from rumen fermentation and from catabolism of excess escape protein might have a direct impact on sperm, ova or embryos;

(2) Imbalances between protein and energy could influence metabolic efficiency, with excess protein consuming energy for disposal, and

(3) Nitrogenous byproducts might affect endocrine secretions.

Ferguson et al. (1993) determined that blood urea nitrogen (BUN) was a useful indicator of excess protein and showed that this index could be inversely related to conception rate in dairy cows. BUN is a measure of both the breakdown of protein and generation of ammonia in the rumen and endogenous protein catabolism. The liver converts both sources of excess nitrogen to urea.

Because body fluid pools equilibrate, MUN was likewise found to be an acceptable measure of excess dietary nitrogen (Roseler et al., 1993).

In all except one of the studies used in the original analysis by Ferguson and Chalupa, dietary protein levels were increased through the provision of additional soybean meal. In several of the studies, this resulted in greater milk production, which might contribute to a reduced conception rate, but this was not the case in all studies.

Is it possible that soybean meal, per se, might contribute to the degradation of reproductive performance?

IN several newer research trials, substituting of other proteins for soybean meal resulted in improvements in reproduction with little change in BUN values.

Carroll et al. (1994) determined that first service conception rates were 89% and 68% and BUN levels were 22.8 and 23.7 mg/dl with soybean-based diets versus diets in which soybean meal was partially substituted for fish meal.

Kenny et al. (2002) more than doubled BUN in cows by elevating the urea level in the diet. There was no effect upon embryo survival.

Reksen et al. (2002) found no relationship between BUN and fertility in Norwegian cattle consuming a broad mixture of supplemental protein sources.

Such data would suggest that soybean meal products might be a contributing factor in the decline in reproduction when BUN levels are high.

We have located recent evidence that phytoestrogens in soybean meal may be a contributing factor in reduced conception rate in dairy cows.

Phytoestrogens

Phytoestrogens are compounds contained in plants that have estrogenic activity. Phytoestrogens generally exhibit weak estrogenic activity and can provide some estrogenic function when estrogen levels are low. Phytoestrogens can also be anti-estrogenic when they compete with estrogen and attach to estrogen receptors (Tham et al., 1998; Woclawek-Potocka et al., 2006).

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Amounts (mg/100 g edible portion) of diadzein and genistein in soybean products[a]

Item	Isoflavone	Mean	Low	High
Soybean flakes, full fat	Daidzein	48.23	22.10	74.35
	Genistein	79.98	28.00	131.96
Soy protein isolate	Daidzein	33.59	7.70	66.89
	Genistein	59.62	27.17	105.10
Roasted soybeans	Daidzein	67.45	53.60	86.00
	Genistein	94.76	86.90	110.55

[a]Food Composition Laboratory, 2007.

Adams (1995) reviewed the effects of dietary phytoestrogens upon reproduction in ruminant animals. These compounds have been demonstrated to cause infertility in females through increased incidence of cystic ovaries, irregular estrus and anestrus. In feedlot animals, phytoestrogens can have additive effects with estrogenic implants. This can lead to mounting, bruising and vaginal prolapse in heifers.

Endogenous estrogen exerts control over the estrous cycle by influencing prostaglandin synthesis (Goff, 2004). Phytoestrogens may, therefore, interfere with this process.

Coumestrol, the estrogen most often associated with alfalfa, is the most potent of the plant estrogens. Coumestrol has also been reported to reduce the amount of endogenous estrogen produced by dairy cows (Adams, 1995).

Moravcova et al. (2004) found that wilting alfalfa prior to ensiling increased coumestrol concentrations, but ensiling reduced the levels found in alfalfa. Most of the compound was lost by 50-100 days after ensiling.

Soybeans, on the other hand, contain varying amounts of phytoestrogens, including small amounts of coumestrol and two noteworthy isoflavones: daidzein and genistein. Both isoflavones are converted to active phytoestrogens in the rumen: diadzein to equol and genistein to para-ethyl phenol (Woclawek-Potocka et al., 2006).

Elevated levels of equol and para-ethyl phenol were found in heifers receiving 2.5 kg of soybean meal per day (Piotrowska et al., 2005). The actual levels of diadzein and genistein are quite variable in soybeans and soy products (Food Composition Laboratory, 2007; Table).

Soybean isoflavone metabolites disrupt corpus luteum function by inhibiting progesterone secretion (Piotrowska et al. (2006) as well as by increasing levels of prostaglandins in dairy cattle (Woclawek-Potocka et al., 2005). Furthermore, isoflavones from soybeans were found to have an effect opposite to endogenous estrogen with regard to vasoconstriction and tubular contraction within the oviduct (Reinhart et al., 2003).

Therefore, it is probable that using high levels of soybean products may negatively effect reproduction in a fashion totally unrelated to MUN if isoflavone levels happen to be high.

Other factors

It appears that phytoestrogens can have a significant impact upon reproductive performance in cows and that soybean products can contain high levels of phytoestrogens. It might be possible to relax the constraints on MUN if alternative proteins with lower levels of phytoestrogens are used in cow diets.

Very high levels of dietary protein, regardless of source, can still influence reproduction, however. Bishonga et al. (1996) provided ewes with 0, 24 or 48 g of urea per day. While hormone levels were not affected, the high urea levels still had a negative effect on early embryo development.

Reduced embryo survival was similarly found in cows when embryos were exposed to high levels of ammonia or urea (Rhoads et al., 2006; Sinclair et al., 2000).

Thus, lowering the amount of soybean meal in the diet may benefit reproduction, and MUN may then be less of a concern.

However, a sound nutritional program without excessive levels of nitrogen is still vitally important.

References

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