Effect of Harvest Method and Ammoniation on Digestibility and Intake of Corn Residue

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Summary with Implications

The effects of three harvest methods, both with and without ammonia treatment, on the in vivo digestibility and intake of baled corn residue were assessed in a digestion trial with lambs. Treatments included three corn residue harvest methods (conventional rake and bale, New Holland Cornrower™ with eight rows or with two rows of corn stalks chopped into the windrow containing the tailings [leaf, husk and upper stalk] from eight harvested rows) and the effects of ammoniation at 5.5% of DM compared to no ammoniation of the residue. The 2-Row baled residue (51.7%) had greater dry matter digestibility than both 8-Row (47.3%) and CONV (44.7%). Ammoniation increased dry matter digestibility by 24% (10 percentage units) across all residue types. Additionally, ammoniation increased intake. Utilizing alternative harvesting technologies and ammoniation can improve the digestibility of baled residue. These effects are additive and combining the two technologies resulted in the greatest improvement in digestibility.

Introduction

Technologies designed to improve the feeding value of corn residue are becoming more relevant for beef producers. The New Holland Cornrower™ varies the proportion of lower stalk to leaf, husk, and upper stalk (tailings) in the corn residue bale by chopping 2, 4, 6, or 8 rows of stalk from the 8 harvested corn rows in to the windrow that will be baled. The digestibility of different parts of the corn plant varies and increasing the proportion of tailings (relative to lower stalk) results in improved *in vitro* digestibility (2015 Nebraska Beef Cattle Report, pp. 62–63). Although no difference in *in vivo* dry matter digestibility (DMD) was observed between corn residue harvested with 4 Rows (49.9%) vs. 8 Row (48.5%; 2016 Nebraska Beef Cattle Report, pp. 74–75), more recent results (2017 Nebraska Beef Cattle Report, pp. 53–54) demonstrate residue harvested with 2 rows of stalks being chopped had greater DMD (51.7%) when compared to conventionally baled residue (46.1%). Additionally, ammoniation improves both digestibility and intake of low quality forages, such as baled corn residue. The objective of this study was to determine the effect of harvest method and ammoniation on the intake and digestibility of baled corn residue in lambs.

Procedure

Nine crossbred wether lambs (108.6 ± 16.5 lbs BW) were fed in a 126-d digestion trial using an unbalanced 9 x 6 Latin rectangle design with a 3 x 2 factorial treatment structure. Treatment diets consisted of corn residue harvested using three different methods: conventional rake and bale (CONV), a New Holland Cornrower™ chopping stalks from all 8 rows (8ROW), and stalks from 2 rows (2ROW) of corn being harvested by the combine into a windrow containing the tailings (leaf, husk and upper stalk) from 8 rows. Anhydrous ammonia was added at 5.5% of DM to a portion of each of the baled residues and allowed to sit for 33 d in black plastic in July of 2015, resulting in three more treatment diets: conventional ammoniated (CONVAM), 8-Row ammoniated (8RAM) and 2-Row ammoniated (2RAM). Diets consisted of 64.2% corn residue, 29.8% Sweet Bran, 3.3% smooth-bromegrass hay, and 2.8% mineral mix (DM basis). Six 21 d periods consisted of 14 d adaptation and 7 d total fecal collection. Lambs were fed *ad libitum* (110% of the previous day's DMI) during d 1–12 and reduced to 95% of *ad libitum* intake for d 13–21. During the adaptation period, lambs were housed in individual pens with grate floors, individual feed bunks and automatic waterers. Feeding occurred twice daily at approximately 0800 and 1500, and orts were collected, weighed, and fed back during the adaptation period.

At the end of the adaption period, lambs were moved to individual metabolism crates and fitted with harnesses and fecal collection bags. Total fecal output was collected twice a day beginning on d 14 at approximately 0800 and 1500, weighed and retained. Orts were collected at feeding, weighed, and retained for analysis. Total fecal material and orts were composited at the end of the collection period and three sub-samples were taken for analysis. Samples were dried in a 60˚C forced air oven (orts for 48 h and feces for 72 h) and then ground through a 1-mm screen in a Wiley mill. Diet and fecal samples were analyzed for dry matter (DM), organic matter (OM) and neutral detergent fiber (NDF). Ground feed and fecal samples were dried in a 100˚C oven for 24 h to determine lab-adjusted DM, and then incinerated in a muffle furnace at 600˚C to determine the ash content to calculate OM. Neutral detergent fiber was determined by refluxing samples in beakers for 1 h. Total tract apparent digestibility was calculated using DM, OM, and NDF disappearance. Treatment diets were fed over 6 periods, with the non-residue proportion (Sweet bran, Brome grass and mineral) of the diet fed in an additional period at 2% of BW to determine the digestibility of the corn residue by difference.

Data were analyzed using the MIXED procedure of SAS (SAS Inst., Inc., Cary, N.C.). Lamb was the experimental unit, and the model included harvest method, ammoniation, period and a harvest method by ammoniation interaction. Period and lamb were treated as fixed effects, and interactions were assessed for inclusion in the model. Significance was declared when $\alpha \leq 0.05$.

Table 1. Effect of harvest method on dry matter (DMD), organic matter (OMD) and neutral detergent fiber (NDFD) digestibility of baled corn residue[1].

	CONV	8-Row	2-Row	SEM	*P*-value
Residue DMD,%	44.7	47.3	51.7	1.9	0.03
Residue OMD,%	50.5	51.5	55.4	1.7	0.12
Residue NDFD, %	42.7	54.1	62.7	2.8	<0.01

[1]The non-residue portion of the diet was fed alone in a separate feeding period to determine digestibility. Residue digestibility was calculated by removing the contribution of non-residue component of the diet.

Table 2. Effect of post-harvest ammoniation treatment at 5.5% of DM on the dry matter (DMD), organic matter (OMD) and neutral detergent fiber (NDFD) digestibility of corn residue[1].

	Non-ammoniated	Ammoniated	SEM	*P*-value
Residue DMD,%	42.8	53.0	1.4	<0.01
Residue OMD,%	47.4	57.4	1.7	<0.01
Residue NDFD, %	44.8	61.4	2.3	<0.01

[1]The non-residue portion of the diet was fed alone in a separate feeding period to determine digestibility. Residue digestibility was calculated by removing the contribution of non-residue component of the diet.

Results

There was a harvest method by ammoniation interaction ($P < 0.01$) for *ad libitum* whole diet DMI (d 7–11). The intake of diets containing non-ammoniated residue did not differ ($P \geq 0.92$) among harvest methods and were consistent at 2.6% BW. Conversely, ammoniation increased intake for all harvest methods, and the amount of response varied among harvest method. This resulted in intake being greatest for 2RAM at 4.1% BW, intermediate for COVAM at 3.6% BW and 8RAM showing the smallest increase in DMI at 3.1% BW, which were all significantly different both from each other and from non-ammoniated diets ($P = 0.03$). There was no harvest method by ammoniation interaction ($P \geq 0.82$) for OM, DM or NDF digestibility (NDFD). Harvest method affected DMD ($P = 0.04$) and NDFD ($P < 0.01$) of the residue (Table 1). Harvesting with the New Holland Cornrower™ with 8 rows of stalks chopped resulted in a 6% increase (2.6 percentage units; $P = 0.34$) in DMD and harvesting with 2 rows increased DMD by 15% (7 percentage units; $P = 0.01$) compared to conventional rake and bale method. The effect was more pronounced in NDFD, with 8-Row increasing NDF digestibility by 27% (11.9 percentage units; $P = 0.01$) and 2-Row increasing NDFD by 46% (19.9 percentage units; $P < 0.01$) over conventionally harvested residue. Digestibility of OM was not affected ($P = 0.12$) by harvest method. Ammoniation improved ($P < 0.01$) DM, OM, and NDF digestibility for all harvest methods (Table 2), resulting in a 24% and 21% (10.1 percentage units; $P < 0.01$) increase in digestibility for DM and OM, respectively, and a 37% increase (16.6 percentage units; $P < 0.01$) in NDF digestibility.

Conclusions

Consistent with other studies, changing the proportion of husk and leaf to stalk in baled residue can influence digestibility characteristics. No difference DM and OM digestibility was observed between 2-Row and 8-Row (non-ammoniated) in this study but there was a significant improvement in DM, OM, and NDF digestibility between the 2-Row and conventional rake and bale. Moreover, ammoniation increased intake and all digestibility characteristics of the corn residue regardless of harvest method, and was additive with harvest method.

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