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Fecal Starch – What Do We Know?

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A potential tool that can be used in evaluating milk production in dairy cattle is fecal starch values. This area has received attention in the last few years as an index of starch and energy utilization in dairy rations. Typically, 5 to 10 fecal samples are collected per group, composited, mixed and a sample sent to a lab for analysis. It is important to obtain fresh fecal samples that are not contaminated with urine, bedding, etc. Analytical cost is $15 – 20 per sample. The following points summarize our current understanding of the use of fecal starch analysis in dairy herds:

1. A trial was done by Dr. Jim Ferguson at the University of Pennsylvania using 72 feed and fecal samples from 8 herds. He reported that a 1 percent change in fecal starch content was equal to 0.72 lbs. of milk production. Fecal starch ranged from about 1 to 12 % in these samples.
2. A strategy for use and interpretation of fecal starch values is:
   a. < 3% on a dry matter basis = No need for additional investigation.
   b. 3 – 5% - Apparent total tract starch digestibility is probably > 90%. May be some opportunity to adjust rations or management some.
   c. >5% - Evaluate individual feeds, rations and feeding management.
3. The University of Illinois reported results of a field survey using 19 Holstein herds. Fecal starch averaged 6% with a range of 3.9 to 9.9%. The calculated starch digestibility was 84.6% (range was 70 to 96%) using the University of Pennsylvania equation. Fecal starch and fecal NDFD were the 2 variables that were statistically correlated with calculated starch digestibility.
4. A number of labs have summarized and reported fecal starch values from submitted samples. These include:
   a. Dairyland Labs –
      i. 50% were < 3% fecal starch.
      ii. 20% were 3 – 5% fecal starch.
      iii. 28% were > 5% fecal starch.
   b. Cumberland Valley (1420 samples) –
      i. Range was 0.2 to 36.9% fecal starch.
      ii. 62% were < 5% fecal starch.
5. A Vita Plus survey of 71 herds found that 32% of the fecal starch samples were > 5% starch.
6. There are a large number of factors that can influence fecal starch values. These include:
   a. Poorly processed corn silage – In the Vita Plus survey, herds with a corn silage processing score (CSPS) > 60 had an average fecal starch score of 4%. Those with a CSPS <50% had a fecal starch value of 6.7%. This indicates lower

starch utilization in herds feeding poorly processed corn silage. CSPS scores from 50 to 70 are considered to be adequately processes while > 70 is optimally processed.

b. Corn silage moisture content – In the Vita Plus survey, herds feeding corn silage < 35% DM had a fecal starch score of 3. Fecal starch was 6.8% in herds feeding corn silage > 35% DM.
c. Time in storage – Fecal starch was 3.9% in herds feeding corn silage that had been stored > 4 months in the Vita Plus survey. In herds feeding corn silage that had been stored <4 months, fecal starch was 6.4%.
d. Ration starch level - The work at the University of Pennsylvania indicated a very poor relationship between ration and fecal starch levels.
e. Other factors – There are a large number of other factors that can alter fecal starch levels. These include corn grain particle size, ration NDF and NDFD level, feeding management dry matter intake and rate of passage.

Summary:

Fecal starch analysis is another tool that may be helpful in evaluating dairy herd performance or in problem solving situations. The first step is to evaluate manure in a herd by visual observation for consistency, fiber particles and grain particles. The visual observation may be adequate as a base for making feed and feeding management changes. Fecal analysis provides some quantitative data that can be used in conjunction with your visual appraisal of the manure.

Dairy Nutrition Fact Sheet
October, 2013 (Revised)

Using Small Grain Silages in Dairy Rations

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There has been increased interest in using small grain silages in New York dairy rations in the last couple of years. One reason is the use of small grains as emergency or supplemental forages in years with low hay crop or corn silage yields. A second reason is the increasing use of small grain forages as cover crops that are planted after corn silage harvest and then harvested as a silage crop in the late spring before other crops are planted. This use can increase the total tons of home produced forage available for use in feeding the dairy herd and allow more manure nutrients to be applied as part of a nutrient management plan.

A key consideration is the nutrient composition of the small grain silages. Table 1 contains data from the Dairy One Forage Lab feed composition library. It is important to note that these are the average values for each small grain. There is a wide range in nutrient composition within forage type. As an example, the "normal range for crude protein in the triticale samples analyzed ranged between 12.9 and 19.4%. This range represents about 67% of the total samples analyzed. NDF ranged from 50.4 to 60.4% while NDF digestibility (NDFD) was between 57.8 and 68.2%. This variation emphasizes the need to have specific samples analyzed rather than using "average" values in formulating rations.

Three triticale samples from the Cornell T&R Center were sent to Dairy One for analysis. These samples ranged from 13.9 to 17.8 % CP and 49.4 to 61.6% NDF. These changes in composition were related to stage of maturity at harvest. The 30-hour NDFD of the sample with 49% NDF was 75% which is very high. Bill Verbeten from the Northwest New York Dairy, Livestock and Field Crops Team sent 8 samples of first cutting triticale to the Rock River Lab in Wisconsin. These samples ranged from 12.8 to 16.7% CP and 49.8 to 62.4% NDF. These samples were obtained from bunker silos after going through fermentation. Soluble protein ranged from 54 to 78% of CP. Silage pH values were between 3.96 and 4.68. Lactic acid values were between 3.4 to 8.18% of DM. Acetic acid ranged from 0.67 to 2.46% of DM. These values indicate that the triticale silages were generally well fermented.

These silages are most often used as a partial replacement for corn silage. In general, these small grains are higher in crude protein and NDF but lower in starch content and energy value than corn silage. Early cut small grain silages can have energy values similar to corn silage since lignin content is low and NDF digestibility is high. However, the energy value drops rapidly as maturity increases.

Table 1. Nutrient Composition of Small Grain Silages [a]

Item	Oats	Rye	Wheat	Triticale
Number of Samples for Dry Matter	835	630	954	387
Dry matter, %	32.9	40.17	35.1	34.5
Crude protein, % of DM	13.18	14.3	12.2	14.6
Soluble Protein, % of CP	65.17	60.55	71	72.3
ADF, % of DM	38	37.9	36.6	37.6
NDF, % of DM	58.4	58.37	55.8	58
Lignin, % of DM	5.15	4.74	4.76	4.59
Simple Sugars, % of DM	5.2	6.78	6.16	5.5
Starch, % of DM	3.4	1.6	8.4	2.06
NFC, % of DM	15.7	15.76	19.8	13.6
Fat, % of DM	3.7	3.8	3.3	3.6
Ash, % of DM	10.9	10.6	10.8	12.2
NE-l, Mcal/lb.	0.57	0.57	0.58	0.56
NDFD, 30 hour, %	60.9	65.1	59.9	64.2
Ammonia-N, % of total N	15	10.1	11.4	8.8
pH	4.67	5.1	4.45	4.5
Lactic acid, %	5.24	3.2	5.26	6.38
Acetic acid, %	3.16	1.95	2.79	1.88
Butyric acid, %	0.77	0.77	0.36	0.19
Calcium, %	0.41	0.48	0.34	0.39
Phosphorus, %	0.33	0.35	0.3	0.35
Magnesium, %	0.18	0.19	0.14	0.16
Potassium, %	2.65	2.85	2.33	3
Sulfur, %	0.19	0.21	0.18	0.2
Sodium, %	0.22	0.22	0.09	0.07
Chloride, %	0.93	0.89	0.8	1

[a] Source: Dairy One Forage Lab, samples analyzed between May, 2012 and April, 2013

A research trial was conducted at The Ohio State University comparing rations containing triticale silage, a commercial mixture of sorghum, soybeans and peas, alfalfa silage or corn silage for dairy cows. The triticale was planted after corn silage harvest and harvested in the boot stage the following May. The forage mixture was planted in the same field in June and harvested in August. Dry matter yields per acre were 1.8 tons for triticale and 5.3 tons for the commercial forage mixture. Rations were formulated for mid-lactation cows to have equal contents of CP, NDF and NFC. Table 2 contains the nutrient composition of the forages fed, Table 3 contains ration information and Table 4 contains the animal performance results. Cows fed the alfalfa and corn silage ration had higher dry matter intakes than cows on the other rations. However, there were no differences in milk production or milk components between the three rations. Ration dry matter digestibility was also not different between these rations. The pounds of concentrate dry matter fed were higher for cows on the triticale (2.4 lbs.) and forage mixture (8.4 lbs.) rations. The authors concluded that triticale silage and the sorghum mixed silage were acceptable for use in dairy rations. However, these forages required additional concentrate when compared with an alfalfa-corn silage based ration.

Table 2. Nutrient composition of forages fed (dry matter basis)

Nutrient	Corn silage	Alfalfa silage	Triticale	Forage mixture [a]
DM, %	36.7	60.6	28.4	37
CP, %	8.1	20.4	16.7	11
NDF, %	40.9	42.9	52.9	62.3

[a] Forage mixture was 71% sorghum, 18% soybeans and 11% peas on a dry matter basis.

Table 3. Ration Composition and Nutrient Content

Item	**Control Ration**	**Triticale**	**Forage Mix**
Ration Ingredients, % of DM			
Corn silage	28	-	-
Alfalfa silage	21	-	-
Triticale	-	39	-
Forage mix	-	-	29
Corn grain	27	40.2	43.5
Soybean meal	7.2	3.9	9.6
Soyhulls	6.6	5.7	6
Roasted soybeans	4	4	4
Distillers grains	3.3	3.6	4
Molasses	0.9	1.1	1.3
Mineral mix	2	2.5	2.6
Ration nutrient composition, % of DM			

CP, %	16.4	15.7	16
NDF, %	32.1	32.7	31.5
Forage-NDF,%	20.5	20.6	18.4
NFC,%	40.5	40.7	41.2

Table 4. Dry Matter Intake, Milk Production and Milk Composition

Item	Control Ration	Triticale	Forage Mix
DMI, lbs./day	50.3	45.9	47.6
Milk, lbs./day	65.1	64.2	64.1
Milk fat, %	3.25	3.32	3.25
Milk total protein, %	3.21	3.17	3.18
3.5% FCM, lbs./day	62.4	62.3	61.5

A trial conducted at the University of Alberta compared barley/triticale and field pea/triticale silages with alfalfa silage in dairy rations. The alfalfa silage used was 17.5% CP and 49% NDF. The CP was 16.1% for the barley/triticale silage while NDF was 54%. High and low protein mixes of the field peas/triticale silages were used. These contained either 15.6 or 12.7% CP while both were 50% NDF. The rations fed were 60% forage and 40% grain on a DM basis. The forage component of the rations was 25% alfalfa hay and 75% of alfalfa silage or one of the mixes containing triticale. Table 5 contains the results from this trial. Milk production, 4% FCM and milk protein were not different between treatments in this trial. Milk fat yield was highest for cows fed the high protein field peas/triticale silage mixture.

Table 5. Dry Matter Intake, Milk Production and Milk Composition in Cows Fed Silage Based Rations

Item	**Alfalfa Silage**	**Barley/Triticale**	**Field Peas/Triticale (High CP)**	**Field Peas/Triticale (Low CP)**
DMI, lbs./day	47.5^{ab}	45.1^{b}	44.9^{b}	50.4^{a}
Milk, lbs./day	74.6	73.7	73.3	69.1
4% FCM, lbs./day	66.4	69.3	66.7	60.7
Milk Fat, %	3.39	3.72	3.5	3.36
Milk Fat, lbs./day	2.4^{ab}	2.57^{ab}	2.71^{a}	2.29^{b}
Milk Protein, %	3.27	3.29	3.27	3.32
Milk Protein, lbs./day	2.37	2.44	2.44	2.31

$^{A, B}$ Means in a row with different superscripts differ (P<.05)

Summary:

Small grain silages can be used in rations for dairy cattle and replacement dairy heifers. The key factor is an actual analysis of the specific crop to be fed on the farm due to the variation that exists both within and between forage types and stage of maturity. This information will permit rations to be formulated using the procedures typically used by the feed professional working with the farm. Some additional grain may be needed to account for the lower starch and NFC content of these silages.

Sources of Information:

Weiss, W.P., M. E. Koch and T.E. Steiner. Comparison of diets based on triticale silage, sorghum, soybean and pea silage or alfalfa and corn silage when fed to dairy cows. The Ohio State University, Animal Sciences Research and Reviews, Special Circular 156. http://ohioline.osu.edu/sc/sc156/sc156_29.html. Accessed 6/10/2013

Khorasani, G. Reza and J.J. Kennelly. 1997. Optimizing cereal silage quality. Poc. Western Canadian Dairy Seminar. http://www.wcds.ca/proc/1997/xh19-97.htm. Accessed: 5/27/2013.

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Transition cow updates and fresh cow feeding strategies

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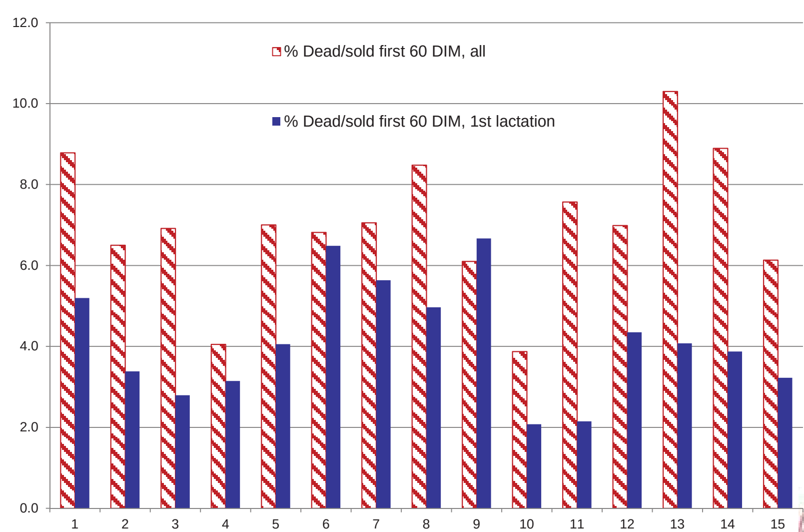
Current field study (Overton, Burhans, and Nydam) Funding partners: NY Farm Viability Institute, USDA Multistate Hatch, Poulin Grain Inc)

- Objectives:
  - Identify relationships between dry period nutritional strategy, fresh period nutritional strategy, and postpartum outcomes related to health, milk yield, and reproduction.
  - Determine if interactions exist between dry period nutritional strategy, fresh period nutritional strategy, and biomarkers related to the above postpartum outcomes on commercial dairy farms (focus on NEFA, BHBA, and haptoglobin)
  - Identify relationships of nonnutritional factors affecting cows during the dry period and early lactation (stocking density, commingling of cows and heifers, pen moves) with postpartum health, milk yield, reproduction, and biomarkers related to these outcomes on commercial dairy farms.

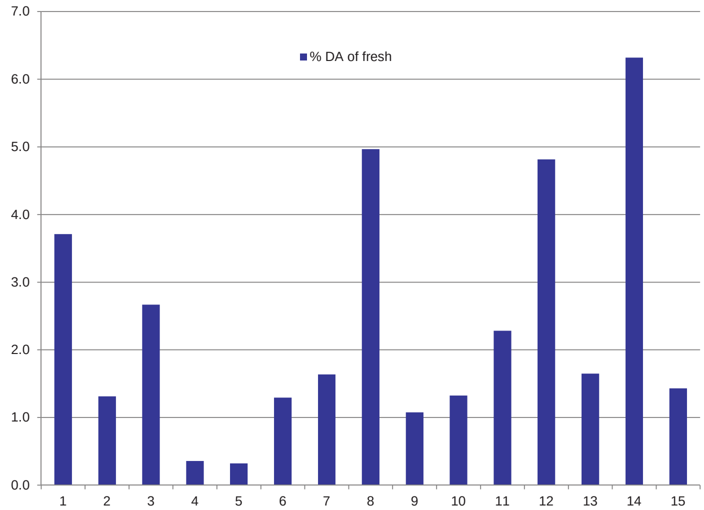
General study approach

- 72 herds total across four nutritional management categories
  - Controlled energy one-group dry, fresh cows fed high diet
  - Controlled energy one-group dry, fresh cows fed fresh diet first
  - Step up (two-group) dry, fresh cows fed high diet
  - Step up (two-group) dry, fresh cows fed fresh diet first
  - High energy one/two group dry, fresh cows fed high diet
  - High energy one/two group dry, fresh cows fed fresh diet first
- Will follow cohort of cows (24 per herd) through dry period and early lactation
  - BCS, lameness, calving score, blood biomarkers, metabolic disorders, milk production, reproduction
  - TMR analyses and particle size as cows move through different groups/stages

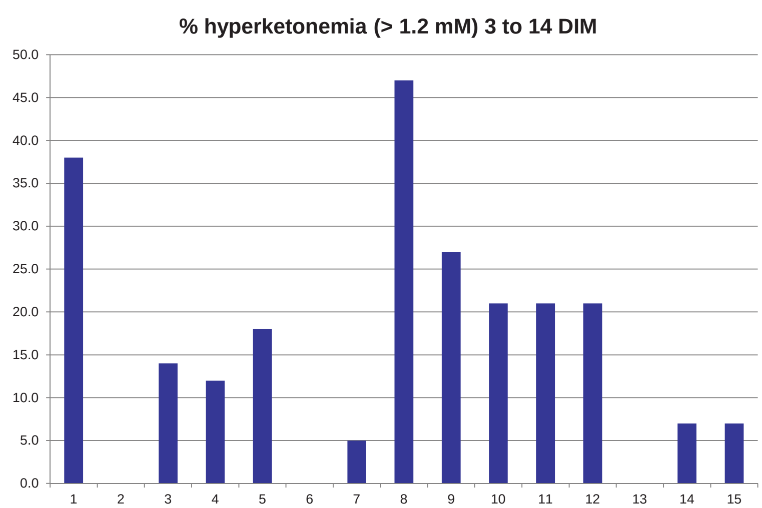
15-farm summary – Cull/death rates first 60 DIM



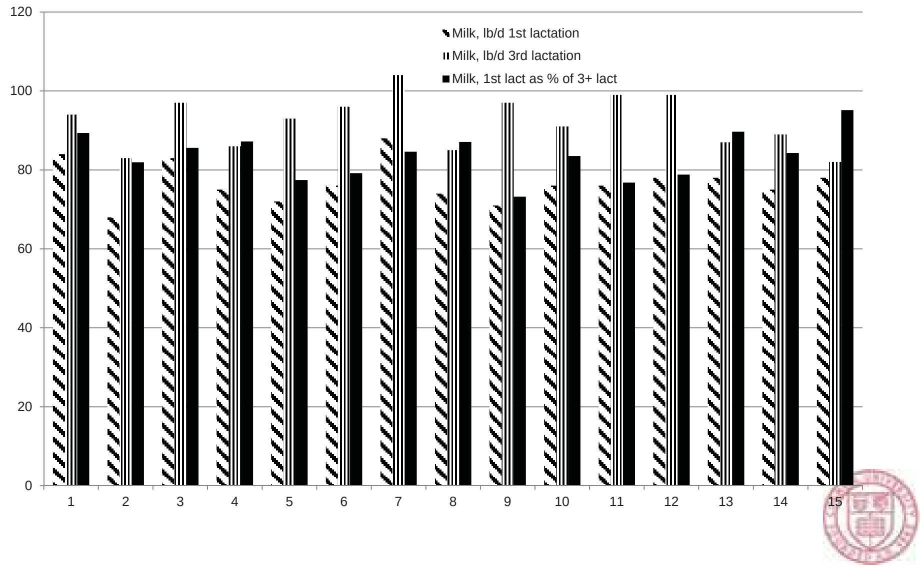
15-farm summary – DA rates (% of calvings)



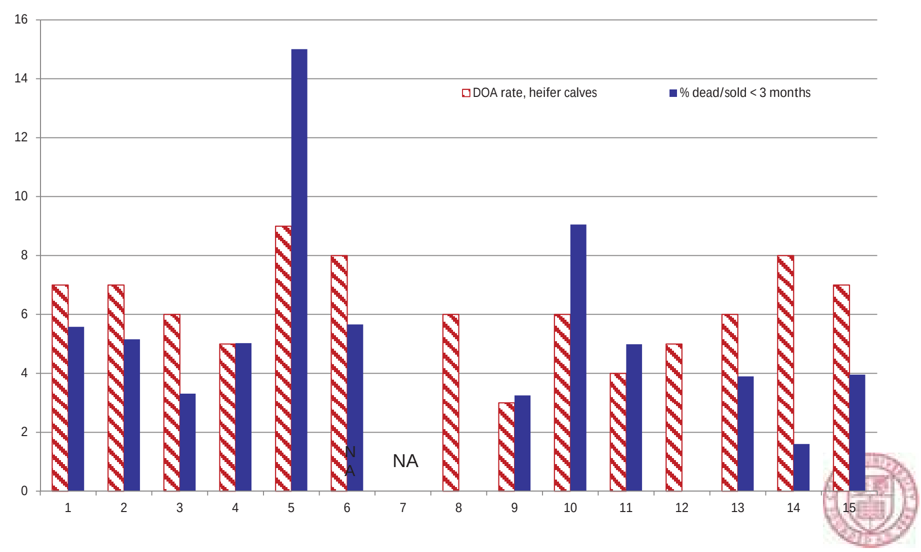
15-farm summary – hyperketonemia (BHBA > 1.2 mM) for 3 to 14 DIM



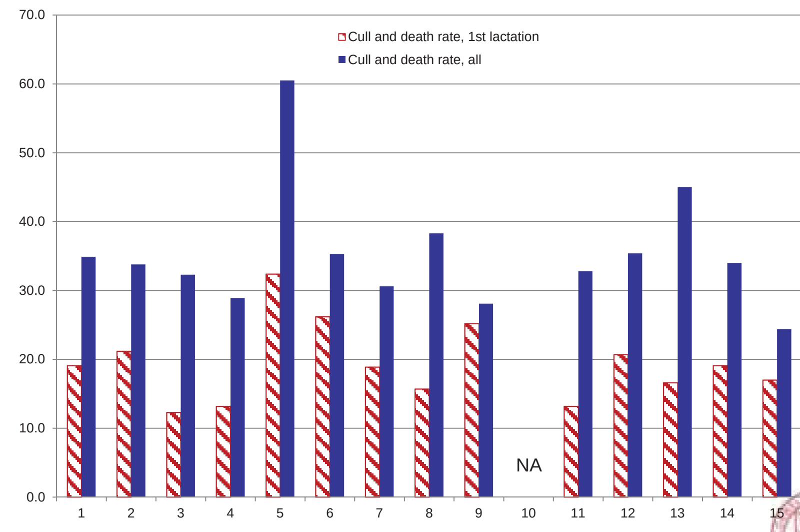
15-farm summary – average daily milk yields in 1st lactation and 3+ lactation cows



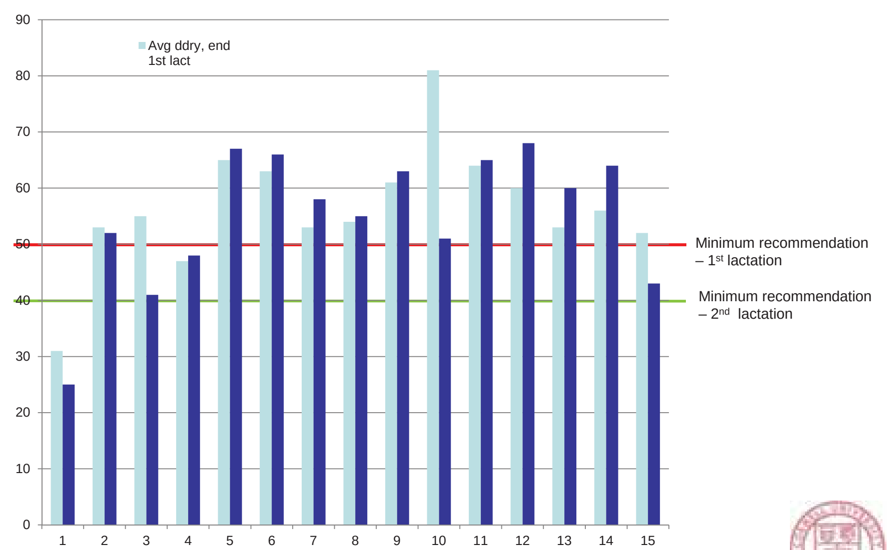
15-farm summary – average stillborn rates and calf death/cull rates first 3 months of age



15-farm summary – cull and death rates for 1st lactation animals and overall lactating herd



15-farm summary – average days dry for 1st lactation and 2+ lactation cows



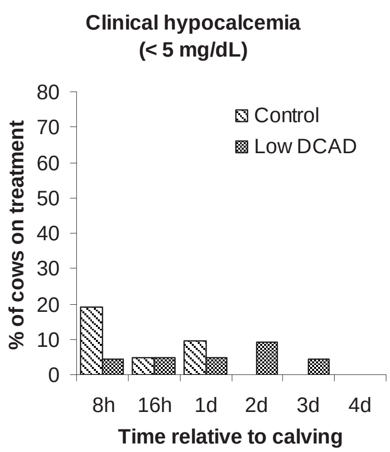
A few topics for today

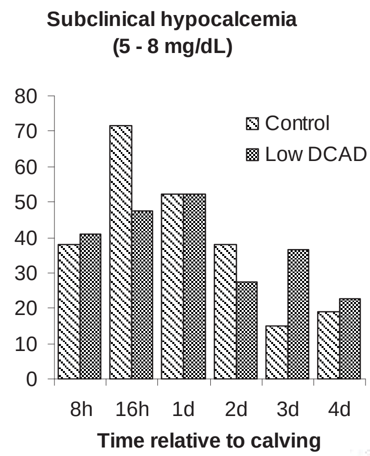
- What are some ways we can assess metabolism opportunities in transition cows at the herd-level?
- How should we approach energy/carbohydrate nutrition in transition cows?
- What are the opportunities for trace mineral nutrition during the transition period?

Challenges with assessing herd-level metabolism and inflammation-related opportunities in transition cows

- Most of dairy industry works on averages
- Challenges related to energy/grouping mgt/nonnutritional factors cause increases in ***variation*** in DMI/performance/metabolism
  - Almost impossible to detect some of these on farms
- Potential tools for use in monitoring variation in transition cow management
  - Calcium (getting renewed attention)
  - NEFA (best marker for negative energy balance)
  - BHBA ("gold standard" blood ketone)
  - Haptoglobin (acute-phase response/systemic inflammation)
  - Fecal cortisol metabolites? (likely research tool rather than herd use)
  - Rumination monitors? – other electronic monitoring?
  - Variation in early lactation milk yield

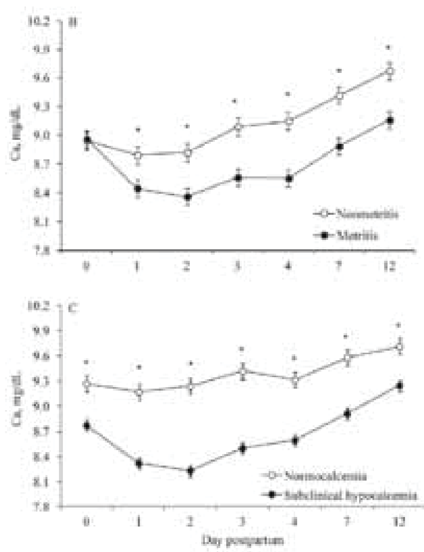
Hypocalcemia incidence analysis





Ramos-Nieves et al., 2009

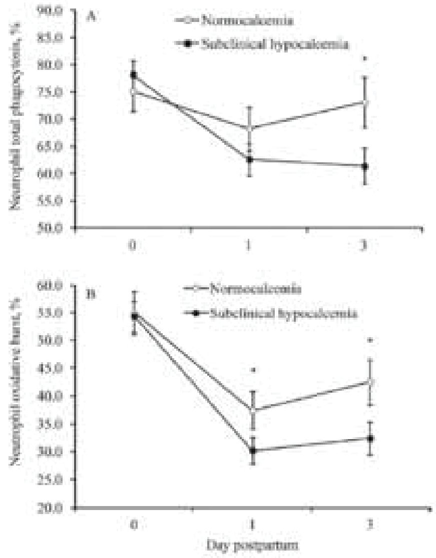
Cows with metritis have lower blood Ca concentrations



Martinez et al., 2012. J. Dairy Sci. 95 :7158–7172

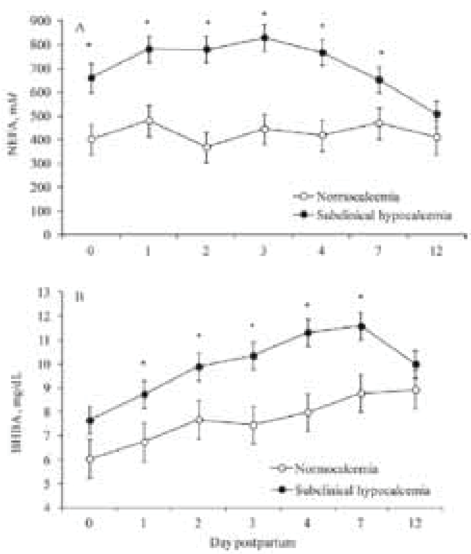
Subclinical hypocalcemia defined as one or more samples with Ca < 8.6 during first 3 DIM

Cows with subclinical hypocalcemia have impaired immune function



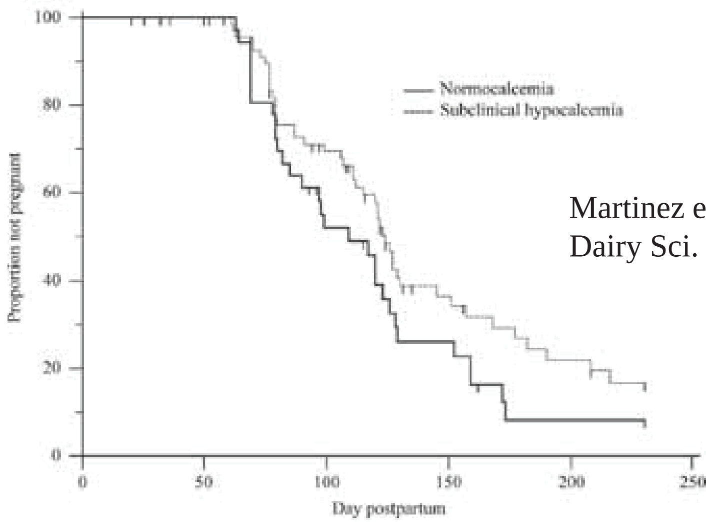
Martinez et al., 2012. J. Dairy Sci. 95 :7158–7172

Cows with subclinical hypocalcemia have higher NEFA and BHBA



Martinez et al., 2012. J. Dairy Sci. 95 :7158–7172

Cows with subclinical hypocalcemia have delayed reproduction



Martinez et al., 2012. J. Dairy Sci. 95 :7158–7172

Chapinal et al., 2012. JDS 95:5676-5682

- 55 herds in US and Canada
- Cows sampled 1X/wk from wk -1 to wk +3 relative to calving
- Median number of cows sampled/herd – 36
- 27% of animals sampled were first lactation
- Focus on Ca, NEFA, and BHBA

Herd-level associations of low Ca during wk +1 (< 2.1 mM; 8.4 mg/dL) with outcomes

Item	Herd-level threshold (%)	Farms above threshold (%)	Outcome	P-value
DA (all cows)	≥ 35	24	OR = 2.4	0.003
DA (multiparous)	≥ 30	43	OR = 1.9	0.004
Milk[1] (all cows)	≥ 15	73	- 3.8 kg/d	0.01
Milk (multiparous)	≥ 25	55	- 2.9 kg/d	0.05
Pregnancy 1st AI (all cows)	≥ 25	40	OR = 0.7	0.02

[1] At 1st DHI test day

Chapinal et al., 2012. JDS 95:5676-5682

Prevention of hypocalcemia

- Manage/decrease dietary cation-anion difference (DCAD) of prepartum diet
  - *$(Na^+ + K^+) - (Cl^- + S^{-2})$*
  - *most commonly used equation*
  - *shifting the balance of this equation toward the right helps cow absorb Ca from intestine and resorb from bone*

Major strategies for application of DCAD for close-up dry cows

- Focus on feeding low K (and Na) forages and feeds to close-up dry cows
  - *Calculated DCAD ~ +10 mEq/100 g of DM*
  - *Urine pH ~ 8.3 to 8.5*
- Feeding low K forages along with partial use of anionic supplement in close-up ration or one-group dry cow ration
  - *Calculated DCAD ~ 0 mEq/100 g of DM*
  - *Urine pH ~ 7.5*
- Feeding low K forages along with full use of anionic supplement in close-up ration or one-group dry cow ration
  - *Calculated DCAD ~ -10 to -15 mEq/100 g of DM*
  - *Urine pH ~ 6.0 to 7.0 – need to monitor weekly and adjust DCAD supplementation if < 6.0*
- Need to supplement Mg (dietary target 0.40 to 0.45%) during close-up
- Recommend supplementing Ca (0.9 to 1.0% if low K only; 1.2 to 1.4% if full anionic diet)

J. Dairy Sci. 93:546–554
doi:10.3168/jds.2009-2277

Evaluation of nonesterified fatty acids and β-hydroxybutyrate in transition dairy cattle in the northeastern United States: Critical thresholds for prediction of clinical diseases

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J. Dairy Sci. 93:1596–1603
doi:10.3168/jds.2009-2852

Associations of elevated nonesterified fatty acids and β-hydroxybutyrate concentrations with early lactation reproductive performance and milk production in transition dairy cattle in the northeastern United States

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J. Dairy Sci. 93:3595–3601
doi:10.3168/jds.2010-3074

Association between the proportion of sampled transition cows with increased nonesterified fatty acids and β-hydroxybutyrate and disease incidence, pregnancy rate, and milk production at the herd level

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Materials and Methods

- **Convenience sample of herds**
  - Visited by study personnel
  - <10% of herds submitted by veterinarians
- **Cross-sectional sampling**
  - ~15 cows 2 to 14 days prior to calving sampled/herd
  - ~15 cows 3 to 14 DIM sampled/herd
  - All appeared to be normal/not treated/not in sick pen
    - → 90% CI that sample represents herd prevalence

Ospina et al., 2010. J. Dairy Sci. 93:546-554.

Ospina et al., 2010. J. Dairy Sci. 93:1596-1603.

Herd-level impacts of elevated NEFA/BHB

Metabolite level	Herd Alarm	Associated with:
PRE-Partum NEFA $\geq$ 0.3 mEq/L	15%	+3.6% Disease incidence -1.2% Pregnancy rate - 529 lbs ME305 milk (both heifers and cows)
POST-Partum NEFA $\geq$ 0.6[a] - 0.7[b] mEq/L	15%	+1.7% Disease incidence[b] - 0.9% Pregnancy rate[a] Heifers: -640 lbs, Cows: - 1,272 lbs
BHB $\geq$ 10[a]-12[b*] mg/dL	15% *20%	+1.8% Disease incidence[b] -0.8% Pregnancy rate[b] Heifers: -1,179 lbs*, Cows: - 732 lbs[a]

***15% of 15 = 2-3 animals**

Ospina et al., 2010

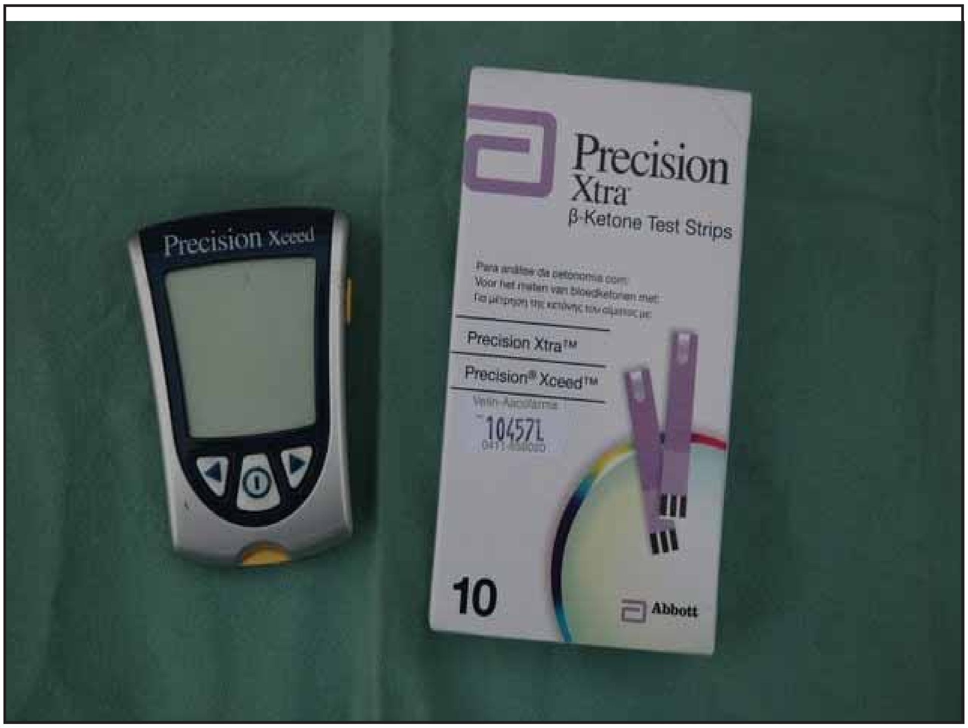
Energy-related blood analytes – cow-level values

- 1472 pre-partum animals
  - 45% (245/540) heifers NEFA ≥ 0.3 mEq/L
  - 26% (246/932) cows NEFA ≥ 0.3 mEq/L
- 1315 post-partum animals
  - 25% (131/517) heifers NEFA ≥ 0.7 mEq/L
  - 33% (267/798) cows NEFA ≥ 0.7 mEq/L
  - 15% (77/517) heifers BHB ≥ 10 mg/dL
  - 27% (214/798) cows BHB ≥ 10 mg/dL

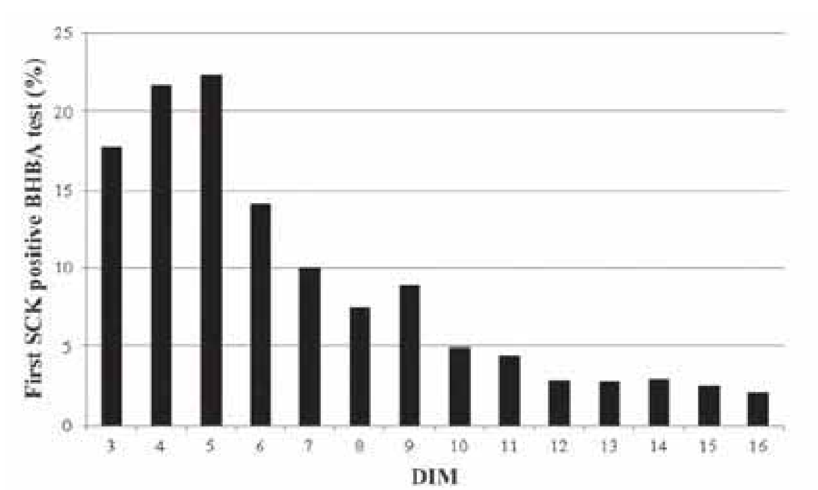
Ospina et al., 2010. J. Dairy Sci. 93:546-554.

Approach for monitoring energy-related analytes in transition cows

- Sample size:
  - 15 to 20 cows
- Cows to sample
  - Pre-partum: 14 to 2 days before calving
  - Post-partum: 3 to 14 DIM
- Sample to take
  - Serum (red top tubes)
  - Don't shake, keep cool
  - Milk (ketones only)
- What to do with sample?
  - BHB: Lab or Precision Extra Meter (blood) or ketotest or infrared (milk)
  - NEFA: Lab
- What to do with results
  - Interpret % above cut-point
  - More than 15% above cut-point indicates herd-level problem

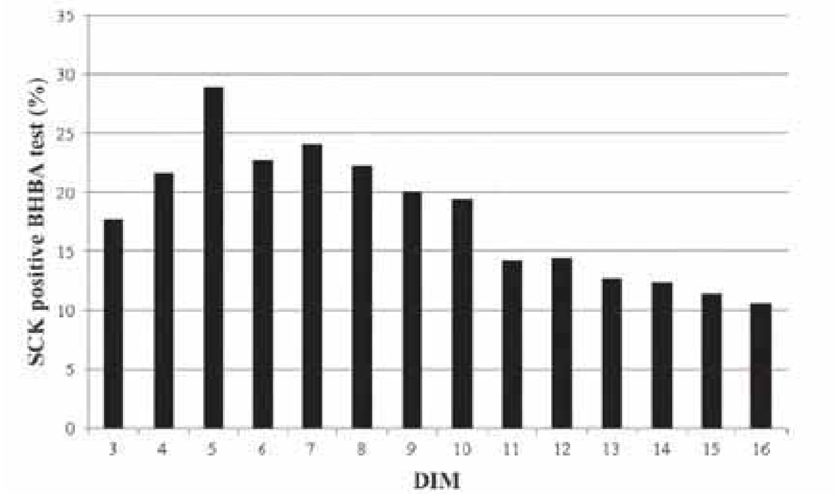


Histogram of incidence of subclinical ketosis (SCK) in 1,717 Holstein dairy cows undergoing repeated testing for ketosis from 3 to 16 DIM. A positive test was defined as a blood BHBA concentration of 1.2 to 2.9 mmol/L



McArt et al., 2012. J. Dairy Sci. 95 :5056–5066

Histogram of prevalence of subclinical ketosis (SCK) in 1,717 Holstein dairy cows undergoing repeated testing for ketosis from 3 to 16 DIM. A positive test was defined as a blood BHBA concentration of 1.2 to 2.9 mmol/L



McArt et al., 2012. J. Dairy Sci. 95 :5056–5066

Interpretation of metabolites to assess herd-level opportunities

- Scenario 1 – High prepartum NEFA, High postpartum NEFA and/or BHB
  - Likely starting with low DMI in close-up cows
  - Too low energy in prefresh diet, facility and/or management issues (grouping, stocking, heat stress)?
- Scenario 2 – High prepartum NEFA, low postpartum NEFA and/or BHB
  - Likely low DMI in close-up cows
  - Are you sampling the survivors in the fresh pen?
  - Is the herd outmanaging or putting band-aids on fresh cow issues?
- Scenario 3 – Low prepartum NEFA, high postpartum NEFA and/or BHB
  - Is herd overfeeding energy either far-off or close-up?
  - Diet or facility/management issues specific to maternity/fresh cow group

Summary guidelines -- dry period nutritional strategies

- Far-off
  - Keep energy down (1.30 to 1.39 Mcal/kg of NEL; 110 to 120% of energy requirements
  - Macromineral balances not important (within reason)
- Close-up (if same ration fed to heifers and older cows)
  - Low to moderate energy (1.40 to 1.45 Mcal/lb of NEL; 110 to 130% of energy requirements
  - Supplement with RUP (MP for Holsteins 1100 to 1200 g/d)
  - Macromineral relationships (K, Mg, Na, Cl; maybe Ca) critically important; Vitamins D and E; trace elements
- Feeding management/consistency critical during both periods

Particle size recommendations using Penn State Particle Separator

Screen	Lactating cow TMR	Dry cow or heifer TMR	Corn silage	Hay crop silage	Straw/dry hay for TMR
Top (> 0.75" sieve)	6 to 10%	10 to 20%	5 to 10%	10 to 20%	33%
Middle (0.31 to 0.75 in sieve)	45 to 55%	50 to 60%	45 to 65%	45 to 75%	33%
Bottom (< 0.31 in sieve)	< 50%	< 40%	30 to 40%	20 to 30%	33%

Adapted from Penn State guidelines by T. Overton 9/2013

Email from nutritionist 5/16/13

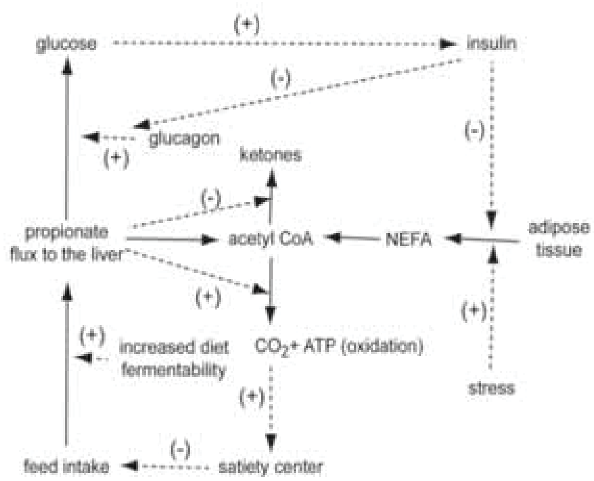
Hi Tom,   I was wondering what kind of work has been done concerning prefresh heifers and what type diet they should be fed. I'm thinking they could probably use a bit of a densed up diet over the normal low energy, straw prefresh diet. It appears to me that maybe the lower nel diet is perhaps holding back start up milk in these 1st lactation animals. Curious of your thoughts and how to feed them if we have the opportunity to separate. Probably don't need the anionic approach?

What about fresh cow diets?

Key questions

- How fermentable should fresh cow diets be (i.e., do we need to feed lower starch diets?)
- How important is physically effective NDF in fresh cow diets?
- Should we try to feed a separate fresh cow diet?

Mechanisms of intake regulation according to the hepatic oxidation theory



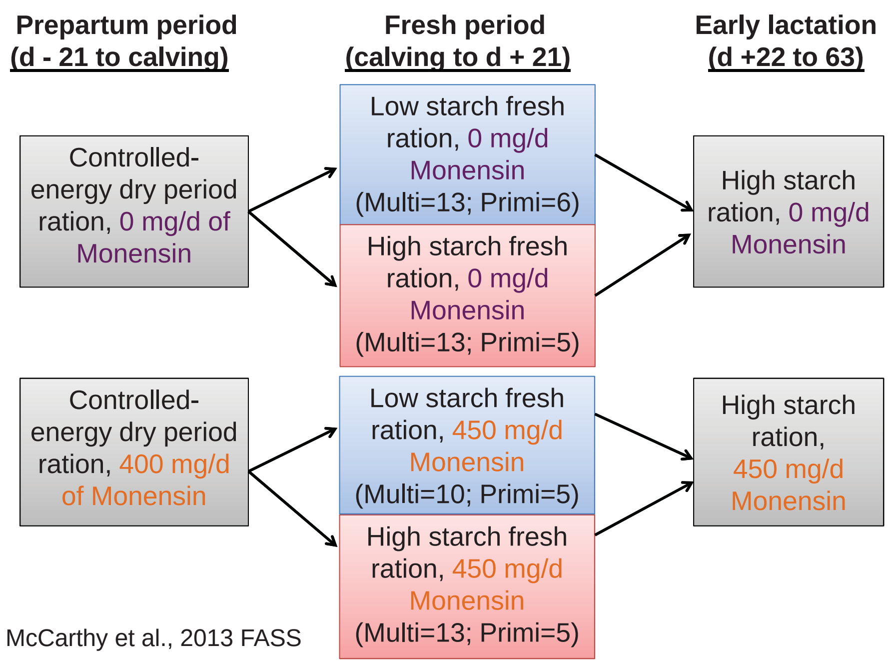
Allen et al., 2009

Lower starch fresh diets?

- Lots of conjecture, but evidence not conclusive
- Miner Institute research demonstrated higher DMI and milk yield if lower starch fresh cow diet fed (Dann and Nelson, 2011)
- Higher milk yield and same DMI when cows were fed HMSC rather than dry corn meal at same starch level (Rockwell and Allen, 2011)
- Higher DMI and milk yield for BMR corn silage-based diet starting precalving (Stone et al., 2012)
- Higher DMI and milk yield for cows fed higher starch diets or monensin during the fresh period (McCarthy et al., 2013)

McCarthy et al., 2013 FASS

- How does fresh cow ration starch content affect intake and production?
- How does Monensin in fresh diets with different starch levels modulate intake and production?



McCarthy et al., 2013 FASS

Diet Composition, % of DM

Item	Prepartum	Postpartum	
		High Starch	Low Starch
Corn Silage	39.5	—	—
BMR Corn Silage	—	37.0	37.0
Haylage	—	9.3	9.3
Wheat Straw	20.5	11.1	11.1
Corn Grain	3.9	20.2	9.9
Corn Germ Meal	—	2.4	5.4
Citrus Pulp	6.6	0.9	6.7
Soy Hulls	6.6	—	3.4
Soybean Meal	5.0	5.5	3.7
Canola Meal	4.3	2.6	2.0
Blood Meal	1.0	1.9	1.9
Supplements	6.6	5.3	5.9
Topdress	6.1	4.2	4.2

McCarthy et al., 2013 FASS

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Analyzed Diet Composition(± SD)

Item	Prepartum	Postpartum		Topdress	
		High Starch	Low Starch	No Monensin	Monensin
DM, %	50.7 (2.4)	48.3 (2.7)	48.0 (3.2)	93.2 (1.0)	93.7 (1.2)
CP, %	13.0 (0.8)	15.5 (1.2)	15.4 (0.8)	37.5	37.0
ADF, %	28.2 (1.2)	22.7 (1.2)	25.2 (1.2)	11.1	12.9
NDF, %	42.9 (2.0)	34.3 (1.5)	36.9 (1.5)	22.6	21.3
30 h NDFD, %	—	18.9 (1.2)	20.7 (1.1)	—	—
30 h NDFD, % of NDF	—	55.1 (2.0)	56.1 (1.4)	—	—
Sugar, %	4.9 (0.8)	3.5 (0.6)	4.5 (0.4)	10.6	11.3
Starch, %	17.4 (1.2)	26.2 (1.2)	21.5 (1.0)	13.1	13.8
Fat, %	2.6 (0.2)	4.0 (0.2)	2.2 (0.6)	2.4	2.5

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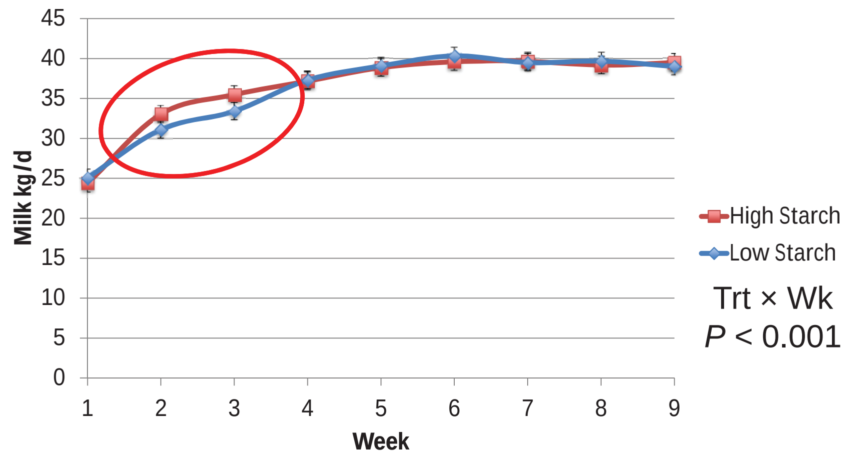
Milk yield and composition, wk 1-9

	Starch Level			*P*-values		
Item	High	Low	SEM	Starch	Starch × Wk	Starch × Parity
Fat, %	3.76	3.97	0.09	0.11	0.16	0.97
True protein, %	2.92	3.10	0.09	0.12	0.22	0.47
Lactose, %	4.82	4.93	0.04	0.03	0.08	0.03
Total Solids, %	12.42	12.97	0.17	0.03	0.08	0.46
3.5% FCM, kg/d	37.1	37.8	1.0	0.61	0.22	0.37
ECM, kg/d	36.9	37.6	1.0	0.59	0.19	0.44

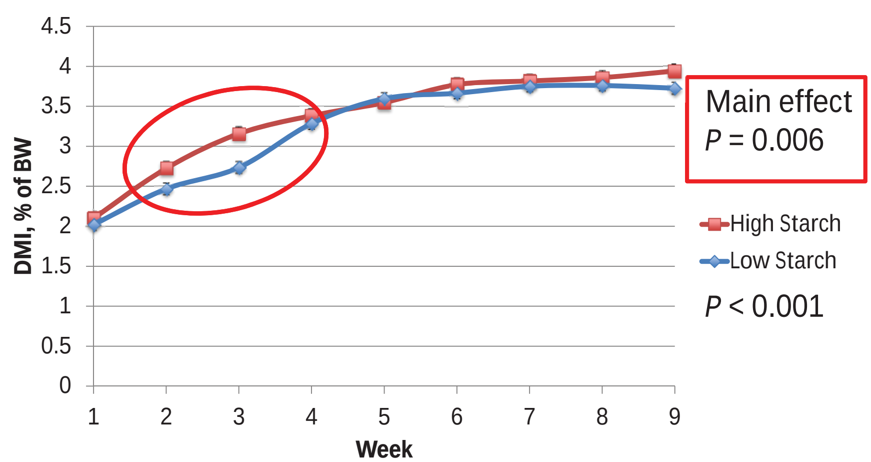
McCarthy et al., 2013 FASS

Starch Treatment Milk Yield, wk 1-9



McCarthy et al., 2013 FASS

Starch Treatment DMI % of BW



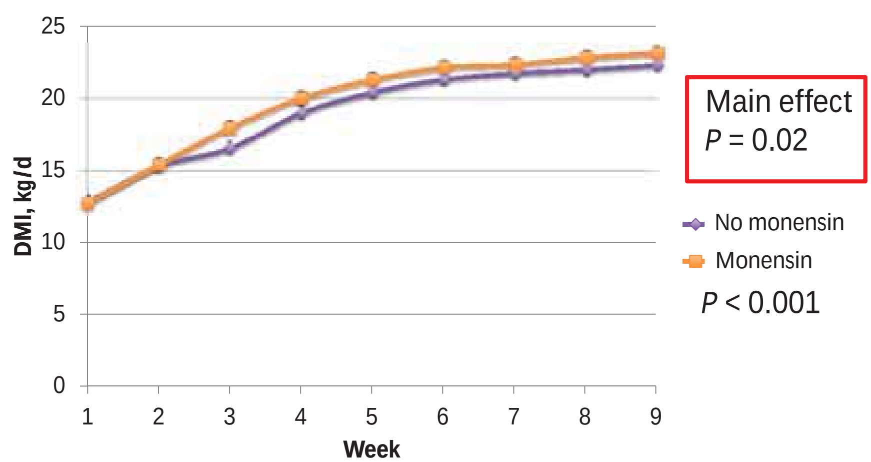
McCarthy et al., 2013 FASS

Milk yield and composition, wk 1-9

	Monensin Treatment			*P*-values		
Item	No	Yes	SEM	Monensin	Monensin × Wk	Monensin × Parity
Fat, %	4.00	3.77	0.09	0.13	0.69	0.52
True protein, %	3.01	3.01	0.09	0.96	0.90	0.75
Lactose, %	4.93	4.82	0.04	0.03	0.69	0.69
Total Solids, %	12.88	12.52	0.18	0.13	0.88	0.86
3.5% FCM, kg/d	37.0	38.0	1.0	0.52	0.44	0.74
ECM, kg/d	36.8	37.8	1.0	0.47	0.48	0.55

McCarthy et al., 2013 FASS

Monensin Treatment DMI, wk 1-9

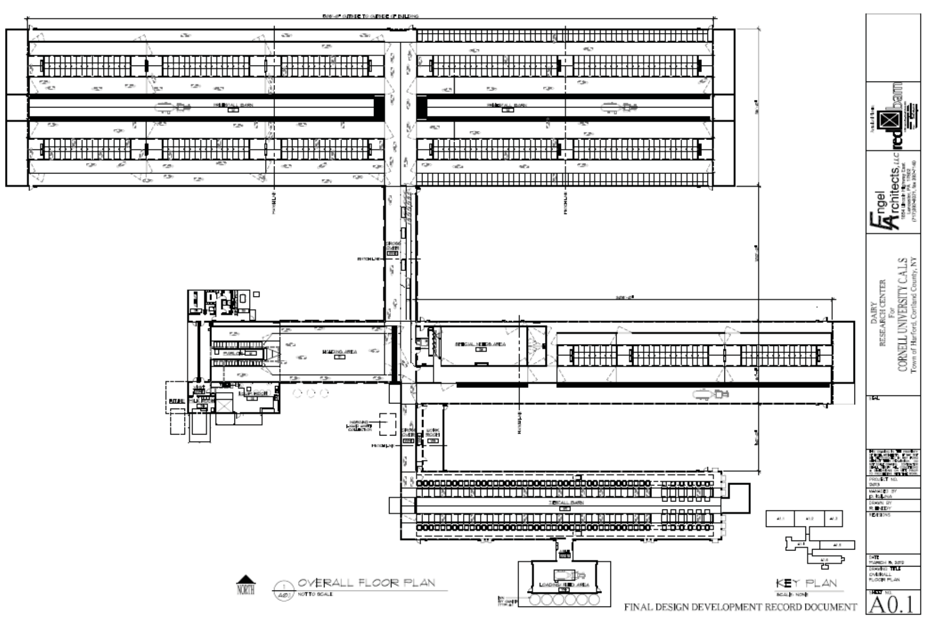


McCarthy et al., 2013 FASS

Summary and conclusions

- Increasing availability of diagnostic tools for use at the herd-level
  - BHBA (herd-side and infrared may be coming for milk)
  - NEFA (lab and infrared may be coming for milk)
  - Haptoglobin (lab)
- Need to refocus on hypocalcemia in the fresh cow and how to prevent – downstream implications beyond milk fever
- Fresh cow diets with higher fermentability, higher starch concentrations, and monensin result in improved performance and metabolism
  - Maintaining peNDF likely also important consideration
  - Opportunities for MP and AA formulation?
- Trace mineral nutrition also an opportunity in transition cows
  - More bioavailable sources modulate oxidative metabolism and production
  - Chromium decreases endometritis during early lactation and

Cornell Dairy Research Unit Overall Schematic Design




TORO


Thanks!!
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Shredlage Update

Dr. L. E. Chase
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Cornell University

There are a number of New York dairy farms that are using shredlage heads when harvesting corn silage. At this point, there is only one research trial that has been conducted comparing shredlage and conventionally processed corn silage. This trial was done at the University of Wisconsin by Dr. Randy Shaver. He reported the results from this trial at the 2013 Herd Health and Nutrition Conference in Syracuse. Key points from this presentation are:

1. The shredlage was harvested with a 26-30 mm theoretical length of cut and a 2-3 mm roll gap. The conventional kernel processed corn silage was harvested using a 19 mm length of cut and 3 mm roll spacing.
2. The corn silage processing scores were 75% for the shredlage and 60.3% for the conventional corn silage.
3. Corn silage particle size distribution using the Penn State box was:

Screen	Shredlage	Conventional CS
Top, % retained	31.5	5.6
Middle, % retained	41.5	75.6
Pan, % retained	26.2	18.4

4. The rations fed contained 50% of the total ration DM as corn silage and also had 10% of the ration DM as alfalfa silage. The rations contained 17.2% CP, 28% NDE and 25.5% starch.
5. The 2 corn silages were similar in CP, NDF, lignin, 30-hour NDFD, starch and 7-hour in vitro starch digestibility.
6. Particle size distribution of the total mixed rations fed using the Penn State box were:

Screen	Shredlage	Conventional CS
Top, % retained	15.6	3.5
Middle, % retained	38.2	52.9
Pan, % retained	38.9	35.8

7. Feed sorting was minimal and was not different between treatments.
8. The results for dry matter intake and milk production are:

Item	Shredlage	Conventional CS	P-value
DMI, lbs./ day	55.8	54.4	0.08
Milk, lbs./day	96.0	94.2	0.14
3.5% FCM, lbs./day	100.1	97.2	0.07

Milk fat, %	3.74	3.70	0.66
Milk True Protein, %	3.18	3.21	0.29
MUN, mg/dl	13.9	13.6	0.48
Lbs. 3.5% FCM/lb. DMI	1.77	1.79	0.65
Week 8 Total Tract Starch Digestibility, %	99.4	97.5	0.001
Total Tract NDF Digestibility, %	36	32	0.04

9. The results of this trial can be summarized as follows:
    a. A higher proportion of the corn silage is on the top screen when shredlage is harvested. This was true for both the silage and the TMR.
    b. There was a tendency for DMI and 3.5% FCM to be higher when shredlage was fed.
    c. There was no difference in milk components or MUN between the treatments.
    d. Ruminal and total tract starch digestibility was higher for cows on the shredlage ration. This was also true fir total tract NDF digestibility.
10. Dr. Rich Muck at the U.S. Dairy Forage Research Center has indicated that the packing density in bunker silos when using shredlage is similar to the densities obtained with conventional kernel processed corn silage.
11. Given the larger portion of coarse particles in shredlage, it may be possible to replace some of the chopped hay or straw in dairy rations. This will need verification with animal trials.

On-Farm Processing of Soybeans – Update

Dr. L. E. Chase
Department of Animal Science
Cornell University

With the increase in the acres of soybeans grown on New York dairy farms, there is renewed interest in processing methods that can be used on the farm. Currently, there are 2 primary methods used to process soybeans on New York dairy farms. These are roasting or cold pressing. The cold pressing system is one that is relatively new in the last few years.

1. Roasting Soybeans –
    a. A lot of work was done on the processing variables in the early 1990's.
    b. The key is to obtain the right combination of temperature and time to shift some of the protein degradation from the rumen to the small intestine.
    c. A treatment combination of about 295^{o} F for 15 to 30 minutes appears optimum for increasing the rumen undegradable protein without elevating ADIN values.
    d. These temperatures are for the beans not the temperature of the roaster used.
    e. Fat content will be 18-20% since no fat is removed in the process. The fat content is one factor that will limit the quantity of roasted beans that can be fed while minimizing the risk of milk fat depression.
    f. Soybeans should be processed to quarter or halves before feeding. One research trial indicated a 3 – 4 lb. increase in milk production when roasted beans with smaller particle sizes were compared with whole roasted beans.
2. Cold-Pressed Soybeans –
    a. This is an on-farm system that uses a press that extracts some of the fat from the soybeans and produces a pelletized feed.
    b. Some heat is used in this process but the soybeans are exposed to the heat for a very short time.
    c. Residual fat in the processed product seems to range between 10 – 15%. Adjusting processing conditions to extract fat seems to be one of the challenges in learning to operate this system.
    d. Crude protein should be slightly higher than the original soybeans since some fat is removed. Initial limited results indicate this may be 2 – 3 units of protein.
    e. The protein fractions (soluble, RDP, RUP) will be similar to raw soybeans since minimal heat is applied during processing.
    f. A trial was conducted in South Arica using early lactation cows fed rations containing 0, 6, 12 and 18% cold-pressed soybean meal. The control ration contained 6% of the ration dry matter as soybean meal. No soybean meal was in the other rations. These rations were about 16% CP, 34-38% NDF, 24 – 29% NFC and 3 – 5.5% fat. These rations were about 30% forage and contained byproduct feeds such as whole cottonseed and corn gluten feed.

g. There were no significant differences in dry matter intake, milk, 3.5% fat corrected milk, milk composition and feed efficiency in this trial. Daily milk production was 70 – 75 lbs. per day.
h. Some initial information from using cold-pressed soybean meal on a dairy herd in Delaware County has been compiled by Paul Cerosaletti and Dale Dewing using feeding rates of up to 5 lbs. per cow per day. Initial observations indicate that there may be a small decrease in milk fat and protein while milk production didn't appear to change. Since these observations were made over a period of months, the results could be confounded with seasonal or other factors.
i. Additional analytical data on more samples and a more controlled animal response trial are needed to better define the potential role of on-farm pressing of soybeans.

Low Oxygen Permeability Silo Covers – Update

Dr. L. E. Chase
Department of Animal Science
Cornell University

There are a large number of products on the market that are used to cover bunker silos. The goal of all of these is to seal the silo and minimize the infiltration of oxygen into the silo. The most common products used are single sheets of black or white plastic. In recent years, a new generation of products with low oxygen permeability has become available. Two products available in New York are Silostop and Feed Fresh.

A number of trials have compared the oxygen permeability or oxygen transmission rate of various plastic products for covering silos. This is basically a measure of how much oxygen can flow through the various products in a standardized test. Example results are:

1. Silostop –
   a. 5 mil plastic – 1811 cm^3/m^3/24 hours (100% oxygen atmosphere)
   b. Silostop 1 – step cover – 38 cm^3/m^3/24 hours
   c. Silostop 2-step cover – 65 cm^3/m^3/24 hours
2. Feed Fresh –
   a. Typical black or white plastic cover – 1650 cc/m^3/day
   b. Feed Fresh cover – 4.1 cc/m^3/day

These tests were done using 2 different testing procedures so you can't directly compare the results for the 2 products. A lower value indicates less oxygen passing through the cover and should be linked with a better feed, less spoilage and a better fermentation. Both of these products had lower oxygen permeability values than conventional black or white silo covers.

At the 2008 Cornell Nutrition Conference, Dr. Richard Muck from the U.S. Dairy Forage Research Center presented some of his results using Silostop. He tested the Silostop 2-step process on 4 corn silage and 2 alfalfa silage bunker silos. An 8 mil plastic white cover was used as the comparison. Key results were:

- The biggest difference between the 2 systems was in the silage closest to the walls of the silo. The differences between the 2 systems in the middle of the silo were small.
- The losses in the top 6 inches was 19% for the white plastic in the alfalfa silos while it was 1% for the Silostop bunkers. The loss was measured at 2 feet from the silo wall.
- The losses between 6 and 24 inches in depth were similar for the 2 systems.
- He would have expected bigger losses if 5-6 mil plastic would have been used. Dr. Muck indicated a 5 % higher loss when 5-6 mil plastic was used compared with using the 8 mil plastic.

- Dr. Muck has also done 1 trial comparing a 5 mil white cover and a Feed Fresh cover. Dry matter loss in the top 6 inches was reduced from 12.1% with the plastic cover to 3.9% when the Feed Fresh product was used.

Dr. Keith Bolsen from Kansas State has also reported results from his trials using Silostop. Key points are:

- Dry matter loss in the top 36 inches in a corn silage bunker was 34.8% with a traditional plastic cover compared with 17.8% when Silostop was used.
- Dry matter loss in the top 18 inches of a high moisture corn silo was 12.7% when a plastic cover was used compared with 6.7% when Silostop was used.

A key concern of dairy producers is the higher cost of the Silostop and Feed Fresh products compared with using plastic silo covers. Recently, Dr. Bolsen did a calculation for a 6 by 80 by 400 foot drive over pile. This was a corn silage pile and he valued the corn silage at $60/ton. He reported a net benefit of $8,000 to 12,000 when Silostop was used compared with a plastic cover. This calculation included a value for the lower dry matter loss and the higher cost of using Silostop.

Summary:

This new generation of lower oxygen permeability silo covers offers an opportunity to recover more pounds of high quality feed from silos compared with using the black or white silo covers usually used. Field observations indicate very minimal spoilage in the top layer of silage when these oxygen limiting silo covers are properly used. Initial economic evaluations indicate a good return on investment when compared to using plastic silo covers. As herds strive to provide larger quantities of higher quality forages, utilizing oxygen limiting silo covers will assist in getting more value from these forages.

Dairy Nutrition Fact Sheet
September, 2013 (Revised)

Using Liquid Whey in Dairy Rations

L. E. Chase[1], T. R. Overton[1] and D. R. Balbian[2]
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[2] Central New York Dairy & Field Crops Team

The recent expansion of Greek yogurt production in New York has resulted in large quantities of liquid whey being available. One potential use of the liquid whey from this process is use as a feed in dairy and livestock rations. The whey produced from yogurt production is considered to be an acid whey product similar to that produced from the manufacture of soft cheeses. It is important to realize that liquid whey has been fed to animals since the time of the Romans. Thus, this is not a new or novel use of liquid whey. The following points should be helpful in assessing the potential for using liquid whey in your operation.

1. <u>Nutrient Composition</u> - The actual nutrient composition will vary some with each plant that produces cheese or yogurt. Table 1 contains summary data from the Dairy One Forage Testing Lab. The data in this table indicates a wide variation in the nutrient content of the whey available in New York. The actual nutrient composition of the whey produced will vary between plants depending on the type and composition of the cheese or yogurt produced. The high levels of minerals may be a concern in some rations. Lactose content was not analyzed and is not in Table 1. The level of simple sugars is an "index" of lactose content. It will be very important to obtain an actual analysis of the whey to be fed from the specific plant it is coming from. Most plants should have this data available but some additional analyses may also be useful.

Table 1. Nutrient Composition of New York Liquid Whey Samples[1]

Item	Number of Samples	Average	Standard Deviation	Normal Range[2]
Dry matter, %	293	10.17	13.79	0 – 23.97
Crude protein, % of DM	113	10.0	11.5	0 – 21.5
Soluble CP, % of CP	80	85.26	16.7	68.5 – 100
Simple Sugars, %	28	39.19	25.06	14.1 – 64.25

of DM				
Fat, % of DM	116	6.65	5.4	1.23 – 12.07
Ash, % of DM	282	11.53	3.66	7.87 – 15.18
NE-l, Mcal/lb.[3] (DM basis)	113	0.95	0.11	0.84 – 1.06
Calcium, % of DM	101	1.98	0.81	1.21 – 2.79
Phosphorus, % of DM	100	1.3	0.44	0.87 – 1.75
Magnesium, % of DM	99	0.20	0.07	0.14 – 0.27
Potassium, % of DM	99	3.13	0.81	2.32 – 3.94
Sulfur, % of DM	92	0.15	0.08	0.07 – 0.23
Sodium, % of DM	105	0.94	1.45	0 – 2.39
Chloride, % of DM	17	2.44	0.79	1.66 – 3.23
pH	11	4.1	0.58	3.53 – 4.69

[1] Source: Paul Sirois, Dairy One Forage Laboratory, samples analyzed between 1/2010 and 8/2013.

[2] Normal range is the mean plus or minus 1 standard deviation. This represents about 67% of the total samples analyzed in a normal distribution.

[3] Calculated value.

2. Economic Value – The estimated value of liquid whey (7% dry matter) was $16.84/ton in the September, 2013 feed price list compiled by Penn State. This is based on shelled corn priced at $203/ton and 48% soybean meal priced at $545/ton. This is a nutrient value only and does not account for any additional on-farm costs associated with the storage, handling and feeding of this product. The energy in 100 lbs. of liquid whey is similar to the energy contained in 5 – 6 lbs. of corn grain depending on the dry matter content of the whey.
3. Feeding Systems – There are a number of options for using liquid whey on dairy farms. One is to add the liquid whey as an ingredient when mixing a total mixed ration. Other options include free-choice feeding and providing whey through the water bowls in a tie-stall barn.
4. Feeding Rates – Feeding rates will vary between farms depending on how the whey is used in the feeding program. When liquid whey is added as an ingredient in a total mixed ration, a typical feeding rate is about 1 lb. of dry matter/cow/day. This is about 10 lbs. as-fed if the whey is 10 % DM or 20 lbs. if the whey is 5% DM. In terms of gallons,

these rates would be 1.2 or 2.4 gallons/cow/day. When whey is offered free-choice, the following daily intakes have been reported:

   a. Dairy heifers (440 – 700 lbs.) – 5 – 10 gallons/day.
   b. Dairy steers (200 to 900 lbs.) – 5 -15 gallons/day.
   c. Holstein bulls (500-900 lbs.) – 15 – 20 gallons/day.
   d. Dry cows – 5 – 15 gallons/day.
   e. Lactating cows – 10 – 30 gallons/day.

5. Storage and Handling – Equipment such as holding tanks and pumps may be needed to handle liquid whey on the farm and transfer it into the mixer wagon. The added cost for these needs to be accounted for in evaluating the economics of utilizing liquid whey.
6. Shelf Life – Liquid whey has a relatively short shelf life (2-4 days) to maintain the quality of the product. The balance between the quantity delivered, frequency of deliveries and the daily quantity used on the farm needs to be determined. Currently, most herds in New York are receiving large tanker loads (7 to 8,000 gallons). This makes it difficult to use liquid whey in smaller operations. There may be some opportunities for using liquid whey in smaller operations. One is the delivery of smaller loads. There are also some preservatives that can be added to liquid whey to extend the shelf life. These are currently being used in some processing plants in the Midwest.
7. Nutritional Considerations – Even though liquid whey has many positive nutritional attributes, there are a few considerations for using it in specific animal groups:
   a. Dairy heifers – Dairy heifers consuming liquid whey free-choice may become fat or have a high body condition score due to the high energy content of the liquid whey.
   b. Bloat – Reports indicate that high levels of liquid whey intake on low or limited forage rations may increase the risk of bloat due to the breakdown of sugars in the rumen. This risk can be decreased by providing adequate levels of forage NDF in the ration.
   c. Dry cows – The high levels of minerals (especially potassium) make it difficult to use liquid whey free-choice for dry cows. It may be possible to use some liquid whey in a dry cow TMR, depending on the nutrient composition of the forages and other feeds used in the ration. The herd nutritionist will need to evaluate this for each herd.
8. Other Considerations – Animals fed large amounts of liquid whey will excrete more urine and have more fluid manure. Liquid whey will also draw flies as it starts to spoil. Minimizing spoilage by feeding it up fast and using water to wash away any spilled or excess whey will help decrease the fly problem.

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