Working Paper no 7

CHEMICAL COMPOSITION AND ESTIMATION OF THE DIGESTIBILITY OF NATURAL FORAGE IN SOMALIA

by

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Originally published in Italian as

COMPOSIZIONE CHIMICA E STIMA DELLA DIGERIBITA DI FORAGGI SPONTANEI DELLA SOMALIA

in the journal

Rivista di Agricultura Subtropicale e Tropicale (1982)

76, 243 - 250

translation prepared by

M.R. Bowen et. al* (1986)

Ministry of Livestock, Range and Forestry

National Range Agency

Research Division

British Forestry Project

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Mogadishu
December 1986

PREFACE

This paper is one of a series translated from the Italian forestry literature by the Research Division of the British Forestry Project - Somalia, with the intent of making the information available to a wider audience.

In some instances there has been difficulty in translating technical terms: where doubt exists the questionable word or phrase is indicated by a question mark and enclosure in brackets, thus [?]. Where words have been added for the sake of clarity during translation, these are also enclosed in brackets.

chemical composition ....

SUMMARY

(added by translators)

Giorgetti A., Poli B.M., Camiciottoli R., Scek N.H., and Sabrie M.E. (1982) Chemical composition and estimation of the digestibility of natural forage in Somalia translated from the Italian by M.R. Bowen et. al (1986) from the journal Riv. Agric. Subtrop. Trop. 76, 243 - 250.

In vitro techniques were used to study the digestibility to livestock of various indigenous fodder and forage species growing in Somalia. Regression equations were used to estimate total digestibility of the food-stuff. These were based on (1) the acid detergent fibre (ADF), and (2) the acid detergent lignin (ADL), contents of the different species as independant variables in the regression analysis. No correlation was found between raw fibre content and ADC. There are however, positive correlations between raw fibre and ADF, and between ADF and ADC.

In general trees and shrubs had a much higher raw protein content than the herbs: exceptions were the herbs Iustica sp. and Indigofera arrecta. Proteinaceous content of the branch tips of the five Acacia spp. tested was high.

Authors English summary

Twenty four samples of herbaceous tree crops and shrubby feedstuffs were harvested on Hagai season 1981 in Lafoole area near Mogadishu. Proximate analyses, acid-detergent fibre and acid-detergent lignin contents were determined by using these parameters as independant variables in regression equations according to Aerts et al, organic matter digestibility was evaluated.

Chemical Composition and Estimation of the Digestibility of the Natural Forage in Somalia

INTRODUCTION

In all developing countries of the tropics and sub-tropics in which cattle feed is based largely on natural forage species, it has been felt necessary to clarify the food species and to prepare maps showing the vegetation present in different areas during different seasons. This taxonomic research must also be accompanied by an estimate of their nutritive value, without which the classification has no practical value in the livestock production field.

The nutritional value of the great majority of foodstuffs for cattle raised in the tropics is still practically unknown: starting from the digestible organic intake there are no practical equations to determine the net energy [? available to the animal] because of the difficulties of in-vivo studies in tropical regions the better approach, to obtain quick and sufficiently reliable answers, could be to use in-vitro yechniques - this applies to all domesticated animals but particularly to ruminants.

In-vitrostudies have been used and applied to fodders of temperate countries but it is difficult to apply the results directly to the tropical foodstuffs which are consumed by animals of different genetic lineage and with different capacity to adapt to climatic conditions which are markedly different from these found in Europe and North America. These differences are sufficient reasons to use in-vitro techniques to study the digestibility of the different food species of ruminants: animals in which the 'true' digestive process is superimposed upon by the complex metabolic activities of a rich protozoan and bacteria flora. The exact degree of digestion can be obtained only by using inoculums from the rumen, starting with the contents of the pre-stomachs of the various animals (both species and breeds) an additional condition which makes studies difficult.

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On the other hand, in countries with an advanced livestock programme there has recently been a trend towards using regression equations to estimate digestibility: these are based only on the content of some components which are known to have a high level of digestibility. This simplifies the procedure and leads to a more rapid testing. The first equations were based on the raw fibre content of the foodstuff and gave variable [? conflicting] results, which showed little correlation with digestibility. Better estimates have been obtained more recently by using [analyses] based on [? the content of] acid detergent fibre (ADF) and acid detergent lignin (ADL), which themselves often showed high correlation with such nutritional characteristics. These close correlations have, however, only been found to date in fodder from temperate countries i.e. in plants which often differ considerably in their anatomy and composition from tropical and sub-tropical areas. In these latter areas research workers are in doubt as to whether the proposed equations are adequate to express correctly the digestible energy of tropical fodders intended for consumption by local ruminants.

In a previous paper (Giorgetti and Franci, 1981) we noted a complete lack of correlation between raw fibre content and ADF in some Somali fodders, where ruminant digestibility was obtained using 'inoculo' from adult goats, which are considered physiologically more closely related to other European ruminants than to the bovine and ovine-caprine population of central east Africa. However a significant correlation was noticed between ADC content and percentage digestibility. We were tempted to make a first estimation of the nutritional value of some Somali fodders (within the framework of a wider research programme, which will carry out a [full] biochemical assessment of the edible vegetation) using regression equations which correspond to the ADC content of some of the browse trees and shrubs eaten by local domestic animals.

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MATERIALS AND METHODS

Twenty four samples of feedstuffs were harvested in the Lafoole area near Mogadishu during hagai[1] 1981. The samples were harvested from individual plants, bearing in mind to collect only these parts which are normally selected by cows from the herbs, and the goats, sheep and camels from the shrubby and tree species.

The samples were weighed soon after collection and then dried in a forced draught [oven] at 60°C. After grinding in a knife-mill with 1.0mm holes a standard analysis was made of fibre, acid detergent fibre (ADF), (Anon, 1980), and acid detergent lignin (ADL) (Goering and Van Soest, 1970).

The chemical composition of the fodders is given in table 1.

The values of ADF and ADC determined for each species have been used in regression equations to estimate the digestible organic substances (Aerts, et al. 1977).

This completes the determination of the correlation between the analysed values of the different fibrous components.

[1]Hagai - the 'short dry' season, sometimes with coastal showers, which lasts from appoximately early July until early October, and during which the winds blow from the south west.

Table 1.

Chemical Composition of Fodders
(percentage given on a dry weight basis)

species[1]	moisture content	raw protein	ether extract	raw fibre	ash content	inazotized extract	ADF	ADL
ıchrus ciliaris L.	60.0	10.1	2.2	30.4	12.4	44.9	40.08	7.7
ıchrus biflorus Roxb.	61.2	6.5	2.2	36.2	11.7	43.4	47.5	7.8
ɜticia sp.	73.9	13.3	5.1	29.5	13.8	38.3	34.6	9.2
ıontia cespitosa[2]	45.0	8.9	4.7	38.4	5.7	42.3	49.2	11.6
ɨgonum atriplicifolium (Meisn.) Martelli	73.7	10.8	1.8	28.2	10.0	49.2	41.8	10.8
ıvolvulacea I	75.4	14.0	2.5	24.5	16.3	42.7	16.6	3.5
ıvulvulacea II	74.9	12.9	2.9	36.9	11.6	35.7	44.2	7.8
ɨgrostis cilliaris (L.) R. Br.	23.7	5.3	1.4	35.5	8.0	49.8	43.4	6.9
ɨligofera arrecta A. Rich	65.3	14.3	2.7	30.8	15.3	36.9	39.7	9.7
ɔa mista[3]	57.2	7.5	2.5	31.6	9.3	49.1	40.2	7.8
ɜcia sp.	70.4	19.1	2.8	12.5	24.9	40.7	20.6	8.6
ɔera glabra (Forsk.) Poir.	53.2	12.3	1.9	26.4	19.3	40.1	33.1	13.7
ɨcia tortilis (Forsk.) Hayne	61.9	19.6	5.0	14.8	6.9	53.6	26.2	12.8
ɨcia horrida (L.) Willd.	68.0	17.1	5.2	10.3	8.8	58.6	15.0	6.2
ɨcia senegal (L.) Willd.	60.8	20.4	4.8	16.0	7.9	50.9	25.0	11.1
ɨcia nubica Benth.	79.1	35.2	5.7	12.4	8.6	38.1	18.0	5.1
ɨcia nilotica (L.) Del.	59.3	14.4	6.2	13.2	4.4	61.8	16.3	7.6
ɨcia mellifera (Vahl) Benth.	60.8	18.1	4.2	10.9	8.2	58.6	18.8	7.7
ɨcia mellifera defoliata[4]	59.4	18.2	2.6	9.2	8.3	61.7	19.8	8.9
ɨcia tortilis pods	72.4	15.8	0.9	13.6	5.4	64.3	20.3	5.0
ɨcia horrida pods	61.7	15.0	4.6	26.1	5.0	49.3	37.1	11.0
ɨcia nilotica pods	67.6	11.6	1.8	17.5	4.0	65.1	23.8	7.2
ɨcia senegal pods	60.9	21.0	2.2	34.4	7.0	35.5	41.8	13.0
ɨcia nubica pods	67.4	20.9	1.6	33.5	7.6	36.4	38.9	10.6

1 authority added by translator

2 misspelt, correctly Kohautia caespitosa Schnizl.

3 not traced

4 the sub-species not traced

RESULTS AND DISCUSSION

As seen from table 1 the various components show remarkable differences between the various plant species. In general the trees and shrubs had a much higher raw protein content than the herbs - although even among the herbs there were some (Iustica sp., Indigofera arrecta) which had protein values comparable to these from good fodders of the temperate countries. The two members of the Convolvulaceae examined (genus and species not determined) also had a reasonably high protein content. Many of the other [herbaceous]species had lower protein contents; interestingly these included a sample of mixed herbs which represented a sample of fodder destined to feed the small, bovine population of urban Mogadishu. These fodders are traditionally harvested immediately outside the city limits by local villagers [who then transport the cut fodder to town on donkey carts]. This cut fodder contained a large variety of species but the most common were Eragrostis ciliaris (Graminaceae), Commelina foskali (Commelinaceae), Borreria scabra (Rubiceae), Hypomea karkiana (Convolvulaceae) and some labiates.

As was expected from the work of Bettini et al (1980), the proteinaceous content of the Acacia species was high - and in general comparable to the value found by the authors using samples harvested in the same area but during a different season, the jilal[2] of 1980. We collected and analysed only the apical parts of small branches, in which the thorns were incompletely lignified and the leaves were lush: this is shown by the low raw fibre content. Except in Acacia senegal, the 'husks' [? bark or outer regions of the stem] had a lower protein and. in general, higher raw fibre levels. Ether extracts had higher levels [than other species] when taken from the Acacia species, and also had lower ash contents.

The inconsistency in fibre content, noted by Weende quoted by Van Soest, and also noted by Bettini et al (1980) and Giorgetti and Franci (1981) for similar Somali fodders, is partially confirmed. Table 2 shows that no correlation has been found between raw fibre and ADC, although there is a positive correlation between raw fibre and ADF, and also between ADF and ADC.

[2]jilal - the 'long dry' season, usually more severe than the hagai dry, and lasts from early December to mid April of the following year: the north-east winds blow more or less continuously and are particularly dessicating.

Two regression equations have been proposed by Aerts et al (1977) starting from the ADF content (y = 114,6 - 1,23x) and lignin (y = 87,3 - 3,25x) [Applying these to our results] gives the value shown on table 3.

Table 2.

Correlation Between Raw Fibre, ADF and ADL. Value of r, Significance and Regression

	ADF	ADL
Raw fibre	-0.93 **(1)	0.28 n.s.
ADF		0.43 *(2)

(1) y = 6.057 + 1.06x
(2) Y = 5.564 + 0.103x

** significant for P < 0.01
* significant for P < 0.05
n.s. not significant

In almost all cases the value calculated from the ADF content is higher than the ADL content: the bigger differences being in the tree and shrub species. Based on past experience, based on work on fodders both of temperate countries and of Somalia,Giorgetti and Franci, (1981), it is possible to conclude that the digestibility value is best calculated on the generally lower value of the lignin content. The chemical analysis of the various species at the end of the hagai season shows that there are valuable nutritive substances present in herbaceous, shrubby and tree species.

Table 3.

Digestibility Values as a Function of the ADF and ADL Content (values as percentages)

	ADF	ADL
Cenchrus ciliaris	64.5	62.1
Cenchrus biflorus	56.2	62.0
Iusticia sp.	72.0	57.4
Kohontia cespitosa	54.0	49.6
Oxygonum atriplicifolium	63.2	52.2
Convulvulaceae I	94.1	75.9
Convolvulaceae II	60.2	61.9
Eragrostis ciliaris	64.2	65.0
Indigofera arrecta	65.8	55.7
Erba mista	65.7	62.5
Boscia sp.	89.3	59.3
Dobera glabra	73.9	42.7
Acacia tortilis	82.4	45.6
Acacia horrida	96.1	67.2
Acacia senegal	83.8	51.3
Acacia nubica	92.5	70.6
Acacia nilotica	96.4	62.7
Acacia mellifera	91.5	62.3
Acacia mellifera defoliata	90.2	58.3
Acacia tortillis pods	89.7	70.9
Acacia horrida pods	68.9	51.7
Acacia nilotica pods	85.3	63.8
Acacia senegal pods	63.2	45.1
Acacia nubica pods	66.8	52.7

References

Giorgetti A. and Franci O. (1981). Carrater istiche nutritive di alcuni forragi arborei e arbustivi della Somalia. In corso di stampa du: Studi/e/Ricerche. Universita Nazionale Somala.

Anon (1980). Comissione valutazione degli alimenti: Valutazione degli alimenti di interesse zootecnico. J. Analisti chemica. Zoot. Nutr. Anim. 6, 19.

Goering K. and Van Soest P.J. (1970). Forage fibre analysis. Agricultural handbook no.379, USDA Washington.

Aerts J.V., Brabender D.L., De Cottyn B.G. and Buysse F.X. (1977). Estimation of the feeding value of course forage, 4. Estimation of digestibility and energy value from true digestibility in-vitro according to Van Soest. Revue de l'Agriculture 30, 437.

Bettini T.M., Abukar A.M., and Ismail A.D. (1980). Comportamento alimentare del dromadario Somalo. Tentativo de inventario della veget azione pabulare, Riv. Agric. Subtrop. Trop. 74, 151.