



Limitations of on-site dairy farm regulatory debits as milk quality predictors

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ABSTRACT

In the United States, compliance with grade A raw fluid milk regulatory standards is assessed via laboratory milk quality testing and by on-site inspection of producers (farms). This study evaluated the correlation between on-site survey debits being marked and somatic cell count (SCC) or standard plate count (SPC) laboratory results for 1,301 Wisconsin grade A dairy farms in 2012. Debits recorded on the survey form were tested as predictors of laboratory results utilizing ordinary least squares regression to determine if results of the current method for on-site evaluation of grade A dairy farms accurately predict SCC and SPC test results. Such a correlation may indicate that current methods of on-site inspection serve the primary intended purpose of assuring availability of high-quality milk. A model for predicting SCC was estimated using ordinary least squares regression methods. Step-wise selected regressors of grouped debit items were able to predict SCC levels with some degree of accuracy (adjusted $R^2 = 0.1432$). Specific debit items, seasonality, and farm size were the best predictors of SCC levels. The SPC data presented an analytical challenge because over 75% of the SPC observations were at or below a 25,000 cfu/mL threshold but were recorded by testing laboratories as at the threshold value. This classic censoring problem necessitated the use of a Tobit regression approach. Even with this approach, prediction of SPC values based on on-site survey criteria was much less successful (adjusted $R^2 = 0.034$) and provided little support for the on-site survey system as a way to inform farmers about making improvements that would improve SPC. The lower level of correlation with SPC may indicate that factors affecting SPC are more varied and differ from those affecting SCC. Further, unobserved deficiencies in postmilking handling and storage sanitation could enhance bacterial growth and increase SPC, whereas postmilking sanitation will have no effect on SCC because somatic cells do not reproduce in stored

milk. Results suggest that close examination, and perhaps redefinition, of survey debits, along with making the survey coincident with SCC and SPC sampling, could make the on-site survey a better tool for ensuring availability of high-quality milk.

Key words: milk, standard plate count, somatic cell count, milk quality, on-farm regulatory survey

INTRODUCTION

The regulation of grade A milk produced in the United States is based on requirements set by the US Public Health Service (US PHS)/Food and Drug Administration (FDA). The US PHS/FDA publishes the Grade A Pasteurized Milk Ordinance (PMO) which, as of 2012, had been adopted wholly or in part by 45 US states. Wisconsin regulates milk under rules found in the Wisconsin Administrative Code (ATCP 60, 80, and 82; Wisconsin Administrative Code, 2013), which are as stringent as the PMO. The PMO and Wisconsin rules set maximum levels for SCC and SPC: 750,000 cells per mL, and 100,000 cfu per mL, respectively. Bulk tank measures of SCC are widely considered a strong indicator of both milk quality and udder health (Jayarao and Wolfgang, 2003). SPC is also regarded as a milk quality indicator and is influenced by milking equipment maintenance and sanitation, milk storage temperatures, general herd health, and the cleanliness of the farm (Chambers, 2002).

Each Wisconsin dairy farm is assigned to an individual bulk tank unit (BTU), consisting of one or more farms producing milk for a single processor of raw fluid milk. Evaluation of the BTU is part of the Interstate Milk Shipper Program, which is the collective federal-state program intended to ensure the sanitary quality of milk and milk products shipped interstate. Grade A milk processors in each state that meet the PMO requirements are listed in the Interstate Milk Shipper's Report published by FDA Center for Food Safety and Applied Nutrition, Milk Safety Branch. Each grade A dairy farm is associated with only one firm on the Interstate Milk Shipper's Report at a time.

Individual producers (dairy farm operators) are evaluated by state personnel for compliance with Section

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7 of the PMO (US Department of Health and Human Services, 2011). This evaluation, commonly known as survey, is performed separately from dairy farm inspections regularly done by state personnel, although the latter inspections also at least indirectly determine compliance with PMO standards. After a survey, the producer receives an individual rating. Violations observed during survey are recorded as deductions, or debits, and represent noncompliance with a required PMO element. Debits are assigned a value from 1 to 10 points based on their perceived effect on public health. Producers must score at least 90% on the individual rating to pass. A failing score could result in the loss of a producer's grade A permit, which can lead to a lower price received for milk they produce. Egregious or systemic violations can result in a producer losing the ability to sell milk altogether.

In Wisconsin, farms in a BTU are selected for an unannounced survey by the state agency responsible for survey—the Wisconsin Department of Agriculture, Trade, and Consumer Protection (**WDATCP**). Farms are typically surveyed every 2 yr, although the frequency may differ based on factors such as the number of farms in the state and BTU, and random selection (US Department of Health and Human Services, 2009).

A survey is done by an FDA-certified milk sanitary rating officer (**MSRO**), who is a state employee standardized, evaluated, and certified by the US PHS/FDA for evaluating milk producers. An MSRO must not have any other regular regulatory inspection, enforcement, or auditing duties that may conflict or interfere with survey objectivity (US Department of Health and Human Services, 2009). Assessment of deficiencies during survey is based on the professional judgment and training of the MSRO which alone “must dictate whether an observed deficiency is representative of significant day-to-day sanitary conditions or is an anomaly” (US Department of Health and Human Services, 2009); therefore, some variance between MSRO is possible.

Debits outlined in the PMO are observed deficiencies in hygienic practices or conditions believed to be causally linked with poor milk quality. Objective measures of milk quality include SCC and SPC. Research has not conclusively demonstrated a link between subjective on-site evaluation and either SCC or SPC. Previous work conducted by Peeler et al. (1989) and Ingham et al. (2010) examined the link between on-farm inspection results and various milk quality indicators. Both studies focused strictly on the relationship of the indicators with the overall inspection result, but not individual debits or groups of debits within the inspection. Whereas Hutchison et al. (2005) used linear regression to evaluate the relationship of SPC and other milk quality indicators with observed hygiene-related

deficiencies, farmers in their study received prior notice of inspection. The authors also did not use the FDA debits and reporting format, and the SPC results used were obtained according to United Kingdom microbiological assay standards (specifically incubation at 30°C for 72 h), which differ from US regulatory standards. Elmoslemany et al. (2009) and Kelly et al. (2009) likewise examined observable hygiene characteristics for predicting various milk quality indicators, but did not use US regulatory standards.

To date, no known research has been conducted to determine if a relationship exists between one or more observed regulatory debits in Wisconsin dairy farm surveys and corresponding SCC and SPC milk quality results. Proper identification of shortcomings related to SCC or SPC (via survey debits) and subsequent improvements made by the producer could lead to less bacterial contamination (Pantoja et al., 2009) and perhaps improve dairy farm profitability.

The objective of this study was to evaluate whether the debits composing the regulatory survey of Wisconsin dairy farms accurately predict raw milk quality as reflected in SCC and SPC.

MATERIALS AND METHODS

The approach taken in this observational study was to (1) obtain survey debit, SCC, and SPC data; (2) evaluate, sort, and transform (if appropriate) the data; and (3) repeatedly develop, test, evaluate, and refine predictive equations for SCC and SPC which contained survey debits and other information as independent variables.

Description of Survey Debit Categories

The form used in the survey of Wisconsin dairy farms contains 82 elements corresponding to required sanitation elements outlined in the PMO. These elements are elsewhere grouped into 19 debit categories (Table 1). Three additional debit categories are based on regulatory records of laboratory test results. A 5-point debit, SCC, is marked if a producer is in warning status as a result of having official reported monthly SCC counts in excess of 750,000 cells/mL in 2 of the last 4 mo, including the month in which the producer is being surveyed. This debit is uncommon as it only occurs if the survey is done between 3 and 21 d after a warning letter has been issued and before the plant receiving the producer's milk has submitted a new, acceptable SCC result. A 10-point debit, bacteria count, is marked if a producer is in warning status as a result of having officially reported SPC counts in excess of 100,000 cfu/mL in 2 of the last 4 mo, including the month in which

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