The effect of dietary alfalfa silage to corn silage ratios on cow performance and ammonia nitrogen emission

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Introduction
- Corn silage (CS) and alfalfa silage (AS) are the primary forages in dairy cow diets in the Midwest region of the U.S.
- When increasing the proportion of AS to CS in the forage portion of the diet, crude protein (CP) and rumen degradable protein (RDP) content of the diet increased.
- Feeding greater amount of AS in the diet could lead to greater nitrogen (N) intake, ruminal N secretion, ammonia N, greenhouse gas (GHG) emissions, and reduced milk production performance when the supply of high quality rumen undegradable protein (RUP) is compromised.

Objective
- To determine the effect of AS to CS ratio on cow production performance, ammonia and GHG emissions from the tie-stall dairy barn when RUP content of the diet is maintained relatively constant. Only cow performance and ammonia emissions are reported here.

Materials and Methods
- The experimental design was a 4x4 balanced latin square design using 16 multiparous cows (79 ± 40 DIM, 640 ± 20 kg BW), which were randomly assigned to four modified airflow controlled chambers (Powell et al., 2007). Each chamber (four cows/chamber, see photo) was also randomly assigned to one of four dietary treatment sequences.
- The trial was conducted for 21 day periods from September 14th to December 3rd 2006.
- Air flow measurement and sampling were conducted on three consecutive days at the end of each period (averaged 18 - 19 L/d). Air samples were analyzed for N2H, with a photo-acoustic Multi-gas Monitor (Inova Model 1412).
- Dry matter intake (corrected for refusals), milk yield, and milk composition were measured and reported for the three days of gas emission measurements.
- Chambers were opened twice a day for morning (05:00 h) and evening (16:00 h) milking and the data collected in the first hour after chambers were closed were not included in the analyses.
- Analysed emission data averaged 17 - 18 h/d and was extrapolated to 24 h/d.

Treatments
- Cows were fed a TMR once daily after morning milking.
- Diets contained a forage concentrate ratio (% DM) of 55:45.
- Dietary treatments included the following AS:CS ratios (% DM basis): 20:80 (AS), 40:60 (AS), 60:40 (AS), and 80:20 (AS).
- Expeller soybean meal (SBM) and ground corn replaced solubilized SBM in the concentrate with increasing in the forage ratio.

Statistical Analysis
- Data were analyzed using the mixed procedure of SAS (Version 9.2, SAS Institute Inc., Cary, NC) using the following model: yijk = μ + P + C + T + Eijk, where yijk is the dependent variable with data expressed on a per-cow basis, μ is the overall mean, P, C, and T are the fixed effect of period, cow, and treatment, respectively.
- The residual error was least square means which were separated using the LSD test in SAS.

Results
- Diet composition data (Table 1 and 2) indicated that with greater proportions of AS in the diet, CP and RDP increased and RUP slightly decreased.
- Performance data were presented in Tables 3 and 4. An effect of diet was observed for milk protein %, N intake (pp/d), and N efficiency (milk N intake).
- With increasing AS proportion in the diet, N intake (pp/d) increased linearly whereas milk N (pp/d), and N efficiency decreased linearly.
- No significant effect of diet was found for NH3 (µg/d/cow) emissions (Table 4).
- A quadratic effect was observed for 3.5% for corrected milk (FTCM) kg/d, milk fat kg/d, and N2H3/N2H4 per intake with numerically greater values for 40 AS, but the magnitude of the responses across dietary treatments were generally small.

Discussion
- In this trial, the proportion of AS in the diet had no effect on cow production performance. These findings are in accordance with Dhir and Salton (1997).
- Increasing AS in the diet led to a linear increase in N intake but no effect on NH3 emissions and N2H3/N2H4 emission per kg N.
- Numerically lowest NH3 N per kg N intake was observed when AS was 80% of the total forage in the diet.
- Numerically greatest 3.5% FTCM and N2H3/N2H4 emissions were observed when including 40% of the total forage as AS in the diet.
- In this experiment, overall N intake, N2H3 N and N2H3/N2H4 per N intake were on average 745 µg/d, 16.4 µg/d and 2.25% per cow, respectively. The observed emission measurements agree with those reported by Powell et al. (2008) when cows consumed similar levels of N.

Conclusions
- Our results suggest that a large substitution in the proportion of AS and CS in the forage portion of the diet may not have a profound impact on milk production and NH3 emissions.

References

Table 2. Chemical composition of the diets (µ ± SD)

Table 3. Dry matter intake and cow performance

Table 4. Nitrogen intake, milk secretion, and ammonia nitrogen emission

Table 5. Nitrogen intake, milk secretion, and ammonia nitrogen emission

* = linear effect, C: quadratic effect, n.s: not significant (P > 0.05).

Photos courtesy of J. M. Powell.