Short Communications

The response of different portions of the maize plant to NaOH treatment

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Different portions (stalks, cobs, plant leaves, and cob leaves) from mature dry maize plants remaining after grain harvest were collected on two occasions, 8 weeks apart. Composition (proportion of plant portions) differed considerably between first and second cutting dates. All plant portions were treated with NaOH. Initial IVOMD and extent of improvement in IVOMD with NaOH treatment differed between plant portions. The difference in composition between first and second cutting dates only marginally affected IVOMD of maize straw before and after treatment with NaOH. However, it is evident that changes in maize straw composition could have a considerable effect on its response to NaOH treatment.

Verskillende plantdele (stamme, stronke, plantblare en kopblare) van volwasse droë mielieplante wat na die graanoes in die land agtergebly het, is by twee geleenthede, 8 weke uitmekaar, verkry. Samestelling (verhouding tussen plantdele) het aansienlik verskil tussen die eerste en tweede snydatums. Alle plantdele is met NaOH behandel. Aanvanklike IVOMV en die mate van verbetering in IVOMV met NaOH-behandeling het verskil tussen plantdele. Die verskil in samestelling tussen eerste en tweede snydatums het slegs 'n klein verskil in IVOMV van mieliestrooi voor en na behandeling tot gevolg gehad. Dit is egter duidelik dat veranderinge in die samestelling van mieliestrooi 'n aansienlike invloed kan hê op die reaksie wat met NaOH-behandeling verkry word.

Keywords: Maize straw, NaOH treatment, *in vitro* digestibility

Harvesting of grain after the maize plant has dried out (grain 85% DM) leaves approximately 50% of the total DM yield in the field as maize straw (Johnson, McClure, Klosterman & Johnson, 1966). This straw is a potential source of energy for ruminants (Leffel, 1981). One problem, however, is that the plant is mature at the time of grain harvest, so that the remaining straw has a high cell wall content and the cell walls are highly lignified, which in turn result in poor digestibility (Van Soest, 1967). Chemical treatment of the maize straw with an alkali such as NaOH can increase its digestibility and hence energy availability (Berger, Paterson, Klopfenstein & Britton, 1979). Such treatment of maize straw under practical farming conditions in South Africa appears to give variable improvement in its utilization by ruminants, although no definite data are available. Laboratory analyses of various maize straw samples also indicated appreciable variation in *in vitro* OM digestibility (IVOMD) (unpublished data). Considerable differences occur in the composition (proportions of plant portions namely stalks, cobs, plant leaves, and cob leaves) of what is normally referred to as maize straw. This is most likely caused by factors such as harvesting method and the length of time maize straw is left exposed to weathering before being collected from the field. Straw portions with a lower initial digestibility can be expected to give greater improvements in digestibility with chemical treatment than portions with a higher initial digestibility (Pigden, Pritchard & Heaney, 1966). Thus, batches of maize straw with different proportions of the various plant portions (stalks, cobs, plant leaves, cob leaves) can be expected to react differently to NaOH treatment.

An experiment was conducted to determine the response of different portions of the maize plant to NaOH treatment, and to investigate what effect a change in the composition of maize straw will have on its reaction to NaOH treatment.

The following experimental procedure was adopted. A site of one acre was randomly selected from a maize field at the Animal and Dairy Science Research Institute. From this site 15 whole maize plants were randomly selected on each of two occasions, 8 weeks apart. The plants were mature and dry, corresponding to post-harvest conditions. Each plant was divided into stalk, cobs, plant leaves, and cob leaves. The corresponding portions from the different plants were then combined for each cutting date and weighed. The DM content in each portion was determined by drying at 100°C to constant mass. All portions were ground to pass a 1 mm sieve using a Wiley mill. An appropriate amount of each portion was treated with 60 g NaOH dissolved in 3 l of water per kg DM treated. The treated material was left for 24 h after treatment before storing at −10°C. All samples were freeze-dried before being analysed for IVOMD according to the method of Tilley & Terry (1963).

The results in Table 1 show that there were actual differences in composition of the maize plants collected on the two cutting dates. From the results in Table 2 it can also be seen that there were considerable differences in IVOMD between different portions of the maize plant with concomitant differences in the response to NaOH treatment. The IVOMD of the various plant portions remained quite similar on both cutting dates. Using the results in Tables 1 and 2 it is possible to calculate initial and improved IVOMD for maize straw (stalks, cobs, plant leaves, and cob leaves combined) for the first and second cutting dates. This was done by multiplying the fraction of each plant portion in the maize straw by its IVOMD percentage and then adding-up the values obtained for the four plant portions. The respective values obtained for IVOMD of maize straw before and after NaOH treatment were 55,8% and 74,2% for the first cutting date and 53,9 and 74,6% for the second cutting date.

Table 1 Dry matter yield and composition of 15 maize plants at two cutting dates

	8 April		9 June	
Component	yield (g)	% of total mass	yield (g)	% of total mass
Stalks	2070	33,6	1800	45,3
Cobs	930	15,1	780	19,6
Plant leaves	1920	31,1	765	19,3
Cob leaves	1245	20,2	630	15,8
Total	6165	100	3975	100

Table 2 *In vitro* OM digestibility and response to NaOH treatment of different portions of the maize plant

	8 April			9 June		
Component	Untreated	6% NaOH	% unit increase	Untreated	6% NaOH	% unit increase
Stalks	49,6	75,9	26,3	50,8	77,4	26,6
Cobs	a	a	a	49,0	70,2	21,1
Plant leaves	55,5	72,0	16,5	52,9	70,4	17,5
Cob leaves	71,2	77,5	6,3	70,5	76,9	6,4

[a]Samples lost

It thus appears that the difference in composition of the maize straw between first and second cutting dates in this study, only marginally affected the response to NaOH treatment of the straw. However, considering the differences in IVOMD and response to NaOH treatment between the various portions of the maize plant, it is evident that changes in the composition of the maize plant could have a considerable effect on its response to NaOH treatment.

References

BERGER, L.L., PATERSON, J.A., KLOPFENSTEIN, T.J. & BRITTON, R.A., 1979. Effect of harvest date and chemical treatment on the feeding value of corn stalklage. *J. Anim. Sci.* 49, 1312.

JOHNSON, R.R., McCLURE, K.E., KLOSTERMAN, E.W. & JOHNSON, L.J., 1966. Corn plant maturity. III. Distribution of nitrogen in corn silage treated with limestone, urea and diammonium phosphate. *J. Anim. Sci.* 26, 394.

LEFFEL, E.C., 1981. Utilization of corn residues. In: Proceedings of the Maryland Nutrition Conference for Feed Manufacturers. University of Maryland. p.72.

PIGDEN, W.J., PRITCHARD, G.I. & HEANEY, D.P., 1966. Physical and chemical methods for increasing the available energy content of forages. In: *Proc. 10th Int. Grassld Congr., Helsinki.* p.397.

TILLEY, J.M.A. & TERRY, R.A., 1963. A two-stage technique for the digestion of forage crops. *J. Br. Grassld Soc.* 18, 104.

VAN SOEST, P.J., 1967. Development of a comprehensive system of feed analysis and its application to forages. *J. Anim. Sci.* 76, 119.