

In Vivo Digestibility of Lignin Downregulated Alfalfa

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Alfalfa (*Medicago sativa* L.) is an important ingredient in many dairy cow rations. Increasing alfalfa fiber digestibility would improve forage management and ration formulation flexibility. Greenhouse and space planted studies demonstrated that caffeic acid 3-O-methyltransferase (COMT) and caffeoyl CoA 3-O-methyltransferase (CCOMT) downregulated alfalfa have reduced lignin and increased *in vitro* neutral detergent fiber digestibility (NDFD). The objective of this study was to determine *in vivo* fiber digestibility of these novel plants. Sheep were used as a model ruminant for lactating dairy cows because they eat less feed and can be fed hay-only diets. Field-scale swards of four entries (COMT, COMT-null, CCOMT, and CCOMT-null) of the lignin downregulated alfalfas were used to obtain hays for evaluation. Each lignin downregulated population consisted of multiple independent downregulation events for the same enzyme. Null populations were produced from the same germplasm as the downregulated alfalfa populations, but were derived from null segregants out of these populations. The four alfalfas were planted 2006 in Nampa, ID, and hay was harvested in May 2007. There were no significant forage yield differences between treatments, but the COMT treatment showed increased lodging. This was also noted in previous space-plant studies. The downregulated hays compared to their nulls had: reduced lignin, increased *in vitro* NDFD, and equivalent NDF. Hays were fed as 100% of the ration or as a total mixed ration (TMR) similar to that fed to lactating cows, which contained 50% hay, 10% corn silage and 40% dairy concentrate mixture. Sheep were fed both at *ad libitum* and restricted at 2% of body weight. Total collection of refusals and fecal samples were used to determine *in vivo* digestibility.

Alfalfa Hay	ADL	NDF	<i>In vitro</i> NDFD	<i>In vivo</i> NDF digestibility in lambs			
				100% Hay		TMR	
				<i>ad libitum</i>	Restricted	<i>ad libitum</i>	Restricted
	----- % DM -----			----- % NDF -----			
COMT	5.7	38.3	55.5	56.5*	52.9*	52.3*	53.7*
COMT-null	6.0	38.2	48.4	48.1	44.3	46.7	48.5
CCOMT	5.2	38.7	53.2	48.8	46.8*	43.8	51.0*
CCOMT-null	5.9	38.3	48.6	45.0	41.8	43.8	44.8

Transgenic and null significantly different from each other at $p < 0.05$

The COMT hay had increased *in vivo* NDF digestibility compared to its null when fed *ad libitum* or restricted for both the 100% hay and TMR diets. The CCOMT hay had increased *in vivo* NDF digestibility compared to its null in both the 100% hay and TMR diet, only with restricted feeding. The *in vivo* digestibilities by lambs had a similar pattern to the *in vitro* results, but were lower in magnitude. The difference from nulls was larger and more consistent for COMT compared CCOMT downregulated alfalfa. Alfalfa with downregulated enzymes for lignin biosynthesis would improve the digestibility of hays with similar maturity.