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EVALUATION OF RUMINAL NET WRAP ACCUMULATION IN COWS FED GROUND HAY

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ABSTRACT

Plastic net wrap is a common binding material for large round hay bales, but cow death loss has been associated with net wrap buildup in the rumen. To quantify how rapidly net wrap builds up, six ruminally cannulated Angus cows were fed hay that was ground without net wrap removal prior to grinding. Three cows had a piece of net wrap placed in the rumen (Net+) at the beginning of the feeding period to determine if prior feeding of net wrap influenced further accumulation, while 3 cows had no net wrap in the rumen at initiation of feeding (Net-). There were no treatment differences for net wrap weight or volume displacement between prior net wrap treatment, but there was significant weight (0.79 to 1.02 lb DM) and volume displacement (1.02 to 1.28 gallon) during the 140 d feeding period. Feeding ground hay without net wrap removal prior to grinding resulted in build-up of net wrap in the rumen, which could result in long-term negative impacts on the cows.

INTRODUCTION

Plastic net wrap is a common binding material for large round hay bales because it helps maintain the integrity of bales during transport and storage. Utilizing plastic net wrapped hay for chopped or ground forage for winter feeding programs is common, but the net wrap is rarely removed prior to grinding due to time constraints, resulting in the hay containing pieces of plastic that are then fed to cattle. Various ranchers have experienced cows losing weight with diarrhea during a relatively short time frame, exhibiting symptoms similar to Johne's or hardware disease (Thomas, 2016). No veterinary treatments worked and when animals were posted following death, a wad of net wrap and feed was removed from the digestive tract. The results of this plastic net wrap building up in the rumen of cattle and causing death is being termed "plastic" or "software" disease. Research at North Dakota State University evaluated digestibility of multiple binding materials for hay and found that after 14 days, plastic net wrap and other non-biodegradable products did not break down in the rumen. However, a sisal product was broken down by 70% over a 14-day period (Klein & Dahlen, 2014). Research from Montana showed that young cows fed a ground hay diet for 7 months in the winter had approximately 1.82 lbs of net wrap in the digestive tract, with 99.9% found in the reticulum and rumen (Prizol, et al., 2017). As a result of these studies and questions from local producers and veterinarians, this project was conducted to quantify how rapidly net wrap builds up in the rumen and to have a better understanding of how it behaves in the rumen. A secondary objective was to determine if previous exposure to net wrap would increase the rate of net wrap accumulation in the rumen. Therefore, the hypothesis was that net wrap would accumulate more rapidly in the rumen if a piece of net wrap already resided in the rumen at initiation of the feeding trial.

MATERIALS AND METHODS

All protocols were approved by the South Dakota State University Institutional Animal Care and Use Committee.

Six mature Angus cows with ruminal cannulas were utilized at the SDSU Cottonwood Field Station, located approximately 11 miles west of Philip, SD from November 2019 to April 2020 to represent a 5-month winter feeding period. At initiation of the feeding trial, four of the cows were pregnant, one was open and one was a free-martin. On d -1, complete rumen evacuations were performed and digesta was hand-sorted to remove and discard any pre-existing plastic wrap or foreign material. All clean digesta was placed back into the rumen of each cow. Cows were weighed and scored for body condition (BCS; Pruitt & Momont, 1988) on d 0 and stratified by weight and BCS into two groups of three cows, with one open cow per group (Table 1). Each group was randomly assigned to one of two treatments: no net wrap added through the rumen cannula (Net –), or a 4.72 in x 4.72 in piece of net wrap placed inside the rumen through the cannula (Net +).

Grass hay, 88% dry matter (DM), 12.5% crude protein (CP), and 60% total digestible nutrients (TDN) was purchased from a single source and ground (Mighty Giant, Beemer, NE) at two time points during the 140 d feeding period using a 5 inch screen. Bales had 1½ wraps of Pritchett® Net Wrap Green (O'Neill, NE) per bale. Ground hay was placed in a covered commodity storage shed to minimize wind loss and DM variability. Ten random bales were removed from the hay pile prior to grinding during the first grind and 8 during the second grind. Bales were loaded onto a flatbed trailer and hauled to Philip, SD, where they were weighed as a lot on a certified scale at the local elevator. Total weight was divided by number of bales to determine an average bale weight. The net wrap was removed from the bales and all hay or dirt debris was removed from the net wrap and net wrap from each bale was weighed individually. Net wrap and bale weights were used to calculate lb of ground net wrap per ton of hay. Prior to grinding, there was 0.87 lb of net wrap per ton of hay. This information was then

used to calculate potential amount of net wrap delivered per cow for the 140 d feeding period based on individual intakes. The total potential net wrap offered per cow was 1.78 lbs and 1.78 lbs for Net+ and Net-, respectively.

On d 0, cows were placed individually in feedlot pens and fed ground hay once daily based on cow weight and body condition scored (BCS), with quantity offered tracked and adjusted over time. Hay offered was initially set at 74% of predicted intake (OSU Cowculator, Stillwater, OK) on a DM basis for the first 28 d. Cows were weighed and BCS every 28 days in the months of December, January, February, March and April (Table 1). Adjustments were made to diets to maintain weight and BCS. Cows were not weighed in March because of late pregnancy cows, and not adding any stress to these cows. At each weigh date, cows were rotated to different pens to eliminate potential pen effect and hay delivered was adjusted to maintain weight and BCS.

Table 1. Description of cow weights and BCS throughout the 140 d feeding period.

Treatment	Month	Body weight (lb)	SE	BCS	SE
Net -	November	1613	169.4	6.4	0.85
	December	1580	206.8	6.7	1.09
	January	1615	183.8	6.3	0.93
	February	1632	193.3	6.5	1.04
	March	ND*	ND*	6.3	0.88
	April	1663	157.7	6.6	0.73
Net +	November	1588	112.6	6.4	0.72
	December	1562	93.3	6.7	0.44
	January	1572	94.0	6.2	0.17
	February	1645	109.8	6.2	0.17
	March	ND*	ND*	5.9	0.08
	April	1492	51.3	5.5	0.00

*ND = No data

The 4 pregnant cows calved prior to the end of the 140 d feeding period and intake was adjusted for increased nutrient requirements due to lactation. On d 139 and 140, 3 cows per day were weighed, BCS, and rumens were evacuated to remove accumulated net wrap from the rumen. All net wrap was removed from the rumen digesta and the clean digesta was placed back in the rumen of each cow. Photos were taken of the balls of net wrap that were removed from the cows to document the characteristics of the mass of net wrap and digesta (Fig. 1, 2, and 3). Net wrap removed from each cow was dried in a 140 degree F oven for 72 hours and weighed to quantify the amount of net wrap in the rumen. To determine the rumen volume displaced by the net wrap, the net wrap collected from each cow was placed in a plastic bag and then submerged in a tub of water to determine the volume of water displaced by the net wrap.

Figure 1. Start of net wrap ball being removed from cow through the rumen cannula. Approximately 1/4 of the ball is outside the animal.

Figure 2. Net wrap after removal from the rumen. Net wrap and feed entangled was approximately 3 feet in length when laid out flat.

Figure 3. Net wrap ball with placental tissue wound up in it that was found in a cow that had recently calved.

Net wrap weight and volume displacement data were analyzed using the Mixed Procedure of SAS (SAS Institute, Cary, NC) in a completely randomized design to evaluate whether the treatment effect of addition of a pre-exisiting piece of net wrap influenced the amount of net wrap that accumulated in the rumen. Individual cows were considered the experimental unit. Least squares means and standard errors were calculated (Table 2).

RESULTS AND DISCUSSION

Net wrap was collected from the rumen of all six cows. In all cows, most of the net wrap was tangled together in one ball of material (Fig. 1 and 2); however there were several individual, loose pieces of net wrap also present (balled up to about the size of a softball). The material removed from the rumen did not consist of pure net wrap, as it became a mass of digesta and net wrap, with two samples from recently calved cows also having placental tissue that was consumed by the cow tangled in them (Fig. 3). There were no treatment differences ($P > 0.05$) for total net wrap weight or volume displaced by net wrap recovered from the rumen (Table 2).

Based on the potential net wrap offered compared to the net wrap removed during rumen evacuations, about half (53%) of the potential net wrap offered was recovered. The question remains why a larger portion was not recovered, but these results were similar to that found by Prizol et al. (2017), where 47% of the net wrap was recovered throughout the digestive tract. There are multiple possible explanations for where this net wrap disappearance could have occurred. During the grinding process, a portion of the net wrap could have remained in the grinder and never reached the pile of ground feed to be delivered to the cows, as the potential offered was a calculation based on 100% of the net wrap on the bales being ground. Due to the light weight of net wrap, a portion could have been lost due to wind. Additionally, there were some instances during the 140 d feeding period that cows regurgitated small amounts of net wrap and these small balls were found on the ground in the pens where cows were being fed. Finally, there was no evaluation of the presence of net wrap in the feces, so there could have been a portion of the net wrap that made it through the entire digestive system and was expelled with the feces.

The results of this study indicate a significant amount of net wrap accumulated in the rumen of all cows during a single, 140 d feeding period. The fate beyond this single feeding period of the net wrap that accumulated in the rumen is unknown. However, because it is a plastic material that is known to degrade at an extremely slow rate, it is possible that at least a portion of it will remain in the rumen throughout the life of the cow. Also unknown is whether similar amounts of net wrap will be added to the accumulation during subsequent feeding periods throughout the life of a cow. Potentially, several pounds of net wrap may accumulate across years in an older cow, with several gallons of rumen capacity displaced by net wrap. The cumulative effect on digestive capacity and health of cows is unknown beyond cases of mortality cited above.

Table 2. Total net wrap weight and volume displacement means, standard error (SE) and P value for treatments.

	Means			
	Net -	Net +	SE	P value
Net wrap weight (lb)	0.79	1.07	0.19	0.4216
Net wrap volume displacement (gallon)	1.02	1.28	0.21	0.4201

CONCLUSIONS

We reject our hypothesis that the Net+ cows would accumulate net wrap more rapidly than the Net- treatment. However, consistent accumulation of net wrap was documented in all six cows. Additionally, cases of cows dying from complications associated with the buildup of net wrap or other plastic materials in the rumen are becoming more frequently documented. This short-term project provided a snapshot of the potential long-term implications of not removing net wrap from bales prior to grinding. Many additional questions remain to be answered in regard to long-term impact on cow performance and longevity. How much net wrap does it take in the rumen to stop or slow the flow of digesta? Will the digesta that is wound up in the wad of net wrap ever break down or will it always continue to build? What happens to the placental tissue that is wound up in the net wrap wad? Will the pieces of net wrap that were free floating in the rumen contents end up entangled in the rest of the net wrap and increase the size of the ball? What is the impact of developing replacement heifers on ground hay without net wrap removal prior to grinding? Will the net wrap stay with them for the entirety of their life, even if they are never allowed access to net wrap in future years? Further research is needed to fully understand the long-term implications of net wrap in cattle diets.

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