Nutritive evaluation of *Medicago truncatula* (cv. jemalong) pasture for sheep. 1. Seasonal influences on the chemical composition and digestibility of pasture.

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The experiment was conducted (a) to determine the relationship between *in vitro* digestible organic matter (IVDOM) and *in vivo* digestible organic matter (DOM); (b) to quantify the monthly variation in chemical composition and digestibility of medic pasture; and (c) to compare the chemical composition and digestibility of manually collected pasture samples with those collected in oesophageally fistulated (OF) sheep. The equation, *in vivo* DOM = 0,643 IVDOM + 24,5 (r = 0,91), was derived from the data and may be used to convert IVDOM to *in vivo* DOM contents. Significant ($P \leq 0,01$) variation was found in the CP (OM basis) (from 11,7 ± 1,5% to 37,5 ± 0,7%), CF (OM basis) (from 12,7 ± 1,0% to 42,1 ± 2,2%), IVDOM (from 36,4 ± 3,9% to 77,6 ± 4,9%), and *in vivo* DOM contents (from 47,9 ± 2,6 to 74,4 ± 3,0%) between months. A typical seasonal pattern, related to the amount of rain received, was observed with significant ($P \leq 0,01$) differences in CP, IVDOM and *in vivo* DOM contents between months. The CP content was found to be 15,4 ± 5,8% in the summer, 27,1 ± 8,1% in the autumn, 30,8 ± 3,7% in the winter, and 20,8 ± 7,3% in the spring. The corresponding IVDOM content was determined to be 50,4 ± 8,5% (summer), 61,3 ± 11,3% (autumn), 74,2 ± 4,0% (winter), and 64,3 ± 7,4% (spring). Sheep selected pasture samples with a higher percentage CP than those of manually collected samples during the wet season. Fistula sample values (f) may be predicted from manually collected samples (h) by the equations, CPf = – 0,76 + 1,5 CPh (r = 0,82), CFf = – 2,8 + 0,99 CFh (r = 0,74) and IVDOMF = 26,5 + 0,61 IVDOMH (r = 0,87).

Die eksperiment is uitgevoer om (a) die verwantskap tussen *in vitro* verteerbare organiese materiaal (IVOM) en *in vivo* verteerbare organiese materiaal (VOM) te bepaal; (b) om die variasie in die chemiese samestelling en verteerbaarheid van medic weiding te kwantifiseer; en (c) om die chemiese samestelling en verteerbaarheid van hand versamelde monsters met die monsters versamel met oesofageaal gefistuleerde (OF) skape, te vergelyk. Die vergelyking, *in vivo* VOM = 0,643 IVOM + 24,5 (r = 0,91) kan gebruik word om IVOM- na *in vivo* VOM-waardes om te skakel. Betekenisvolle ($P \leq 0,01$) verskille in RP- (OM-basis) (variasie van 11,7 ± 1,5% tot 37,5 ± 0,7%), RV- (OM-basis) (variasie van 12,7 ± 1,0% tot 42,1 ± 2,2%), IVOM- (variasie van 36,4 ± 3,9% tot 77,6 ± 4,9%) en *in vivo* VOM-inhoud (variasie van 47,9 ± 2,6% tot 74,4 ± 3,0%) het tussen maande voorgekom. 'n Tipiese seisoenale patroon (afhanklik van reënval) met betekenisvolle ($P \leq 0,01$) verskille in RP-, RV-, IVOM- en *in vivo* VOM-inhoud tussen maande, is waargeneem. Die RP-inhoud was 15,4 ± 5,8% gedurende die somer, 27,1 ± 8,1% gedurende die herfs, 30,8 ± 3,7% gedurende die winter, en 20,8 ± 7,3% gedurende die lente. Die ooreenkomstige IVOM-waardes was onderskeidelik 50,4 ± 8,5% (somer), 61,3 ± 11,3% (herfs), 74,2 ± 4,0% (winter), en 64,3 ± 7,4% (lente). Dit blyk dat skape weidingsmonsters met 'n hoër RP-inhoud, as dié van handversamelde monsters, gedurende die maande met 'n hoër reënval versamel. Fistelmonster waardes (f-waardes) kan afgelei word van handmonster waardes (h) deur die volgende vergelykings, CPf = – 0,76 + 1,5 CPh (r = 0,82), CFf = – 2,8 + 0,99 CFh (r = 0,74) en IVOMF = 26,5 + 0,61 IVOMH (r = 0,87).

Keywords: Chemical composition, digestibility, *Medicago* spp., oesophageally fistulated sheep, pasture, seasonal fluctuations.

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Introduction

Medic pastures are annuals of Mediterranean origin which grow, bloom, and produce seed in the winter in order to overcome the long, hot and dry summer and re-establish with the onset of the next winter rainfall. Such pastures are sown throughout the 250 – 450 mm winter rainfall area while Barrel medic (*Medicago truncatula*) is suited to the drier climate zones (Puckridge & French, 1983) where it grows well in soil with a pH of at least 5,5 (Langenhoven, 1978).

Medic pastures were introduced in South Africa during the mid 1960s. Presently, in the Rûens area of the southern Cape (Van Heerden & Tainton, 1987) and in the Swartland (De Villiers, 1982; unpublished results), medics are one of the major dryland pasture legumes, where they are used as a short-term pasture in a pasture-wheat rotational system. Medics are high-yielding, producing 6 – 10 t dry matter (DM) per hectare per year (Van Heerden & Wassermann, 1977; Silsbury *et al.*, 1979). Another factor, apart from the supply of high quality winter pasture, that adds to the popularity of medics is the supply of residues and seed burrs which are well utilized by sheep during the dry summer season (Wassermann, 1980).

The extreme fluctuations in climatic conditions in areas where mediterranean pastures are grown, result in definite seasonal variation in the quality and availability of pasture. Although medics are valued highly, it seems that the available green material (Van Heerden & Tainton, 1987) as well as digestible organic matter (DOM) and crude protein (CP) content vary seasonally (Viljoen *et al.*, 1984). More information regarding the chemical composition and nutritive value of medics under local conditions, at different growth stages and in different seasons, was therefore urgently needed.

Although proximate analysis of hand-cut herbage samples collected from pastures differs from the analysis of herbage selected with oesophageally fistulated ruminants (Engels, 1983). It is uncertain whether this generalization will also apply to cultivated medic pastures where only a few species of similar acceptability are expected, thus limiting the choice of herbage selected by ruminants (Davis, 1964). Secondly, *in vivo* digestibility of herbage samples was shown to be entirely different to digestibility results obtained by laboratory work, using *in vitro* techniques (Engels *et al.*, 1981). These authors therefore accentuate the necessity of obtaining a regression equation for the prediction of *in vivo* digestibility coefficients of herbage samples from *in vitro* digestibility results.

Against this background, the current experiment attempted to: (i) establish a regression equation to convert *in vitro* digestible organic matter (IVDOM) to *in vivo* digestible organic matter (DOM); (ii) determine seasonal effects on chemical composition and digestibility of barrel medic pasture; and (iii) compare the nutrient content of manually collected pasture samples to samples selected by oesophageally fistulated (OF) sheep.

Experimental procedures

In vivo regression study

Seven digestion trials were undertaken to determine the *in vivo* DOM content of seven different feedstuffs, namely, green oat pasture, green medic pasture, oat silage, lucerne hay, oat hay, urea-ammoniated wheat straw, and medic burrs. The feeds were milled through a 18-mm sieve, except for the medic burrs, which were not processed prior to feeding. Ten South African Mutton Merino (SAMM) wethers with a mean livemass (± SD) of 67,8 ± 2,8 kg were used per digestion trial. Following an adaptation period of 34 days, the sheep were fed at 85% of *ad libitum* intake for a 10 day collection period. The daily feed was divided into equal portions, fed at 08:00 and 13:00. The sheep had free access to water at all times. Representative feed and faeces samples were taken daily and pooled for analysis. The procedures followed for the total collection of faeces and calculation of apparent digestibility coefficients were described by Schneider & Flatt (1975). Samples for the determination of *in vitro* digestibilities were determined on three day bulked samples collected by OF sheep.

Chemical composition study

Medic pasture was established in the early winter, on a predominantly Hutton-Shortland soil type, in three separate paddocks at Elsenburg, at a density of 10 kg seed/hectare. During the first year after establishment, the pasture was grazed at high stocking rate in the early bloom stage for a short period, to stimulate flower development for maximum seed production. The experiment was started the following winter after the pasture had re-established itself. Sampling commenced in February the following year. The pasture was grazed continuously by 6,5 Merino wethers (paddock 3) and 5,2 SAMM ewe-units (paddocks 1 and 2) per hectare for two years.

The herbage from individual paddocks was sampled on a monthly basis using three oesophageally fistulated wethers. Pasture samples were collected on three consecutive days, in the middle of each month. The fistulated sheep were fasted overnight prior to a 30 min sampling period in the morning. Samples contaminated with rumen digesta were discarded. Samples were frozen after collection, prior to subsequent freeze-drying.

Manually collected pasture samples were obtained at the same time as the fistula samples, according to the technique described by Hutchinson (1967).

Chemical analysis

Samples were analysed for organic matter (OM), crude protein (CP) and crude fibre (CF) content (AOAC 1985). *In vitro* digestibility of OM (IVDOM) was determined by the technique of Tilley & Terry (1963), as modified by Engels & Van der Merwe (1967).

Statistical procedure

Differences in the chemical composition and digestibility of the pasture between different months and seasons (as determined from samples taken from OF sheep), as well as differences between manually collected samples and samples selected from OF sheep, were tested for significance by analysis of variance and detected by least significant difference (LSD). The equations to predict *in vivo* DOM from IVDOM, and to correlate the chemical composition and digestibility of manually collected samples with values obtained with OF sheep were obtained by regression analysis, as described by Snedecor & Cochran (1980).

Results and discussion

In vivo regression study

The digestibility data for the seven feedstuffs are summarized in Table 1. Marked differences occurred in DM intake between feedstuffs, which might be attributed to differences in inherent palatability as well as physical characteristics and chemical characteristics and chemical composition. The IVDOM as well as *in vivo* DOM also differed largely between feedstuffs due to differences in chemical composition. These differences were expected, since the 7 feedstuffs were chosen to be representative of a rather wide range of apparent digestibility coefficients. It was found that the following linear regression equation fitted the data best:

In vivo DOM = 0,643 IVDOM + 24,5 ($r = 0{,}91$; $SE_b = 0{,}0385$; $P \leq 0{,}01$; n = 68)

This equation is similar to the equation described by Engels (1972) for the same purpose (*in vivo* DOM = 0,703 IVDOM + 20,1). Both prediction equations yield results which are practically the same, but values predicted by our equation were slightly lower for highly digestible samples, and slightly higher for samples with low digestibility, compared to values predicted by the equation of Engels (1972). It is clear from the equation that IVDOM values lower than 68,6 underestimated *in vivo* DOM value, while IVDOM values higher than 68,6 overestimated *in vivo* DOM value.

Chemical composition study

The monthly rainfall at Elsenburg for the sampling period is presented in Figure 1. A typical distribution pattern for Mediterranean climate zones, with a wet winter and a dry summer, was observed. Monthly rainfall for the experimental period varied between 0,5 mm (February 1981) and 144,4 mm (July 1981). A very high precipitation was recorded during January 1981 (69,8 mm), which exceeded the long-term average for January. This uncharacteristically high summer precipitation resulted in unusual conditions at the beginning of the experiment.

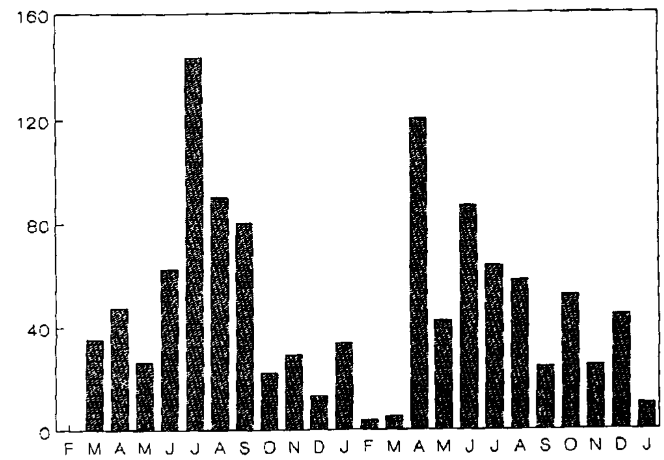

Figure 1 Monthly rainfall at Elsenburg, during the experimental period, from February 1981 to January 1983.

The IVDOM contents of the pasture samples collected by the OF Merino wethers in the different paddocks are presented in Figure 2. Statistical appraisal of these results suggested that paddocks and month of sampling data interacted ($P \leq 0{,}05$). It is evident, from Figure 2 that no consistent tendency was obtained, and that this interaction cannot be readily explained. The effect of monthly sampling alone accounted for 88,1% of the total variance in IVDOM content. The effects of paddock and the interaction between months and paddock contributed only another 4,2% to the model that was used to explain 92,3% of the variance in IVDOM content. Judged from Figure 2 and the good fit of the model to the data, the interactions between paddocks and months does not appear to be biologically significant. It was therefore decided to ignore the between paddock effects in further discussion of data such as IVDOM and other measures of chemical composition.

The monthly OM, CP, CF, IVDOM, and predicted *in vivo*

Table 1 Means ± SD for *in vivo* and *in vitro* digestible organic matter content of seven different feedstuffs tested

	Feed source						
Parameter	Medic pasture (late bloom stage)	Medic burrs (Ripe)	Oaten hay (Early dough stage)	Oaten pasture (Six leaf stage)	Urea ammoniated wheat straw	Oaten silage (Early dough stage)	Lucern hay (one third bloom stage)
DM intake, g/day	854	1996	1145	1616	1306	1550	2106
± SD	±203	±818	±141	±339	±148	±251	±250
In vivo organic matter							
digestibility, %	67,2	43,9	64,2	69,3	59,4	64,5	63,5
± SD	±2,4	±7,1	±0,9	±3,1	±0,5	±1,7	±1,2
In vitro organic matter							
digestibility %	64,1	30,1	60,7	69,4	55,2	62,6	63,7

Figure 2 IVDOM content of medic pasture selected by oesophageally fistulated sheep from three different paddocks.

DOM contents of pasture samples selected each month over the two year experimental period by OF sheep are presented in Table 2 and graphically illustrated in Figure 3. The CP and CF contents, as well as the digestibility values, were calculated on an organic matter (OM) basis, because of the variation in ash contents of the samples between different months. The ash content of the selected samples varied between months ($P \leq 0,01$), with monthly averages ranging from 11,7 to 47,5%.

The CP content of the pasture varied significantly ($P \leq 0,01$) between months. When the monthly data was pooled, the CP content (±SD) was 15,4 ± 5,8% in the dry season (summer: December, January and February), 27,1 ± 8,1% in the transitional stage from the dry season to the wet season (autumn: March, April and May), 30,8 ± 3,7% in the wet season (winter: June, July and August) and 20,8 ± 7,3% in the transitional stage from the wet season to the dry season (spring: September, October and November). This typical seasonal tendency (see Figure 3), with a high CP content in the winter and a low CP content in the summer, was related to the amount of rain received during the different months. Similar seasonal trends were reported by De Villiers (1982; unpublished results), suggesting that the CP content (mean ± SD on a DM basis) decreased from 28,3 ± 2,8% in the winter to, respectively, 24,0 ± 9,4% and 23,8 ± 4,2% in the autumn and spring to decrease to 13,9 ± 0,6% in the summer. The CP content in this study was in the same range found by Denney *et al.* (1983) who reported

Table 2 Organic matter (OM), *in vitro* digestible organic matter (IVDOM), predicted *in vivo* digestible organic matter (*in vivo* DOM), crude fibre (CF) and crude protein (CP) contents of medic pasture samples selected by oesophageally fistulated sheep from February 1981 until January 1983 on a monthly basis

	Chemical composition (Mean ± SD)				
Month	OM(%)	IVDOM(%)	*In vivo* DOM(%)	CP[a](%)	CF[a](%)
February 1981	62,8 ± 1,4	60,7 ± 0,8	63,5 ± 0,5	27,1 ± 0,9	19,25 ± 0,7
March 1981	59,1 ± 1,8	52,4 ± 1,4	58,2 ± 0,9	22,9 ± 0,7	20,5 ± 1,0
April 1981	52,4 ± 1,9	54,5 ± 1,4	59,6 ± 0,9	28,6 ± 0,6	21,0 ± 0,8
May 1981	77,3 ± 0,6	76,4 ± 0,9	73,6 ± 0,6	37,5 ± 0,2	13,8 ± 0,15
June 1981	78,5 ± 0,6	74,8 ± 0,9	72,6 ± 0,6	33,3 ± 0,4	12,7 ± 0,4
July 1981	75,6 ± 2,0	75,7 ± 1,1	73,2 ± 0,7	30,5 ± 1,2	14,1 ± 0,5
August 1981	80,1 ± 1,0	77,6 ± 1,6	74,4 ± 1,0	28,9 ± 0,7	14,2 ± 0.4
September 1981	82,3 ± 0,6	73,3 ± 0,9	71,6 ± 0,6	31,5 ± 0,9	15,6 ± 0,7
October 1981	88,2 ± 0,5	61,5 ± 2,5	64,0 ± 1,6	20,1 ± 0,5	26,4 ± 0,4
November 1981	85,3 ± 1,2	59,6 ± 1,2	62,8 ± 0,8	12,3 ± 0,6	31,1 ± 4,2
December 1981	73,6 ± 3,7	56,2 ± 1,3	60,6 ± 0,9	14,1 ± 0,8	34,4 ± 0,2
January 1982	82,2 ± 0,4	44,8 ± 1,0	53,3 ± 0,7	12,8 ± 0,8	42,1 ± 0,8
February 1982	83,2 ± 0,9	36,4 ± 1,3	47,9 ± 0,9	13,4 ± 0,8	39,6 ± 0,7
March 1982	81,6 ± 1,6	49,3 ± 1,1	56,2 ± 0,7	13,4 ± 0,4	37,4 ± 0,5
April 1982	61,9 ± 2,3	64,6 ± 1,2	65,6 ± 0,8	30,0 ± 0,8	17,9 ± 0,8
May 1982	74,9 ± 1,6	70,4 ± 1,3	69,7 ± 0,8	30,1 ± 1,5	15,6 ± 0,6
June 1982	74,7 ± 2,3	73,9 ± 1,1	72,0 ± 0,7	32,6 ± 0,6	14,3 ± 0,4
July 1982	77,5 ± 2,0	73,0 ± 0,9	71,4 ± 0,6	30,4 ± 1,4	18,4 ± 3,0
August 1982	77,8 ± 2,1	70,5 ± 1,3	69,8 ± 0,8	28,9 ± 1,1	18,2 ± 1,4
September 1982	85,1 ± 0,6	68,2 ± 0,9	68,3 ± 0,6	27,9 ± 0,9	18,8 ± 0,8
October 1982	88,0 ± 0,7	65,7 ± 0,8	66,7 ± 0,5	18,3 ± 0,6	28,2 ± 1,4
November 1982	88,3 ± 0,4	57,3 ± 3,0	61,3 ± 1,9	13,4 ± 0,6	33,8 ± 1,2
December 1982	87,2 ± 0,7	54,5 ± 0,7	59,5 ± 0,4	11,7 ± 0,5	36,6 ± 1,0
January 1983	84,2 ± 0,6	49,9 ± 0,8	56,6 ± 0,6	13,1 ± 0,4	35,4 ± 0,5
LSD ($P \leq 0,05$)	4,3	3,7	2,4	2,31	3,4
LSD ($P \leq 0,01$)	5,7	4,9	3,1	3,05	4,5

[a] Expressed on an ash free basis

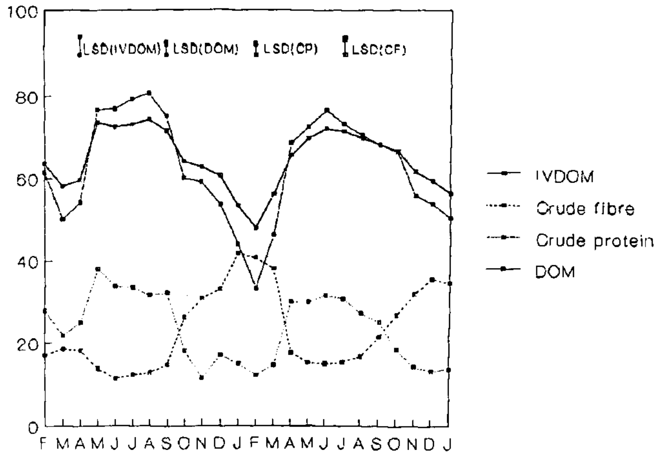

Figure 3 IVDOM (*in vitro* digestible organic matter), *in vivo* DOM (digestible organic matter), CF and CP contents of medic pasture selected by oesophageally fistulated sheep during different months (from February 1981 to January 1983).

values of 224 g/kg OM (spring) and 327 g/kg OM (early spring). Viljoen *et al.* (1984) found CP contents (DM basis) of 21,9% at the beginning of flowering (early spring) and 15,7% at burr colouring (mid to late spring).

The CF content of the pasture was inversely related to the CP content, (Figure 3) with a negative correlation (r = −0,87; $P \leq 0{,}01$) between these parameters. The CF content of the pasture was lower in the periods with a high probability for rain and significant differences ($P \leq 0{,}01$) in CF content were found between months, ranging between 12,7 ± 0,4 in June 1981 and 42,1 ± 2,2% in January 1982. The CF content (±SD) was high in the summer (34,5 ± 7,3%) when the pasture was dry, decreased in the autumn (21,1 ± 7,9%) and winter (15,4 ± 4,5%) when the pasture had re-established, and increased in the spring (25,6 ± 8,0%). It is clear from Table 2 that the CF content (±SD) of the pasture was considerably lower during February and March 1981 (19,2 ± 2,1 and 20,5 ± 3,0%, respectively) than the corresponding months in 1982 (39,6 ± 1,8 and 37,4 ± 1,5%, respectively). This was due to the exceptionally high summer rainfall received in January 1981. Similar tendencies which differ from the normal expectations occurred with regard to CP and IVDOM for January 1981.

The IVDOM and *in vivo* DOM (DOM) contents of the pasture for the 24 months are presented in Table 2 and Figure 3. The DOM content of the pasture was predicted by the regression equation calculated in the present study. Significant ($P \leq 0{,}01$) differences in IVDOM and DOM contents were measured between the different months and IVDOM varied seasonally in the order, summer (50,4 ± 8,5%), autumn (61,3 ± 11,3%), spring (64,3 ± 7,4%), and winter (74,2 ± 4,0%). The corresponding predicted DOM values were 56,9 ± 5,5%, 63,9 ± 6,9%, 65,9 ± 4,8% and 72,2 ± 2,5%. This tendency was positively associated with the precipitation received during the different seasons. The IVDOM content (mean ±SD) of medic pasture reported by De Villiers (1982; unpublished results) was slightly lower (42,0 ± 5,6%, 53,0 ± 12,5%, 64,3 ± 2,3%, and 66,0 ± 2,2%) than the respective values for the corresponding seasons found in this study. Denney *et al* (1983) found IVDOM values of 75,3% and 74,4% for spring and early spring, respectively. A significant positive correlation (r = 0,74; $P \leq 0{,}01$) was found between the CP content of the pasture and the IVDOM content, while CF content was negatively correlated (r = −0,79; $P \leq 0{,}01$) with IVDOM content.

Comparison of manual and OF sheep collected samples

The ash, CP, CF, and IVDOM contents of the pasture

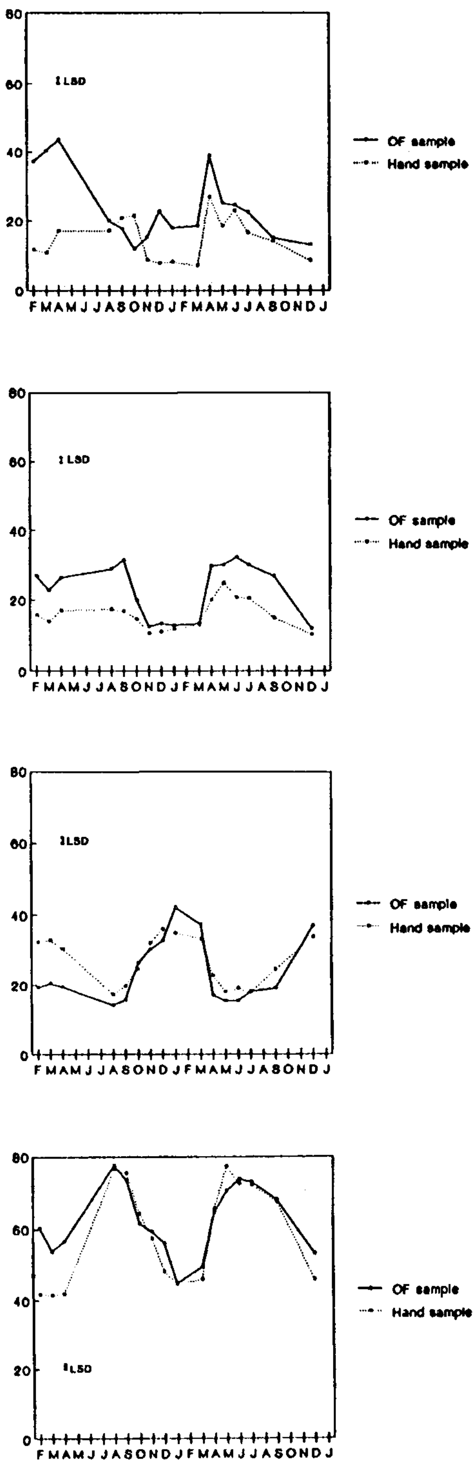

Figure 4 The ash, CP, CF, and IVDOM contents of medic pasture samples selected by oesophageally fistulated sheep and collected manually during different months (from February 1981 to December 1982).

samples selected from OF sheep or cut by hand for the experimental period are presented in Figure 4. Data for certain months (May, June and July 1981; February, August and September 1982, and January 1983) were not included, because the relevant hand collected samples were lost. Significant ($P \leq 0{,}01$) differences occurred in the CP, CF, and IVDOM contents of hand collected samples between different months. Significant ($P \leq 0{,}01$) interactions occurred in ash, CP, CF, and IVDOM contents of the two types of samples. It is clear from Figure 4 that sheep selected pasture samples with a high ash content during the summer, when the available material was limited. This high ash content is probably due to the ingestion of soil. The CF content of OF samples tended to be lower than the CF content of the hand-cut samples, particulary at the beginning of the trial, as a result of high rainfall recorded in January 1981. Samples collected from OF sheep tended to have higher IVDOM contents than corresponding hand samples, particulary at the beginning of the trial. The CP content of the OF samples was higher ($P \leq 0{,}05$) than the CP content of the corresponding hand collected samples for most of the trial except the 1982 summer. This result clearly illustrates the ability of the sheep to select pasture with a high CP content, which is in accordance with results reported by Engels (1983) and Engels & Malan (1973). Hume & Purser (1975) and Arnold & Barret (1974) also suggested that the rate of decline in digestibility of pasture was less when estimated with grazing animals compared to cutting trials. Purser (1981) attributed this result to selection by the grazing animal. It is also clear from Figure 4 that a definite tendency was found for sheep to select samples with a high CP and IVDOM content and a low CF content in the 1981 dry season when green feed was available as a result of the abnormal precipitation in January 1981.

A close relationship was found between the chemical composition and digestibility of the hand and fistula samples, and the following regression equations predicted the CP, CF, and IVDOM values (on a percentage basis) for samples selected from OF sheep (f) from hand-cut samples (h):

CPf (OM basis) $= -0{,}76 + 1{,}5$ CPh ($r = 0{,}82$; $SE_b = 0{,}155$; $P \leq 0{,}01$; $n = 48$)

CFf (OM basis) $= -2{,}8 + 0{,}99$ CFh ($r = 0{,}74$; $SE_b = 0{,}132$; $P \leq 0{,}01$; $n = 48$)

IVDOMf $= 26{,}5 + 0{,}61$ IVDOMh ($r = 0{,}87$; $SE_b = 0{,}051$; $P \leq 0{,}01$; $n = 48$)

Conclusions

In conclusion, this investigation revealed a seasonal variation in the chemical composition of medic pasture. Although the chemical composition and digestibility of the pasture is an indication of quality, nutritive value is also related to intake (Purser, 1981). Ulyatt (1973) pointed out that variations in voluntary intake accounted for at least 50% of the variation in nutritive value of herbage material. To evaluate a pasture, it seems necessary to determine the intake of certain nutrients as well. The quantity of nutrients consumed on Medic pastures by Merino wethers and reproducing SAMM ewes will be addressed in a following paper. The paper will also deal with production levels observed in these sheep.

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References

AOAC, 1985. Official methods of analysis (13th edn.). Association of Official Analytical Chemists, Inc. Arlington, Virginia, USA.

ARNOLD, G.W. & BARRET, D.W., 1974. The effect of paraquat desiccation in spring on plant and animal production from annual pastures. *Aust. J. Exp. Agric. Anim. Husb.* 14, 23.

DAVIS, J.F., 1964. Diet selected by sheep grazing on annual pasture in southern Victoria. *Proc. Aust. Soc. Anim. Prod.* 5, 249.

DENNEY, G.D., HOGAN, J.P., LINDSAY, J.R. & DAVIS, P., 1983. Digestion of *Medicago truncatula* pasture by sheep. *S. Afr. J. Anim. Sci.* 13, 11.

ENGELS, E.A.N., 1972. A study of the nutritive value of sown pastures in the central Orange Free State with special reference to the energy requirement of sheep. PhD. (Agric) thesis, University of Stellenbosch.

ENGELS, E.A.N., 1983. Voedingsnavorsing met die weidende dier. *S. Afr. Tydskr. Veek.* 13, 292.

ENGELS, E.A.N., DE WAAL, H.O., BIEL, L.C. & MALAN, A., 1981. Practical implications of the effect of drying and treatment of nitrogen content and *in vitro* digestibility of samples collected by oesophageally fistulated animals. *S. Afr. J. Anim. Sci.* 11, 247.

ENGELS, E.A.N. & MALAN, A., 1973. Sampling of pastures in nutritive evaluation studies. *Agroanimalia* 5, 89.

ENGELS, E.A.N. & VAN DER MERWE, F.J., 1967. Application of an *in vitro* technique to South African forages with special reference to the effect of certain factors on results. *S. Afr. J. Agric. Sci.* 10, 983.

HUME, I.D. & PURSER, D.B., 1975. Ruminal and post-ruminal protein changes in sheep fed on subterranean clover harvested at four stages of maturity. *Aust. J. Agric. Res.* 26, 199.

HUTCHINSON, K.J., 1967. A caring technique for the measurement of pasture of low availability to sheep. *J. Brit. Grassl. Soc.* 22, 131.

LANGENHOVEN, J.D., 1978. 'n Ondersoek na die fosforvereistes van *Trifolium subterraneum* L. en *Medicago truncatula Gaertn.* op gronde van die Glenrosa-vorm in die Winterreënstreek. MSc.(Agric.)-verhandeling, Universiteit van Stellenbosch.

PURSER, D.B., 1981. Nutritional value of Mediterranean pasture. In: Grazing Animals, F.H.W. Morley, Ed., World Animal Science, Disciplinary Approach. B.1. Elsevier Scientific Publishing Company, New York.

PUCKRIDGE, D.W. & FRENCH, R.J., 1983. The annual legume pasture in cereal-ley farming systems of Southern Australia: A review. *Agric., Ecosyst. and Environ.* 9, 229.

SCHNEIDER, B.H. & FLATT, W.P., 1975. The evaluation of feed through digestibility experiments. University of Georgia Press, Athens.

SILSBURY, J.H., ADEM, L., BAGHURST, P. & CARTER, E.D., 1979. A quantitative examination of the growth of awards of *Medicago truncatula* cv. Jemalong. *Aust. J. Agric. Res.* 30, 53.

SNEDECOR, G.W. & COCHRAN, W.G., 1980. Statistical methods (7th Ed.). Iowa State University Press. Ames Iowa.

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

ULYATT, M.J., 1973. The feeding value of herbage. In: Chemistry and Biochemistry of herbage, G.W. Butler & R.W. Bailey, Eds., Academic Press, London.

VAN HEERDEN, J.M., & TAINTON, N.M. 1987. Potential of medic and lucerne pastures in the Rûens area of the southern Cape. *J. Grassl. Soc. sth. Afr.* 3, 95.

VAN HEERDEN, J.M. & WASSERMANN, V.D., 1977. Die invloed van plantdatum op die blomvorming en produksie van twaalf eenjarige mediterreënse weidingspeulgewasse in 'n mediterreënse omgewing. *Hand. Weid. Ver. Suid-Afr.* 12, 45.

VILJOEN, L., WASSERMANN, V.D., FOUCHÉ, H.J., & HUMAN, P.A., 1984. 'n Studie van ruproteïeninhoud en verteerbaarheid van vyf eenjarige *Medicago* genotipes in die sentrale Oranje-Vrystaat. *J. Grassl. Soc. sth. Afr.* 1(3), 4.

WASSERMANN, V.D., 1980. Belangrike gematigde eenjarige weidingspeulgewasse. *Bdy S. Afr.* Peulgewasse E.4.1.