Northern New York Agriculture Development Program
2021 Project Report

Evaluating Transition Cow Health on Northern New York Dairy Farms and Associations with Feeding Management Practices

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Collaborators:

- Dr. Trevor DeVries, University of Guelph, Professor and Canada Research Chair in Dairy Cattle Behavior and Welfare, Guelph, Ontario, Canada
- Dr. Allison Kerwin, Cornell University, Dairy Field Research Specialist, Ithaca, NY

Cooperating Producers:

- 10 dairy farms from Jefferson, Lewis and St. Lawrence counties

Background:

The transition period, typically defined as 3 weeks pre-calving to 3 weeks post-calving, is a vulnerable time for the dairy cow. This is largely because of the immediate increased nutrient demand due to the onset of milk production, resulting in physiological and behavioral challenges. To improve success (health, reproduction, milk production, and overall welfare) across the transition period, there are many related physiological and nutritional factors that should be considered.

Over the past decade, key research areas of focus during the transition period have included inflammation and metabolic status, as well as feeding management. Blood metabolites may be useful at the herd level to identify opportunities to improve feeding management, and at the individual cow level to monitor health status and predict the onset of disease. For example, preliminary work in Dr. Tom Overton's lab at Cornell University has successfully identified that different acute-phase proteins can be used as a predictive indicator of subsequent impaired reproductive and lactation performance. Researchers have used that information to successfully develop a Liver Health Index (LHI), which can be used to evaluate transition cow health and performance. This LHI assigns a value to each cow based upon circulating levels of albumin, bilirubin, and cholesterol in the blood. Animals with a higher LHI score have been demonstrated to have better clinical health, milk production, and reproductive performance. Animals with a lower LHI score also showed lower levels of feed intake and lower milk production. In collaborating with dairy farms, that research has been demonstrated to improve cow- and herd-level diagnostic strategies, which ultimately has improved cow health and well-being.

There are several feeding management practices that can influence a cow's metabolic health and overall success through the transition period. For example, past research has demonstrated that greater intake in the dry period, and various measures of feeding behavior (including reduced feed sorting) are associated with lower rates of ketosis and metritis post-calving.

Feeding management becomes increasingly important to consider as farms are more commonly feeding controlled-energy dry cow diets. These diets typically incorporate large amounts of wheat straw or grass hay to reduce the dietary energy density, in attempt to limit the cow's energy consumption to ~100% of her requirements. From a physiological standpoint these diets can work great; however, feeding management protocols can affect feeding behavior of cows fed these diets. Thus, understanding feeding management strategies that can promote more desirable feeding behaviors, particularly when fed these controlled energy dry cow diets, is becoming increasingly important.

Additionally, understanding how the physical characteristics of these controlled-energy dry cow diets (particle size and moisture content), particularly in the weeks leading up to calving, influences post-calving performance is of interest. |

Despite several research groups investigating how individual aspects of feeding management (feed space, feed push-ups, TMR particle size, moisture content, etc.) influence success across the transition period, there is an opportunity to design and implement a tool that combines several best management practices. Additionally, research groups have investigated transition cow feeding management in a controlled research environment; however, there is an opportunity to explore this at the commercial farm level.

Specific objectives of this Northern New York Agricultural Development Program-funded research were to:

- apply the Liver Health Index and make associations with post-calving metabolic health on dairy farms in Northern New York, and

- evaluate how feeding management practices during the dry period may be associated with post-calving metabolic health and performance.

METHODS:

Selection of Farms

10 farms in Northern NY were selected based on certain criteria. Farms had to be feeding a negative dietary cation-anion difference (DCAD), high-straw dry cow diet for at least 21 days prior to calving. Farms also had to be willing to share individual cow records and formulated diets with researchers, and allow for researchers to enter pens and draw blood samples from eligible cows. Each farm participated in one baseline assessment where feeding management practices during the dry period were evaluated on a three-point scoring system (Table 1). Following the baseline assessment, each farm had 2 visits spaced at least 3 weeks apart for data collection. All data were collected between June and October, 2021. The farm-level data and farm-specific results are treated confidentially.

Table 1. Feeding Management Scoring System for Dry Cow Diets on Northern NY Dairy Herds; Evaluating Transition Cow Health project, NNYADP, 2021.

	Excellent = 3 points	**Good = 2 points**	**Poor = 1 point**	**Score**
Straw PSPS Distribution (Top screen)	< 10%	11-20%	>20%	
TMR Particle Distribution on Top Screen	<15%	16-25%	26%+	
Coefficient of Variation on Top Screen	<5%	5-10%	>10%	
				Total Score:

Selection of Cows

At each farm visit, 15 eligible pre- and post-partum cows (10 multiparous, 5 primiparous) were randomly selected. Pre-calving, cows were considered eligible if they were within 16 days of calving. Post-calving, cows were considered eligible if they were within 3-15 days in milk (DIM).

Animal Data

Blood samples were taken from the tail vein of all cows both pre- and post-partum. Blood was collected into a sodium-heparin tube. Post-partum blood samples were analyzed cowside for β-hydroxybutyrate (BHB) using a handheld meter. Pre- and post-partum samples were then centrifuged and the plasma was frozen for future analysis. The frozen plasma samples were sent to the University of Missouri diagnostic lab.

Post-partum samples were analyzed for bilirubin, cholesterol, albumin, haptoglobin and non-esterified fatty acids (NEFA). Pre-partum samples were analyzed for NEFA.

Urine samples were collected from pre-partum cows approximately 6 hours after feed delivery. Urine samples were analyzed for urine pH using a handheld pH meter. Body condition scores (BCS) were assigned to each cow both pre- and post-partum using a 5 point scale, where 1=emaciated and 5=obese.

Liver Health Index (LHI):

The LHI was calculated using the following formula: $[(Alb - \mu Alb) / \sigma Alb] + [(Chol - \mu Chol) / \sigma Chol] - [(Bili - \mu Bili) / \sigma Bili]$ as referenced by Kerwin et al., submitted.

Feed Data:

Feed samples were collected from pre- and post-partum diets at feed delivery. Samples were taken from three locations along the feed bunk: front, middle, and back (Figure 1). These feed samples were analyzed in real-time for particle distribution. Particle size distribution was

Figure 1. Locations of feed collection for analysis; Evaluating Transition Cow Health project, NNYADP, 2021. Photo: https://thedairyalliance.com/blog/how-cows-stay-warm/.

determined by the Penn State Particle Separator (PSPS), which has a 19-mm screen (long), 8-mm screen (medium), 1.18-mm screen (short), and a pan (fine). Approximately 6 hours after feed was delivered to pre-partum cows, feed samples were taken again at roughly the same three spots along the feed bunk and analyzed for particle distribution using the PSPS.

Statistical Analysis:
Data were analyzed using SAS 9.4 analytics software. Data was summarized by status (dry or lactating) using PROC SUMMARY and analyzed for normality using the UNIVARIATE procedure. Both BHB and NEFA were log transformed to achieve a normal distribution. The MIXED procedure was used to model the relationship between LHI and health outcomes.

Health outcomes (milk fever and metritis and/or retained placenta) were taken from each herd's Dairy Comp files. Ketosis was included as a health outcome using BHB results taken by researchers (i.e., not from Dairy Comp records). Farm was included as a random effect. Covariate variables including parity and BCS were first tested, but only remained in the model if significant. Days in milk (DIM) was forced in the model. Linear regression relationships were analyzed using PROC REG.

Results and Discussion:

Baseline Assessment
Table 1 outlines the scoring system used to evaluate pre-calving feeding management for each participating herd at the baseline assessment. Results from the baseline assessment are reported in Table 2 for each herd. The categories and thresholds within each category are based on previous research exploring individual feeding management practices during the dry period; however, further work is needed to establish a scoring system that is more encompassing. It should be noted that the low variability between herds is a limitation to the study, as several of the herds scored similarly between categories. In addition, herds were scored based on a single assessment, which is another limitation to the study. Repeated assessments with an increased sample size across farms with greater variability may be required.

Table 2. Results from Baseline Assessment using Feeding Management Score System for Dry Cow Diets on Northern NY Dairy Herds (n=10); Evaluating Transition Cow Health project, NNYADP, 2021.

Farm ID	Straw PSPS	TMR PSPS	CV% on Top Screen	Total
1	1	3	1	5
2	1	1	1	3
3	2	3	3	8
4	2	3	1	6
5	1	1	2	4
6	2	3	2	7
7	1	1	1	3
8	2	3	3	8
9	2	2	1	5
10	1	2	1	4

Blood Analysis and Herd Alarm Levels

A total of 297 post-partum and 289 pre-partum cows were included in the blood analysis. Pre-partum cows were excluded from analysis if the blood sample was collected more than 16 days prior to actual calving. Previous research identified threshold values and herd alarm levels for pre- and post-calving NEFA and BHB (Table 3; Ospina et al., 2010).

Table 3. Herd Alarm Levels and Blood Metabolite Thresholds for Pre- and Post-Partum Dairy Cows[1]; Evaluating Transition Cow Health project, NNYADP, 2021.

Metabolite Level	Herd Alarm	Associated with:
Pre-partum NEFA ≥ mmol/L	15%	+ 3.6% disease incidence -1.2% pregnancy rate - 529 lbs ME305 milk (both heifers and cows)
Post-partum NEFA ≥ 0.6[a] – 0.7[b] mmol/L	15%	+ 1.7% disease incidence[b] -0.9% pregnancy rate[a] Heifers: -640 lbs, Cows: - 1,272 lbs
Post-partum BHB ≥ 1.0[a] -1.2[b] mmol/L	15%	+ 1.8% disease incidence[b] -0.8% pregnancy rate[a]

[1]Table 3 is adapted from Ospina et al., 2010

Pre-calving blood NEFA levels are reported in Table 4 for each herd.

Table 4. Average Pre-Calving Blood NEFA Levels for Cows Within 16 Days of Calving on Northern NY Dairy Herds (n=10); Evaluating Transition Cow Health project, NNYADP, 2021.

Farm ID	Average, mmol/L	Standard Deviation	% of Cows Above Threshold[1]
1	0.24	0.14	27
2	0.40	0.26	59
3	0.29	0.19	37
4	0.27	0.13	37
5	0.20	0.10	13
6	0.13	0.12	3
7	0.21	0.17	19
8	0.29	0.21	37
9	0.37	0.29	54
10	0.54	0.33	72

[1]Thresholds are based on research by Ospina et al. (2010)

As demonstrated in Table 4, only Farm 5 and Farm 6 were below the recommended 15% of sampled animals testing above 0.3 mmol/L in the pre-partum period (Ospina et al., 2010). High NEFA levels pre-calving are a known risk factor for post-calving metabolic health disorders, so this is an area of opportunity for some Northern NY herds. Elevated NEFA level is a sign that the cow is mobilizing body fat. Pre-calving, this can be result of over-conditioned dry cows and environmental stressors that limit dry matter intake (DMI), such as increased competition at the feed bunk.

Elevated NEFA levels post-calving are expected because intake cannot meet the energy demand for milk production in the first weeks of lactation. To assist in meeting this energy demand, cows will mobilize body fat in the form of NEFA. Therefore, post-calving NEFA release is a natural adaptation to lactation. However, only Farm 8 was below the herd alarm level for post-calving NEFA levels, which suggest that remaining herds were experiencing negative energy balance (NEB) in a more severe form that could then put cows at increased risk of metabolic health challenges (Table 5).

Table 5. Average Post-Calving NEFA Levels for Post-Partum Cows 3-15 DIM on Northern NY Dairy Herds (n=10); Evaluating Transition Cow Health project, NNYADP, 2021.

Farm ID	Average, mmol/L	Standard Deviation	% of Cows Above Threshold[1]
1	0.70	0.39	53
2	0.80	0.40	60
3	0.43	0.19	21
4	0.75	0.36	65
5	0.52	0.25	33
6	0.66	0.40	39
7	0.50	0.23	33
8	0.39	0.19	10
9	0.73	0.36	60
10	0.63	0.34	45

[1]Thresholds are based on research by Ospina et al. (2010)

When excessive NEFA levels are released, the liver can become quickly overwhelmed and partially oxide NEFAs, resulting in the release of ketone bodies. The ketone body that is measured in the blood as a proxy for measuring NEB is beta hydroxybutyrate (BHB). Typically, when BHB values are above 1.2 mmol/L, cows are diagnosed with ketosis. Table 6 outlines average post-calving BHB levels by farm. Most farms (60%) were below the herd alarm level threshold for post-calving BHB levels.

Table 6. Average Post-Calving BHB Levels for Post-Partum Cows 3-15 DIM on Northern NY Dairy Herds (n=10); Evaluating Transition Cow Health project, NNYADP, 2021.

Farm ID	Average BHB, mmol/L	Standard Deviation	% of Cows Above Threshold[1]
1	1.0	0.7	21
2	1.3	0.8	42
3	0.6	0.5	7
4	0.8	0.5	13
5	0.6	0.4	3
6	0.9	1.1	17
7	0.7	0.4	3
8	0.6	0.2	3
9	1.0	0.9	27
10	0.8	1.1	3

[1]Thresholds are based on research by Ospina et al. (2010)

Figure 2 (see next page) illustrates the relationship between NEFA and BHB levels post-calving for each herd.

Liver Health Index and Blood Analysis:
The Liver Health Index (LHI) used in this study was adapted and investigated by Kerwin et al. (submitted). This index evaluates negative acute-phase protein reactants (albumin, cholesterol and bilirubin) of lactating cows between 3-15 DIM. There was no difference in the LHI for primiparous or multiparous cows, so all cows were analyzed together.

From previous work, higher LHI values indicate better liver health and can result in better postpartum performance (Kerwin et al., submitted). The average LHI values for each herd are depicted in Figure 3 and summarized in Table 7.

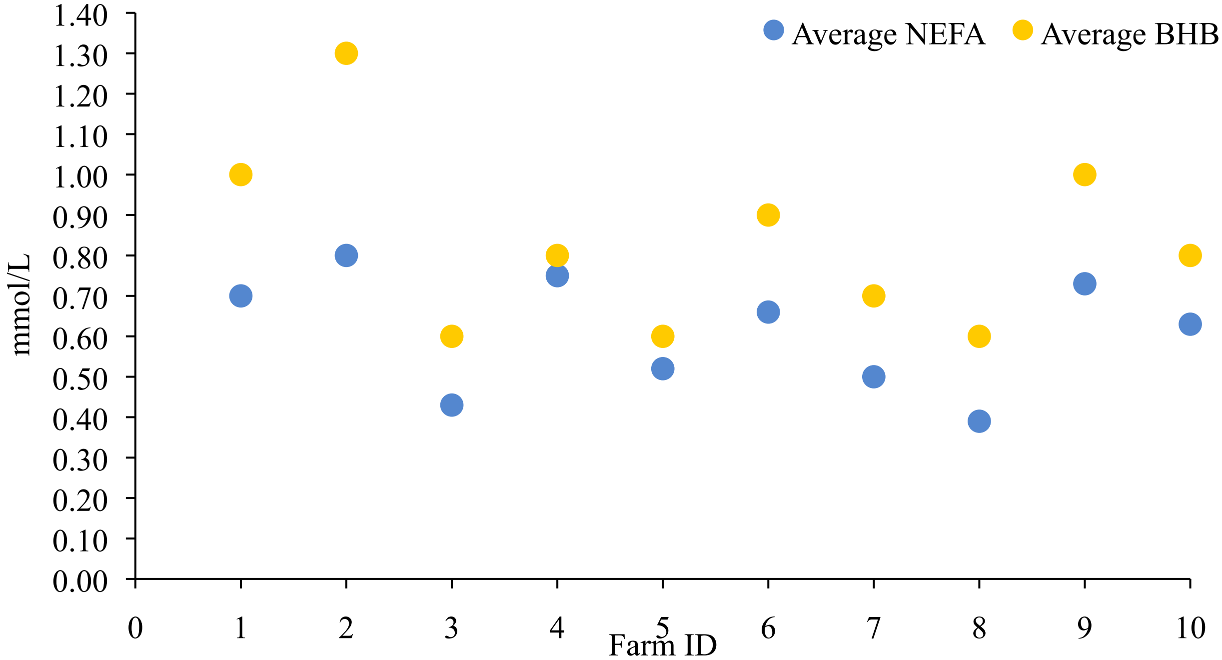

Figure 2. Average Post-Calving BHB and NEFA level by Farm for Cows 3-15 DIM on Northern NY Dairy Farms (n=10); Evaluating Transition Cow Health project, NNYADP, 2021.

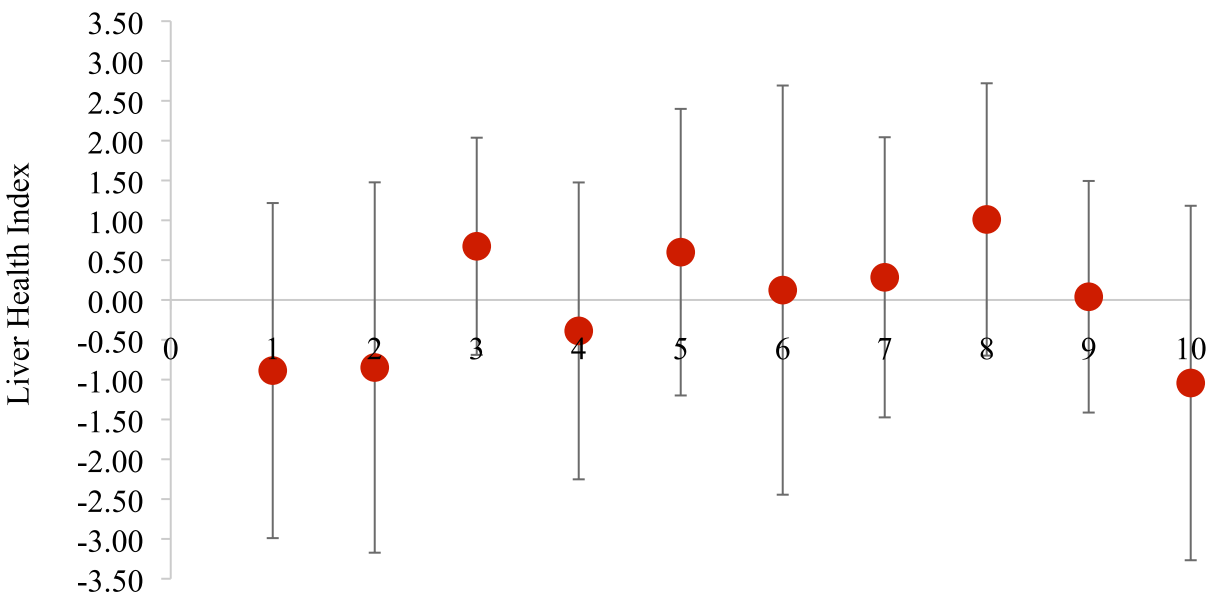

Figure 3. Average Liver Health Index Results by Farm for Post-Partum Cows 3-15 DIM on Northern NY Dairy Herds (n=10); Evaluating Transition Cow Health project, NNYADP, 2021.

Interestingly, the herds with the highest LHI scores (healthiest herds) are also the herds with some of the lowest post-partum NEFA levels (Figure 4a, R^2 = 0.64). Likewise, Figure 5a illustrates the relationship between post-partum BHB levels and LHI values, at the herd level.

Table 7. Average Liver Health Index[1] for Post-Partum Cows 3-15 DIM on Northern NY Dairy Herds (n=10); Evaluating Transition Cow Health project, NNYADP, 2021.

Farm ID	Average Liver Heath Index[1]	Standard Deviation
1	-0.89	2.10
2	-0.85	2.32
3	0.67	1.36
4	-0.39	1.86
5	0.60	1.80
6	0.12	2.57
7	0.28	1.76
8	1.01	1.71
9	0.04	1.45
10	-1.04	2.23

[1]Liver health index was calculated using the following formula: $[(Alb - \mu Alb) / \sigma Alb] + [(Chol - \mu Chol) / \sigma Chol] - [(Bili - \mu Bili) / \sigma Bili]$ as referenced by Kerwin et al., submitted.

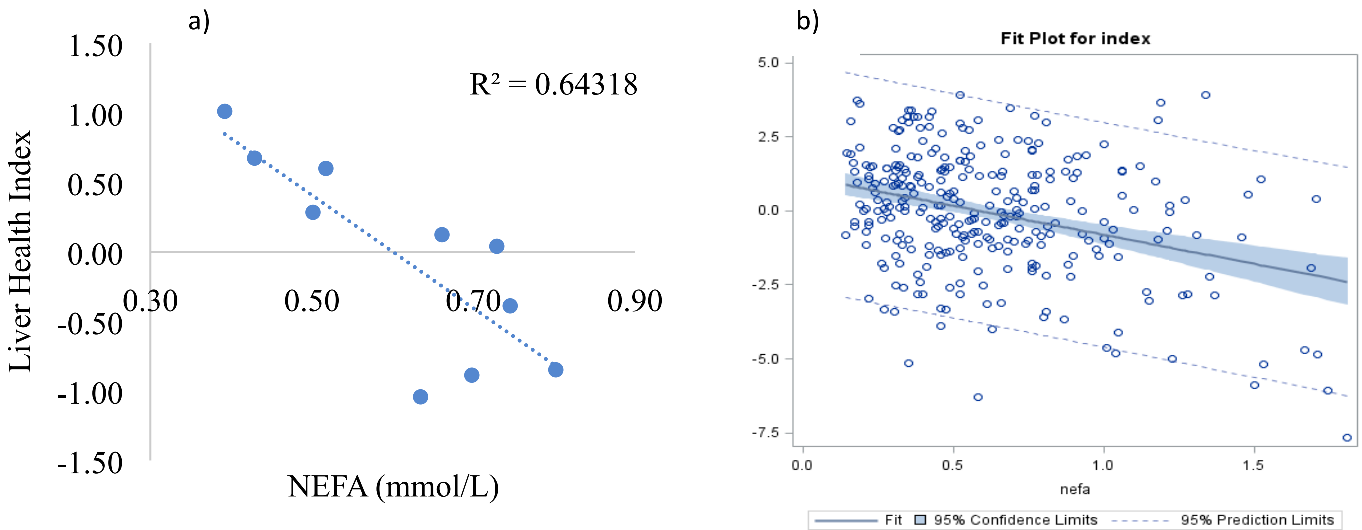

Figure 4. Linear Regression Model for Relationship Between Average Post-partum NEFA and Average Post-partum LHI Values at a) herd level (n=10), and b) cow level (n=197; y= 1.5615 – 1.96325x, R^2= 0.11); Evaluating Transition Cow Health project, NNYADP, 2021.

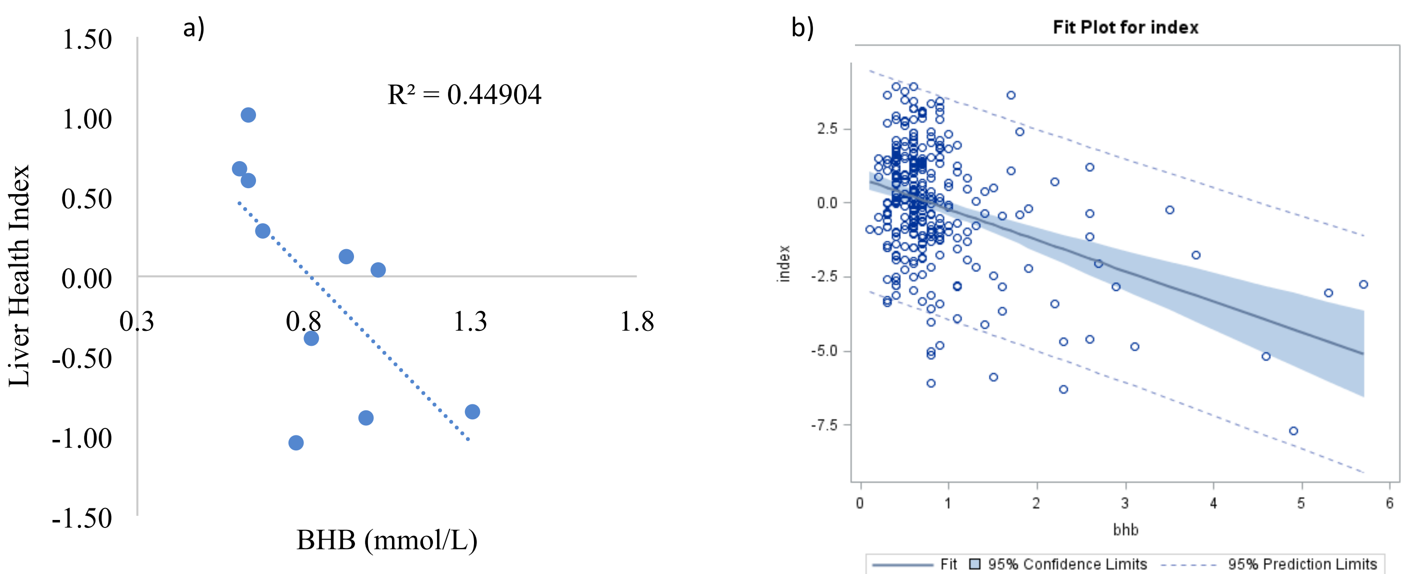

Figure 5. Linear Regression Model for Relationship Between Average Post-partum BHB and Average Post-partum LHI Values at a) herd level (n=10) and b) cow level (n=297; y= 0.82484 – 1.04085x, R^2=0.14); Evaluating Transition Cow Health project, NNYADP, 2021.

As demonstrated, herds that had, on average, higher LHI had, on average, lower BHB values than herds with lower LHI values (R^2 = 0.45). Similar results are shown at the cow level in Figures 4b and 5b. Given the integral role the liver plays in metabolic health, this is not surprising, but very interesting to see the relationship between liver health and energy status.

Liver Health Index and Cow Health Events

The relationship between the LHI and health events was also evaluated. Cows that had ketosis (defined by blood BHB ≥1.2 mmol/L) had a lower LHI (-1.71) than cows that did not have ketosis (0.36; $P< 0.001$). Cows diagnosed with milk fever also had a lower LHI (-2.19) compared to non-milk fever cows (0.05; $P= 0.01$). Lastly, cows diagnosed with metritis and/or a retained placenta had a lower LHI (-1.14) compared to cows that did not have metritis and/or a retained placenta (0.08, $P= 0.01$).

The health events used in the above analysis, excluding ketosis, were recorded by the participating farms in DairyComp; therefore, there could be discrepancies between herd protocols and diagnostic criteria. Ketosis was classified as a health event based on the BHB readings the researchers took at each visit. Figure 6 illustrates the relationship between average pre-calving NEFA levels and post-calving LHI values between herds. As illustrated, higher pre-calving NEFA levels were associated with lower LHI post-calving. This is in agreement with previous research concluding that elevated pre-calving NEFA is a risk factor for post-calving metabolic health issues.

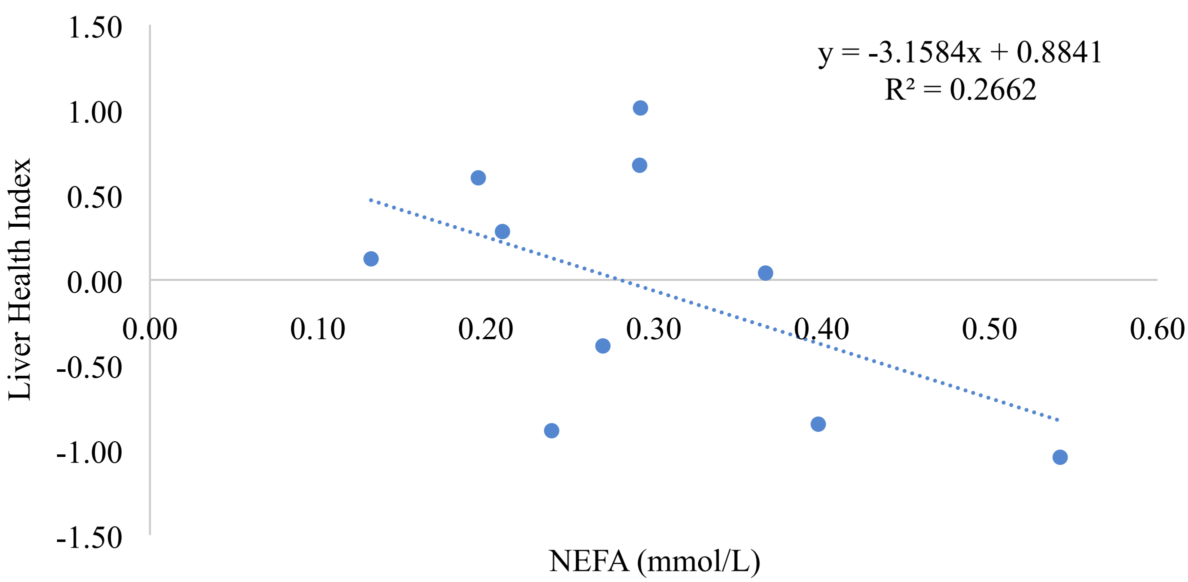

Figure 6. Linear Regression Model Describing the Relationship Between Average Pre-partum NEFA and Average Post-partum LHI Values Between Farms (n=10); Evaluating Transition Cow Health project, NNYADP, 2021.

Urine Analysis

Pre-partum urine pH levels are summarized in Table 8 and shown in Figure 7.

According to nutritionists, all diets were formulated to be fully acidified negative DCAD diets. The average pH from herds was higher than expected, but this could be a result of sampling error relative to the time of feeding. It is important to note that urine pH was tested consistently at the same time relative to feeding for all herds and for all assessments.

The coefficient of variation (CV) is a measure of dispersion around the average urine pH values. Ideally, herds should aim to have a CV under 10%. When CV values are greater than 10% that could indicate a potential issue with variable intake, both in amount and composition, e.g., due to feed sorting.

Typically, lactating cows will sort in favor of the fine particles which is where the rapidly fermentable grains are located, and against the long particles. Some research has demonstrated that when cows are fed a high-straw, negative DCAD diet they will sort against this fraction, which is generally where the anionic salt products fall.

Regardless of the direction in which cows sort, when this behavior occurs, cows are at risk of consuming an imbalanced diet. We can speculate that herds that sort more will have a greater dispersion in urine pH amongst their cows because some cows may be consuming more or less of a fraction relative to another cow.

Table 8. Urine pH Values for Cows Within 16 Days of Calving on Northern NY Dairy Herds (n=10); Evaluating Transition Cow Health project, NNYADP, 2021.

Farm ID	Average pH	Minimum	Maximum	Coefficient of Variation
1	7.24	5.5	8.4	8.8
2	6.21	5	8.7	12.5
3	6.57	5.4	7.9	8.2
4	5.41	4.8	7.3	8.8
5	5.63	4.8	7	8.9
6	7.02	5.5	8.1	10.8
7	6.25	5.1	7.9	8.8
8	5.37	4.9	7.1	6.4
9	5.54	4.9	6.2	5.3
10	7.05	5.3	8.3	12.6

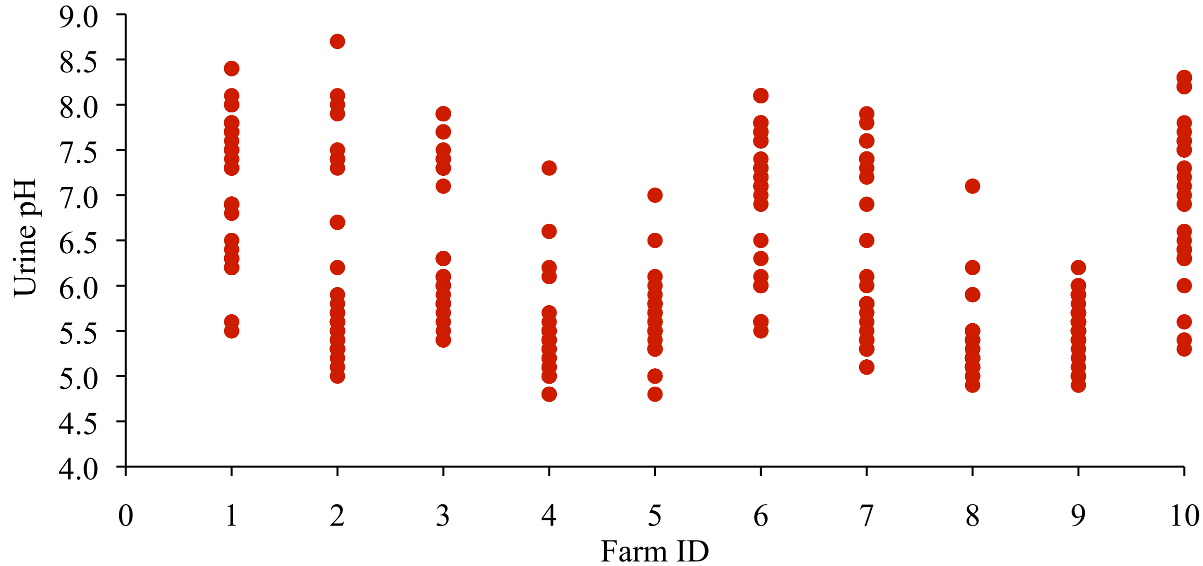

Figure 7. Urine pH of cows within 16 days of calving fed a negative DCAD diet; Evaluating Transition Cow Health project, NNYADP, 2021.

Penn State Particle Separator Analysis & Liver Health Index

The Penn State Particle Separator (PSPS) results for the dry cow diet at 0 h and 6 h are shown in Table 9.

PSPS results for each herd were averaged across the visits. As demonstrated, most farms had a higher percentage of particles retained on the top screen and fewer small particles retained on the bottom two screens at the 6 h timepoint relative to the 0 h timepoint. Without measuring intakes, sorting is hard to quantify; however, we can speculate that cows were sorting against the long particles and in favor of the smaller particles. This is in agreement with previous research investigating sorting behavior when cows are fed high straw, controlled energy dry cow diets. These findings are also in agreement with the urine CV data presented in Table 8 and discussed above.

Herds 2, 6, and 10 all had a CV higher than 10 suggesting an imbalanced consumption of the diet. Looking at the PSPS results from herds 2, 6, and 10, all these herds had a numerically higher percentage of particles on the top and a lower percentage of particles in the pan after 6 h compared to 0 h. Combined, we can speculate sorting was occurring at the pen level.

Table 9. Average PSPS Results from the Dry Cow Diet at the 0 hr and 6 hr Timepoint on Northern NY Dairy Herds (n=10); Evaluating Transition Cow Health project, NNYADP, 2021.

Farm ID	Time Point	Top Screen (> 19mm)	Middle Screen (< 19mm and >8mm)	Bottom Screen (< 8mm and >1.18mm)	Pan (< 1.18mm)
1	0hr	6.4	49.7	11.0	33.0
	6hr	7.0	51.1	10.7	31.2
2	0hr	21.7	45.5	9.7	23.1
	6hr	24.6	44.3	9.9	21.1
3	0hr	24.8	38.2	11.0	26.1
	6hr	23.7	38.5	11.1	26.8
4	0hr	16.6	45.5	11.8	26.1
	6hr	23.2	45.4	11.1	20.3
5	0hr	27.0	44.4	11.5	17.0
	6hr	29.6	39.7	9.9	20.8
6	0hr	9.7	38.6	14.0	37.7
	6hr	14.7	42.0	13.4	29.9
7	0hr	11.3	40.2	12.5	36.0
	6hr	14.1	42.9	12.1	30.9
8	0hr	18.6	43.0	13.5	24.9
	6hr	21.4	42.9	12.2	23.5
9	0hr	20.0	47.4	13.8	18.8
	6hr	18.4	46.8	12.2	22.6
10	0hr	22.9	33.1	13.8	30.2
	6hr	25.1	35.3	12.8	26.8

Lastly, Table 10 demonstrates the deviation across the feed bunk (between samples taken at the front, middle and back of each bunk) at feed delivery for the dry cow diet. In theory, the particle distribution across the bunk should be nearly identical at the 0 h timepoint (at feed delivery). To our knowledge, no research has investigated the acceptable amount of deviation across the bunk at feed delivery for the dry cow diet, therefore, it is difficult to make conclusions on this data. That said, the amount of variation that was observed within herds indicates an opportunity to improve mixing procedures before feed is delivered.

Table 10. Coefficient of Variation for Particle Distribution Across the Bunk at 0hr for the Dry Cow Diet on Northern NY Dairy Herds (n=10); Evaluating Transition Cow Health project, NNYADP,

Farm ID	Top Screen (> 19mm) CV	Middle Screen (< 19mm and >8mm) CV	Bottom Screen (< 8mm and >1.18mm) CV	Pan (< 1.18mm) CV
1	13.46	2.02	2.37	3.32
2	13.41	8.68	4.33	7.81
3	3.19	2.68	2.37	3.30
4	18.66	4.17	3.59	3.31
5	8.01	5.63	4.11	3.63
6	8.60	1.87	2.58	5.10
7	11.23	5.20	2.73	7.75
8	4.78	1.84	3.94	2.67
9	12.17	4.70	2.70	17.02
10	11.71	4.16	2.89	5.02

Figure 8 demonstrates the relationship between the CV on the top screen of the dry cow diet and liver health. As illustrated, herds that, on average, had a higher CV on the top screen (more variation) during the dry period had a lower LHI post-partum (poorer liver health). As previously mentioned, to our knowledge, no research to date has evaluated a target CV for the top screen of the dry cow diet. For this project, herds were classified as having a “high” CV if they were over 10, and having a “low” CV if they were under 10.

Herds that had a low CV (less variation) had, on average, an LHI of 0.61. Herds that had a high CV (more variation) had, on average, an LHI of -0.47. Similarly, herds that had a low CV on average had a pre-calving NEFA value of 0.23, whereas herds with a high CV had an average pre-calving NEFA value of 0.34. Interestingly, the herds with a high CV were above the pre-calving NEFA threshold of 0.3, but herds with the lower CV were not. This suggests that proper mixing of the dry cow diet and proper forage particle size can have a positive impact on post-calving health.

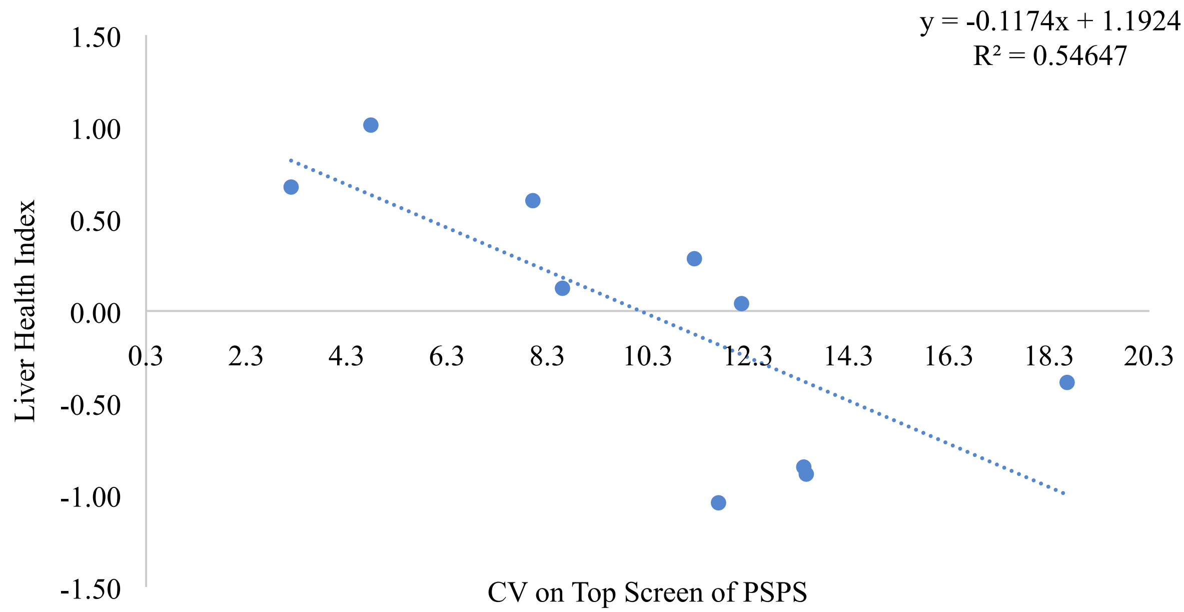

Figure 8. Linear Regression Model Describing the Relationship of the CV on the Top Screen of the PSPS for the Dry Cow Diet and LHI for Post-partum Cows on Northern NY Dairy Herds (n=10); Evaluating Transition Cow Health project, NNYADP,

Conclusions:

Overall, this research was impactful in helping NNY dairy producers better understand the importance of proper feeding management as well as the relationship between different metabolic health parameters on transition cow success. Key findings from this study:

- 80% of herds (8/10) were above the herd alarm level threshold in the pre- post-partum period for NEFA which suggests an opportunity for improved pre-calving feeding management. Likewise, 90% (9/10) of herds were above the herd alarm level threshold in the post-partum period
- 40% (4/10) herds were above the herd alarm level threshold for post-partum BHB, but 60% (6/10) were within an acceptable range.
- Elevated pre-calving NEFA resulted in lower LHI values (poorer health) at the herd level
- Elevated post-calving NEFA and BHB resulted in lower LHI values (poorer health) at both the herd level and at an individual cow level.
- Anecdotally, herds that a higher urine pH CV sorted more against the long particles in the dry cow diet.
- Herds that had a higher CV on the top screen of the PSPS for the dry cow diet had a lower LHI value, suggesting that proper mixing and appropriate forage particle size in the dry cow diet plays a role on post-calving metabolic health.

Outreach:

- The preliminary results of this project were presented at CCE NCRAT Virtual Dairy Day (Jan 18- Jan 20, 2022).

- Each farm received a final report summarizing the project data and their farm-specific data.
- A series of newsletter and blog articles will be published in spring 2022 editions of CCE North Country Advisor Extension Newsletter and on the NCRAT blog.
- An abstract may be submitted to the American Dairy Science Association Annual Meeting in June 2022.

Next Steps:

- The project results will be reviewed in depth with each participating farm and its trusted advisors to discuss areas of opportunity and excellence relating to transition cow feeding management.
- Milk production and reproduction data will be collected and analyzed in 2022.
- An ongoing next step will be further work on developing a statistically-accurate tool that can be used by farm consultants and producers to help producers track the success of their dry cow feeding management.
- Each farm will be re-visited in the summer of 2022 to have a more thorough feeding management analysis completed on their herd.
- This NNY trial indicates areas where further research is needed to explore different feeding management strategies in the dry period that could influence post-calving performance and success.

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