

Effects of maize cultivar and dry matter content at harvest on rumen fermentation properties

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Introduction Forage maize is mainly composed of starch in the ears and cell walls in the stover. Upon feeding maize to cattle starch can be fermented in the rumen, but after bypassing the rumen it can also be digested in the intestines. There is not much knowledge on the influence of maturation of the maize plants on the amount of rumen fermentable starch and on the kinetics of the rumen degradable part. There is also not much insight in the variation in rumen fermentation properties by different genotypes (cultivars). In many feed evaluation systems the total cell wall degradability of maize is valued and not its rate of degradation in the rumen. To get insight in the changes in cell wall and starch quality 4 different maize cultivars were harvested during the growing season and analysed for chemical composition and rumen fermentation kinetics, determined with the gas production technique.

Materials and methods Four maize cultivars were harvested at dry matter (dm) contents of 250 (dm250), 320 (dm320) and 390 g/kg (dm390). Cultivar 1 (cv1) was an early dry down cultivar, cv2 early stay green, cv3 late dry down and cv4 was a late stay green cultivar. Plants were separated in ears and stover, freeze dried and ground to pass a 1 mm screen. Samples of 0.5 g dm were incubated in the gas production technique as described by Cone *et al* (1996). Non-lactating donor animals received 9 kg DM grass hay and 1 kg DM concentrate daily. Gas production profiles were run in duplicate and fitted to a three-phasic model as described by Groot *et al* (1996). Presented are values for gas production after 20 h (GP20) and for A1 and A2, gas production caused by fermentation of the soluble and insoluble fraction respectively and B2 the time (h) needed to reach half of A2. Starch degradation after 10 h was calculated using gas production and starch content as described by Chai *et al* (2004). Statistical differences were recognised using analysis of variance.

Results Table 1, showing the main effects of the research, displays starch content, starch degradation after 10 h incubation and gas production parameters for the ear and stover samples. Dry matter content at harvest showed significant effects on all parameters. Cultivar was not significant for starch content and B2 in ears. Effects for dry matter x cultivar were only observed in ears for GP20, A1, A2 and degraded starch.

Conclusions Early harvest results in low starch contents and decreased fermentation of the non-soluble fraction (A2). Upon maturation (higher dm content) rate of degradation of both starch and cell wall decreased (higher B2). This lead to a decrease in percentage starch degradation after 10 h incubation, which indicates a higher percentage of rumen escape starch. Prolonged maturation results in decreased cell wall degradability (low A2) and decreased rate of degradation (high B2). Expanded studies should point the optimum harvest date (dm content) to obtain maize with high yield, high starch content and high cell wall degradability and optimal starch degradation in the rumen with desired amounts of rumen escape starch and maximum digestibility in the intestine.

Table 1 Content of starch (g/kg DM), gas production (ml/g OM) after 20 h (GP20), caused by fermentation of the soluble fraction (A1) and the insoluble fraction (A2), time (h) needed to reach half the maximum of A2 (B2) and the starch degraded (g/kg) after 10 h incubation.

	Starch	GP20	A1	A2	B2	Starch degr.
	g/kg DM	ml/g OM	ml/g OM	ml/g OM	h	g/kg
Maize ears						
dm250	426	299	45.6	253	7.25	771
dm320	630	310	28.2	282	7.54	665
dm390	648	309	23.9	285	7.77	619
lsd	29	5.2	1.9	4.2	0.23	13
cv1	576	304	32.9	271	7.40	682
cv2	563	312	32.1	280	7.61	694
cv3	546	305	37.0	268	7.44	701
cv4	586	303	28.3	275	7.64	650
lsd	33	6.0	2.2	4.8	0.27	15
Effect dm	***	***	***	***	**	***
Effect cv	ns	*	***	***	ns	***
Effect dm x cv		*	**	*	ns	**
Maize stover						
dm250		210	52.1	158	8.47	
dm320		193	38.3	155	9.05	
dm390		191	43.3	147	9.40	
lsd		6.3	2.9	4.8	0.15	
cv1		190	40.1	150	9.34	
cv2		193	39.2	154	8.96	
cv3		211	52.8	158	8.84	
cv4		197	46.1	151	8.76	
lsd		7.2	3.3	5.6	0.17	
effect dm		***	***	**	***	
effect cv		***	***	*	***	
effect dm x cv		ns	ns	ns	ns	

References

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