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Field study on dietary acidification in transition dairy cows: assessing feed homogeneity and urinary parameters as indicators of DCAD optimization and metabolic adaptation

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Introduction

The transition period in dairy cows represents a pivotal phase marked by significant metabolic challenges. One of the most critical issues during this time is hypocalcemia, caused by increased calcium demands for colostrum and milk production. A well-established strategy to mitigate this risk is reducing the dietary cation-anion difference (DCAD) by incorporating anionic salts into the diet. This approach stimulates calcium mobilization and enhances metabolic stability. However, the success of dietary acidification relies heavily on consistent feed intake and uniform distribution of anionic salts within the total mixed ration (TMR). Variability in feed distribution or selective feeding behaviors can undermine the intended effects and lead to inconsistent metabolic responses. This study evaluates the practical application of dietary acidification in transition cows, focusing on feed homogeneity, urinary parameters, and their correlation with DCAD. The goal is to provide actionable insights for optimizing acidification strategies in commercial dairy operations.

Material and Methods

Study design: Analysis of operational data from five selected dairy farms in the Münsterland region, Germany

Farm selection: Two test farms (TF) without recommended dietary acidification, and three farms where acidification was feasible

Dietary acidification:

- Mild acidification: 50–100 meq/kg
- Pronounced acidification: -50 meq/kg
- Use of ammonium chloride-based supplementary feed (**BEWI-FATRIX® Anionic**) combined with feed-grade limestone as a calcium source

Evaluation:

- Assessment of potential for ration sorting using a shaker box
- Samples: Urine samples from 45 individual Holstein Friesian cows

Measured parameters:

- Fractional Net acid base excretion (fr. NABE)
- Urine pH value
- Urinary calcium level

Results

Feed homogeneity:

- Farms TF1 and TF2 showed inconsistent TMR, allowing selective feeding and uneven acidification
- Homogeneous TMR on farms TF3 and TF4 ensured consistent acidification

Fractional NABE vs. urine pH:

- NABE correlated significantly with DCAD ($p < 0.01$)
- NABE variability was higher on farms with inconsistent TMR
- Urine pH showed lower sensitivity and insignificant variability

Urinary calcium:

- Increased after acidification but lacked correlation with NABE or DCAD

Table 1: Comparison of relative standard deviation of fractional NABE and urine pH between testfarms.

	TF1	TF2	TF3	TF4
RSD fr. NABE, %	63.3[a]	65.7[a]	32.9[b]	12.0[b]
RSD urine pH, %	2.8	6.2	2.3	0.8

[a,b] Values within a row with different superscripts differ significantly ($p \leq 0.05$); TF, test farm; RSD, relative standard deviation.

Discussion

Importance of consistent feeding

- Consistent feed delivery and homogeneous TMR are critical for achieving effective dietary acidification. Farms TF1 and TF2 demonstrated significant variability in fractional NABE due to inconsistent TMR distribution, which allowed selective feeding. Acidic salts lose their effect after 12 hours, making consistent intake crucial to avoid overdosing or metabolic imbalances (Bäuml, 2014).

Fractional NABE as a sensitive indicator

- Fractional NABE was highly sensitive to changes in TMR composition and showed a stronger correlation with DCAD compared to urine pH (Glosson et al., 2020). Farms with inconsistent feeding practices had higher variability in fractional NABE, highlighting its reliability as a monitoring tool for acidification success.

Urine pH limitations

- Urine pH, while cost-effective and commonly used, was less sensitive to metabolic changes induced by dietary acidification. It showed lower variability across farms, even when TMR composition differed significantly. This aligns with findings by Nikkhah (2023), who emphasized that urine pH often fails to capture subtle shifts in metabolic adaptation.

Urinary calcium as a supplementary parameter

- Urinary calcium levels reliably increased following dietary acidification, indicating calcium mobilization. However, no quantitative correlation was observed between fractional NABE and urinary calcium, suggesting it should not be used as a standalone indicator. A stepwise acidification approach demonstrated that fractional NABE remained the most reliable parameter for monitoring metabolic acidification (Schmidtmann et al., 2020).

Multi-Parameter monitoring

- Combining fractional NABE, urinary calcium levels, and DCAD in TMR provides a robust framework for evaluating dietary interventions. This multi-parameter approach addresses the limitations of single indicators and ensures a comprehensive assessment of calcium mobilization and metabolic adaptation (Bäuml, 2014; Glosson et al., 2020).

Conclusion

- **Consistent and homogeneous feed delivery:** The success of dietary acidification in transition cows depends on the uniform and consistent distribution of acidic salts in the feed. Initial evaluations using a particle separator (shaker box) are essential to ensure feed homogeneity.
- **Monitoring tools:** While urine pH is a cost-effective method for assessing dietary acidification, it is not a reliable standalone indicator. Fractional NABE is a more sensitive and robust parameter for evaluating metabolic acidification.
- **Multi-Parameter approach:** Combining fractional NABE, urinary calcium levels, and the DCAD in the total mixed ration provides a comprehensive and reliable method for monitoring the effectiveness of calcium mobilization and dietary interventions.

Literature

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