The nutritional value of some common pasture plants harvested in late rainy season at En Nahud, Northern Kordofan, Sudan

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Summary

A study was conducted to assess the chemical composition, *in vitro* organic matter digestibility and estimate energy contents of some Sudanese rangeland plant in Northern Kordofan. The results indicated that crude protein ranged from (19.98%) in Zornia *glochidiata* to (2.68%) in *Aristida funiculata.* The highest OM was represented by *Eragrostis tremula* (96.63%) and the lowest in Sida *cardifolia* (78.55%). Ether extract ranged from 0.42 % in *Andropagon gayanus* to (3.82 %) in *Gueria senegalensis*. The highest ADF, NDF, and ADL, were 63.22 %, 82.50 %, and 16.00 % in *Aristia pallida*, *Eragrostis tremula* and *Chrozophora brancheris* respectively, and the lowest were 35.03%, 43.50% and 4.00 % *in Sida cardifolia, Aristida adscesnois and Ipomea belopharosepla* respectively. The maximum value of NFE was recorded in *Aristida herbarium* (34.73%) while the minimum value was recorded in *Cenchrus ciliaris* (11.15%). The IVOMD value was highest in *Boscia senegalensis* (47.60 %) and the lowest was in C*enchrus ciliaris (*10.80 %). There were marked correlation between percentages of IVOMD and CP, ADF, and NDF contents. These relationships were significantly ($P<0.05$), positive between percentages of CP and IVOMD, and significantly negative ($P<0.05$), between ADF, and NDF.

The results also, showed that Chemical composition and *in vitro* organic matter digestibility can be considered as useful indicators for the preliminary evaluation of the nutritive value of range plants. Most of these range plants, with high protein concentration, and *in vitro* OMD digestibility. As such, they have potential use to maintain livestock, as well as to supplement poor quality roughages, in order to increase productivity of ruminant livestock in the region.

Introduction

Livestock in developing countries are still facing the challenge of poor nutrition. The basic reason for the poor performance of livestock in most of these countries is the seasonal inadequacy of feeds; in quantities and quality, together with low nutritional value of the available crop residues and agro-industrial by-products as well as the general ignorance about the feeding value of shrubs, trees and browse plants (Babyemi, *et al.*, 2006). In North Kordofan cover about 25 million hectare (ha), out of this area; 14.5 million ha are rangeland (AFr.ecover, 2004). The region is considered among the leading regions of Sudan in terms of animal and range resources, where more than 13 million heads of sheep, goats, camels and cattle are present (RPA, 2005).

The region habitat is kept under traditional extensive livestock production systems, depending on natural rangeland (Cook and Fadlalla, 1987).

Nutritional quality of range plants varies from one area to another, and between seasons and growing stages, (Mohammed and Salih, 1991). The potential of any feed to support animal production depends on the quantity consumed by the animal and extent to which the feed meets energy, protein, minerals and vitamin requirement (Minson, 1990). In many cases determination of ADF and crude protein is sufficient to give an adequate assessment of forage quality. Digestibility is an important factor of the nutritive value of feed. It determines the relation between contents of nutrients and energy that are available to ruminants (Expert Committee on Animal Nutrition, 1986).

Chemical analysis, particularly in combination with *in situ* degradability, can provide a suitable evaluation of nutritional value of forage (Elhassan *et al.*, 2000).

In this study, some pasture plants from En Nahud-Northern Kordofan area, were evaluated for nutritive value and *in vitro* digestibility in ruminant.

Materials and methods

The study area

Location

The plant samples were collected from En Nahud Desert Sheep Research Station, 12 kilometres east of En Nahud town, lying between latitudes 12-14° North and longitudes 27-30° East, and at about 800 meters west of Khartoum.

Climate

The area is located within the Savannah belt. The climate is warm in wet season, hot dry in summer and cool dry in winter. The rainy season is about four months (mostly from July to October), peaking in August, and the annual average rainfall is between 300-400 mm En Nahud Meteorological Station, (2007).

Topography and vegetation

The soil of the area, is generally of smooth undulating sandy plain (*Goz*) dissected by batches of loamy sand (Gardood or Gurraba) in the southern part. The dominant vegetation is a mixture of thorny trees, shrubs, herbs and grasses. Grasses include *Dactyloctinium aegyptiun* (Abu-Asabi),*Cenchrus biflorus* (Haskaneet), *Echnochloa colonum (*Difra), *Eragrostis tremula* (Banu), *Andropogon gayanus* (Abu Rakhies), *Zornia glochidiata* (Shiline), and *Ipomea cordiosepala* (Tabar), as described by Yehia (2002).

Sample collection

Samples of eighteen grasses and shrubs were collected from the range of En Nahud Research Station in December 2010, after the end of rainy season. One kilogramme sample from plants were hand-picked, air dried and sealed in plastic bags ready for analysis. Description of plant material is shown in **Table 1.**

Table 1. Local name, plant type, scientific and family name of collected range plant from Northern Kordofan (Enuhoud)-Sudan.

No.	Local name	Plant type	Scientific name	Family
1	ابواصابع	Grass	*Dactyloctenium Aegyptium*	Poaceae
2	قوابيض	Grass	*Aristida hordeseae*	Poaceae
3	قواحمر (قو النقعة)	Grass	*Aristida funculata*	Poaceae
4	ام صميمه	Grass	*Aristida pallida*	Poaceae
5	حمره (قوعادي)	Herb	*Aristida adscesionis*	Poaceae
6	حسكنيت خشن	Grass	*Cenchrus biflorus*	Poaceae
7	حسكنيت ناعم	Grass	*Cenchrus ciliaris*	Poaceae
8	ام فسيسات	Grass	*Fimbristilis hespidula*	Poaceae
9	ابورخيص	Grass	*Andropogon gayanus*	Poaceae
10	بنو	Grass	*Eragrostis tremula*	Poaceae
11	مخيط	Shrub	*Boscia senegalensis*	Caparaceae
12	غبيش	Shrub	*Guieria senegalensis*	Combretaceae
13	حنتوت	Herb	*Ipomeao belpharosepla*	Convolvuvaceae
14	شيليني	Herb	*Zornia glochidiata*	Leguminaceae
15	بغيل	Herb	*Blepharis linarifolia*	Acanthaceae
16	ارقسى	Shrub	*Chrozophora branchieris*	Euphorbiaceae
17	مقشاشة الرجال	Grass	*Abutilon panosum*	Malvaceae
18	نجادا	Herb	*Sida cordifolia*	Malvaceae

Chemical analysis:

Collected samples were ground to pass through a mesh of 2mm and analyzed for their approximate constituents of dry matter (DM, ash, ether extract (E.E), and crude protein (CP), according to AOAC (1990) methods and acid detergent fiber (ADF), neutral detergent fiber (NDF) and acid detergent lignin (ADL) according to Van Soest (1994).

***In vitro* organic matter digestibility study:**

Two stages *in vitro* digestibility techniques (Tilley and Terry 1963) were used to determine the *in vitro* organic matter digestibility (IVOMD) of collected samples. Duplicates of 0.25g weighed samples were subjected to 48h digestion period with McDougal's buffer\ rumen fluid mixture in sealed glass marble followed by 48h digestion with Acid/ pepsin solution.
Blank samples with digestion mixture were run through the whole process.
Calculations were done as follows:

$$\text{IVOMD (\%)} = \frac{\text{Initial OM input} - \text{OM residue} - \text{Blank}}{\text{Initial DM input}} \times 100$$

Metabolizable energy was calculated according to MAAF (1975) equation
ME (MJ/kg DM) = DOMD % *0.16

Statistical analysis

Data obtained from proximate analysis of collected plants and their respective digestibility as dependant factor, IVOMD, NDF and ADL as independent factors, were subjected to regression analysis.

Results and discussion

As shown in **Table 2,** the crude protein (CP) contents of range plants studied had a similar range as those reported by Millford and Minson (1965) indicates that the CP of tropical grasses and legumes range between 2.2-25.3%. Generally microbial requirements are met at 6-8% crude protein in the diet. Ruminant animal CP requirements range from 7-20% in the diet depending upon species, sex and physiologic state (Huston *et al*., 1991). More than 80% of the range plants collected in the current study had CP content above 8%DM. This indicates that most of these tropical plants are high in CP and

can be used to maintain ruminant livestock in tropical regions (Butler and Baily, 1973). Even more, about 40% of studied samples, recorded a CP contents higher than 13% indicating that those high protein containing range plants particularly shrubs, can be used to supplement poor quality roughages to

increase productivity of ruminant livestock in the region. A critical value of about 3.6% crude proteins in feed is required (NRS, 1981), below which the crude protein digestibility declines. The results of the current study agree with those of Mohammed and Salih (1991), Rittner and Reed (1992), Makkar and Becker (1998), and Njidda *et al*., (2009). They found that all browses plant in their studies had CP content above 13% DM.

The highest organic matter digestibility (IVOMD) was observed in *Boscia senegalensis* and the lowest in *Cenchrus ciliaris*. The variation in IVOMD between the ranges plants studied can be attributing to compositional differences especially of crude protein and crude fiber, due to stage of maturity. Other factors may be anti-nutritionals. The highest metabolizable energy was observed in *Bosica Senegalesis* 7.62 MJ/kg DM and the lowest in C*enchrus ciliaris* 1.73 MJ/kg DM. However, other scientists in North Sumatra of Indonesia - (Nouregia *et al*., 1999) reported higher energy contents of some tropical grasses that varied between 5.76% to 9.12% MJ/kg DM.

As shown in **Figure 1**, the crude protein contents were positively correlated to IVOMD ($P = 0.038$, $n = 18$). CP content is in the permissible level for, optimal feed intake and rumen function considering the range of the 10.80% - 47.60%, since a digestibility value of 40 to 50% was recommended for high performance of ruminants in pasture (McDowell 1985). A positive correlation between IVOMD and CP indicate that as the crude protein increase, there was improvement in OMD. In line with our finding, in Australia; CSIRO (2007) similarly, found a positive correlation between CP content and OMD in tropical forages and pasture plants.

However, cell wall constituents and IVOMD were negatively correlated, **(Figure 2 and 3)**, as indicated by the correlation between IVOMD and the cell wall contents ADF and NDF. This result is consistent with findings of Seresin and Iben (2003) and Ammar *et al*., (2004), indicating that the cell wall contents(ADF, NDF) indices, in the present study; are relatively good predicators of OM digestibility.

It is well accepted that forage degradation in the rumen is mainly affected by cell wall content and its lignifications, as lignin is indigestible and acts as a barrier limiting the access of microbial enzymes to the structural polysaccharides of the cell. Ammar (2002) reported that NDF, ADF were significantly and negatively correlated with *in vitro* digestibility, an assumption which supports the results of our study. Generally, it is well established, that a

low content of poorly digestible cell components (ADF, ADL) and high CP contents are indicators of a good forage quality (Van Soest, 1994).

Table 2. Chemical composition and *in vitro* organic matter digestibility of selected range plants of Northern Kordofan

Scientific Name	Family	DM	OM	CP	EE	ADF	NDF	ADL	NFE	IVOMD	ME
Dactyloctenium Aegyptium	Poaceae	94.80	90.00	10.69	1.27	53.27	69.00	11.00	19.57	34.00	5.44
Aristida herbarium	Poaceae	95.10	92.00	4.21	2.94	45.22	70.50	8.00	34.73	36.00	5.76
Aristida funculata	Poaceae	94.50	93.23	2.68	0.84	54.49	69.00	12.00	29.72	17.20	2.76
Aristia pallida	Poaceae	95.70	96.10	4.51	1.25	63.22	81.00	7.00	22.82	16.00	2.56
Aristida adscesionis	Poaceae	94.70	81.41	10.04	2.96	45.41	43.50	5.00	17.71	17.60	2.82
Cenchrus biflorus	Poaceae	95.10	83.09	12.32	0.42	41.01	64.00	11.00	21.44	30.80	4.81
Cenchrus ciliars	Poaceae	92.17	91.14	14.41	0.87	55.88	75.00	7.50	11.15	10.80	1.73
Fimbristilis hespidula	Poaceae	94.90	88.42	13.97	1.26	37.93	47.00	10.00	30.16	36.00	5.76
Andropagon gaynus	Poaceae	95.60	92.78	10.39	0.42	51.26	80.00	7.00	26.31	12.80	2.05
Eragrostis tremula	Poaceae	95.10	96.63	8.44	1.68	53.10	82.50	10.50	28.51	12.80	2.05
Boscia senegalensis	Caparaceae	94.70	91.88	19.87	1.27	41.18	49.50	6.00	24.26	47.60	7.62
Guieria senegalensis	Combretaceae	94.30	96.00	10.60	3.82	44.54	53.00	16.00	31.34	31.60	5.06
Ipomea belpharosepala	Convolvuvaceae	94.30	91.53	12.86	0.85	59.38	59.00	4.00	12.74	23.00	3.68
Zorina glochidiata	Leguminaceae	94.50	92.69	19.98	0.85	42.33	49.00	8.00	22.04	28.00	4.48
Blepharis linarifolia	Acanthaceae	94.70	95.24	17.30	1.69	45.93	47.50	9.00	25.02	43.20	6.92
Chrozophora branchieris	Euphorbiaceae	95.00	92.67	13.70	1.68	41.05	55.00	16.00	31.24	28.80	4.61
Abutilon panosum	Malvaceae	95.60	93.62	17.69	1.67	53.87	63.00	9.50	15.99	32.00	5.12
Sida cordifolia	Malvaceae	94.20	78.55	14.39	2.97	35.03	52.00	9.00	20.09	44.4	7.10

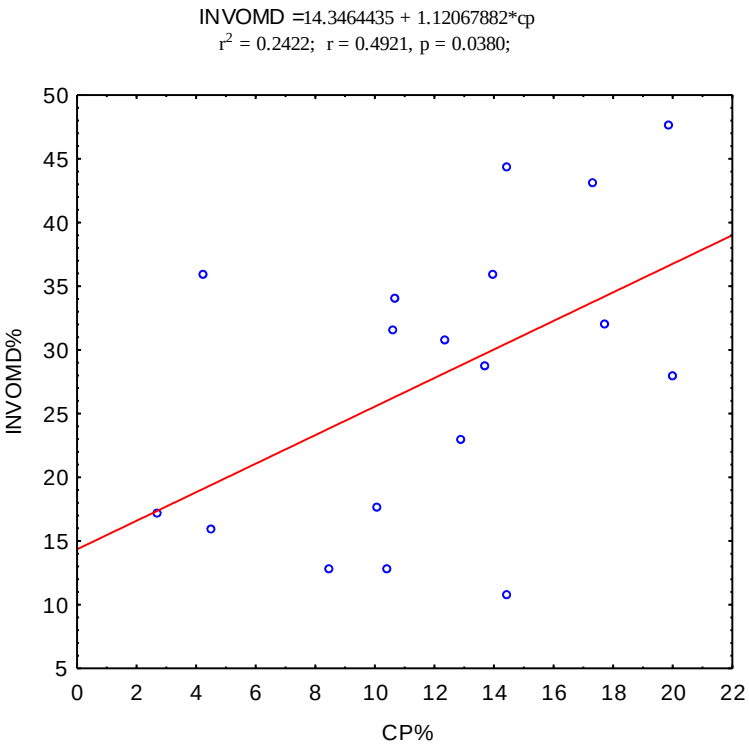

Figure 1. Relationship between IVOMD and CP percentage of selected range plants of
Northern Kordofan- Sudan.

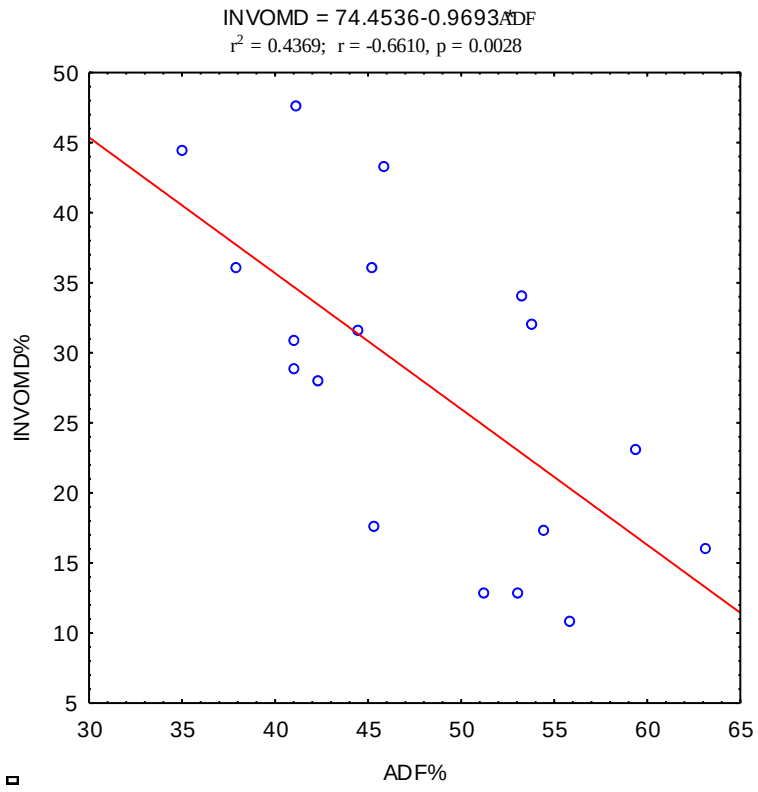

Figure 2. Relationship between IVOMD and ADF percentage of selected range plants of

Northern Kordofan- Sudan.

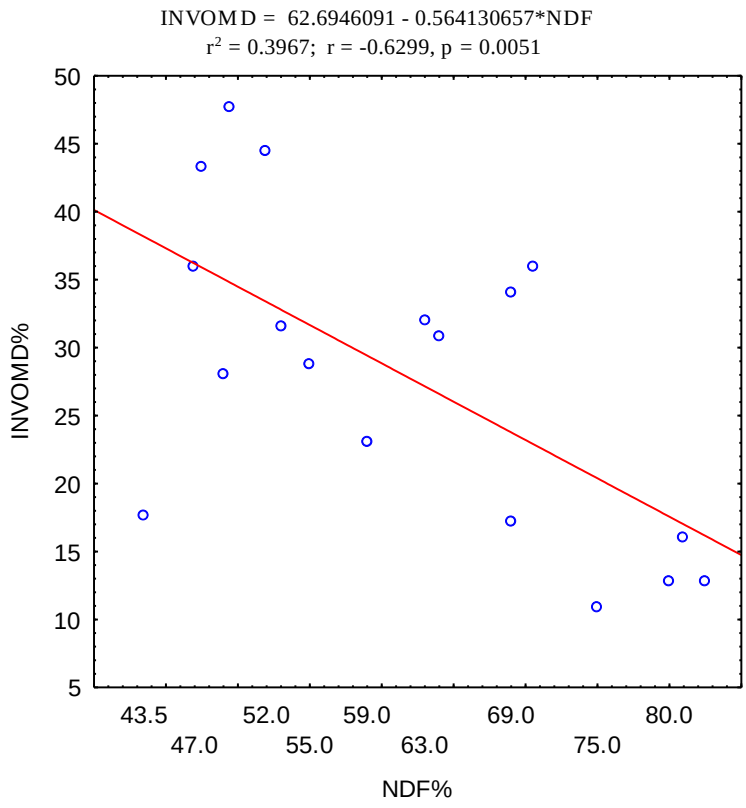

Figure 3. Relationship between IVOMD and NDF percentage of selected range plants of

Northern Kordofan- Sudan.

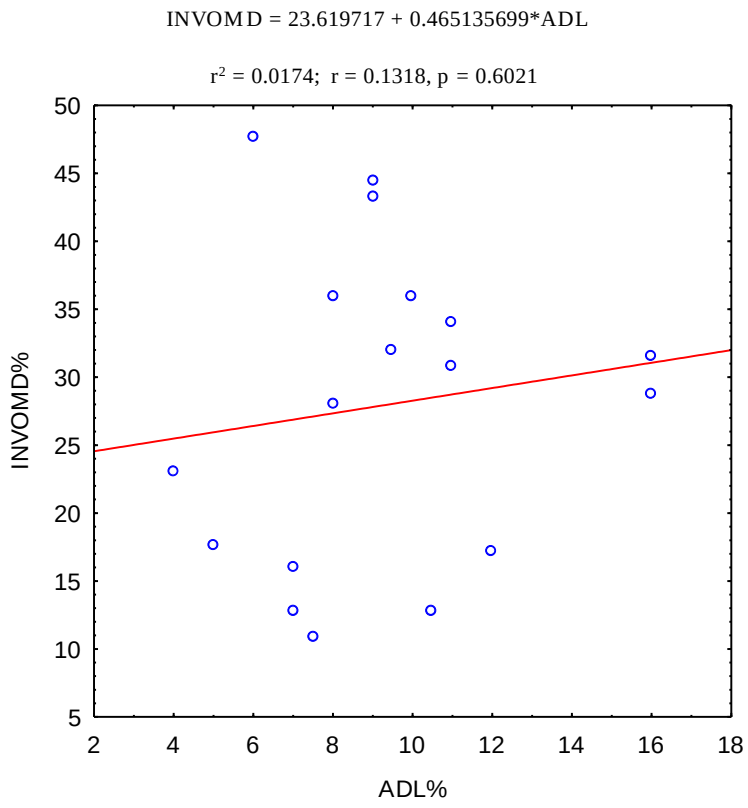

Figure 4. Relationship between IVOMD and ADL percentage of selected range plants of

Northern Kordofan- Sudan.

Conclusion

Chemical composition and OM digestibility, can be considered useful indicators for the preliminary evaluation of the nutritive value of range plants. Most of the plants studied were high in protein concentration and *in vitro* OM digestibility. As such, they have the potential to maintain livestock, as also, to supplement poor quality roughages, and enhance productivity of ruminant livestock in the region. In this respect, to mention the use of the browse plants in this study, particularly *Boscia senegalenesis* and *Guieria senegalenes* use, during the dry summer season. However, there is little experience with the use of these plants as ruminant feed, which had to be examined for freedom from toxicity to rumen micro flora, and possible injury to the health of the consuming ruminant.

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القيمة الغذائية لبعض النباتات الرعوية المجموعة في آواخر فصل الخريف من منطقة النهود – شمال كردفان – السودان

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الملخص:

تمت هذه الدراسة بهدف تحديد القيمة الغذائية لبعض النباتات الرعوية السودانية من منطقة شمال كردفان (18) عينة ويتمثل ذلك في المكونات الكيمائية ومعامل الهضم للمواد العضوية وتقدير الطاقة الأيضية لتلك النباتات.

النتائج أوضحت أن محتوي البروتين يتراوح بين 19,98 إلي 2,68% ومحتوي المواد العضوية 96,63 إلي 78,55% والدهون الكلية تدرجت من 0,42 إلي 3,82% وكذلك كانت النسبة العظمي لكل من الألياف غير الذائبة ، والألياف الذائبة واللجنين 63,22 ، 82,50 ، 16,00 والقيمة الصغري 35,03 ، 43,5 , 4,00 بالتتابع. القيمة العظمي للمواد الخالية من النتروجين كانت 34,73 والقيمة الصغري 11,15% أما المواد العضوية المهضومة فتراوحت بين 47,60 ، 10,80% .

لقد أثبتت النتائج علاقة إيجابية كبيرة بين محتوي البروتين والمواد العضوية المهضومة بينما سجلت الدراسة علاقة عكسية كبيرة بين محتوي الألياف غير الذائبة والألياف الذائبة مع المواد العضوية المهضومة.

خلصت الدراسة إلي أن التحاليل الكيمائية الأولية لهذه النباتات الرعوية والمواد العضوية المهضومة يمكن أن تمثل مؤشر للتقييم الأولي لتلك النباتات الرعوية كغذاء للحيوانات المجترة. معظم هذه النباتات ذات المعنوي البروتيني العالي والمواد العضوية المهضومة يمكن أن تساعد الحيوان المجتر للإدامة ، كما يمكن أن تعتبر إضافة غذائية للأعلاف الخشنة قليلة القيمة الغذائية وبالتالي يؤدي ذلك إلي زيادة إنتاج القطعان في تلك المناطق المعنية.