Challenges and opportunities of milk recording methods in Irish dairy farms: A comparison of test day milk recordings and daily bulk collection samples

M. Thompson

Irish Cattle Breeding Federation, ICBF, Link Road, Ballincollig, P31 D452, Co. Cork, Ireland.
Corresponding Author: mthompson@icbf.com

Abstract

The objective of this study was to explore and quantify the differences in fat and protein percentages between milk samples collected on test day milk recordings and those obtained from daily bulk collections in commercial dairy herds in Ireland. The dataset comprised 5,742 milk recordings from 2,841 herds in 2021, where daily bulk collections were taken on the same day as the milk recording. The predicted fat and protein percentages for test day milk were estimated using either the AM or PM milk samples and were incorporated into prediction equations approved by ICAR. The Pearson correlation between fat and protein percentages from test day milk recording and daily bulk samples was 0.82 and 0.96, respectively. These correlations correspond to mean differences of 0.1% and 0.01% for fat and protein percentages, with the average test day milk recording showing lower values for both measurements. Fat percentage correlations for herds using EDIY (electronic do it yourself meters which take a test sample automatically) and Non-EDIY (manual recordings where a milk recorder visits and takes a test sample) recording devices were 0.87 and 0.72, respectively. Herds with a higher average test day cow yield demonstrated a lower fat percentage correlation. Similarly, samples taken during peak milk production season exhibited larger differences in fat percentages compared to those taken during the off-peak milk production season. The findings of this study clearly indicate that the largest variation is observed in the fat percentage reported in test day milk recordings when compared to the corresponding daily bulk samples. The extent of this variation is affected by yield, season, recording type, or a combination of all three factors.

Keywords: Milk recording; Irish dairy farmers.

Introduction

Irish dairy farming is currently facing numerous challenges, including regulatory, economic, and environmental pressures. To overcome these challenges and ensure sustainable, profitable, and efficient dairy farming practices, milk recording has become a vital tool. Milk recording organisations (MROs) provide this service during a milking, using milk meters to measure the volume of milk and take samples from each individual cow. This process grants farmers access to a significant amount of data, offering crucial insights into herd health and performance. As a result, farmers can make informed breeding decisions, identifying cows for replacements and determining which cows should be culled or not bred further.

The practice of milk recording on Irish dairy herds has been steadily increasing since the abolition of milk quotas in 2015. The percentage of milk recorded herds has risen from 35% in 2018 to 44% in 2021 (ICAR, 2021). Recent years have seen a significant uptake in milk recording, with the latest data from the ICBF database showing a nearly 12% increase in the number of cows' milk recorded in 2022 compared to the same period in 2021 (ICBF, n.d., 2023a). One reason for this sudden increase is the introduction of new legislation in late 2022, which no longer permits blanket dry cow therapy. Instead, the legislation encourages the implementation of milk recording as a means of routinely monitoring mastitis levels, as well as managing dry cows and antibiotic use. Another contributing factor to the increased adoption of milk recording is the commitment made by the Department of Agriculture, Food, and the Marine (DAFM) to raise the percentage of dairy herds undergoing milk recording from the current level of 50% to 90% by 2030 (DAFM, 2020).

Traditionally, Ireland has been slower in adopting milk recording technologies compared to other dairy-producing countries such as the Netherlands and New Zealand, where 89% and 75% of herds were milk recorded, respectively, in 2021 (ICAR, 2021). The reasons for Irish dairy farmers' slower adoption of this technology are not fully understood. Despite the low total cost and labour associated with milk recording (€10 per cow to milk record four times per year with no upfront investment required), it is unlikely to be a reason for poor uptake (ICBF, n.d., 2023a). However, Balaine *et al.* (2020) suggest that the slower adoption may be due to ineffective communication of the many benefits of milk recording in previous years.

MROs offer two types of milk recording services: a) a manual recorder service, and b) an electronic "do-it-yourself" service (EDIY). A manual recorder service involves a milk recorder technician visiting the farm to conduct a manual milk recording. On the other hand, an electronic DIY service allows farmers to operate the service themselves with training and support provided by an MRO technician (ICBF, n.d., 2023a). Currently, there is limited knowledge regarding the differences in reporting between these two services. Anecdotal reports present contrasting views on which service provides a more accurate way of milk recording, as well as concerns about differences that might arise between milk samples taken during milk recording and those taken by dairy processors during bulk collections.

Objective

The objective of this study was to explore and quantify the differences in fat and protein percentages between milk samples collected from test day milk recordings and those obtained from daily bulk collections by dairy processors on Irish commercial dairy herds. In addition, this study aimed to shed light on the factors that influence the accuracy of milk recording reporting. By doing so, intending to improve communication surrounding the advantages and limitations of milk recording as a service.

Materials and methods

Data

Milk recording (MR) samples were reported according to the alternative AM-PM recording scheme previously approved by the International Committee for Animal Recording (ICAR) (Berry *et al.,* 2006). Daily bulk (DB) samples were reported as recorded by the dairy processor during bulk collections. The dataset consisted of a total of 5,742 milk samples from 2,841 herds, all of which had test day MR on the same day as DB collections. All of these herds had at least 4 milk recordings in 2021 and were contracted to supply milk to dairy co-ops.

Analysis

The analysis compared the fat and protein percentages of test day milk recording (MR) samples with daily bulk (DB) samples collected on the same day in 2021, where the DB sample results were assumed to be the true values, given that farmers are paid based on these values by the dairy processors. The accuracy of MR was assessed using three metrics: 1) Pearson correlation, 2) Unit difference, and 3) Percentage difference between MR and DB fat and protein percentages.

Unit difference was defined as the:

$$Unit\ Difference = MR_{Trait} - DB_{Trait} \quad (1)$$

If the unit difference is less than zero, the MR is underestimated compared to the DB. If the unit difference is greater than zero, the MR is overestimated compared to the DB.

Percentage difference was defined as:

$$\%\ Difference = \left(\frac{MR_{Trait} - DB_{Trait}}{\frac{MR_{Trait} + DB_{Trait}}{2}} \right) * 100 \quad (2)$$

Similarly, if the percentage difference is less than zero, the MR is underestimated compared to the DB. If the percentage difference is greater than zero, the MR is overestimated compared to the DB.

The impact of recorder service type on MR accuracy was assessed across the 2,841 herds. Manual recording services were used in 1,631 of the herds, while the remaining 1,210 herds used EDIY recordings. Correlations for fat and protein percentages were calculated for both types of herds. Additionally, the impact of cow test day yields and season of recording on MR accuracy was assessed across the all herds. Average cow test day yield categories per herd (<10kg, >10-20kg, >20-30kg, and >30kg) were created, and correlations between MR and DB fat and protein percentages were calculated within each yield category. Finally, the impact of season on the accuracy of MR was assessed by comparing the correlations of fat and protein percentages between MR and DB during peak and off-peak milk production seasons. Peak was defined as any MR samples taken in April and May, whereas off-peak was defined as any MR samples taken in September and October of 2021.

When evaluating the unit difference and percentage differences at the herd level, averages were calculated for those herds that had MR and DB taken on the same day more than once in 2021.

Results and discussion

Summary statistics

The mean, standard deviation and min/ max values for MR and DB fat and protein percentages across the 5,742 samples are as shown in Table 1.

Table 1 Summary statistics of MR and DB milk fat and protein percentage.

Trait		Mean	SD	Min/Max
MR	Fat %	4.24	0.4	2.9/6.6
	Protein %	3.65	0.2	3/4.8
DB	Fat %	4.33	0.4	3.3/6.2
	Protein %	3.66	0.2	2.9/4.8

On average, there is a -0.09 unit difference between MR and DB fat percentage, and a -0.01 unit difference between MR and DB protein percentage. In both cases, MR is underestimated compared to DB.

These differences are reflected by the Pearson correlations, which are 0.82 for fat percentage and 0.95 for protein percentage between MR and DB.

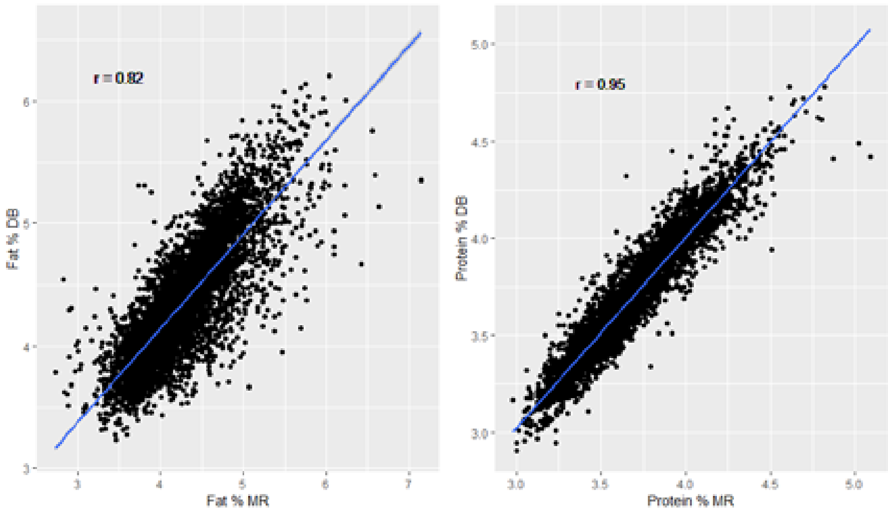

Figure 1 MR fat and protein percentage (x-axis)versus DB fat and protein percentage (y-axis)

The lower correlation observed in fat percentage compared to protein percentage may be due to the variation in milking intervals between MR and DB samples, which has been shown to impact reported fat percentages (Berry *et al.,* 2005).

Expressing these differences as percentage differences using Formula 2 provides a clearer understanding of the magnitude of the challenge. When comparing samples from two different sources, a certain level of variability is expected. To assess the accuracy of MR compared to DB samples, it can be useful to establish thresholds for acceptable error levels. Typically, a threshold of 5% is used, where any sample with a percentage difference greater than 5% is deemed an unacceptable level of error. Please refer to Table 2 for the conversion of percentage differences to percentage units for both fat and protein.

Table 2 Conversion of percent difference in unit difference.

Trait	Percentage difference	Unit difference
Fat %	1%	0.05 %
Protein %	1%	0.04%

Of the 2,841 herds analysed, the average absolute percent difference was 4.7% for fat and 1.4% for protein. In the case of fat percentage, over one third of the herds (38%) had an absolute percent difference greater than 5%. However, for protein percentage, only 2% of the herds had an absolute percent difference greater than the 5% threshold. This starkly highlights the inconsistencies in fat percentage reporting between MR and DB samples.

Impact of recorder service type

Table 3 presents the correlations for fat and protein percentages between MR and DB samples across different recording service types.

Across both recording service types, there was a lower correlation for fat percentage compared to protein percentage. However, the most significant finding from this analysis is the clear impact of recording type on the accuracy of MR when compared to DB samples. Herds using EDIY recordings had more accurate recordings, with a difference of nearly 0.1 in reported correlations.

It is difficult to pinpoint the exact factors driving the difference in MR accuracy between recording devices. However, it is likely that multiple factors, such as equipment type or management practices, contribute to these reporting discrepancies. EDIY devices are re-calibrated and serviced annually by ICBF at a meter calibration laboratory (ICBF, 2021). In contrast, manual recording devices rely on the farmer's discretion regarding servicing and calibration, which may contribute to increased inconsistencies between recording service types. The regular and standardized servicing and maintenance applied to EDIY meters may contribute to increased accuracy of MR compared to manual meters, as maintenance practices for manual recording devices are likely to vary from farm to farm. Moreover, the associated maintenance cost for manual recording devices may discourage regular upkeep and maintenance, further contributing to the inconsistencies observed.

Impact of yield and season

The impact of MR average cow test day yield (at the herd level) on the strength of correlations between MR and DB samples was assessed across all 2,841 herds. The results indicate that test day yield had a greater impact fat percentage correlations compared to protein percentage. Protein percentage correlations remained relatively consistent across yield categories, ranging from 0.87 to 0.93. In contrast, fat percentage correlations decreased as yield increased, dropping from 0.80 in lower yield categories to 0.58 in the highest yield category. This suggests that as cow test yields increase, the accuracy of MR fat percentage compared to DB samples decreases. These trends were consistent across both recording service types.

Similarly, a seasonal impact was observed, where fat percentage correlations between MR and DB samples during the peak season (May/April) were at their lowest (0.69

Table 3 The Impact of recording service type on the correlations of fat and protein percent between MR and DBV samples.

Recording type	Number of herds	Fat % correlation	Protein % correlation
EDIY	1,210	0.87	0.95
Manual	1,631	0.78	0.96

and 0.47) compared to the off-peak season (September/October), where correlations were 0.82 and 0.73 for EDIY and manual recording herds, respectively.

Conclusion

The analysis demonstrates that differences exist when comparing fat and protein percentages obtained from test day MR and DB samples. The largest differences are observed in fat percentage, with MR fat on average being 0.09% lower than its corresponding DB sample. The results also highlight that differences in MR accuracy compared to DB are influenced by various factors, including recording service type, test day yield, and MR season. EDIY devices exhibit a lower margin of error compared to manual recording devices. The differences in fat percentage reported by MR and DB increase as cow test day yield increases, and a similar pattern is observed during the peak milk production season.

Overall, this analysis sheds light on the complexities and challenges associated with accurately comparing MR and DB samples, emphasizing the importance of considering multiple factors that may impact the accuracy of MR measurements in dairy herds.

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