Prevention Of Displaced Abomasum

R. D. Shaver, Ph.D.[1]
Professor and Extension Dairy Nutritionist
Department of Dairy Science
College of Agricultural and Life Sciences
University of Wisconsin – Madison
University of Wisconsin – Extension

Abstract

Because of intake depression prior to calving and slow intake ascent post-calving, the transition period is the major risk period for abomasal displacements. Feeding and management practices that prevent other calving-related disorders reduce the risk of abomasal displacements. Cows that have excess body condition at calving are at increased risk of ketosis and abomasal displacements. Both excessive and minimal feeding of concentrates pre-calving may increase the risk of abomasal displacements. Feed bunk management is an important risk factor for abomasal displacements. Inadequate bunk space, high competition at the feed bunk, restricted bunk access time, and restricted feed availability may limit intake. Poor environmental and social adaptation of transition cows may limit feed intake. Low feed intake may lower rumen fill, providing greater opportunity for migration of the abomasum. The importance of bunk management practices that limit feed intake in causing LDA is likely greatest during the early post-calving period, because of the coinciding events of the transition period. Feed delivery practices can alter the actual nutrient densities of the consumed ration relative to nutrient specifications of the formulated ration. Sorting of the TMR in the feed bunk can also cause this problem. Fiber densities of the consumed ration that are below minimum recommended allowances may result. Excess TMR mixing may grind coarse particles and cause a lack of fiber physical form. Transition programs and feed bunk management practices should be monitored closely when investigating LDA problem herds.

Introduction

Shaver (1997) published a review of nutritional risk factors for abomasal displacements. The purpose of this paper is to summarize the important findings from that review, update any new information, and discuss the management practices necessary for the prevention of abomasal displacements.

Abomasal displacements cause economic loss in dairy herds through treatment costs, premature culling, and production loss. Current treatment costs range from $100 to $200 per case and 10% of cows diagnosed with displaced abomasum are culled or die before the next test day. Treated cows that remain in the herd produce about 800 lb less milk the following month than cows without a displaced abomasum.

[1] Contact at: Department of Dairy Science, Room 280 Animal Sciences Building, 1675 Observatory Drive, University of Wisconsin, Madison, WI 53706, (608) 263-3491, FAX (608) 263-9412, Email: rdshaver@facstaff.wisc.edu.

Eighty to 90% of all abomasal displacements are left sided. Estimates in the literature of average incidence rates for left displaced abomasum (**LDA**) range from 1.4% to 5.8%. We (Pehrson and Shaver, 1992) reported an average LDA incidence rate of 5% (range 0 to 21.7%) from a survey of 71 commercial dairy herds with 5,742 cows. Jordan and Fourdraine (1993) reported an average LDA incidence rate of 3.3% (range 0 to 14%) from a survey of 61 high-producing commercial dairy herds averaging about 24,000 lb of milk per lactation.

Transition Period

Eighty to 90% of LDA are diagnosed within one month post-calving. Estimates in the literature of the proportion of LDA diagnosed within two weeks post-calving range from 52% to 86%. This denotes the transition period 2 to 4 weeks pre-calving through 2 to 4 weeks post-calving as the major risk period for LDA.

The transition period is characterized by intake depression pre-calving and slow intake ascent post-calving. Low feed consumption during the transition period is a risk factor for LDA through reduced rumen fill and increased incidence of other calving-related disorders. Low rumen fill may provide greater opportunity for migration of the abomasum. Decline of dry matter intake (**DMI**) is about 35% over the last week pre-calving and causes increased liver tri-glyceride immediately post-calving (Bertics et al., 1992). Concurrent calving-related disorders have been implicated as risk factors for LDA.

Post-Calving Disorders

Cows with uncomplicated ketosis, retained placenta, metritis or subclinical milk fever are at an increased risk of LDA. This suggests that feeding and management practices that prevent other calving-related disorders will reduce the risk of LDA.

Conversely, LDA has been found to increase the risk of other calving-related disorders. Cows with LDA are at increased risk of complicated ketosis and metritis. This suggests that feeding and management practices that prevent LDA will reduce the incidence of some other calving-related disorders. Ketosis and LDA are closely related calving-related disorders.

Body Condition Score

Cows with excess body condition score (**BCS**) at calving are at increased risk of LDA; incidence rates for cows (n=1401, 95 commercial dairy herds) with low (2.75 to 3.25), medium (3.25 to 4), and high (> or = 4) BCS at calving were 3.1, 6.3, and 8.2%, respectively (Dyk, 1995). This may be related to increased ketosis and fatty liver, greater pre-calving intake depression, and slower post-calving intake ascent for cows that are over-conditioned at calving.

Cows with excess BCS at calving were at increased risk of ketosis; incidence rates for cows with low, medium, and high BCS at calving were 8.9, 11.5, and 15.7%, respectively (Dyk, 1995). Higher ketosis incidence in cows with greater BCS at calving may have predisposed them to the higher observed incidence of LDA.

European workers (Garnsworthy and Topps, 1982) fed cows to a BCS (adjusted to a 1 to 5 scale) at calving of 2 to 3 (low), 3 to 4 (medium), and 4 to 5 (high) in two trials. During the first 16 weeks postcalving, cows with higher BCS at calving consumed less dry matter (**DM**) and reached maximum DMI later. Similar results were reported by (Treacher et al., 1986) using two groups of cows with BCS at calving of 3 and 5 (adjusted to a 1 to 5 scale).

Lead Feeding

Lead feeding, the practice of increasing concentrates during the last few weeks prior to calving, is a common practice on commercial dairies. Lead feeding energy and protein have been shown to lower the risk of LDA and ketosis (Curtis et al., 1985).

Coppock and co-workers (1972) fed total mixed rations (**TMR**) containing 75, 60, 45, and 30% forage (DM basis) to 40 Holstein cows from 4 weeks pre-calving through 4 weeks post-calving. No LDA were observed in cows fed the high forage diet. Incidence rates for LDA in cows fed the 60, 45, and 30% forage diets were 16.7, 40, and 36%, respectively. This study involved an abrupt switch to TMR with higher levels of concentrate at 4 weeks pre-calving rather than a gradual increase in the amount of concentrate fed during the last few weeks prior to calving. This abrupt dietary switch may have aggravated the LDA response to higher concentrate feeding, but it reflects lead feeding practices in commercial dairy herds feeding TMR.

European workers (Dirksen et al., 1985) reported that the ruminal papillae cross-sectional area declined when cows were placed on a low-energy dry cow diet reaching a low point 1 to 2 wk prior to parturition. The ruminal papillae cross-sectional area increased gradually after cows were placed on a high-energy lactation diet starting 2 wk prior to calving, but was not maximized until 6 to 8 wk post-calving. This suggests that capacity for ruminal VFA absorption is lowest during the transition period.

Minimal lead feeding pre-calving may increase the risk of acidosis and LDA through failure to increase the absorptive capacity of the ruminal papillae prior to the feeding of high-energy post-calving diets. Pre-calving adaptation of the rumen microbial population prior to the feeding of high-energy postpartum diets may also be important. Further, pre-calving concentrate lead feeding may increase energy intake and reduce fatty acid mobilization from adipose tissue, which may reduce the incidence of fatty liver and ketosis.

Both excessive and minimal lead feeding of concentrates pre-calving may increase the risk of LDA. After considering that intake depression during the close-up period results in a total DMI of 1.5% of body weight (**BW**), then guidelines for concentrate DM lead feeding of up to 0.75% of BW restricts the close-up TMR to 50% concentrate or less. This rate of concentrate feeding should allow for adequate ruminal conditioning along with sufficient energy intake to address the fat mobilization issue if a high-starch concentrate is supplemented. We recommend that pre-fresh diets be formulated for 0.70 to 0.72 Mcal of net energy lactation (**NE_L**) per lb of DM. Cameron et al. (1997) implicated pre-fresh diets with >0.75 Mcal NE_L per lb DM as a risk factor for LDA.

Another supplementation strategy being used in the field for pre-fresh cows is the feeding of high-fiber rather than high-starch concentrates. One Midwest-based feed company reports, from in-house research trials and field experiences, good success with their pre-fresh diet recommendation of 5 lb grass hay (as-fed basis) and 12 lb high-fiber concentrate (as-fed basis) with the rest of the diet from corn silage. There is a lack of published research data comparing high-starch concentrates versus high-fiber concentrates as supplements in pre-fresh diets. Fiber sources with high ruminal fermentability (i.e. soy hulls or beet pulp) should be used if the high-fiber concentrate supplementation strategy is employed. This approach may offer some advantages from the standpoint of LDA prevention, but research data are lacking.

Post-Calving Concentrate Feeding

A special TMR for early post-calving cows is becoming more common, especially on large commercial dairies. We do not recommend formulation of post-fresh diets with less than 21% neutral detergent fiber (**NDF**) from forage. Ohio State workers (Wang et al., 2001) compared post-fresh diets that contained 17%, 21%, or 25% NDF from forage. Milk production and DMI of post-fresh cows (first 30 days in milk) were highest on the 21% NDF from forage diet. We recommend 35% to 40% non-fiber carbohydrate (**NFC**; DM basis) in post-fresh diets. Whole cottonseed, soy hulls, and beet pulp are good ingredients for limiting starch concentrations in post-fresh diets. Whole cottonseed also contributes significant effective fiber. These recommendations should offer some advantages from the standpoint of LDA prevention, but research data are lacking. Dietary supplementation of sodium bicarbonate buffers the decline in ruminal pH that is observed post feeding (Erdman, 1988). This may help prevent laminitis and LDA. The recommended inclusion rate for sodium bicarbonate is 0.75 to 1.0% of TMR dry matter.

Hypocalcemia

From a study with 510 Holstein cows in a commercial dairy herd, Florida workers (Massey et al., 1993) reported that cows hypocalcemic at parturition (total serum calcium < 7.9 milligrams/100 milliliters and serum ionized calcium < 4.0 milligrams/100 milliliters) were at increased risk of LDA. This increased risk of LDA for cows that are hypocalcemic at calving may be due to reduced ruminal and abomasal motility (Goff and Horst, 1997). There may be a role for strategies to prevent hypocalcemia at calving, such as formulation of pre-calving diets for dietary cation-anion difference, in the prevention of LDA.

Ration Physical Form

Oklahoma workers (Dawson et al., 1992) reported that cows fed ground alfalfa hay (1/4" hammer-mill screen) and concentrate in a pelleted (1/8") experimental TMR starting at calving were at increased risk of LDA (17.4 vs. 1.6%) compared with cows fed the standard herd ration of sorghum silage (1/2" theoretical length of cut) and concentrate mixed plus loose alfalfa hay. Cows that developed LDA were diagnosed within 8 to 18 days post-calving.

These results demonstrate that an extreme alteration in ration physical form (i.e. pelleted TMR) during the early post-calving period increases LDA. Lack of physical form reduces chewing activity and ruminal fill, motility, and fiber-mat formation and increases ruminal VFA concentration, which all may play a role in causing LDA. The importance of physical form as a risk factor for LDA is likely greatest during the early post-calving period, because of the coinciding events of the transition period.

Data are lacking with regard to the impact of varying silage and TMR physical form within typical field ranges on the incidence of LDA. We recommend that transition diets should contain adequate coarse particles to support good chewing activity and rumen fill. Diets with 8% - 10% of particles on the top screen of the Penn State – Nasco shaker box are recommended for both pre-fresh and post-fresh cows. Inclusion of 3 – 5 lb. of hay in the TMR for transition cows can help meet this coarse particle recommendation. Sorting of the transition-cow TMR should be monitored closely.

Dry Cow Forages

A wide variety of forages are used for dry cows on commercial dairies, but data are limited regarding their impact on the incidence of LDA. Purdue workers (Zamet et al., 1979) reported LDA incidence rates of 1/29 (LDA/n), 3/30 and 3/30 for chopped hay, haycrop silage and corn silage dry cow forage programs, respectively.

Agway workers (Nocek et al., 1983) evaluated dry cow forage programs consisting of long hay, 50% long hay and 50% corn silage (DM basis), and corn silage DM restricted to 1% of BW plus 2.0 lb. liquid protein supplement per cow per day. Incidence rates for LDA were 3.0, 4.3 and 6.3% for hay, hay - corn silage and corn silage, respectively. Incidence rates for ketosis were highest for hay (9.1% vs. 6.3 to 6.4%). Higher incidence of LDA for corn silage may have been due to low rumen fill related to limit-feeding and lack of physical form. Higher incidence of ketosis for hay may have been due to lack of energy. The lowest incidence of LDA plus ketosis was observed for hay - corn silage (10.6% vs. 12.1 to 12.7%). It appears that all corn silage rations should not be fed to dry cows. If all corn silage rations are limit-fed, rumen fill may not be sufficient to prevent LDA. If they are not limit-fed, excess energy consumption may cause over-conditioning and associated metabolic disorders.

However, controlled use of corn silage as a component of forage programs for dry cows may be beneficial. We generally recommend limiting corn silage to 50% or less (DM basis) of the dry cow forage program. Corn silage comprised 50% to 80% (DM basis) of the close-up dry cow forage programs in the trials of Mashek and Beede (2000 and 2001) with LDA incidence rates of 4.3% vs. 8.3% for 3 vs. 6 week pre-fresh feeding periods (Mashek and Beede, 2001) and 7.5% vs. 10.3% for pre-fresh diets without or with corn grain supplementation. It is unknown whether feeding pre-fresh diets with a lower proportion of corn silage in the forage program would have reduced the incidence of LDA observed in these trials.

Transition Cow Environment

Bazeley and Pinsent (1984) reported that herds with a high incidence of laminitis tended to put cows through more abrupt changes at calving than low incidence herds. Although not evaluated in their field survey, the same relationship likely applies to LDA also. Their observation underscores the importance of specific feeding and management programs that allow prepartum and early postpartum cows to adapt gradually to social, environmental, and nutritional changes. Cow comfort, ventilation, and bunk management are especially important for transition cows.

Feed Bunk Management

Cameron et al. (1998) implicated feed bunk management as a risk factor for LDA. Feed bunk management is a risk factor for LDA through effects on feed consumption and actual nutrient densities of the consumed ration.

Feed analysis

Errors in nutrient delivery can occur because of errors in the nutrient composition assigned to feed ingredients. The use of tabular values for nutrient composition of feed ingredients can be a source of error.

Error in the nutrient analysis of feed ingredients can result from poor sampling technique on farm, infrequent feed sampling and testing, or inaccurate laboratory analyses. Variation in the layering of forages into bunker silos (i.e. alfalfa silage versus corn silage or silage of different qualities) and the relative uniformity of sample and feed removal from the face can lead to a discrepancy between the forage test and what is actually fed. Switching between silo bags before forage tests are received and a new ration is formulated can cause wide swings in nutrient delivery. To ensure consistent and accurate nutrient delivery, effort should be made to assess and control these sources of error.

Procedures are available to evaluate forage and TMR particle size in commercial testing laboratories (ANSI, 1988) or on farm (Lammers et al., 1996) and should be employed to evaluate physically effective fiber. Dietary NDF from forage should also be included in the evaluation of physically effective fiber.

Ingredient dry matter adjustments

Errors in nutrient delivery can occur because of failure to routinely determine the DM content of wet ingredients and adjust the rations accordingly to maintain correct and consistent DM proportions of ingredients. This is especially true for the DM proportion of forage to concentrate.

There may also be error in the on farm determination of DM content. Considerable care and time must be taken to drive off all of the water to reach a stable endpoint weight before calculating sample DM content when using microwave-oven and Koster-tester methods or DM content will be over-estimated.

Ingredient feeding rates

Errors in nutrient delivery can occur because incorrect amounts of ingredients have been added to the TMR. This can be due to an error in communication between the nutritionist, herd manager, and the feeder. More often it is due to a feeder that free lances from the formulated ration, attempts to cover up an error by adding more or less of another ingredient later on in the batch, or simply makes an honest mistake in batch preparation.

Computer programs (i.e. Easy Feed, Feed Watch, Dairy Tracker, and Feed Supervisor) are now available that lock the desired recipe for each batch in the scale, record the amount of each ingredient actually added to the batch, and record the total batch amount delivered to each pen. These programs have the potential to dramatically reduce the operator error that is associated with feed mixing and delivery. They can also help ensure batch to batch and day to day consistency of the TMR.

Feeding a partial TMR or some portion of the daily allotment of forage or concentrate separate from the mix can be a large source of variation in nutrient consumption among cows within a group. Adding forage to a set mixer volume rather than a scale weight can not be done accurately enough. Floating the amount of forage that is added to the batch mix depending on the amount of feed refusal is not accurate either.

Scale error can occur and the calibration of scales should be done routinely. Faulty scales should be either fixed or replaced.

Feed mixing

Incorrect and inconsistent TMR mixes can arise from mismanagement of the mixing process. Sampling the bunk mix and performing a nutrient and particle size analysis can assess this. Mixing error can occur for the following reasons:

- batch size too small (common problem with transition rations)
- batch size greater than the mixing capacity of the mixer
- trying to mix too much hay in the batch (this may also cause dispensing problems)
- improper sequencing of ingredients into the mixer
- under mixing or mixing for too short a period of time (causes inadequate mixing)
- over mixing or mixing for too long a period of time (causes unmixing of some ingredients and particle size reduction of the batch mix).

Feed delivery

Cows that slug feed the TMR may be more prone to laminitis and LDA. Cows with reduced DMI may be more prone to LDA. Factors that may cause slug feeding of the TMR or that may limit feed consumption include:

- limited bunk space
- limited feed access time
- restricted feeding versus feeding for 5% to 10% refusal
- inconsistent feeding schedule
- infrequent TMR push up
- bunk competition.

The combination of limited bunk space (< 1.5 feet per cow) and feed access time (< 16 to 20 hours per day) is worse than either situation alone. The use of lock-ups in situations of limited bunk space and feed access time exacerbates the problem, because each lock up and the cow in it takes up 2 feet of bunk space. When overcrowding of free stalls coincides with limited bunk space, as is often the case, the potential for laminitis is greater because cows may spend more time standing on concrete rather than lying in stalls (Colam-Ainsworth et al., 1989). Cows which develop laminitis would be expected to have reduced DMI, and therefore may be more prone to LDA. First lactation heifers fed in a separate group spent 10% to 15% more time eating and consumed 0.5 to 2.0 more meals per day than herdmates grouped with mature cows (Krohn and Konggaard, 1979). Bunk competition may play a role in laminitis and LDA.

Sorting

Armentano and Leonardi (1999) and Martin (1999) observed extensive TMR sorting in the feed bunk in university and on-farm trials, respectively. Data on particle size of TMR and orts (ANSI, 1988) and intake indicated that cows sorted against the coarse particles (Armentano and Leonardi, 1999). This was more evident for TMR containing 40% alfalfa hay than 20% (DM basis). The variation in sorting among cows was large. Martin (1999) determined particle size of the TMR and bunk mix (Lammers et al., 1996) at 6-hour intervals post feeding on a commercial dairy. The percents on the top screen of the Penn State – Nasco shaker box for the TMR and bunk mix at 6, 12, 18, and 24 hours post feeding were 9.3%, 13.7%, 21.5%, 27.5%, and 58.7%, respectively. Cows sorted against the coarse particles. From a projection of the coarse particle intake at each time period, it appeared that intake of coarse particles was less than predicted during hours 0 – 12 post feeding and more than predicted during hours 13 – 24 post feeding. An on-farm evaluation of sorting should include particle size determination (Lammers et al., 1996) of the TMR, bunk mix, and orts.

Factors that may make a TMR prone to sorting include:

- DM content of forage and mix
- particle size of forage and mix
- cobs in corn silage
- amount of hay added to mix
- quality of hay
- frequency of feeding
- bunk space
- feed access time.

If sorting is a problem, then one or more of the following may need to be considered:

- feeding smaller amounts of TMR more frequently
- adding less hay to the mix
- processing hay finer
- using higher quality hay
- using hay that is more pliable
- processing corn silage
- addition of water to dry TMR
- addition of a liquid-molasses product to TMR to tie up fines.

Summary

Herds with inadequate feeding and management programs for transition cows are at an increased risk of developing LDA. Over-conditioned cows are more likely to develop LDA. Feed bunk management is a risk factor for LDA. There is a myriad of errors in feed delivery and bunk management that can occur on commercial dairies to cause a variation in nutrient intake relative to the formulated ration. This variation is particularly evident for coarse particles that are prone to sorting in the feed bunk. Feed sorting may be a major risk factor for LDA, and merits investigation.

References

American National Standards Institute. 1988. Method of determining and expressing particle size of chopped forage materials by screening. ASAE S424.

Armentano, L., and C. Leonardi. 1999. Effect of different particle size, quality and quantity of alfalfa hay on selective consumption of dairy cattle. Pages 1-6 in Proc. UW Arlington Dairy Day. Arlington, WI. Dairy Sci. Dept., Univ. of WI-Madison.

Bazeley, K., and P. J. N. Pinsent. 1984. Preliminary observations on a series of outbreaks of acute laminitis in dairy cattle. Vet. Rec. 115:619-622.

Bertics, S. J., R. R. Grummer, C. Cadorniga-Valino, and E. E. Stoddard. 1992. Effect of prepartum dry matter intake on liver triglyceride concentration and early lactation. J. Dairy Sci. 75:1914.

Cameron, R. E. B., P. B. Dyk, T. H. Herdt, J. B. Kaneene, R. Miller, H. F. Bucholtz, J. S. Liesman, M. J. Vandehaar, and R. S. Emery. 1998. Dry cow diet, management, and energy balance as risk factors for displaced abomasums in high producing dairy herds. J. Dairy Sci. 81:132-139.

Colam-Ainsworth, P., G. A. Lunn, R. C. Thomas, and R. G. Eddy. 1989. Behavior of cows in cubicles and its possible relationship with laminitis in replacement dairy heifers. Vet. Rec. 125:573-575.

Coppock, C. E., C. H. Noller, S. A. Wolfe, C. J. Callahan, and J. S. Baker. 1972. Effect of forage:concentrate ratio in complete feeds fed ad libitum on feed intake prepartum and the occurrence of abomasal displacement in dairy cows. J. Dairy Sci. 55:783.

Curtis, C. R., H. N. Erb, C. J. Sniffen, R. D. Smith, and D. S. Kronfeld. 1985. Path analysis of dry period nutrition, postpartum metabolic and reproductive disorders, and mastitis in Holstein cows. J. Dairy Sci. 68:2347.

Dawson, L. J., E. P. Aalseth, L. E. Rice, and G. D. Adams. 1992. Influence of fiber form in a complete mixed ration on incidence of left displaced abomasum in postpartum dairy cows. JAVMA 200:1989.

Dirksen, G. U., H. G. Liebich, and E. Mayer. 1985. Adaptive changes of the ruminal mucosa and their functional and clinical significance. Bovine Pract. 20:116.

Dyk, P. B. 1995. The association of prepartum non-esterified fatty acids and body condition with peripartum health problems on 95 Michigan dairy farms. M.S. Thesis, Michigan State Univ., East Lansing.

Erdman, R. A. 1988. Dietary buffering requirements of the lactating dairy cow: A review. J. Dairy Sci. 71:3246-3266.

Garnsworthy, P. C. and J. H. Topps. 1982. The effect of body condition of dairy cows at calving on their food intake and performance when given complete diets. Anim. Prod. 35:113.

Goff, J. P., and R. L. Horst. 1997. Physiological changes at parturition and their relationship to metabolic disorders. J. Dairy Sci. 80:1260-1268.

Jordan, E. R., and R. H. Fourdraine. 1993. Characterization of the management practices of the top-producing herds in the country. J. Dairy Sci. 76:3247.

Krohn, C. C., and S. P. Kongaard. 1979. Effects of isolating first-lactation cows from older cows. Livestock Prod. Sci. 6:137-146.

Lammers, B. P., D. R. Buckmaster, and A. J. Heinrichs. 1996. A simple method for the analysis of particle sizes of forage and total mixed rations. J. Dairy Sci. 79:922-928.

Martin, R. 1999. TMR particle distribution analysis at six hour time intervals. Pages 7-16 in Proc. UW Arlington Dairy Day. Arlington, WI. Dairy Sci. Dept., Univ. of WI-Madison.

Mashek, D. G., and D. K. Beede. 2001. Peripartum responses of dairy cows fed energy-dense diets for 3 and 6 weeks prepartum. J. Dairy Sci. 84:115-125.

Mashek, D. G., and D. K. Beede. 2000. Peripartum responses of dairy cows to partial substitution of corn silage with corn grain in diets fed during the late dry period. J. Dairy Sci. 83:2310-2318.

Massey, C.D., C. Wang, G.A. Donovan, and D.K. Beede. 1993. Hypocalcemia at parturition as a risk factor for left displaced abomasum in dairy cows. JAVMA 203:852.

Nocek, J. E., J. E. English, and D. G. Braund. 1983. Effects of various forage feeding programs during the dry period on body condition and subsequent lactation health, production, and reproduction. J. Dairy Sci. 66:1108.

Pehrson, B. G., and R. D. Shaver. 1992. Displaced abomasum: Clinical data and effects of peripartal feeding and management on incidence. Page 116 *in* Proc. Am. Assoc. Bovine Pract. World Buiatrics Congress. St. Paul, MN. Am. Assoc. Bovine Pract., Stillwater, OK

Shaver, R. D. 1997. Nutritional risk factors in the etiology of left displaced abomasum in dairy cows: A review. J. Dairy Sc. 80:2449.

Treacher, R. J., I. M. Reid, and C. J. Roberts. 1986. Effect of body condition at calving on the health and performance of dairy cows. Anim. Prod. 43:1.

Wang, Z., M. L. Eastridge, and X. Qui. 2001. Effects of forage neutral detergent fiber and yeast culture on performance of cows during early lactation. J. Dairy Sci. 84:204-212.

Zamet, C. N., V. F. Colenbrander, R. E. Erb, C. J. Callahan, B. P. Chew, and N. J. Moeller. 1979. Variables associated with peripartum traits in dairy cows. II. Interrelationships among disorders and their effects on intake of feed and on reproductive efficiency. Theriogenology 11:245.