

# An evaluation of milk components for use as biochemical markers that will help detect rumen acidosis and indigestion in dairy cows

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## Introduction

Rumen indigestion or subacute ruminal acidosis (SARA) is common even in well-managed dairy herds, and is difficult to diagnose as clinical signs vary by individual cow. A cow suffers from rumen indigestion when she experiences a prolonged period of low ruminal pH (pH<5.8) which may have returned to normal (pH 6.2-7.2) once clinical signs are evident. The purpose of this research was to find biological markers in milk that could be used to detect rumen indigestion prior to clinical signs, allowing for earlier treatment and prevention of prolonged reduced milk yield and therapy.

## Materials and Methods

Milk component data from 23 Holstein cows (> 30 DIM) diagnosed with rumen indigestion were evaluated for detectable changes. Parameters were measured using the AfiFarm system at the University of Florida Dairy Unit. The variables analyzed included milk yield; percentage milk fat, milk protein, and milk lactose; fat: protein and fat: lactose ratios measured in the 16 milkings before and after diagnosis of indigestion. For each case of rumen indigestion, 2 control cows (n = 33) were selected for a comparative analysis. Diagnostic criteria included deviation of at least -10% in milk yield at 2 consecutive milkings and reduced rumen motility. Deviations in any variable were calculated based on the previous 10-day mean. At time of diagnosis, a sample of rumen fluid was collected using an oro-ruminal probe and the rumen pH was measured. The same procedure was conducted on the control cows. Differences in baseline data and rumen pH between cases and controls were determined using ANOVA (Analysis of Variance). Milk yield and milk component data were analyzed using the mixed procedure of SAS (repeated measures of analysis of variance). When significant associations were found between case-control status and a milk component, the sensitivity and specificity of that milk component was determined at several cut-off points. A ROC (receiver operating characteristic) analysis was used to determine the optimal cut-off point of that milk component for diagnostic use.

## Results

The rumen motility of case cows was reduced compared to control cows ( $p < 0.0001$ ). Rumen pH was within normal range in both the control cows (mean pH 6.25) and case cows (mean pH 6.47). No cows had a rumen pH measured below pH 5.8 to assist in confirming diagnosis of SARA. Deviations in milk fat percentage, milk fat to lactose ratio, and milk yield were apparent during the PM milking and AM milking prior to diagnosis. Milk yield showed the largest negative deviation and difference between case and control cows with a -31% deviation ( $p < 0.0001$ ) at the morning milking of diagnosis and a -23% deviation ( $P = 0.004$ ) at the evening milking prior. We observed a sharp increase in milk fat percentage to a mean nadir value of 3.90 and positive deviation of 11% ( $P = 0.001$ ) during the evening milking prior to diagnosis of rumen indigestion in the case cows. Milk lactose percentage did not show a marked difference in deviation (-3%,  $P = 0.0842$ ) when analyzed as a single variable at the evening milking prior to the day of diagnosis. However, when analyzed with the fat percentage as a fat to lactose ratio, it showed the widest change in deviation of the milk component variables with a positive deviation of 13% ( $P = 0.0099$ ) at the evening milking and 15% ( $p < 0.0001$ ) at the morning milking prior to diagnosis. We did not observe a difference in milk protein percentage and milk fat to protein ratio between the case and control cows. The fat to lactose ratio showed to have the highest combined sensitivity and specificity for diagnosing rumen indigestion using ROC analysis. Using the criteria of a 10% deviation in fat to lactose ratio to select cows for rumen indigestion will have a specificity of 57% and sensitivity of 85% (PPV = 72%, 41% prevalence).

## Significance

Based upon our results, using a deviation in fat: lactose ratio in combination with a deviation in milk yield will help detect rumen indigestion 1 to 2 milkings sooner than using only milk yield deviation as criteria. The increase in fat percentage could potentially be explained by mobilization of fat in response to a decrease

in feed intake and reduced rumen motility as a result of the rumen indigestion. The normal rumen pH at time of diagnosis of rumen indigestion could have been due to inappropriate technique in the collection of the ruminal fluid using the weighted oro-ruminal probe. Another

explanation could be that rumen pH had already returning to normal once clinical signs of decreased milk yield and rumen motility were evident, as has been observed in cows experiencing subacute ruminal acidosis in the research setting.