Variation in Milk Yield Within Dairy Herds

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Abstract

Variation in milk yield within a given farm can be rather large, and variation differs among groups within a farm. Formulation of diets for dairy cows necessitates the adjustment of the milk yield above the average for a herd/group so that the higher producing cows are less compromised. One approach is to formulate diets based on the mean + 1 standard deviation **(SD),** and these statistics are readily available, or easily computed, from on-farm computer records programs. Using three herds, the mean, median, and SD were calculated for the herds and groups within the herds. The SD for the herds differed and the SD differed within herds, but some groups had higher SD based on it being a very heterogeneous group (e.g. hospital pen). The distribution of data with such heterogeneous groups may not be normally distributed around the mean. Variation within farms may be higher than one expects, resulting in excessive underfeeding of the higher producing animals in the group. Making use of such data on variation in milk yield in formulating diets can improve nutrient availability to animals, improve income over feed costs **(IOFC)**, and provide information to the consultant that they can discuss with the farmer which may result in a new grouping strategy for improved herd performance.

Introduction

The nutritional requirements of dairy cattle have been studied for many years and the determination of the actual nutrient requirements for maintenance, growth, lactation, and reproduction have been improved (NRC, 2001). Yet even with improved equations and models for determining the nutrient requirements, we continue to struggle with formulating diets for dairy cattle. Most of the time, at least for the majority of cows, cows are fed as groups, but diets are formulated for a "cow" that represents the group. Oftentimes, the ration is balanced for the targeted milk yield rather than the actual milk yield with some adjustment. The targeted milk yield may never be achieved on a given farm due to inadequate management practices/skills on the farm, low forage quality, inadequate feeding bunk management, etc., thus leading to low IOFC. Finney et al. (2013) observed that SD increased with higher total lactation milk yields when dairy herds using the DHI system were stratified into quartiles, with coefficient of variation **(CV)** typically ranging from 15 to 17%. So one of the challenges today is how to describe the "cow" that represents the group for which a diet is being formulated. We continue to learn about the importance of identifying the sources and magnitude of variation that is occurring in feed ingredients, diets formulated and delivered to cows, and also the variation in production that occurs within each respective

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group of animals being fed. In addition, the data for milk yield are often more frequently collected than data on composition of fat and protein in milk. For the diet formulation, the nutrients needed for lactose, fat, and protein have major implications on the sources and amounts of ingredients included in the diets to meet requirements. Thus, 3.5% fat-corrected and energy-corrected milk are often the focus for relating to nutrient demands and efficiency of output relative to DMI, yet the frequency of data collection differs for milk yield and milk composition and variations among milk, fat, and protein yields differ (Finney et al., 2013).

Dairy farmers use various criteria for grouping cows, including age, stage of lactation, pregnancy status, milk yield, illness, and size constraint of facilities. Although some of these categorical areas are based on nutrient needs (e.g. high producing group), others are not (e.g. hospital pen), and then others are intermediate because the criteria for the grouping is not nutritional but indirectly aligns with nutritional needs [e.g. first lactation (growth) or pregnancy status (affected by voluntary waiting period and pregnancy rate, but relates to stage of lactation and milk yield). Even though grouping strategies are used on farms, not every group will receive a different diet, and of course in some herds, only one diet is fed to all lactating cows. Some of the grouping strategies today are based on minimal moves of cows among pens because of additional knowledge we have on the effect of disruption of social hierarchy within groups and because of the often noticed drop in milk yield when animals are moved to a new group. The later was thought to always occur in response to a lower nutrient dense ration than the cow needed (and often occurs), but we now realize that the social changes may be affecting more of this response than once realized.

The variation of the milk yield should be known within a farm to determine the nature of the "cow" used for diet formulation based on the needs of the respective group(s) on the farm in order to maximize the efficiency of milk yield and IOFC. Using 20 Holstein herds with over 100,000 test-day records, Stallings and McGilliard (1984) observed that formulating diets with the lead factor of mean + 1 SD resulted in similar outcome to using the 83rd percentile. They also observed that smaller herds and lower producing herds had higher SD than larger herds and higher producing herds, respectively.

Illustration of Milk Yield Variation Within Herds

For illustration of the variation in milk within dairy herds, the average, median, and SD of milk yield were calculated for three herds with 112, 824, and 1106 lactating cows from each farm (Table 1). These statistics were computed for daily milk yield at the time of the farm visit and for the weekly average milk yield per cow. Several factors can affect the average milk yield on a given day on a farm and a ration formulated for the herd or group is going to be fed for more than one day, so it is best to use a 7 to 10 day average milk yield when formulating diets, noting that SD for milk yield was 1 to 2 lb lower for the weekly average than for the single day. It is important to note that SD differed by herd and that the within group SD was generally lower than for herd SD. As expected, the SD was higher for more heterogeneous groups, such as hospital pen and fresh cows, some of which is caused by a mix of animals in such groups, possibly some "sick" cows placed in the fresh cow pen.

For Dairy A, the SD milk for groups 1 and 2 was 13 to 14 lb. The SD milk was 13 to 16 lb for Dairy B, except for the hospital pen.

In Dairy C, the SD milk was 12 to 16 lb for all groups expect for the fresh cows. So the SD differs by group depending on how the group is really formed relative to the descriptor, e.g. fresh cows (how many DIM, etc.) and whether it includes sick cows. For all three herds, the first lactation cows (or younger cows) had a SD milk of 12 to 14 lb. One adage over the years has been to add 10 lb to the average milk yield for first lactation cows and 5 lb to the average milk for second lactation cows when formulating diets. These three herds illustrate that the 10 lb adjustment for first lactation cows in inadequate if we use the average + 1 SD. Also, the adage has been to add about 10% to the average production when formulating diets. In each case, this strategy would result in inadequate nutrient dense diets for the cows within groups. Even though milk yield varied among farms and for groups within the farms, the SD was less variable. However, due to these changes, the CV [(SD/mean)*100] ranged from 12 to 60% among farms and groups. It is almost always assumed that the production of animals within a herd or group is normally distributed, but this is not necessarily the case, so the median was provided in Table 1. For most of the situations, the median was within 3 lb of the mean. However, for the hospital group in Dairy B, the median was 8.7 lb higher than the mean.

Summary

Accounting for the variation in milk yield within a herd and for groups within the herd is very important when formulating diets for dairy herds. The variation may be higher than one expects, resulting in excessive underfeeding of the higher producing animals in the group. The general statistics of mean and SD are available within software programs commonly used on farms and by consultants. Milk yield and composition data from most any computer management system can be transferred into a format useable by MS Excel or copied and pasted into a spreadsheet for which statistics can be calculated. Within Dairy Comp 305, the following command can be entered “graph milk by pen/h” and click on “Report” at the bottom of the screen to obtain the number of cows, mean, SD, minimum and maximum milk by pen. Making use of such information in formulating diets can improve nutrient availability to animals, improve IOFC, and provide information to the consultant that they can discuss with the farmer which may result in a new grouping strategy for improved herd performance.

References

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Table 1. Variation in milk yield among animal groups and the herd for three dairy farms (average weekly milk yield used for individual groups).

Item	Cows, DIM	Mean	Median	Standard Deviation
Dairy A				
Herd, daily milk (lb/day)	112, 170	50.9	49.4	14.0
Herd, weekly average milk (lb/day)		51.5	48.2	13.3
Group 1 (younger cows)	60, 127	53.3	50.5	14.0
Group 2 (older cows)	52, 220	49.9	47.7	12.8
Dairy B				
Herd, daily milk (lb/day)	824, 184	79.1	79.9	29.2
Herd, weekly average milk (lb/day)		81.0	81.2	27.3
Fresh cows	25, 18	56.7	59.4	13.0
Post fresh cows	120, 77	75.5	78.6	15.9
Older cows, < 2 lactations	172, 120	114.9	113.7	14.4
First lactation cows	170, 179	93.2	93.6	14.7
High cows	165, 206	73.7	72.9	14.3
Low cows	163, 338	49.0	49.1	16.0
Hospital pen	9, 203	57.6	66.3	34.6
Dairy C				
Herd, daily milk (lb/day)	1106, 175	67.8	68.0	22.6
Herd weekly average milk (lb/day)		66.7	68.0	20.4
Fresh cows	110, 29	49.0	53.0	25.6
First lactation cows	263, 148	65.4	66.0	12.3
Second and third lactation cows	255, 164	79.3	80.0	14.3
≥Third lactation cows	238, 164	79.6	80.0	16.1
Low production, pregnant cows	240, 294	50.0	50.0	14.9