FEEDING FOR PRODUCTIVE LIFE

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Introduction

Dairy managers strive to improve profitability on their dairy farms. One challenge that limits profitability is shortened productive life of the dairy cow (less than three lactations). Higher culling rates (over 35 percent) and health disorders related to feeding programs. Three feed-related factors impacting productive life are listed below.

- Lameness
- Transition cow management
- Reduced reproduction performance

Productive Life and Lameness

Foot health or lameness has become the second most expensive disorder that dairy cattle experience (mastitis is first). Wisconsin researchers reported 73 cases per 100 cows in 30 herds (15 free-stall and 15 conventional herds averaging 23,060 pound of milk). The cost was estimated at $122 per cow with lameness, hairy heel wart at $88 per case, sole ulcers at $369 per case, and horn disease at $227 per case.

One approach to solving foot/hoof disorders is to evaluate three factors that contribute to hoof disorders and increase culling: genetics, cow comfort, and feeding. Cow factors included genetic selection of the foot (heel depth for example) and leg confirmation (set to the leg and correct leg position for example) can make the foot prone to lameness problems. The cow’s environment needs more attention. Cow comfort, walking distances (from parlor to pasture or resting area), free stall surface and space, rubber walking surfaces, presence of small stones, heat stress, expose to manure and mud, frozen surfaces, and concrete are examples that increase foot disorders.

Wisconsin researchers suggested two causes of lameness in dairy cows: infectious agents and laminitis/feeding. Infectious agents cause 58 percent of cases including foot rot disease and hairy heel warts. Laminitis (contributes 42 of the lameness) is an inflammation in the foot causing disrupted blood flow to the corium. Several causes of laminitis can be found in research reports and field observations.

- Blood histamine is increased after the death of gram-negative bacteria releasing endotoxin causing blood pooling in the claw. Protein degradation in the rumen also could contribute histamine.

- Based on equine research, rumen acidosis produces a toxin with activates a metalloproteinase (MMP) that breakdown bonds between the epidermis of the hoof wall and soft tissue in the corium leading to sole ulcers and white line abscesses.
- European workers suggest the production of lactic acids (strong acid) in the rumen due to low rumen pH shifting the rumen fermentation to rumen acidosis.

Subacute rumen acidosis (SARA) continues to be major factor in foot disorders as it can lead to laminitis. Factors that can lower rumen pH include high levels of rumen fermentable starch, unsaturated fatty acids, high dry matter intakes, slug feeding of grain (over 5 to 7 pounds of dry matter per meal), forages lower in natural buffering capacity (such as corn silage), forages that are processed too short reducing cud chewing, wet rations, high quality pasture, and feed sorting (both TMR or pasture systems).

Related feeding factors and recommended level to minimize the hoof risk are summarized. Recommended levels are expressed as percent in the total ration on a 100 percent dry matter basis in Table 1. Nutrients with direct relationships to foot health included sodium, chloride, potassium, calcium, phosphorous, cobalt, and magnesium.

Starch and sugar are key factors leading to lower rumen pH and acidosis. These carbohydrates can shift fermentation away from fiber digestion and increase levels of propionic and lactic acids. Grain particle size (finely ground), processing (steam flaking), and starch source (wheat v corn) impact the rate of fermentation. Sugars have faster rates of rumen fermentation (found in high quality pasture for example). Suggested starch levels in the total ration dry matter is 25 to 28 percent starch and 2 to 4 percent sugar.

Protein quality and quantity can impact lameness. High levels of degradable protein and total protein may lead to rumen fermentation products that can impact foot health.

Effective fiber maintains a rumen forage raft to optimize rate of passage and normal rumination (550 to 600 minutes of cud chewing activity daily). Rumen pH should be maintained above 5.9 (ideally 6.0 to 6.2). Five pounds of forage particles over one inch in length or 19 to 21 percent effective NDF are suggested.

Fats and oils can reduce fiber digestion and lower rumen pH due to depressing fiber digesting bacteria and lowering rumen pH. Unsaturated fatty acid can also changed to trans forms of the fatty acid if rumen pH is marginally low causing low milk fat tests. Limit added vegetable oil to 2.5 percent as oilseeds, free oil (not contained in the oil seed cell) to 225 gram per cow per day, and/or fish oil to 50 grams per day.

Copper can impact the claw by increasing the production of a copper enzyme, thiol oxidate, increasing hoof hardness. Cattle deficient in copper were more susceptible to heel cracks, foot rot, and sole abscesses. Suggested level of total copper in the ration dry matter is 10 to 15 ppm (1/3 from organic copper sources and 2/3 from inorganic copper sources). If total feed level of molybdenum is over 1 ppm, higher levels of supplemental copper will be needed.

Sulfur is needed for sulfur containing amino acids made by rumen bacteria (requires a ratio of 10 to 12 parts nitrogen to one part sulfur). Harder hooves have been reported with added sulfur in the ration.

Zinc improves claw integrity through wound healing, epithelium maintenance, and keratin synthesis and maturation. Pasture zinc levels vary with lowest levels in the spring lush growth period. Organic zinc can reduce somatic cell counts and increase milk production. Recommended levels in the total ration dry matter is 40 to 60 ppm (1/3 organic zinc sources and 2/3 inorganic zinc sources).

Biotin is needed for keratin formation and claw horn development leading to foot disorders during deficiencies in cattle and horses. Recent studies at the University of Wisconsin supported earlier work from Ohio State University that biotin increased milk yield by 4 to 6 pounds. Milk production increases were not related to hoof improvement due to the immediate milk response. The mechanism for higher milk yield may be related to its metabolic vitamin B function. Hoof improvement requires 6 to 12 months to observe a response. The recommended level of biotin is 20 milligram per cow per day at a cost 6 to 8 cents per day resulting in a benefit to cost ratio of six to one.

Productive Life and Transition Management

Transition cow feeding programs continue to be one "key" to high production, health, and cow longevity. A University of Illinois survey of thirty-one feed consultants and dairy veterinarians concluded transition cow feeding was the third most critical problem and opportunity seen on clientele's farms (following forage quality and feed bunk management).

Positive energy balance (EB) is critical for optimal cow health, minimal weight change, improved reproduction, and higher milk production. Illinois workers suggest that current energy needs for close up dry cows may be low. Close-up dry cows may require nearly 20 percent more energy related to fetal, colostrums, and mammary gland demand. However, dry matter intake can be dropping 10 to 30 percent as cows approach calving. If the environment factors (such as heat stress and cold weather) are not in the cow's thermal neutral range, energy maintenance needs can also increase 10 to 20 percent. Close up dry cow that do not drop in dry matter prior to calving had higher dry matter intake 21 days after calving has been reported by Wisconsin and Illinois researchers. Any management or ration factor that will maintain nutrient intake at calving is a positive for transition cows. The following transition cow strategies have been recommended by researchers, but consider the pluses and minuses of each program carefully.

Strategy One: Higher starch levels
Plus: Adding starch can increase rumen microbial digestion and stimulate dry matter intake along with energy-dense rations. Minus: Rumen acidosis and lactic acid build-up

could lead to off-feed and displaced abomasums.

Strategy Two: Adding wheat straw
Plus: Including 1 to 3 pounds of wheat straw can maintain rumen fill and pH, avoid empty rumen syndrome leading to DA, and maintain fiber digesting bacteria. Minus: Dry matter intake could be limited and slower rates of passage could shift rumen fermentation.

Strategy Three: Low energy-low intake dry cow rations
Plus: Placing far off dry cows on a restricted or lower energy ration can avoid heavy cows (leading to lower DMI). Minus: Cows could lose body weight leading to lower energy reserve and competition at the feed bunk could lead to variable feed intake within the dry cow group.

Strategy Four: Building on high corn silage rations
Plus: Feeding higher levels of corn silage (10 to 15 pounds of dry matter) in the close up ration may increase dry matter intake, raise forage quality, reduce diet potassium levels, improve ration palatability and stability, and increase fermentable starch in the rumen. Minus: Forage particle size could limit rumen fill and lead to displaced abomasums.

Strategy Five: One dry cow group
Plus: Maintaining the same dry ration prior to calving to avoid social and group changes leading to lower feed intake and transition cows more smoothly. Minus: Key additives can not be added that may increase blood calcium and glucose and shifting to a fresh cow ration may lead to acidosis and displaced abomasums.

Strategy Six: Three transition cow groups
Plus: Feed a series of rations (far-off dry cow, close-up dry cow, and fresh cow), increases nutrient intake gradually allowing for cows to step up nutrient concentration by less than ten percent changes in absolute nutrient concentration. Minus: Constantly moving cows may impact competition and lower feed intake. Several housing and feeding locations that are convenient to the milking parlor and calving area are needed.

Strategy Seven: Anionic products
Plus: Adding an anionic product improves blood calcium levels, reduces the risk of hypocalcemia, DMI increase, and fewer DA due to improved smooth muscle contraction. Minus: Higher feed cost, lower feed intake, and a lack of response first springing heifers lower economic and health benefits.

Strategy Eight: Using by-product feeds
Plus: Adding high fiber digestible by-product feeds can increase feed intake, maintain nutrient intake, and lower dietary potassium levels. Minus: Higher feed costs with more “out-of-pocket” feed costs. Also requires a close-up group of cows.

Strategy Nine: Specific close-up and fresh cow heifer group

Plus: Springing heifers have higher nutrient needs while consuming less dry matter. Heifers are also less competitive after calving when combined with older cows. Minus: Housing and feeding facilities may not be available and herd size limits it implementation.

Higher levels of crude protein and rumen undegradable protein (RUP) prepartum have resulted in mixed and variable results. In some research studies, reproductive performance and higher levels of milk protein were reported. Milk yield has not been improved with higher protein intakes. Supplementation of first limiting amino acids may be beneficial when fed before and after calving. Higher levels of crude protein have lower dry matter intake. Feeding excess crude protein could be problem because the liver may not be able to detoxify excess ammonia related to fatty liver development. The following guidelines can be considered with close up dry cows.

- Mature cows need a ration containing 12 percent crude protein cow.
- Pregnant heifers need a ration containing 14.3 to 15 percent crude protein.
- If dry matter intake is reduced below anticipated levels, higher level of protein maybe needed.
- When increasing crude protein levels in the close-up dry cow ration, the source of RUP and its amino acid profile should be considered.
- Protected amino acids maybe beneficial in close-up rations based on amino acid model predictions and accurate feed analysis.
- Stimulating microbial growth should improve amino acid supply to the close-up dry cow.

Productive Life and Reproduction

Reproduction is impacted by heat detection, conception rate, cow comfort, and other management factor. Feeding can also impact reproductive performance. The following check list may be helpful to minimize the risk of feeding having a negative impact on overall reproductive performance.

- Negative energy balance is clearly a reproduction risk including excessive weight loss, reduction on follicular structures, and impact on reproductive hormones. Increasing energy density, dry matter intake, and rumen microbial fermentation can reduce energy loss. Cow should be in positive energy balance by week 4 to 6 (increasing body condition scores, lowering NEFA or non-esterified fatty acid, normalizing milk fat tests, and positive response to injected BST).
- High levels of protein can reduce conception related to higher levels of nitrogen compounds in the blood and uterine fluids, need to convert excessive ammonia to urea, or negative impact on immune function. MUN can be a useful field tool to monitor protein utilization (MUN values over 18 to 20 may reduce fertility)

Table 1. Illinois nutrient recommendations for dairy cows in different stages of lactation and gestation.

	Dry Cow		Fresh	Milk Cows		
	Early	Close-up	0 to 21d	Early 22 to 80d	Middle 80 to 200d	Late >200d
DMI (lbs)	30	22	>35	53	48	44
Crude Protein(CP)%	12	Cows 12 – 13 Heifers 14 – 15	19	18	16	14
Metabolizable Protein (%)	6.0	8.0	13.8	11.6	10.2	9.2
*RDP:% of CP (DM)	70 (8.4)	60 (10)	60 (11.4)	62 (11.2)	64 (10.2)	68 (9.5)
RUP:% of CP (DM)	30 (3.6)	40 (5)	40 (7.6)	38 (6.8)	36 (5.8)	32 (4.5)
SIP:% of CP(DM)	35 (4.2)	30 (4.5)	30 (5.7)	31 (5.60	32 (5.10	34 (4.8)
TDN%	60	67	75	77	75	67
NE_L(Mcal/lb)	0.63	0.69	0.78	0.80	0.78	0.69
Ether Extract %	2	3	4	5.5	5	3
ADF%	30	24	21	19	21	24
NDF%	40	35	30	28	30	32
*NFC%	30	34	35	38	36	34
*Ratio of NFC to DIP (%of DM) =3.5:1 **Major Minerals in % of DM**						
Calcium (Ca)	0.60	0.7 (*1.0)	1. 0	0.90	0.70	0.60
Phosphorous (P)	0.26	0.30	0.40	0.38	0.36	0.32
Magnesium (Mg)	0.16	0.4	0.33	0.30	0.25	0.20
Potassium (K)	0.65	0.65	1.00	1.00	0.90	0.90
Sodium (Na)	0.10	0.05	0.33	0.30	0.20	0.20
Chlorine (Cl)	0.15	0.15 (*0.8)	0.30	0.25	0.25	0.25
Sulfur (S)	0.16	0.2 (*0.4)	0.25	0.25	0.22	0.22
When anionic salts are used: mineral/anionic salts (%) **Vitamins in IU per Day**						
Vitamin A	100,000	100,000	100,000	100,000	50,000	50,000
Vitamin D	25,000	30,000	30,000	25,000	20,000	20,000
Vitamin E	1,000	2,000	2,000	1,000	600	400

a. Trace minerals: iron (150 ppm), cobalt (0.1 ppm), copper (15 ppm), manganese (60 ppm), zinc (60 ppm), iodine (0.6 ppm), and selenium (0.3 ppm).
b. Ratio of minerals in total ration: zinc to copper 4:1, iron to copper 40:1, potassium to magnesium 4.5:1, copper to molybdenum 6:1, potassium to sodium 3:1, nitrogen to sulfur 11:1