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COMPARATIVE FEED INTAKE AND DIGESTIBILITY STUDIES WITH SHEEP AND CATTLE ON ROUGHAGES

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OPSOMMING: VERGELYKENDE VOERINNAME- EN VERTERINGSTUDIES MET SKAPE EN BEESTE OP RUVOERE

Die daaglikse vrywillige voerinname en verteerbaarheid van 31 ruvoere deur skape en beeste is bepaal. Dit is gevind dat die inname van beeste per $W_{kg}^{0,75}$ by 26 van die 31 voere betekenisvol hoër was as die van skape. Vrywillige inname per W_{kg} van beeste was by slegs 2 van die voere betekenisvol hoër as by skape. Die resultate van die ondersoek het ook getoon dat beeste veral ruvoere van lae gehalte beter verteer as skape. Die verskille in die verband was egter betekenisvol by slegs 5 voere.

SUMMARY:

The daily voluntary feed intake and digestibility of 31 forages by sheep and cattle were measured. It was found that the intake of cattle per kg $W_{kg}^{0,75}$ was significantly higher than that of sheep in 26 out of the 31 forages. Voluntary intake per W_{kg} of cattle was significantly higher than for sheep in only 2 forages. The results also showed that cattle digest roughages on average better than sheep. However, the differences were significant in only 5 forages.

The efficiency with which cattle and sheep digest various feeds has been considered to be essentially the same. Cipolloni, Schneider, Lucas and Pavlech (1951) published their findings after statistical analyses on published data which allowed the comparison of the digestive powers of sheep and cattle. They concluded that the average differences for dry roughages are in favour of cattle for all nutrients. The average differences for silage, although significant only with ether extract, indicated that cattle tended to digest silages better than sheep. With concentrates, however, sheep tended to digest all nutrients better than cattle. These authors therefore suggested that digestibility data to be used, should be obtained with the species in which it is going to be applied. On the other hand it was claimed in several publications that the digestive powers of sheep and cattle are of the same magnitude (Forbes and Garrigus, 1950; Blaxter and Wainman, 1961, Langlands, Corbett and McDonald, 1963; Buchman and Hemken, 1964; Swift and Bratzler, 1959).

Blaxter and Wilson (1962) showed that the voluntary intake of roughages by cattle aged 18 months, when expressed as $g/W_{kg}^{0,75}$, was only slightly greater than that noted in similar but separate experiments with sheep (Blaxter, Wainman and Wilson, 1961). Blaxter, Wainman and Davidson (1966) found that differences were statistically not significant between the voluntary intakes of roughages by cattle and sheep when intake ($g/W_{kg}^{0,75}$)was regressed on apparent digestibility. However, cattle digested the same roughage better than did sheep and consumed more of it.

This paper describes experiments in which the voluntary intake and digestibility of several roughages were measured with sheep and cattle in metabolism cages.

Procedure

A total of 31 forages were used for measuring voluntary intake and digestibility by sheep and cattle. All forages were fed *ad lib.* in either a chopped or coarsely milled form for a period of at least 20 days – the last 10 days being used for measuring digestibility. The sheep were Merino wethers while the cattle were either Fresian or Simmentaler steers. Since the trials were conducted over several years, different animals within a species of different ages were used. The live mass of the sheep does not include wool mass.

The results were statistically analysed according to the method of least sqaures for uneven numbers of Harvey (1972).

Results and Discussion

The daily voluntary intake of sheep and cattle per $W_{kg}^{0,75}$ and per W_{kg} as well as digestibility of organic matter (OM), are presented in Table 1.

A statistical analysis on the results revealed that the voluntary intake per $W_{kg}^{0,75}$ of cattle was significantly higher ($P \leq 0,05$) than that of sheep in 26 of the 31 forages. Forages 12, 18, 20, 26 and 29 were the exceptions but although not significant the trend was con-

Table 1

The daily voluntary dry matter (DM) intake and digestibility of organic matter (OM) of different forages by cattle and sheep

	Description of forages	Average daily DM intake per $W_{kg}^{0,75}$				Average daily DM intake per W_{kg}				Digestibility of OM			
		Cattle g	CV %	Sheep g	CV %	Cattle g	CV %	Sheep g	CV %	Cattle g	CV %	Sheep g	CV %
1	Cowpea hay. Chopped	135,0(4)	8,37	60,3(9)	13,44	32,0(4)	9,25	20,8(9)	14,42	69,4(4)	3,06	64,7(9)	2,46
2	Lucerne hay. Chopped	126,6(7)	4,26	67,6(9)	4,44	31,6(7)	4,46	24,4(9)	9,75	65,0(4)	3,08	64,4(9)	1,65
3	Green *Cenchrus ciliaris*. Fertilized. Chopped	125,3(3)	5,70	84,1(7)	6,97	26,9(3)	3,97	32,1(7)	7,89	70,7(3)	1,16	64,0(7)	2,79
4	Maize stover. Fertilized with N. 1 cm screen	122,9(3)	7,39	59,9(4)	5,32	28,7(3)	5,82	21,9(4)	6,90	61,9(2)	18,60	67,4(4)	6,39
5	Maize stover, 1 cm screen	120,9(3)	3,41	61,8(4)	7,62	28,4(3)	2,46	21,3(4)	9,25	62,1(2)	3,99	69,4(4)	9,08
6	Lucerne hay. Chopped	116,3(8)	7,58	76,6(7)	11,01	27,9(8)	7,10	28,3(7)	12,52	65,2(4)	3,37	64,1(7)	2,20
7	Lucerne hay. Chopped	115,4(8)	13,14	67,4(8)	20,62	26,9(8)	13,37	24,4(8)	21,43	67,1(4)	2,30	65,5(8)	1,37
8	Green *C. ciliaris*. Not fertilized. Chopped	113,4(4)	0,86	70,6(6)	18,25	24,1(4)	2,01	27,1(6)	20,07	71,2(4)	1,71	62,5(6)	3,56
9	Green lucerne. Chopped	109,1(4)	5,51	76,4(6)	11,35	27,8(4)	5,58	29,3(6)	13,15	67,2(4)	3,11	66,3(6)	3,64
10	Green lucerne. Chopped	106,0(4)	6,41	74,6(6)	7,75	25,2(4)	8,17	27,2(6)	9,91	61,7(4)	2,92	67,6(6)	1,39
11	Green oat pasture. Chopped	103,6(4)	3,86	75,0(6)	10,49	23,6(4)	5,57	27,8(6)	12,56	71,1(4)	2,98	67,9(6)	2,76
12	Maize stover. 1 cm screen	101,6(4)	5,88	66,1(4)	19,54	25,4(4)	11,16	25,7(4)	21,48	69,0(4)	5,33	64,3(4)	6,06
13	Maize stover. 1 cm screen	94,0(4)	7,61	69,6(4)	7,37	24,3(4)	10,76	27,6(4)	7,87	65,3(4)	8,98	65,1(4)	4,93
14	*Antephora pubescens* hay. Chopped	93,1(5)	5,48	72,8(8)	9,79	23,6(5)	5,38	27,6(8)	9,41	58,6(5)	6,22	53,3(8)	2,43
15	Green *C. ciliaris*. Chopped	92,3(4)	8,62	58,3(6)	17,12	21,6(4)	10,74	21,3(6)	16,54	60,0(4)	1,34	57,9(6)	6,66
16	Sorghum hay (Haygrazer). Mature. 3,7 cm screen	87,9(6)	6,91	59,9(9)	20,06	20,4(6)	8,66	23,3(9)	21,70	45,9(6)	6,68	40,5(9)	6,40
17	Green sorghum (Haygrazer). Chopped	87,6(4)	1,72	64,6(6)	8,20	20,9(4)	4,60	23,6(6)	9,39	68,0(4)	0,98	63,1(6)	3,82
18	Green *C. ciliaris*. Chopped	83,7(5)	2,77	41,3(8)	22,36	20,1(5)	4,96	16,3(8)	22,73	66,0(5)	2,26	58,7(8)	14,04
19	*C. ciliaris* hay cut in winter. Chopped	80,8(4)	8,50	47,3(6)	5,09	18,8(4)	10,39	17,4(6)	6,49	50,6(4)	4,51	38,2(6)	9,59
20	Green *C. ciliaris*. Chopped	77,4(5)	12,83	51,8(9)	12,28	18,5(5)	14,72	19,9(9)	13,12	61,8(5)	2,56	59,9(9)	7,11
21	Maize straw. Fertilized with N.1 cm screen	77,3(4)	8,82	54,7(4)	12,92	19,7(4)	11,64	21,6(4)	13,83	68,7(2)	2,26	58,9(4)	5,73
22	*C. ciliaris* hay cut in winter. 1 cm screen	74,7(6)	14,87	54,5(8)	25,26	17,4(6)	16,34	21,4(8)	28,24	35,0(6)	14,01	34,9(8)	9,75
23	*Themeda triandra* hay. Chopped	73,5(7)	5,46	36,9(9)	15,35	18,1(7)	5,51	13,0(9)	16,02	53,0(4)	8,66	57,4(9)	4,28
24	Maize straw. Fertilized with N.1 cm screen	73,0(3)	6,82	41,5(4)	7,15	17,2(3)	7,62	14,9(4)	6,03	61,0(2)	0,23	59,3(4)	8,42
25	*C. ciliaris* hay cut in winter. Chopped	72,8(6)	7,62	43,6(8)	16,59	17,2(6)	10,57	16,4(8)	17,87	50,7(6)	3,82	48,5(8)	5,16
26	*C. ciliaris* hay cut in winter. 2,5 cm screen	70,9(4)	12,19	54,5(9)	12,58	16,2(4)	10,76	21,8(9)	11,89	48,8(4)	7,84	38,4(9)	4,17
27	Maize straw. 1 cm screen	66,6(3)	4,12	43,2(4)	4,96	15,6(3)	3,90	15,8(4)	6,75	64,7(2)	10,71	58,7(4)	4,15
28	*Eragrostis curvula* hay. Chopped	66,6(8)	8,94	40,9(9)	14,02	16,7(8)	9,15	14,9(9)	15,63	59,2(4)	5,45	55,6(9)	4,07
29	Maize straw. 1 cm screen	64,6(4)	20,99	34,2(4)	21,24	13,8(4)	12,24	13,4(4)	18,91	64,3(2)	7,26	60,0(4)	4,90
30	*C. ciliaris* hay cut in winter. Chopped	58,7(4)	8,91	40,2(6)	12,69	13,6(4)	10,79	15,5(6)	15,00	46,9(4)	11,21	38,3(6)	9,89
31	*C. ciliaris* hay cut in winter. 3,7 cm screen	53,8(4)	11,41	30,9(6)	6,13	12,5(4)	14,30	11,2(6)	7,38	51,0(4)	4,89	42,1(6)	11,24

Figures in brackets refer to the number of animals used.
CV = Coefficient of variation

sistently in favour of the cattle. Feed intake per W_{kg} of cattle was significantly higher ($P \leq 0,05$) than that of sheep in 2 of the forages viz. No.'s 1 and 19. In all other forages the differences in intake between sheep and cattle were not significant. Furthermore there was no consistent trend regarding superiority of intake between the two species. The cattle digested forages 12, 14, 16, 17 and 18 significantly better ($P \leq 0,05$) than sheep. However, higher digestibilities with cattle in 27 out of the 31 forages, were obtained.

The extent of the differences between sheep and cattle in dry matter intake per $W_{kg}^{0,75}$ of the feeds in this study, was greater that than found by some other workers (Blaxter *et al.*, 1966; Miles, Walters and Evans, 1969). The differences were more or less of the same magnitude as those obtained by Playne (1970) on buffel grass *(C. ciliaris)*. The explanation of Playne (1970) was that the intake of buffel grass by sheep was lower than that of many other grasses of the same digestibility. However, when expressing dry matter intake per W_{kg} in this study the differences between sheep and cattle almost disappeared (Table 1), being statistically significant in only 2 out of 31 forages. In the light of this finding the question arises whether intake per $W_{kg}^{0,75}$ should be used at all to rank forages with sheep and cattle. In this study sheep and cattle definitely ranked forages differently when expressed as DM intake per $W_{kg}^{0,75}$ of W_{kg} However when expressing feed intake per W_{kg}, the cattle were no longer consistently superior to the sheep as was the case with DM intake per $W_{kg}^{0,75}$. Since the significance of the differences almost disappeared when comparing feed intake of sheep and cattle per W_{kg} it could be argued that this should be the unit of expressing intake. Crampton, Donefer and Lloyd (1960) introduced a Nutritive Value Index which equated the intake of a forage on the basis of metabolic size of sheep. The daily feed consumption of their "standard forage" by sheep was 1 361 g per 45 kg sheep which is equivalent to 80 g per $W_{kg}^{0,75}$. They assumed then that the daily intake of the same forage by a cow of 450 kg would be 13,6 kg which is equivalent to 140 g per $W_{kg}^{0,75}$. According to the assumption of Crampton *et al.* (1960) a 150 kg steer will consume 4,54 g of the same feed per day. This is equivalent to 106 g per $W_{kg}^{0,75}$, which differs substantially from the 140 g per $W_{kg}^{0,75}$ suggested by Crampton *et al.* (1960). The problem is however, that there is still not sufficient evidence to prove that there is a better relationship between actual feed intake and $W_{kg}^{0,75}$ or W_{kg}. Calculations regarding this are at present being done at this Institute.

The results of this study indicate that cattle on average digested the forages better than did sheep although the differences were significant in 5 out of the 31 forages only. Furthermore the differences were more pronounced in forages of lower digestibility. This is in agreement with the findings of Cipolloni *et al.* (1951) but contrary to the results of Alexander, Hentges, McCall and Ash (1962). The differences in digestibility between sheep and cattle are in good agreement with the results obtained by Playne (1970) when using buffel grass. The differences in digestibility between sheep and cattle when consuming buffel grass in this study, were quite pronounced. The digestibilities of the different buffel grass cuts varied quite substantially (35,0 to 70,7% for cattle and 34,9 to 64,0% for sheep). Unfortunately there are a few factors that could have influenced the digestibility coefficients in this study. Digestibility was measured at a voluntary intake level which could have been to the advantage of sheep. Sheep normally when given the opportunity, consume material of higher digestibility (Engels & Malan, 1973). There is also the influence of level of feeding on digestibility. A higher level of intake of concentrates is normally accompanied by a decline in digestibility. However, the influence of level on intake of roughages on digestibility is not very clear (Anderson, Reid, Anderson & Stroud, 1959). Therefore the intake of the sheep and cattle relative to maintenance could have had a confounding effect on the comparison between sheep and cattle in this study.

Blaxter *et al.* (1966) stated that the higher intakes by cattle per $W_{kg}^{0,75}$ seemed to be in accordance with their higher maintenance needs. Therefore they argued that cattle and sheep attained the same relative feeding level (energy apparently digested / energy required for maintenance). However, the level of intake on quite a number of forages in this study was insufficient to meet maintenance requirements. Consequently level of intake on those forages in this study was mainly determined by other factors such as distention of the rumen and also rate of passage.

It may be concluded from the results of this study that especially with roughages of lower digestibility, sheep tended to be at a lower feeding level than cattle. Although the differences between sheep and cattle were not necessarily statistically significant the trend was definitely in favour of cattle. Therefore when using sheep, the nutritional value of roughages could sometimes be under-estimated for cattle. Under practical grazing conditions the situation will be reversed because of the more selective way of grazing of sheep.

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