Rumen degradability of dry matter, crude protein and crude fibre of cereal and legume forages grown in the irrigated areas of the Sudan.

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Summary

A policy of introduction of forages in the crop rotation of the irrigated schemes has recently been suggested. Information on the nutritive value of such forages is important for any feed formulations for livestock. Using the nylon bag technique and a mathematical model, the degradability of two legume forages (Berseem and Clitoria) and two cereal forages (Abu 70 and Sorghum hybrid) is reported in this paper. At the different ruminal incubation time intervals and a range of ruminal outflow rates, the legume forages showed a higher degradability than the cereal forages in all forage components (DM, CP and CF). Berseem had the highest degradability and the sorghum hybrid had the lowest.

Introduction

The recently suggested policies of integration of livestock in the big agricultural schemes like the Gezira Scheme (DEVCO, 1987; MANAR, 1990) necessarily imply the introduction of a forage component in the in the current crop rotation. A number of cereal and legume forages are presently grown in the irrigated areas of the country. However, little

information (Ahmed and Ahmed, 1983) is available as regards the nutritive value of the forages. Such information forms the base to any strategic policy of livestock integration, upgrading and intensification.

A series of experiments is being undertaken in this department to evaluate through intake, digestibility and degradability studies, to look at the nutritive characteristics of forages likely to lie introduced in the crop rotation. Degradability is a recent method adopted to evaluate feeds (Roy, Balch, Miller, Orskov and Smith, 1977) and is now central to new systems of formulation of feeds to meet the requirements of ruminants (Agricultural Research Council, U.K., 1980).

The present paper reports the rumen degradation of dry matter, crude protein and crude fibre of two cereal forages {Forage sorghum, *Sorghum vulgare* var. Abu 70 and Sorghum hybrid (Pioneer 988)} and two legume forages {Clitoria *(Clitoria ternata)* and Berseem *(Medicago•sativa)}.*

Materials and Methods

Animals and management:

Two animals, a sheep and a bull calf, were used. The sheep was a local desert type of about 35 kg liveweight while the bull was a local Butana type of about 170 kg liveweight. Both animals were surgically fistutated by a stab wound technique (Ahmed, 1992) and cannula was fitted into the rumen. The cannula was a plastic tube 12 cm in length and 4 cm in diameter. The animals were kept separately in shaded pens. They were offered on *ad libitum level,* the same forage to be tested. Water was available all times.

Forages:

The four forages Abu 70, Sorghum hybrid, Clitoria and Berseem were tested for degradation in the rumen each at a time on the two animals using the *in situ* **polyester bag technique (Mehrez and Orskov, 1977).**

Experimental procedure:

Nylon **bags of 30 cm; in** size weighing 4-5 g each **were used for incubation of the forage samples. The bags were oven dried at 80 °C for 3 hours, then individually weighed. Five to six grammes of oven-dried forage sample was put in the bag and the opening of the bag was closed by tying a nylon ribbon around. It was then incubated into the rumen through the cannula. Two bags were incubated at a time in the rumen of the sheep and four bags at a time in rumen of the bull. The cannula was then lightly closed.**

The bags were incubated for different periods of time : 9, 18, 24, 36 and 48 hours. The bags were immediately remol ed after each incubation period. They were then thoroughly washed under running tap water. The bags were then dried in an oven for 24 hours at 100 °C taken out and weighed. The dry matter content of the residue in the bag was calculated. The samples of each incubation period for each forage were collected together, mixed and a representative sample was taken for crude fibre, and crude protein determination using the standard methods (A.O.A.C., 1975).

The loss of individual components from the forages incubated was calculated for each forage for each period of incubation.

Determination of degradation and degradability:

The degradation of the individual forage component, DM, **CF** and CP, was determined as the fraction lost from the nylon bag at the specific time of incubation in the rumen. The measurements were used to calculate the degradability (P) of the corresponding forage components applying the mathematical model proposed by Orskov and McDonald (1979) and revised b McDonald (1981) as

$$P = a + bc\ (c+k)$$

where a represents the ver·, rapidly degradable component; b represents the second more slowly degraded component, c a rate constant and k the rate of passage from the rumen.

In this experiment a range of outflow rates from as low as 0.03 to as high as 0.08,hour was assumed and the degradabilities of the different forage components were calculated accordingly.

Results

The chemical composition of the four forages tested for degradability is shown in Table 1, Tables 2, 3 and 4 respectively show the disappearance (g/100g) of DM, CP and CF of the forages from the nylon bags at the different incubation periods in the rumen. For all forages it is shown that as the incubation period increases the loss **of the forage components increase but** the rate of lisappearance differs among the different forages.

The disappearance of the CP was higher than that of the CF in all forages. The legume forages (Clitoria and Berseem) showed a higher loss in all components than the cereal forages (Abu 70 and Sorghuth hybrid) at all incubation periods.

At 48 hours incubation the rate of DM and CF disappearance was highest for Berseem followed by Clitoria, Abu 70 and the least was Sorghum hybrid. However the highest CP loss at this incubation period was that of Clitoria followed by that of Berseem then Abu 70 and the least was that of Sorghum hybrid.

Table 1: Dry matter, DM, (g/kg) and the chemical composition (g/kg DM) of the experimental forages.

Forage	DM	Ash	Crude Protein (Nx6.25)	Crude Fibre
Forage sorghum (Abu 70)	300	57	35	286
Sorghum hybrid (Pioneer 988)	280	77	27	304
Clitoria	300	76	175	279
Berseem	270	118	214	215

Tables 5, 6 and 7 show the predicted degradabilities of DM, CP and CF of the forages at an assumed range of ruminal outflow rates (k). At the slowest outflow rates (0.03) Berseem showed the highest degradability of 81.3% to be followed by Clitoria (71.9%) then Abu 70 (64.1%) and the least was Sorghum hybrid (59.4%).

The same trend was seen in the degradability of the CF where Berseem, Clitoria, Abu 70 and Sorghum hybrid had 45, 34, 26 and 22% **degradability. Clitoria, however had the**

Table 2: Disappearance (g/100g) ± S.D. of the dry matter DM, from forage samples incubated in the rumen of fistulated animals for different periods of time.

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Incubation period (Hrs)	Forage Sorghum (Abu 70)	Sorghum hybrid . (pioneer 988)	Clitoria	Berseem
9	6.0 ± 0.92	6.5 ± 0.60	15.5 ± 0.79	10.8 ± 1.11
18	10.1 ± 1.11	12.1 ± 1.10	19.8 ± 0.97	22.7 ± 1.46
24	12.3 ± 1.10	15.0 ± 2.16	24.3 ± 0.65	24.9 ± 2.16
36	19.7 ± 1.23	18.3 ± 1.78	29.7 ± 1.17	31.5 ± 3.31
48	25.5 ± 1.22	19.3 ± 1.90	33.6 ± 1.82	39.6 ± 2.48

Table 3: Disappearance (g/100g) ± S.D. of the crude fibre (CF) from forage samples incubated in the rumen of fistulated animals for different periods of time.

Incubation period (Hrs)	Forage Sorghum (Abu 70)	Sorghum hybrid (pioneer 988)	Clitoria	Berseem
9	3.2 ± 0.07	7.0 ± 1.03	15.8 ± 0.72	15.8 ± 0.92
18	13.9 ± 0.79	12.8 ± 1.17	21.8 ± 1.02	23.6 ± 1.43
24	15.0 ± 2.10	16.9 ± 2.17	26.9 ± 1.38	26.1 ± 2.30
36	23.4 ± 0.60	20.6 ± 1.79	34.0 ± 1.79	29.0 ± 1.61
48	29.9 ± 2.20	23.2 ± 1.10	41.9 ± 1.27	42.3 ± 2.34

Table 4: Disappearance (g/I00g) ± S.D. of the crude protein (CP) from samples of forages incubated in the rumen of fistulated animals for different periods of time.

Incubation period (Hrs) = 4	Forage Sorghum (Abu 70)	Sorghu,.: hybrid (pioneer 988)	Clitorin	Berseem
	14.4 ± 1.33	10.5 ± 0.65	26.8 ± 1.10	23.6 ± 1.10
18	16.5 ± 2.78	20.0 ± 0.76	32.5 ± 1.12	31.4 ± 2.44
24	26.8 ± 2.10	25.9 ± 1.84	35.7 ± 1.30	38.6 ± 2.87
36	38.5 0.47	28.6 ± 1.93	48.0 ± 1.34	45.4 ± 2.54
48	45.5 ± 2.11	35.9 ± 1.63	56.7 ± 1.61	52.9 ± 1.98

Table 5: The predicted degradability: value (P) of dry matter (DM) of the forages, expressed as % at different ruminal outflow rates (k)ihr.

	Ruminal outflow rate (k) / hr					
Forage	0.03	0.04	0.05	0.06	0.07	0.08
Forage Sorghum (Abu *70)*	64.1	58.4	35.9	50.4	46.6	45.2
Sorghum hybrid (pioneer 988)	59.4	53.7	49.5	46.4	43..6	41.4
Clitoria	71.9	66.5	61.1	57..6	54.7	52.2
Berseem	81.3	78.8	73.0	69.7	66.7	64.1

Table 6: The **predicted degradability value (P) of the crude fibre** (CF) of **the forages, expressed as % at different ruminal outflow rates (k)/hr.**

	Ruminal outflow rate (k) / hr					
Forage	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**
Forage Sorghum (Abu 70)	**26.6**	**25.0**	**24.1**	**23.4**	**22.9**	**22.6**
Sorghum hybrid (pioneer 988)	**22.3**	**21.6**	**21.3**	**21.1**	**21.0**	**20..8**
Clitoria	**34.4**	**31.3**	**29.3**	**27.9**	**26.8**	**26.0**
Berseem	**45.2**	**41.6**	**38.8**	**36.7**	**35.0**	**33.6**

Table 7: The predicted degradability value (P) for the crude protein (CP) of the forages, expressed as % at different ruminal outflow rates (k)/hr.

Forage	Ruminal outflow rate (k) / hr					
	0.03	0.04	0.05	0.06	0.07	0.08
Forage Sorghum (Abu 70)	55.3	49.7	45.2	42.6	40.2	38.3
Sorghum hybrid (pioneer 988)	48.1	43.1	39.6	37.0	35.1	33.5
Clitoria	62.6	56.9	52.5	49.1	46.2	43.9
Berseern	57.8	52.2	48.0	44.8	42.2	41.0

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highest CP degradability of 62% to be followed by Berseem (57%), Abu 70 (55%) and Sorghum hybrid (48%).

The type of observations on degradation in the different time intervals each having its own specific degradation and the assumed rate of outflow make the statistical analysis non-consequential and hence the set of results were presented as mean values only.

Discussion

The degradabilities of the components of the forages investigated were decreasing as the ruminal outflow rates increased or in other words the more the feed 'stays in the rumen the higher is the degradability. Legume forages had higher degradation at all flow rates than the cereal forages. For all forage components Abu 70 had a higher degradability than Sorghum hybrid.

The greater values for the disappearance of the different fractions from legumes as compared to the cereal forages could be attributed to the smaller particle size of the legume forages (Playne, Khumaulthong and Echevorria, 1978). Also the high nitrogen content of the feed stuff. increases their disappearance when incubated in the rumen animals (Mehrez and cirskov, 1977). Both Berseem and Clitoria as shown in Table 1 had a higher crude protein content than Abu 70 and Sorghum hybrid. This is also well demonstrated between the cereal forages. Abu 70 had a higher crude protein content than Sorghum hybrid and in all fractions was better degraded than the Sorghum hybrid.

In this study, the animals were offered the same forages that were incubated to maintain the same environment in the minor ecosystem of the bags and also to avoid any associative

effect that may happen from the addition of other feeds. Addition of concentrates at any level would have altered the fermentation pattern in the rumen resulting in higher or lower degradabilities than from that observed in this study. The feeding of the forages in this study was at ad libitum level. The level of feeding affects the rumen retention time and hence the degradability (Orskov and McDonald, 1979).

The range of ruminal outflow rates assumed in this study was chosen to allow for the whole spectrum of possible degradation. However as it is known that forages normally stay longer in the rumen than concentrates, it could be that under the conditions of these studies a ruminal outflow rate of 0.05/hour is acceptable and hence the general degradability values for the different forage fractions could be read from the Tables at this rate.

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