Uncovering hidden or under recognized feed cost and margin opportunities on your dairy farm*

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Over the past 15 years, dairy farms have recognized sizable economic returns and losses. Learning from dairy farm margin summaries and projections reported by Mark Linzmeier, www.marginsmart.com, our industry has recognized dairy margins fluctuating between ($5.00) and $8.00 per hundredweight (cwt). Recently, the estimated net income before tax for an average 1,500 cow dairy in 2018, 2019 and 2020 has been ($1.34), $1.25 and $1.25 per cwt, respectively. In general, dairies in the US are operating on thin margins at best throughout the past half decade. Average is not acceptable, thus we are constantly seeking margin and efficiency opportunities. Forward thinking dairies are tracking feed conversion efficiency and other key performance indicators that are directly related to their balance sheet.

In my experience working with leading dairy consultants, allied industry experts, and business minded dairies, we're recognizing $0.25 or greater margin opportunities per cow per day in some unique spots on the farm. In some cases, $0.05 to $0.10 margin opportunities are captured by recognizing moisture or nutrient content differences relative to that expected. The economic opportunities can be attributed to both forages and commodity feeds. These unrecognized opportunities can appear in two different ways: an abrupt change or a subtle trend over time.

In other experiences, margin opportunities have been uncovered through unlocking more energy in each pound of feed consumed. This has been a focal point with many research efforts, however a simple beginning point is to focus on starch and grain.

The aim with this article will be to review several economic opportunities rooted in unique nutrition trends that may exist for dairy farms across the US.

Corn silage varies more than many recognize

As I've worked with dairies that have dug deeply into their nutrition program to find margin opportunities, the nutrition evaluations have taken numerous forms. It starts with forages. For example, in 2013 one dairy began sampling their forages every 2 weeks to recognize substantial starch content changes within their 13,000+ ton of corn silage piles. I distinctly remember the case, as the nutritionist at the dairy began adjusting the ground corn in the diet to balance against the week to week changes in silage starch content. In this case, corn silage was changing much more than we had previously conceived and I've witnessed this situation play out with other silages and farms.

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We tend to think of corn silage as a consistent crop, which is true relative to hay. However, corn silage is a heterogeneous feed consisting of the ear and the stalk. The ear is filled with grain and starch, whereas the stalk and leaves are filled with fiber. Fiber digestibility is extremely important, however fiber is always less digestible than starch and grain. For example, total tract NDF digestibility (TTNDFD, % of aNDF) averages roughly 42% for CA corn silage whereas total tract starch digestibility (TTSD) will average 92 to 95%. While fiber and starch contain a similar caloric value per pound, dairy cattle are only able to unlock roughly half the calories in fiber relative to starch. Hence, the nutrition value with silage begins with the ear to stover ratio. Environmental and agronomic management practices that improve grain yield will ultimately increase forage quality in general assuming harvest maturity and moisture are appropriate.

With the extreme drought experienced in the South and West recently, coupled with variable weather patterns year to year, the grain and starch content in silage may deviate substantially between fields relative to that we'd recognized a decade ago. In the past I've hypothesized that a well made silage pit or pile effectively blends different fields, however experience is now suggesting otherwise.

To visualize an exemplary starch content change with an aggressively sampling dairy, Figure 1 details the 4 sample average with corn silage starch content for a 7,000 ton pit over the duration of feed out. In this case, the dairy sampled the forage several times per week to characterize the nutrition changes. Based upon this experience and others like this, there could be under-recognized corn silage starch content opportunities for many dairies throughout the US. Dairy cows may not

Feed libraries are a rough starting point

With grain prices at near historically high levels, feed costs are increasingly scrutinized. Many dairies and consultants are evaluating alternative protein or energy options. Often, we seek to identify the best cost option(s) and drive down feed costs while maintaining performance. Our comparative efforts with diet software or feed evaluation tools rely upon robust and accurate moisture and nutrient content values. Recent experience is suggesting that feed library values are only a rough starting point for nutrition evaluations.

For example, in Figure 2 the crude protein content (% DM) in canola meal is shown for several hundred samples analyzed by Rock River Laboratory, Inc. over the past two calendar years. Canola meal across the US has been averaging roughly 39 to 40 % of dry matter, and this is well above a feed library value at 38.7% of dry matter. In this instance, canola meal may be a value opportunity for the dairy industry, with one unit of crude protein equating to roughly 18 pounds of crude protein value per ton and an economic value of roughly $8 per ton. This value proposition is not limited to canola meal. In conjunction with forward thinking dairies more frequently testing their feeds, soybean meal and other expensive commodities have been found to substantially

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deviate from feed library base values. These differences have often been due to subtle trend changes over time which cows didn't respond to, but the check book may have.

St-Pierre and Weiss (2017) have extensively evaluated dry matter and nutrient variation within and between farms. Their group observed substantial feed variations that should be accounted for over time. The authors recognized that variance can be partitioned between farms and within farms. While the science is sound, measuring and managing these economically impactful variances has proven challenging for dairies and nutritionists. Part of the challenge has been rooted in sampling error and limited replication in sampling. St-Pierre and Weiss (2017) commented that feed library nutrition values may be more realistic than a single sample due to sampling error. This concept is important to grasp. Single samples must be interpreted with caution. There is sampling error associated with any single sample that complicates interpretation. However, as more samples are tested over time and more data available, we can observe statistically meaningful trends and cut through the sampling noise. With larger database insight and through novel intensive feed sampling programs, many have confirmed that feed library values can be improved upon in appropriately depicting the feed's changing moisture content or nutritive value over time.

Differentiate between abrupt and subtle trends over time

Both commercial experience and research studies with dairy cattle have clearly demonstrated cows respond to abrupt changes in moisture or nutrient content. For example, following a rainfall event the moisture content in exposed feeds increases. If left unadjusted, the cows' diet will become unbalanced and can contribute to digestive upset and performance losses. Alternatively, different hay lots are known to affect dairy performance if substantially different in nutritive value and fiber digestibility. In this case, there is meaningful variation tied to the hay lot, which we recognize. In practice, abrupt changes in nutrient supply often elicit a positive or negative response on farm and then samples are taken and adjustments are made. However, dairy herd responses to subtle trends and changes in nutrient or moisture content over time are far less studied and understood.

Meaningful feed trends can be buffered by cows

Two studies have documented that dairy cattle appear capable of buffering changes in protein and moisture changes over a short period of time (St-Pierre and Gerstner, 2005; McBeth et al., 2013). In these studies, substantial dietary changes were made to mimic nutrient or moisture changes. However, dairy cow performance did not change significantly, or as would be predicted by dairy nutrition models. In these studies, the dairy cows apparently exhibited some intrinsic ability to buffer protein or energy changes. More recently over the past two years, numerous commercial dairy experiences have been in line with the research observations described above.

Coming back to Figure 1 detailing corn silage starch content during a 9 month feed out period, the 4 sample moving average clearly detailed that starch content in the silage

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changed substantially on numerous occasions. During one 6 week period, starch content decreased from 37 to around 32% of dry matter, which represented roughly 1.6 pounds of corn grain equivalents for this diet feeding around 20 pounds silage dry matter per cow. However, this dairy herd did not recognize substantial dairy herd performance swings relative to the measured starch trends. This single observation is intriguing and warrants further evaluation. However, if the dairy herd was able to buffer this change in some capacity then the real world observation would be in agreement with those of the researchers described previously. Beyond dairy performance changes in this case, the change in starch content contributed by the corn silage over time represented roughly $0.20 per cow per day value in corn grain equivalent from mid-May to July. Often we react to changes in performance or components to initiate adjustments. However, based on this field observation and others like this, there are subtle unrecognized feed cost and economic opportunities that dairy cows show us through performance.

Dry matter pounds fed match expectations

In the cases described above, nutrient concentration and supply were affected. One additional, and more simple, set of cases corresponds to moisture changes in expensive feeds. These can also uncover hidden feed cost opportunities. Most dairies recognize the need to monitor moisture content of their wet feeds several times per week. With forage and wet feed moistures changing from week to week. There are near-infrared reflectance spectroscopy (NIR) instruments that are available to improve the farm's ability to measure moisture content and make adjustments in a short period of time. However beyond forages and wet feeds, in my experience very few have considered adjusting moisture content with dry and purchased feeds.

Often, feeders or managers use feed library values within feed management software programs to build dairy recipes. Recent experience has shown there can be substantially less moisture than what tag guarantees list as a limit for feed management software library values indicate. In these cases, less moisture equates to more dry feed per ton than what dairies or nutritionists recognize. Consider the following case study visualized in Figure 3, with two different soybean meal sources.

In this case, two different soybean meal sources guaranteed to be equivalent at roughly 47.5% crude protein (as-is) differed substantially in moisture content. Each of the soybean meals met or exceeded tag guarantee requirements, however one of the soybean meal sources was consistently 1.5 to 2.0 units lesser in moisture content. The ramifications of this difference equate to roughly 40 pounds per ton more dry soybean meal and roughly $8 per ton value at $400 per ton price point. Economic minded dairies can capitalize on cases like this and make adjustments for less moisture content in their purchased feeds.

Ensure purchased grain is being used by cows

Another hidden economic opportunity is nested within undigested corn grain. In the South and West, we tend to feed less corn grain and starch due to more expensive corn

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grain and alternative feeds or cheaper energy rich byproducts. However, even at 18% dietary starch concentration within a 55 pound dry matter intake, starch and corn grain equivalent in the diet represents roughly $1.65 per cow in feed costs at $6 per bushel corn. Hence, the economic ramifications associated with limited starch digestion can be sizable.

Fecal starch content has been clearly linked to total tract starch digestion (TTSD) in dairy cattle (Fredin et al., 2014). Dr. Jim Ferguson and Dr. Mike Hutjens have taught the industry to begin using this tool over a decade ago (Hutjens, personal communication). More recently, we have analyzed commercial fecal starch data and calculated population statistics to set new goals for today's dairy farms. As of the past 5 years, the 15th percentile for starch content in all dairy manure samples is roughly 0.5% of dry matter. This corresponds to 99% total tract starch digestion and is our new goal. In Figure 4, fecal starch results for 2 years worth of commercial dairy samples from across the United States can be visualized. Recognize that the trendline moves over time, however the average result is nearly always at 2.5% fecal starch or greater. Assuming a 55 pound dry matter intake and 18% dietary starch as described above, 2.5% versus 0.5% fecal starch projects to roughly 0.4 pounds more undigested corn per cow and $15,000 per year economic opportunity for every 1000 cows. Projections such as this with dairy cattle can be determined using an open access web application available from Rock River Laboratory, Inc. The application can be accessed here: https://rockriverlab.shinyapps.io/FecalStarchCalc/

Summary

This article leans heavily upon recent experience and case studies. Admittedly, our industry has much yet to learn and research to continue leading the world in dairy business performance. However, our dairy industry is evolving at a rapid pace due to the demand for continued efficiency and sustainability gains. Whether discussing emissions, environmental stewardship, feed conversion efficiency, income over feed costs, or another efficiency metric, recognize that each of these are highly correlated. Our collaborative goal is to produce more with less, and this will in turn improve the profitability of dairy farms and agribusinesses. Within this article, I've discussed several different areas that may contribute to this collective aim.

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Figure 1: Example corn silage starch content, % DM, for a commercial dairy over a 9 month period.

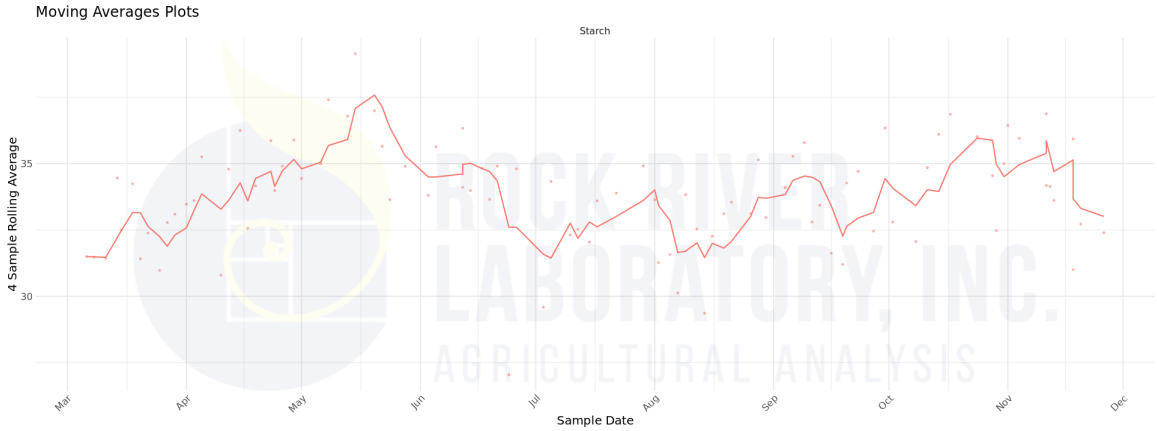

Figure 2: Canola Meal crude protein content, %DM, by calendar year for commercial feed samples analyzed by Rock River Laboratory, Inc. in 2020 and 2021. The vertical black lines within each distribution plot represent the 15th, 50th and 85th percentiles, respectively.

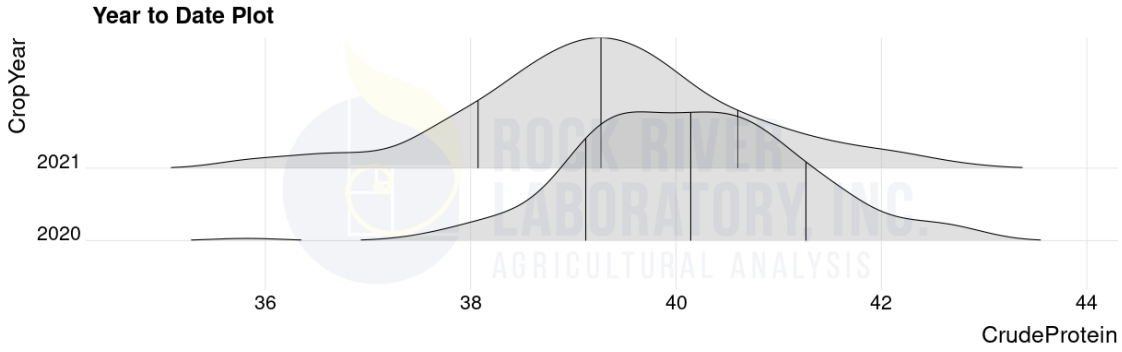

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Figure 3: Total moisture content, %, for two different soybean meal sources over a 90 day period.

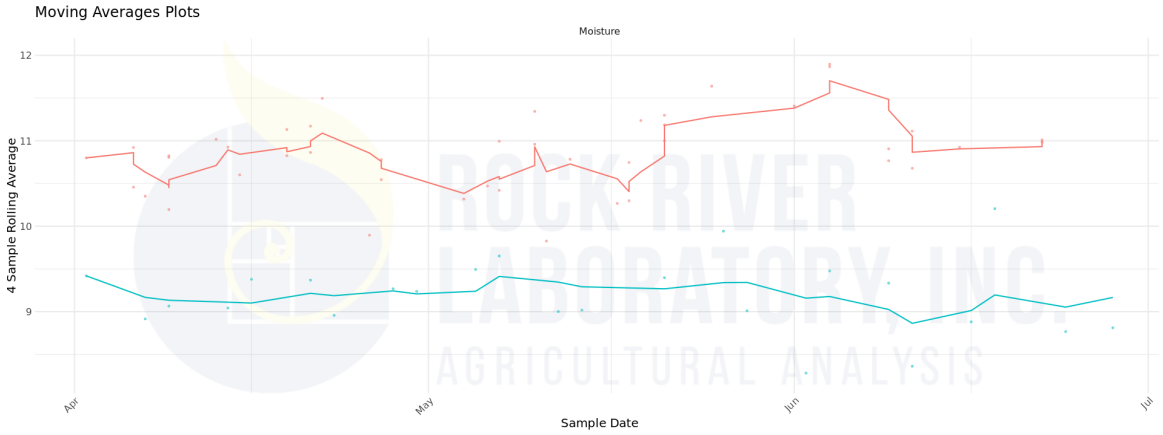
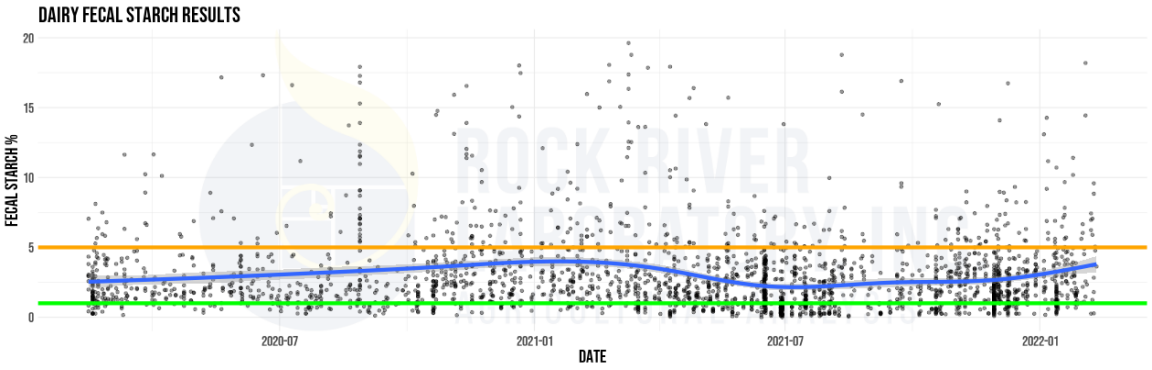


Figure 4: Dairy cattle fecal starch content, %DM, for samples submitted to Rock River Laboratory, Inc. from 2020 through 2022. The flat red line equates to the 15th percentile and goal of 0.5% dry matter fecal starch content. The trendline represents the moving average over a 2 year time period.



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