Inclusion of *Tarchonanthus camphoratus* in finishing diets for lambs

H.J. van der Merwe* and I. Nel

Department of Animal Science, University of the Orange Free State, P.O. Box 339, Bloemfontein 9300, Republic of South Africa

* Outeur aan wie korrespondensie gerig moet word.

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The effect of including 20, 30, 40 and 50% *Tarchonanthus camphoratus* as the sole roughage in a finishing diet for lambs was investigated. Stems (with leaves), not exceeding 12,5 mm in diameter and 600 mm in length respectively, were harvested in June 1987 and milled through a 25-mm mesh screen. Additionally, the chemical composition of ten-month-old coppice shoots was determined. The chemical composition of *T. camphoratus* and shoots (indicated in brackets) on a dry-matter basis (%) was as follows: crude protein 5,65 (16,32); ether extract 3,70 (5,01); ash 4,73 (9,59); cellulose 44,42 (29,03); hemicellulose 9,78 (7,39); lignin 1,59 (3,70); calcium 0,17 (0,67); phosphorus 0,11 (0,63); potassium 0,16 (0,79). A significant ($P < 0,05$) reduction in the apparent digestibility of acid detergent fibre occurred when more maize was included in the diet. The inclusion of 40 and 50% *T. camphoratus* in the diet resulted in a significantly ($P < 0,05$) lower apparent digestibility of dry matter and gross energy as well as metabolizable energy content. Accordingly, metabolizable energy intake, daily live mass-gain and efficiency of feed conversion to live mass of lambs on these diets were significantly ($P < 0,05$) lower. No significant ($P > 0,05$) differences in nitrogen retention as a percentage of nitrogen intake, carcass mass and grading occurred between the various treatments. The results suggest that a maximum of approximately 30% *T. camphoratus* could be included in a finishing diet for lambs.

Die insluiting van 20, 30, 40 en 50% *Tarchonanthus camphoratus* as enigste ruvoerbron in 'n afrondingsdieet vir lammers is ondersoek. Takke (en blare) met onderskeidelik 'n deursnee en lengte wat nie 12,5 mm en 600 mm oorskry het nie, is in Junie 1987 geoes en deur 'n 25 mm-sif gemaal. Eweneens is die chemiese samestelling van tien-maande-oud lote bepaal. Die chemiese samestelling van *T. camphoratus* en lote (aangedui tussen hakkies) op 'n vogvrye basis (%) was as volg: ruproteïen 5,65 (16,32); eterekstrak 3,70 (5,01); as 4,73 (9,59); sellulose 44,42 (29,03); hemisellulose 9,78 (7,39); lignien 1,59 (3,70); kalsium 0,17 (0,67); fosfor 0,11 (0,63); kalium 0,16 (0,79). Die skynbare verteerbaarheid van suuronoplosbare vesel het betekenisvol ($P < 0,05$) verlaag namate meer mielies in die proefdiëte ingesluit is. Verder het die insluiting van 40 en 50% *T. camphoratus* in die dieet met 'n betekenisvolle ($P < 0,05$) verlaging in die skynbare verteerbaarheid van droë materiaal en bruto energie asook metaboliseerbare energie-inhoud gepaard gegaan. Dienooreenkomstig was die metaboliseerbare energie-inname, massatoename en die doeltreffendheid van voeromsetting na lewende massa van lammers op hierdie diëte betekenisvol ($P < 0,05$) swakker. Geen statisties-betekenisvolle ($P > 0,05$) verskille in stikstofretensie as 'n persentasie van stikstofinname, karkasmassa en gradering het tussen die onderskeie behandelings voorgekom nie. Die resultate dui aan dat nagenoeg 30% *T. camphoratus* in afrondingsdiëte vir lammers ingesluit kan word.

Keywords: *Tarchonanthus camphoratus*, digestibility, finishing diets, lambs.

The semi-arid regions of South Africa periodically experience severe droughts. In contrast to grasses, potential feed resources such as trees and shrubs are less vulnerable to droughts and can, therefore, play an important role in these drought-stricken areas. Furthermore, the utilization of woody plant species during normal years could increase the livestock carrying capacity of these areas.

Investigations into the feeding of leaves, ground twigs and branches of woody plants to ruminants have been mainly devoted to the feeding of such materials at a maintenance level (Bonsma, 1942; Kotze, 1965; Lüdemann, 1966; Donaldson *et al.*, 1968; Van Schalkwyk, 1975). Donaldson *et al.* (1968) pointed out that the feeding of livestock on a survival diet for long periods results in virtually no income. Consequently, it is important to investigate the feeding potential of these available feeding resources for production purposes.

Tarchonanthus camphoratus grows on the calcareous soil of the Ghaapse-plato (*ca.* 1 000 000 ha). No information could be found in the available literature about the inclusion of *T. camphoratus* in production diets for animals. Therefore, an initial study has been undertaken to investigate the feeding potential of *T. camphoratus* as a roughage source in finishing diets for lambs.

Twenty SA Mutton Merino ram lambs, with a mean initial body mass of *ca.* 30 kg, were randomly allocated to four groups. The lambs in each group received one of four experimental diets on an *ad libitum* basis. The composition of the experimental diets is shown in Table 1. The diets were composed to provide the crude protein requirements (*ca.* 13% on a dry-matter basis) of lambs (NRC, 1985). The *T. camphoratus* plants were cut at ground level during June 1987. Stems (and leaves), not exceeding 12,5 mm and 600 mm in diameter and length respectively, were milled through a 25-mm mesh screen. Furthermore, 15 mg/kg monensin sodium was included in the diets.

The lambs, implanted with Ralgro, were fed individually in digestion crates during the total feeding period. A growth as well as a digestion study was conducted. The collection period was carried out during the fifth week of the growth study. Lambs were weighed at the beginning and end of the feeding period after an overnight fasting period. Each group was slaughtered when the lambs had reached an average mass of 40 kg.

The chemical composition of feed, faeces, urine and coppice shoots (ten-month growth) was determined according to the methods of AOAC (1965). Gross energy was determined by means of bomb calorimetry. Acid detergent fibre (ADF), cellulose, hemicellulose and lignin were determined according to the methods of Van Soest (1963) and Van Soest & Wine (1967).

The data were analysed by means of a completely random design. An analysis of variance was performed and significant differences were identified by means of Tukey's *t* test (Steele & Torrie, 1960).

The chemical composition of *T. camphoratus* and shoots (indicated in brackets) on an air-dry basis (%) was as follows: crude protein 5,65 (16,32); ether extract 3,70 (5,01); ash 4,73 (9,59); cellulose 44,42 (29,03); hemicellulose 9,78 (7,39); lignin 1,59 (3,70); calcium 0,17 (0,67); phosphorus 0,11 (0,63); and potassium 0,16 (0,79). It is obvious that the

Table 1 Physical and chemical composition of experimental diets

Item	Diets[a] 1 (50%)	2 (40%)	3 (30%)	4 (20%)
Physical composition (air-dry basis) (%)				
Maize meal	28,2	38,7	49,2	59,7
Voermol[b]	10,0	10,0	10,0	10,0
Protein concentrate[c]	10,3	9,8	9,3	8,8
T. camphoratus	50,0	40,0	30,0	20,0
Salt	0,5	0,5	0,5	0,5
Dicalcium phosphate	1,0	1,0	1,0	1,0
Chemical composition (dry-matter basis) (%)				
Dry matter	89,16	89,07	87,93	88,83
Ash	7,49	7,07	7,21	7,64
Crude protein	13,32	13,72	14,22	14,32
Acid detergent fibre	31,07	26,25	21,22	16,00
Ether extract	4,49	4,42	4,26	3,66
Calcium	1,35	1,30	1,26	1,18
Phosphorus	0,68	0,69	0,68	0,68

[a] Percentage *T. camphoratus* indicated in brackets.
[b] Specifications of commercial voermol was minimum 5% urea, minimum 18% crude protein, maximum 10% fibre, maximum 0,8% calcium, minimum 0,6% phosphorus, maximum 16% moisture and minimum 0,8% fat.
[c] Specifications of commercial protein concentrate was minimum 42% crude protein, maximum 12% moisture, minimum 1% fat, maximum 13% fibre, maximum 8% calcium and minimum 2,5% phosphorus.

Table 2 Digestion and balance data

Item	Diets[a] 1 (50%)	2 (40%)	3 (30%)	4 (20%)	Significance
Dry-matter intake (kg/lamb/d)	1,02 ±0,21	0,95 ±0,16	1,26 ±0,06	1,11 ±0,16	NS[b]
Apparent digestibility					
Dry matter (%)	62,34 ±1,81	64,66 ±2,27	68,35 ±1,15	72,07 ±0,91	4>3>1,2[c]
Crude protein (%)	73,80 ±1,16	72,56 ±2,51	73,21 ±1,82	75,75 ±1,50	NS
Acid detergent fibre (%)	49,49 ±2,70	46,59 ±2,35	42,98 ±4,37	37,98 ±6,84	1,2>4[c]
Ether extract (%)	66,06 ±1,86	71,57 ±0,87	62,23 ±3,49	61,29 ±2,85	NS
Gross energy (%)	68,55 ±1,46	69,68 ±1,65	74,49 ±0,91	77,42 ±0,89	4>3>1,2[c]
Digestible crude protein (%)	9,40 ±2,14	10,57 ±0,52	10,98 ±0,26	11,12 ±0,26	NS
Metabolizable energy (MJ/kg)[d]	10,82 ±0,22	10,73 ±0,22	12,07 ±0,13	12,53 ±0,25	4>3>1,2[c]
N retention as % of nitrogen intake	52,09 ±4,51	53,76 ±2,44	53,40 ±7,62	52,12 ±6,54	NS

[a] Percentage *T. camphoratus* indicated in brackets.
[b] Non-significant.
[c] $P < 0,05$.
[d] Digestible energy × 0,82.

particularly high cellulose content of *T. camphoratus* could detrimentally influence the digestibility thereof. The low lignin content of *T. camphoratus* was unexpected. In contrast to *T. camphoratus* stems, the cellulose content of the shoots was lower whereas the crude protein, ether extract, ash, calcium, phosphorus and potassium contents were higher. According to this, the shoots have a potentially greater nutritive value than stems. Donaldson *et al.* (1968) found that the subsequent coppice growth could easily be harvested and, hence, the problem of collecting large amounts of feed was also partially solved. At the same time, bush encroachment could be controlled. A great amount of research is, however, required before definite recommendations on the most efficient and successful methods of feeding this roughage can be made.

The chemical composition of the experimental diets is shown in Table 1. Inclusion of a smaller amount of *T. camphoratus* in the diet resulted in lower ADF and ether extract content. Although the calcium and phosphorus content of the diets exceed the requirements of the lambs, the optimum ratio occurred.

According to the results in Table 2, a significant reduction in the apparent digestibility of ADF occurred when more maize was included in the diet. In this respect several researchers, viz. Van Soest (1983), Gibson (1984), Miller & Muntifering (1985) and Dixon (1986), found that concentrate in the diet resulted in a lower fibre and specifically cellulose digestibility. As previously mentioned, the cellulose content of *T. camphoratus* is particularly high. Reduction of fibre digestion may result from changes in substrate utilization by rumen micro-organisms, reduced numbers of cellulolytic organisms, changes in digesta passage, lowered pH and decreased availability of the iso-acids and ammonia for cellulotic microbes (Hynd, 1984; Coppock, 1985; Shriver *et al.*, 1986).

Furthermore, the inclusion of 40 and 50% *T. camphoratus* in the diet resulted in a significantly lower ($P < 0,05$) apparent digestibility of dry matter and gross energy as well as metabolizable energy content (Table 2). Accordingly, metabolizable energy intake, daily live mass-gain and efficiency of feed conversion to the live mass of lambs on these diets were significantly ($P < 0,05$) lower. On the other hand, no significant ($P > 0,05$) differences in nitrogen retention as a percentage of nitrogen intake (Table 2), carcass mass and grading (Table 3) occurred between the various treatments. According to these results, a maximum of approximately 30% *T. camphoratus* stems could, from a biological point of view, be included in a finishing diet for lambs. This level applies only for the *T. camphoratus* plants as harvested in this study. Further research is needed to evaluate season and year effects as well as different harvesting methods.

Table 3 Intake, gain and carcass data

Item	Diets[a] 1 (50%)	2 (40%)	3 (30%)	4 (20%)	Significance
Dry-matter intake (kg/lamb/d)	1,14 ±0,22	1,17 ±0,28	1,53 ±0,10	1,12 ±0,28	NS[b]
Metabolizable energy intake (MJ/lamb/d)	11,05 ±2,26	10,22 ±1,70	15,20 ±0,73	13,86 ±2,04	4,3>2[c] 3>1[c]
Initial mass (kg)	29,25 ±2,74	30,74 ±2,00	29,75 ±2,06	30,46 ±2,54	NS
End mass (kg)	39,33 ±5,03	40,62 ±1,55	42,08 ±2,35	40,54 ±3,11	NS
Days	99	92	57	57	
Mass gain (kg/d/lamb)	0,10 ±0,03	0,11 ±0,03	0,22 ±0,02	0,18 ±0,04	4,3>1,2[c]
Kg feed/kg live mass-gain	10,59 ±2,33	9,26 ±1,85	5,84 ±0,49	6,39 ±0,89	1,2>4,3[c]
Carcass mass (kg)	18,88 ±1,75	20,60 ±0,96	19,58 ±2,44	20,42 ±1,96	NS
Dressing (%)	48,17 ±1,87	50,76 ±2,70	46,53 ±4,31	50,45 ±4,06	NS
Grading (out of 20 points)	14,5 ±1,73	14,0 ±3,08	17,0 ±1,41	16,6 ±2,51	NS
Fat thickness (mm)	2,6 ±1,5	4,0 ±1,4	4,8 ±1,2	3,6 ±1,9	NS

[a] Percentage *T. camphoratus* indicated in brackets.

[b] Non-significant; [c] $P < 0{,}05$.

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