Use of an On-farm Application to Maximize Milk Fat Production: What We Have Learned

D. McGee
Elanco Animal Health

In virtually every dairy market, milk fat yield is an important component of milk pricing. While different regions in the U.S. have different pricing formulas, all of them use milk fat (or "butterfat") yield as part of the price calculation. In addition, over the last several years, 2015 to 2019 in particular, the value of milk fat relative to other components of milk, whether protein or skim, has significantly increased. It has only been in the last six months or so that the value of milk protein has recovered to a significant degree relative to milk fat (USDA-Economics, Statistic and Market Information System).

Milk fat content or more commonly, "milk fat percent", is the traditional – and, therefore, in some ways, easiest to communicate – metric associated with milk fat production. Having a goal for milk fat percentage is reasonable, but it should also be noted that dairy producers are paid for milk fat by *weight*, not *concentration*. This is important since it is possible to have no change, or even a slight reduction, in milk fat percent, yet produce more *pounds* of milk fat overall, if overall milk production increases. Nevertheless, milk fat percent, even with these obvious drawbacks, is the most common way that producers monitor milk fat performance.

An obvious question then is "what is an acceptable milk fat percent for a given farm?". This answer varies according to the goals and expectations of the dairy management team. It is worth noting that milk fat concentration in U.S. Holstein cows in the U.S. has increased over the last several years(Elanco Animal Health), and based on current data, a milk fat percentage of 3.8 or more in all Holstein herds is very attainable while also achieving high production.

How much can we influence milk fat performance? Milk fat is highly variable – both within a herd and across herds – suggesting that there could be many identifiable factors which could account for this variation, and indeed a great deal has been discovered about the variation in milk fat production in recent years. There are many known nutritional factors that can influence milk fat production, but there are also many non-nutritional factors that should be considered in an investigation of milk fat performance. For example, herd lactational and genetic demographics, feeding management practices, and housing systems can each play an important role in this multifactorial outcome. Like nutritional factors, most of these non-dietary factors can be managed. So, milk fat performance is influenceable, and it can be affected in meaningful ways.

One way to approach the issue of milk fat production is to think of it systematically in terms of three broad areas: herd demographic factors, nutritional factors, and management factors. There are many specific factors within these three categories, but it is helpful to start with a well-defined, repeatable approach. *Herd demographics* include

factors like stage of lactation dynamics, parity distribution, and genetic potential. *Dietary factors* are the specific concentrations of various critical nutrients that the cows consume. *Management factors* represent the decisions that management has made which can influence accurate delivery of the diet or feed access by the cows.

Herd Demographics

Maybe the most profound example, and one we do not have as much control over, is seasonality. In North America season of the year has a significant biological effect on milk fat percentage – specifically, milk fat yield decreases in the summer months. This decrease can be exacerbated by heat stress but is more biologically fundamental than simply a heat stress effect. For example, milk fat concentration begins to decrease in February and March – much earlier than would be expected if the effect were simply a consequence of heat stress. The yearly change in photoperiod with lengthening and shortening days likely plays a role in seasonal milk fat performance (Salfer et al. 2019). It is important to keep this in mind when setting goals or expectations for milk fat yield in the summer.

Other slightly more controllable demographic factors include genetic potential, which could be evaluated by Predicted Transmitting Ability or genomic testing, parity distribution – the proportion of milking cows that are in each lactation, and the distribution of Days in Milk (DIM).

Dietary Factors

While there are many nutritional factors that could limit milk fat, most of them have their effect by:

1) altering the rumen environment, and/or
2) affecting the amount of unsaturated fatty acid in the rumen.

Since unsaturated fatty acids must be converted to saturated fatty acids in the rumen in a process known as *biohydrogenation*, anything that interferes with or overloads this critical process can limit milk fat synthesis. For example, too much starch or too little digestible fiber in the diet can lead to extremes in rumen pH, which may hinder biohydrogenation. Simply overfeeding unsaturated fatty acids can overwhelm the system and allow potent inhibitors of milk fat synthesis to escape the rumen. These are key examples of how the diet itself can affect milk fat concentration and yield (Bauman and Griinari, 2003).

Other dietary considerations include dynamics of dry matter intake, the feed delivery system, the number and timing of feedings, the moisture content of the diet, fiber and fiber digestibility, starch and starch digestibility, fat (and especially unsaturated fat) content of the diet, buffer feeding, dietary cation-anion balance, and amino acid balance.

Management Factors

Many of the management factors have to do with feed access. If you consider, for example, three areas of management: stocking density, time required for milking, and empty feed bunk time, these seem like independent concerns of management. In reality, they all affect the amount of time a cow can spend at the feed bunk eating and other aspects of feeding behavior. So even the perfect diet on paper cannot perform as intended in the cows if management conditions and management decisions do not enable great nutritional performance.

Other controllable factors in this category of management factors include mixing uniformity, timing of feed delivery, frequency of feed delivery, ingredient load order into the feed mixer, proper functioning of the feed mixer, frequency of feed "push-up", feed stability in the bunk, wet forage storage system and frequency of moisture testing and associated ration adjustments, heat stress abatement, stocking density, time away from the home pen for milking, level of feed sorting, duration of empty bunk time, water quality and potential water contaminants or dissolved minerals, and yeasts and mycotoxins.

A systematic "milk fat assessment". An application (Milkfat dTect™) has been developed by Elanco Animal Health which incorporates farm-specific inputs in each of these broad categories (Herd Demographics, Dietary Factors, and Management Factors; Figures 1, 2, and 3).

This digital tool, developed for the iPad®, enables a thorough process of on-farm observations and consultation with the nutritionist to assess each of these areas in great detail. Milkfat dTect includes user aids to assist in key calculations, and photos and notes can be added during the assessment. The application then generates a report which organizes the findings into these three categories and applies a risk score to the various findings within each area (Figure 4). The findings are supplemented with literature citations to support their importance in milk fat performance. This allows the nutritionist to focus on areas of concern and prioritize forthcoming action with the producer to improve milk fat production. The summary report also includes photos and notes captured during the assessment. Milkfat dTect can be used as a troubleshooting tool for milk fat depression or to identify the constraints which may prevent maximizing milk fat yield.

An additional benefit of using a tool like Milkfat dTect is the ability to permanently store and organize the data. Data collected during assessments is automatically saved in a secure, remote database for access later. This creates a unique opportunity to use the data to monitor performance within a herd, create summaries and make comparisons across herds, and collect data for field-based research. All the key data items are saved in a structured environment for more advanced analytical investigation (Figure 5).

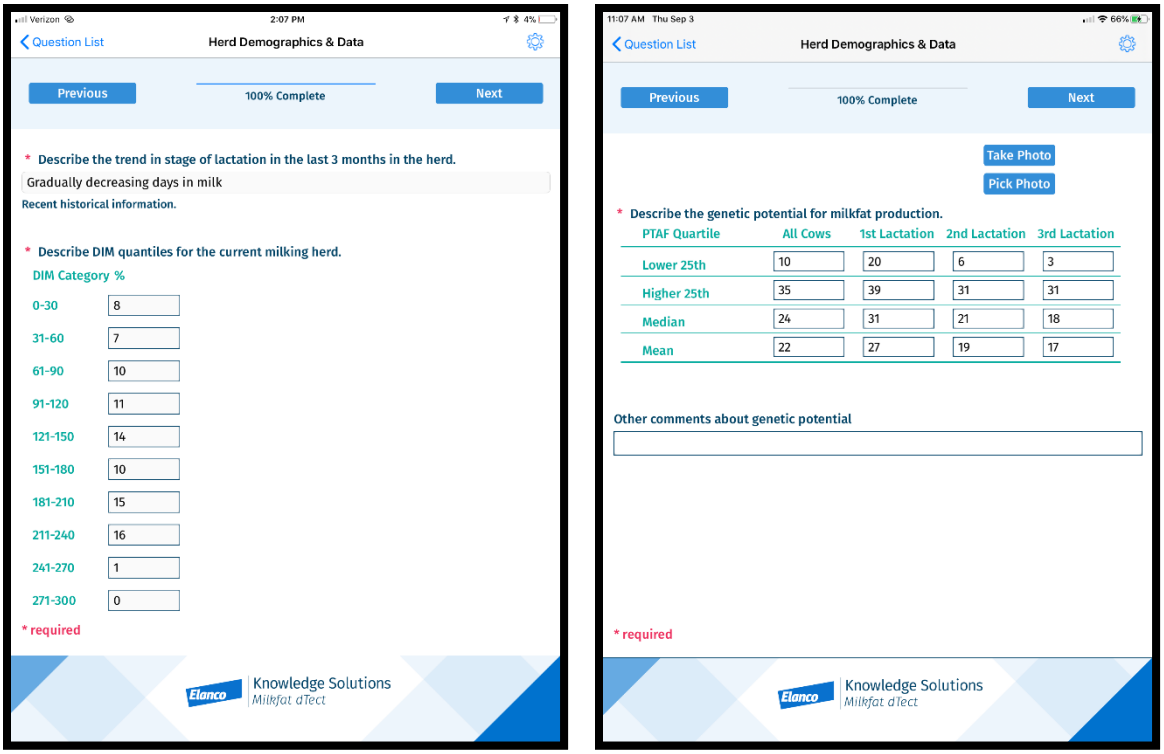

Figure 1. Example “Herd Demographic” Data

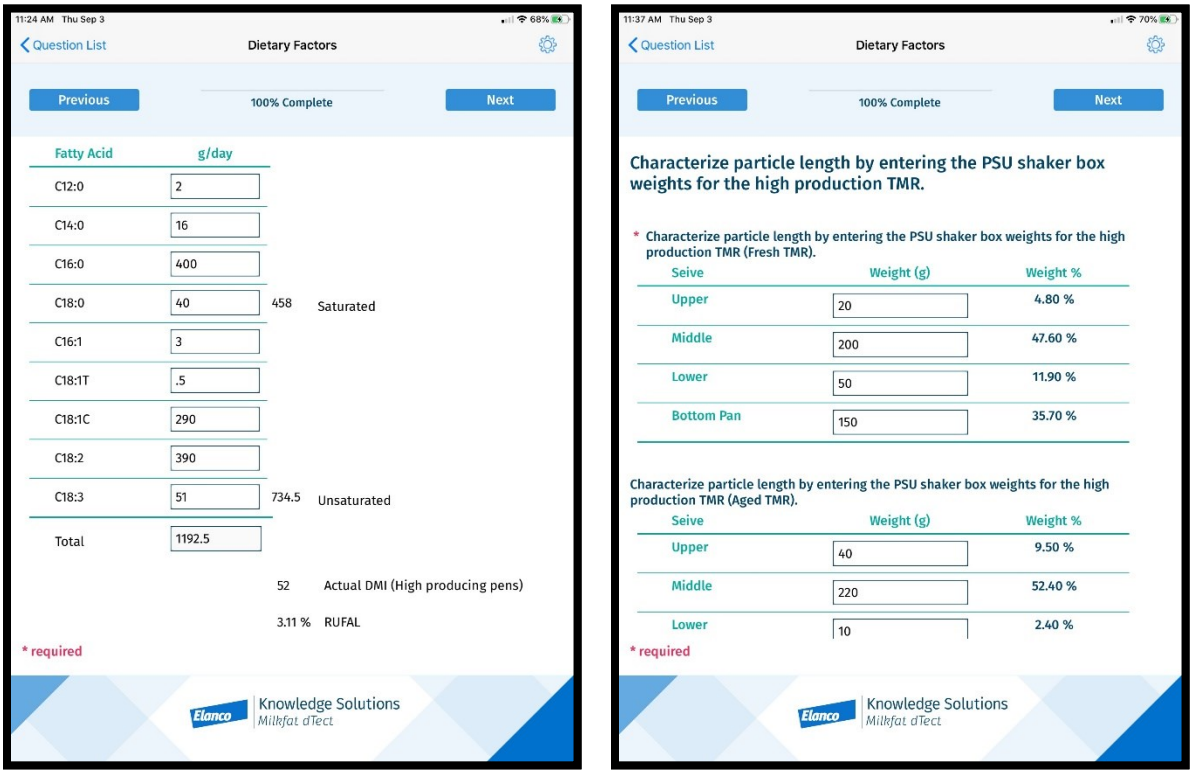

Figure 2. Example “Dietary Factors”

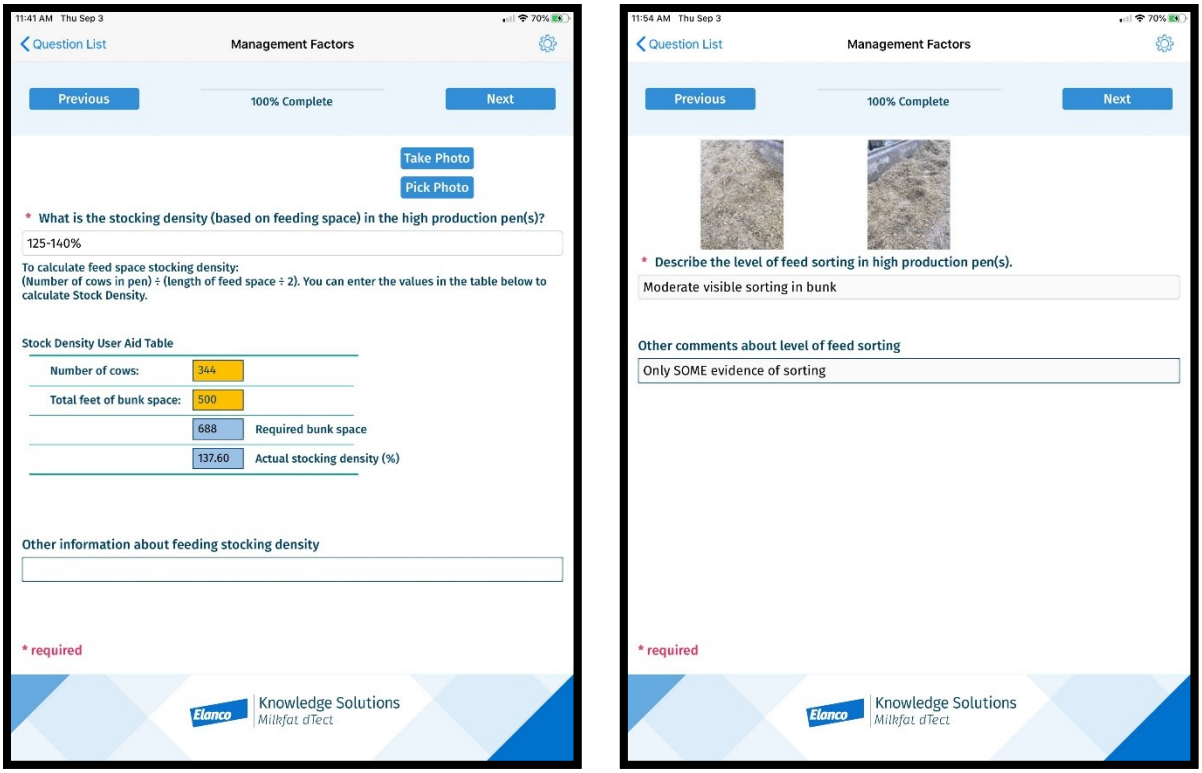

Figure 3. Example “Management Factors”

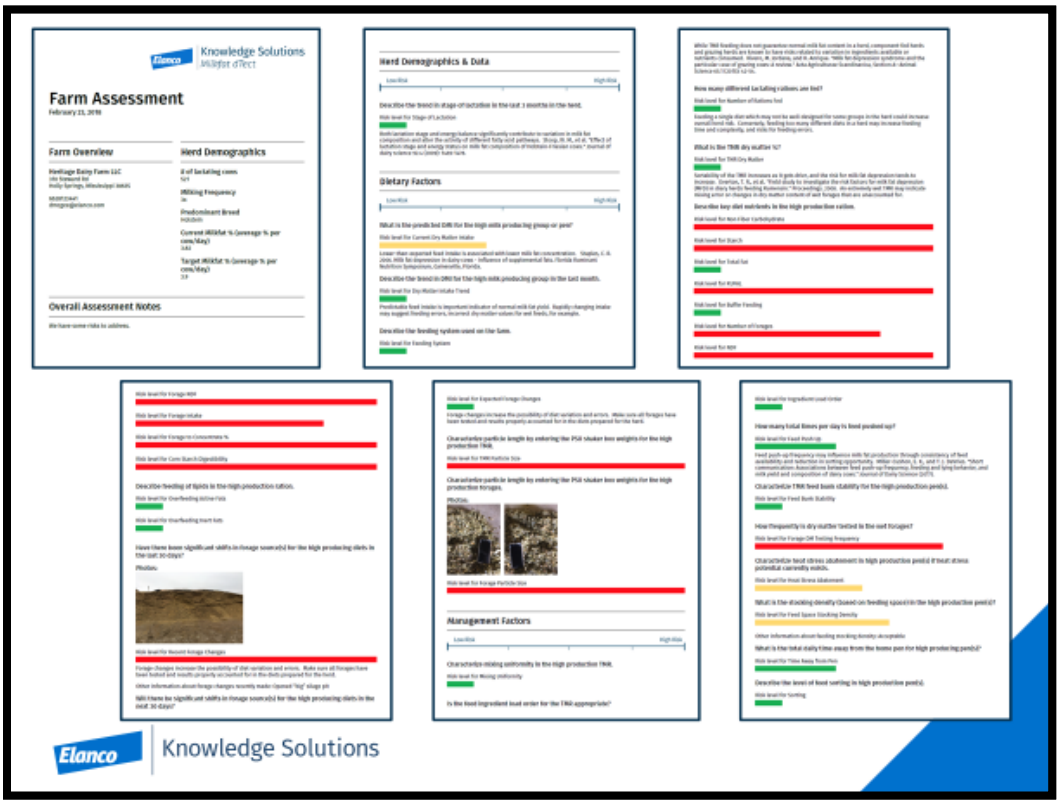

Figure 4. Example Milkfat dTect Report

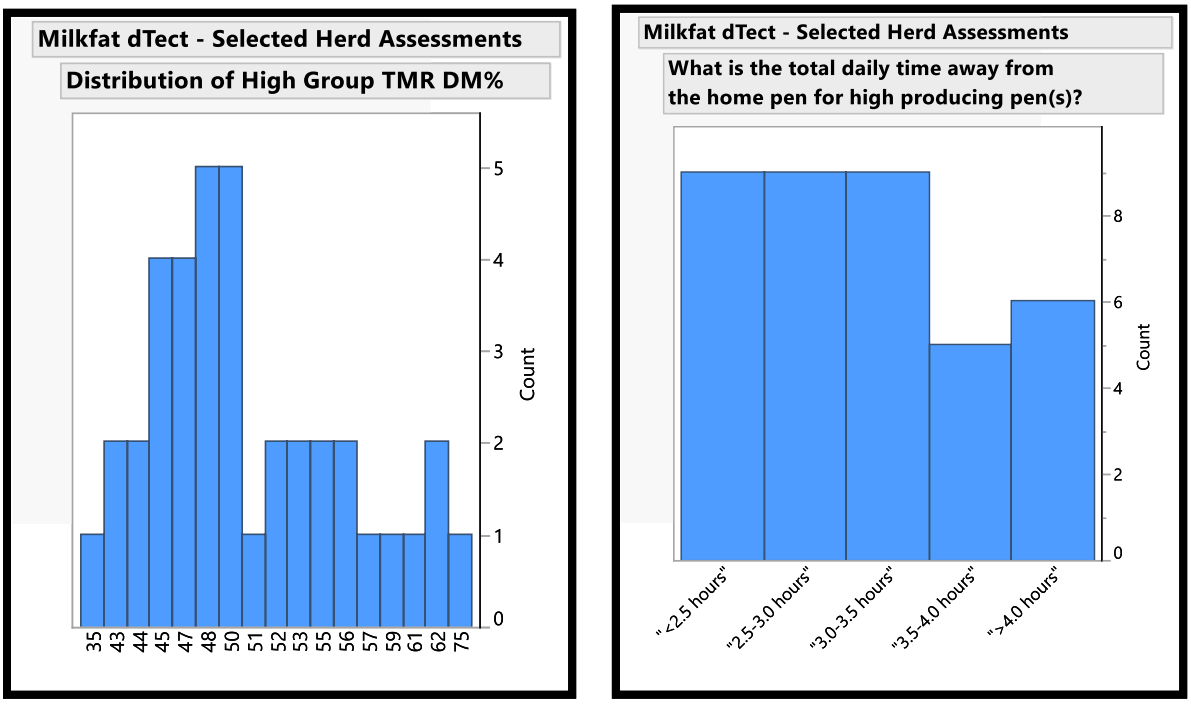

Figure 5. Example "Multiherd Comparisons"

Key Take Aways

- Milk fat is valuable and maximizing milk fat yield, not just concentration, is crucial to the financial success of a dairy operation.
- Maximizing milk fat is a multifactorial process and requires a multifaceted approach to achieve the goal.
- Factors involved in milk fat yield can be grouped into three categories: Demographic factors, Dietary factors, and Management factors.
- Elanco can help provide a very thorough, structured approach to the challenge of maximizing milk fat yield by working with dairy nutritionists and their clients with Milkfat dTect™
- Advanced multiherd analyses and comparisons are enabled through maintenance of assessment data in a secure, accessible, remote database.

References

Bauman, D.E., J.M. Griinari. 2003. Nutritional regulation of milk fat synthesis. Annu. Rev. Nutr. 23:203-27.

Elanco Animal Health. Data on file.

Salfer, I.J., C.D. Dechow, K.J. Harvatine. (2019). Annual rhythms of milk and milk fat and protein production in dairy cattle in the United States. J. Dairy Sci. 102:742-53.

USDA-Economics, Statistic and Market Information System. Announcement of class and component prices Accessed August 20, 2020, available at: https://usda.library.cornell.edu/concern/publications/rb68xb84x?locale=en.