

The effect of type and level of carbohydrate supplementation on intake and digestibility of *Atriplex nummularia* cv. De Kock

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Abstract

The effects of type of carbohydrate supplementation on intake and digestibility of *Atriplex nummularia* cv. De Kock were investigated. Ten rumen cannulated sheep were fed different increments of maize and barley supplements (0%, 15%, 30%, 45%) to a basal diet of *A. nummularia* cv. De Kock. Supplementation of *A. nummularia* cv. De Kock with an energy source tended to increase NDF digestibility, decrease rumen pH and with maize as a supplement, increase intake.

Keywords: *Atriplex*, carbohydrates, fermentability

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Introduction

Atriplex nummularia has proved to be a very useful drought tolerant crop for bridging the periods when natural pasture does not satisfy the nutritional requirements of small stock (Jacobs & Smit, 1977). Research has shown that the nutritive value of *A. nummularia* (cv. De Kock) is sufficient for maintenance of small stock (Verschoor, 1992). The most limiting nutrient is energy (6.1 MJ ME /kg DM), with crude protein (210 g/kg) being sufficient to maintain a certain level of production (Weston *et al.*, 1970). The aim of this experiment was to quantify the influence of type and level of carbohydrate supplementation (high and medium fermentability) on the digestibility of *A. nummularia* cv. De Kock.

Materials and Methods

Ten rumen cannulated sheep were used in a split plot design. The experimental diets consisted of *A. nummularia* supplemented with maize (medium fermentability) and barley (high fermentability) at three different levels (15%, 30% and 45%) on a dry matter basis. Neutral detergent fibre (NDF) concentrations of the diets were determined by the method described by Van Soest & Wine (1967). An electronic pH meter was used to determine the pH of rumen fluid after each sample was taken (Robinson *et al.*, 1986).

An analysis of variance with the Proc GLM model (SAS, 1994) was used to determine the significance between treatments and different levels of supplementation. Least square means and standard errors (SE) were determined. Significance of difference (5%) between least square means was determined by using Bonferroni's test (Samuels, 1989).

Results and Discussion

The results in Table 1 indicate that supplementation of both energy sources tended towards an increase (not significant) in dry matter intake when compared to the control. Significant differences occurred at the 45% of maize and 30% of barley inclusion levels compared to the lower supplementation levels. The higher intake could have been as a result of the higher palatability and digestibility of the two energy sources. The NDF digestibility tended towards a significant increase from 0% to 15% and from 0% to 30% and 45%. These increases may be due to positive associative effects occurred in the rumen. Significant positive associative effects of grain supplementation were noted for feedlot animals by Huck *et al.* (1998). Fermentation of starch in the rumen increased propionic acid concentrations in the rumen and improved starch utilization. It also appeared to increase estimated uptake of amino acids from the small intestine

(Theurer *et al.*, 1999). This may be partly explained by the higher intake with energy supplementation. With the 30% and 45% supplementation rates of both energy sources, there was a drop in the NDF digestibility (not significant), most probably due to negative associative effects in the rumen. There was a significant drop in rumen pH from the control group to 30% and from the control group to 45% supplementation rates in both the energy sources. The drop in pH supported the possibility of negative associative effects in the rumen. These negative associative effects were most probably responsible for the decrease in NDF digestibility (non significant) when the supplementation was raised from 15% to 30% and from 30% to 45% in both treatments. The lower intake of barley at the 45% supplementation level (high fermentation rate), together with a drop in rumen pH, correlated with the lower NDF digestibility. It is well known that a lower ruminal pH will have a negative effect on cell wall digestibility and thus on intake (Minson, 1990).

The differences between the two carbohydrate sources were overall small and not significant, except for intake at the 45% supplementation level. McCarthy *et al.* (1989) reported positive intake results in favour of the slower fermentable carbohydrate source, which was the case with maize supplementation in this study.

Table 1 Dry matter intake, % NDF digestibility and rumen pH, of sheep fed *Atriplex nummularia* cv. De Kock at different levels of supplementation by two energy sources

| | Supplementation level (%) | Treatments | |
|-----------------------|---------------------------|--|--|
| | | Maize | Barley |
| Intake /kg W (g /day) | 0 | 23.46 ₁ ^a (± 3.7)* | 32.2 ₁ ^{ab} (± 3.3) |
| | 15 | 23.58 ₁ ^a (± 3.3) | 21.2 ₁ ^a (± 3.7) |
| | 30 | 33.51 ₁ ^{ab} (± 3.3) | 37.9 ₁ ^b (± 3.3) |
| | 45 | 38.63 ₁ ^b (± 3.3) | 25.7 ₂ ^a (± 3.7) |
| % NDF digestibility | 0 | 30.24 ₁ ^a (6.5) | 28.21 ₁ ^a (5.8) |
| | 15 | 51.58 ₁ ^a (5.8) | 61.57 ₁ ^b (6.5) |
| | 30 | 40.22 ₁ ^a (5.8) | 51.54 ₁ ^b (5.8) |
| | 45 | 42.72 ₁ ^a (5.8) | 41.56 ₁ ^{ab} (6.56) |
| pH (H ₂ O) | 0 | 6.98 ₁ ^a (± 0.11) | 7.05 ₁ ^a (± 0.10) |
| | 15 | 6.77 ₁ ^{ab} (± 0.10) | 6.75 ₁ ^{ab} (± 0.11) |
| | 30 | 6.50 ₁ ^{bc} (± 0.11) | 6.53 ₁ ^b (± 0.10) |
| | 45 | 6.10 ₁ ^c (± 0.10) | 5.94 ₁ ^c (± 0.10) |

Column (a,b,c) and row (1,2) means with common scripts do not differ (P > 0.05)

*Values in brackets designate standard errors

Conclusion

Supplementation of *A. nummularia* cv. De Kock with an energy source tended to increase intake. The tendency of energy sources to increase NDF digestibility diminished when the supplemental level was raised from 15% to 30% and from 30% to 45%. These results suggested that barley and maize supplemented at a level of 15% gave the highest incremental increase in DM and NDF digestibility in *A. nummularia* cv. De Kock. Negative associative effects occurred in the rumen at supplemental levels of 30% and above.

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References

Huck, G.L., Kreikemeier, K.K., Kuhl, G.L., Eck, T.P. & Bolson, K.K., 1998. Effects of feeding combinations of steam flaked grain sorghum and steam flaked high moisture or dry rolled corn on growth performance and carcass characteristics in feedlot cattle. *J. Anim. Sci.* 76, 2984-2988.

- Jacobs, G.A. & Smit, C.J., 1977. Benutting van vier *Atriplex* spesies deur skape. *Agroanimalia* 9, 37-41.
- McCarthy, R.D., Klusmeyer, T.H., Vicini, L.J. & Clark, J.H., 1989. Effect of source of protein and carbohydrate on ruminal fermentation and passage of nutrients to the small intestine of lactating cows. *J. Dairy Sci.* 72, 2002-2016.
- Minson, D.J., 1990. Forage in ruminant nutrition. Academic Press, Toronto. pp. 1-8.
- Robinson, P.H., Tamminga, S. & Van Vuuren, A.M., 1986. Influence of declining level of feed intake and varying portion of starch in the concentrate on rumen fermentation in dairy cows. *Livest. Prod. Sci.* 15, 173-189.
- Samuels, M.L., 1989. *Statistics for the Life Sciences*. Collier MacMillan Publishers, London.
- SAS, 1994. *Statistical Analysis Systems user's guide (Statistics Version 6)*. SAS Institute Inc., Cary, North Carolina, USA.
- Theurer, C.B., Wanderley, R. & Huber, J.T., 1999. Steam flaking grains may improve nutritional value. *Feedstuffs* 71 (20), 16.
- Van Soest, P.J. & Wine, R.H., 1967. Use of detergents in the analysis of fibrous feeds. IV. Determination of plant cell constituents. *J. Assoc. Off. Anal. Chem.* 50, 50.
- Verschoor, A., 1992. Die rol van oumansoutbos (*Atriplex nummularia* Lindl) as weigewas in hoë reënval gebiede. M.Sc. (Agric) dissertation, University of Pretoria, Pretoria, South Africa.
- Weston, R.H., Hogan, J.P. & Hemsley, J.A., 1970. Some aspects of the digestion of *Atriplex nummularia* by sheep. *Proc. Aust. Soc. Anim. Prod.* 8, 507-512.