Corn silage and high moisture corn 3 and 7h rumen in situ DM and starch digestion descriptive statistics

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Introduction:

- Ruminant dietary starch is becoming increasingly important to farm owners and consultants due to grain price increases and desire to maximize starch utilization.
  - Diets for lactating dairy cows, as well as many other ruminants, often contain starch and rely on this nutrient as a vital source of dietary energy (Orskov et al., 1986).
  - Limited starch digestion limits diet total digestible nutrient and microbial protein yield, and limits cattle performance.
- The rate and site of starch D (starch digestion) are two facets that can be used to estimate starch energy availability to ruminants.
  - Starch can compromise 20% - 35% of lactating dairy cows dry matter intake.
  - The rumen can be the main site of starch D, accounting for as much as 90% of starch intake.
  - Digestion potential is limited primarily by effective particle size (Hoffman et al.) and bacterial/enzymatic access to starch granules.
- Ruminal starch digestibility is highly variable across and within feed types. Many factors can contribute to the ruminal starch D in different feeds.
  - Corn grain that has been ensiled or steam processed has an improved starch D (Ferraretto et. al. 2013).
  - Corn silage that is un-processed or has a short ensiling time will decrease the digestion as there is a smaller surface area for enzymes to access (Ferreira and Mertens, 2005).
  - Variation in the extent and site of starch digestion affects the quality and the quantity of the nutrients delivered to the animal (Sauvant et al., 1999).
- Accurately determining rumen starch D is important to continue to advance the nutrition model and dairy performance.

Objective:

Our objective was to determine the degree of variability within corn silage and high moisture corn grain using ruminal in situ dry matter and starch digestion.

Materials and Methods:

- Samples submitted to Rock River Laboratory for commercial nutrient analyses during October 2013 to December 2013 were selected for further digestion analyses.
  - Samples were selected to range in moisture and soluble protein
  - The data set contained whole plant corn silage (n=52) and high moisture corn (n=41)
- All samples were dried at 50 degrees C for 48 h and ground to pass through a 6 mm Wiley screen for rumen in situ digestion analysis, to maintain particle size characteristics.
- Samples for starch, DM, and digested residue were ground to pass a 1 mm screen through a Udy Cyclone Mill.
- Samples were weighed (6 grams per bag) in triplicate and digested within 3 lactating dairy cows consuming a commercial diet.
  - Diets were approximately 60% forage with a 57% to 43% legume to corn silage ratio. Diets were offered at 800 h, once daily, ad-libitum.
  - Rumen in situ incubations began for 7 and 3 h digestions at 900 h and 1300 h respectively, and all samples were removed from the rumen at the same time.
- Sample bags containing residue were rinsed until effluent was clear, to remove microbial protein.
- Bags were dried at 55 degrees Celsius for 20 h and weighed to determine DM digestion.
- Residue samples were composited and ground to pass through a 1mm Udy Mill to be analyzed for starch content.
  - Starch content was measured according to the Hall (2008) procedure, with modifications
- Starch D was calculated as 100 x [(Starch (g) 0h – starch (g) residue) / (starch (g) 0 h)]
- The data set was analyzed using SAS JMP version 11.0 for population descriptive statistics.

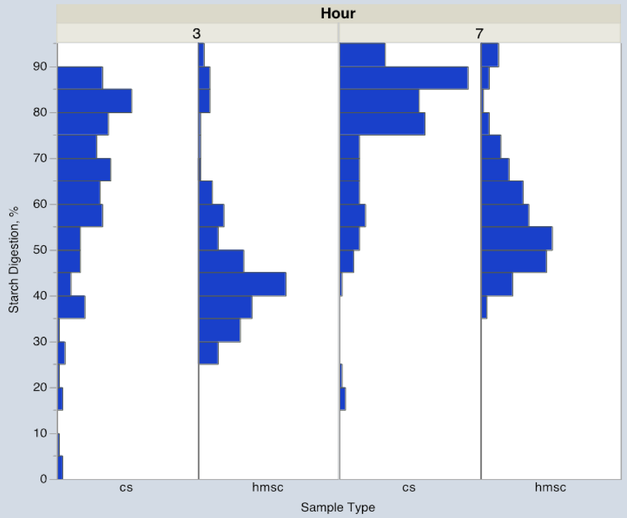
Results and Discussion:

- Ruminal in situ starch D and DMD was substantially variable for HMSC and WPCS (Table 1).
  - Coefficients of variation were greater than 15% across all measures
- Conclusions presented appear to agree with in vivo results present by Goeser (2014)

Table 1. Rumen in situ 3 and 7 hour DM and starch digestion descriptive statistics

Type	Hour	Mean	St.dev.	Min.	Max.	C.V.
Dry Matter Digestion (%)						
HMSC	3	40.3	16.6	19.0	82.5	41.2
HMSC	7	50.6	12.8	28.8	86.6	25.3
WPCS	3	41.6	10.2	15.5	57.5	24.5
WPCS	7	48.4	8.4	22.3	66.9	17.4
Starch Digestion (%)						
HMSC	3	47.1	15.0	26.0	91.2	31.8
HMSC	7	58.2	12.9	36.6	91.3	22.2
CS	3	64.7	18.6	0.9	88.2	28.7
CS	7	77.0	14.5	16.8	93.8	18.8

Figure 1. Rumen in situ 3 and 7 hour Starch Digestion distributions for high moisture corn and whole plant corn silage



Conclusion:

- Corn grain and whole plant corn silage starch digestion within the rumen varied substantially.
- The in rumen situ starch digestion technique can be a practical assay to evaluate starch digestion for whole plant corn silage and high moisture corn.

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