REPUBLIQUE DU SENEGAL

MINISTERE DU DEVELOPPEMENT
RURAL ET DE L'HYDRAULIQUE

INSTITUT SENEGALAIS DE RECHERCHES
AGRICOLES (I.S.R.A.)

DEPARTEMENT DE RECHERCHES SUR LES
PRODUCTIONS ET LA SANTE ANIMALES

LABORATOIRE NATIONAL DE L'ELEVAGE
ET DE RECHERCHES VETERINAIRES
B.P. 2057

DAKAR - HANN





# NUTRITIVE VALUE OF SOME TREE FORAGES SPECIES AVAILABLE IN SAHELIAN PASTURES.

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REF. N°42/RES.AL.
NOVEMBRE 1992.

**ABSTRACT:**

Quality of some tree forages from West Africa, ***Acacia*** albida, Acacia raddiana leaves and pods, ***Guiera senegalensis,*** Calotropis ***procera*** and ***Adansonia digitata*** leaves was studied. Applied methodology involved chemical analysis, ***in vivo*** digestibility, ***in sacco*** degradation, intake and animal performances measurements of rations including different levels of browses.

Results emphasize the high digestible nutrients content of Mimosacea pods, C. procera and A. digitata leaves while G. senegalensis and A. albida old leaves were of poor nutritive value. Feeding trials involving A. albida pods , C. procera, A. digitata and G. senegalensis leaves confirmed chemical analysis and ***in vivo*** digestibilities results. The aptitude to improve energy and nitrogen level of rations for sheep is high for A. albida pods, C. procera and A. digitata leaves. G. senegalensis at a level superior to 40 p100 played a negative role in ration digestion because of low digestibility (30 p100), low rumen degradability (deg 48h < 40 p100) and high tannin content.



***KEY* WORDS:** Sahelian pastures, Nutritive value, Tree forages, ***Acacia albida, Acacia raddiana, Adansonia digitata, Guiera senegalensis, Calotropis procera.***


VALEUR NUTRITIVE D'ESPECES FOURRAGERES **ARBUSTIVES** DISPONIBLES SUR PATURAGES **SAHELIENS**

Par


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# RESUME

La qualité d'arbustes fourragers d'Afrique de l'Ouest, les feuilles et gousses d'Acacia albida et Acacia raddiana, les feuilles de Guiera senegalensis, Calotropis procera et celles d'Adansonia digitata est étudiée.

La méthodologie appliquée porte sur les analyses chimiques, la digestibilité in vivo, la dégradation in sacco, et la mesure de l'ingestibilité et des perfomances animales de rations comportant différents niveaux de ligneux fourragers.

Les résultats mettent en évidence la haute teneur en nutriments digestibles des gousses de Mimosaceae et des feuilles de Calotropis procera ainsi que celles d'Adansonia digitata alors que les feuilles agées d'Acacia albida et celles de Guiera senegalensis ont eu une valeur nutritive médiocre. Ces résultats ont été confirmés par les essais alimentaires. Les gousses d'A. albida et les feuilles de C. procera et A. digitata données en complément aux fourrages pauvres à de jeunes moutons ont permis leur croissance semi-intensive. G. senegalensis à un niveau supérieur à 40 p100 de la ration a joué un rôle négatif sur la digestibilité de la ration probablement a cause d'une faible dégradation intra-ruminale et d'une teneur élevée en tannins.

**MOTS** CLES: Paturages sahéliens, Valeur nutritive, Fourrages arbustif, Acacia ***albida,*** Acacia raddiana, Adansonia diqitata, Guiera seneqalensis, Calotropis procera.

# INTRODUCTION:

Sahelian soils are well reputed for their deficiencies in organic matter and phosphorus. Pastures are more affected by drought and soil degradation than cultivated lands which are yearly improved by manure and or fertilizer. Thus a proliferation of plant indicators like ***Calotropis procera*** or ***Zornia qlochidiata*** is observed in the Sahel. During ten past years, the situation has been specially enhanced by bush fire and predators like locust. The aerial part of pastures, made of trees and shrubs plays a significant role in ecosystem maintenance as it has a great capacity of regeneration and drought resistance. Most of them are ever green and are an invaluable feed resources available all over the year. Therefore, browses are the main ruminants nutrients source providing nitrogen minerals and vitamins during the dry season (Le Houerou 1980).

Although the behaviour of ruminants differs according to seasons and plant species, browses represent up to 30, 70 and 80 p100 of cattle sheep and goat diet respectively during the dry season (Guérin, 1987.).

600 species has been identified as potential feed resources for cattle, sheep and goats (Von Maydell, 1983., Le Houerou 1980). Available résults gives informations about their palatability and chemical composition. The high nitrogen content of tree forages is well known (Rivière, 1978.; Le Houerou, 1980.; Kearl, 1982.; Koné, 1987.). That nitrogen may not be available in the digestive tract (Fall, 1991.) and data about digestibility and influence on animal performances are scarce. That topic was described as a "top priority subject in African livestock nutrition today" (Le Houerou, 1980.)

We intended to evaluate nutritive value of Acacia *albida* and Acacia raddiana leaves and pods, ***Guiera senegalensis, Calotropis*** *procera* and ***Adansonia digitata*** leaves. Those species are popular and well represented in sahelian ecosystems. ***A.*** *albida* and ***A. raddiana*** pods are sold in some west African markets and *c. procera* has been increasingly available in sahelian pastures as a consequence of drought and soil degradation .

## MATERIALS AND METHODS:

**STUDY** SITE:

In vivo measurements has been performed in Dahra an ISRA station located 270 km in the north east of Dakar in the sahelian zone of Senegal at 15°North, and 15°West Longitude.

Average rainfall was 340 mm during past twenty years ranging from 570 to 110 mm.

**SAMPLE COLLECTION AND PREPARATION:**

Tree forage samples has been collected in Dahra zone, sundried and stored for in vivo trials. For each specie a subsample has been ground to pass 1mm sieve for chemical analysis .

**CHEMICAL ANALYSIS:**

Chemical analysis was carried out in LNERV-ISRA Station laboratory of Dakar. They involved dry matter, crude protein, ash, calcium and phosphorus evaluation (AOAC 1975). NDF, ADF and lignin were analysed according to Goering and Van Soest, (1970) and Sodium, potassium, copper and zinc were determined with atomic absorption spectrosphotometry.

***IN VIVO* DIGESTIBILITY:**

Measurements:Classical in vivo balance has been applied. Six Peul-peul sheeps were lodged in individual pens and fed twice a day with diet including different levels of browses (cf table 1) . Each tria1 took place during 15 days of adjustment and 6 days of measurement. Daily measurments involved dry matter intake, and fecal collection. Apparent dry matter, organic matter and crude protein digestibility were represented by the balance between their content in intake and feces.

**Calculation methods:** The calculation method assumed the additivity of different components of the ration. The digestibility of total ration is the sum of digestibility of the different components multiplied by their percentage in the ration. Browse digestion were estimated by difference.

**IN *SACCO* DEGRADATION:** (ORSKOV and Mc DONALD, 1979.; ORSKOV et al., 1980. ; MICHALET-DOREAU et al., 1987.).

*In sacco* measurements was performed with nylon bag method. It involved the placement of tree forage sample in a polyester bag and direct incubation in the rumen of a cow. DM and N loss during a given incubation time represents their degradation.

**Animals and diets: 3** young fistulated Gobra bulls averaging 250Kg of body weight were used for forage incubation. They were fed twice a **day** with rice straw (75 p100) and groundnut cake (15 p100). Minera1 block was available in free choice as source of sodium, potassium, phosphorus, copper zinc and cobalt.

Nylon bags: They were made with Blutex (Tripette et Renaud. France) nylon material (46µm pore size, 6 * 11 cm) and heat sealed.

**Experimental procedure:** 3g of ground sample were put in each nylon bag. The bag were heat sealed then incubated in cattle rumen for 1, 4, 8, 24, 48, 72, 96 hours. The bags were washed and beatten with stomacher to decrease bacterial contamination (Michalet-Doreau and Ould-Bah,1989.) They were washed again prior to drying at the oven (60°C) The residual bacterial contamination of the bags was substracted, assuming a mean N bacterial residual contamination of 4 p100.

**Calculation**: The balance between initial and residual content of the bag for dry matter and nitrogen represents their degradation at a given incubation time.

To estimate degradation parameters ORSKOV and MC DONALD, (1979) mode1 were used:

$D = a + b\,(1 - e^{-ct})$ were D = degraded fraction at a given incubation time (t); a = readily degradable fraction; b = slowly degradable fraction.; c = degradation rate.
Parameters (a, b and c) were calculated with a non linear mode1 of SAS (SAS, 1985).

$$DT = a + \frac{bc}{c + k}$$

k = **0.04** specific for tropical forages and cattle breeds (LECHNER-DOLL et al 1990)

For -forage with slower degradation including a lag phase the above mode1 has been adapted by DHANOA(1988)

$$DT = a + \left(b * \frac{bc}{c + k} * e^{-kto}\right)$$

to = lag time.

**PEEDING TRIALS::** Influence on animal performances of rations including different levels of tree forages was measured during a 70 to 100 days tria1 including 15 days of preliminary adjustement.

Groups of 12 sheeps 1 year aged averaging 22 kg of liveweight were submitted to preliminary treatment against parasites, and main infectious deseases occuring in sahelian zones.

Intake (offered minus refusal) of different ration component were daily recordered. Liveweight change were monthly evaluated by weighing the sheeps during two following days at the same time.

## RESULTS AND DISCUSSIONS

### CHMICAL COMPOSITION OF TREE FORAGES:

The chemical composition of browse samples is described in table 1. A high protein (CP) content, averaging 14 p100 was recordered. Those results are in agreement with the datas reportered in the litterature (LE HOUEROU, 1980.; LAMPREYet al., 1980. and RIVIERE, 1978.) and confirm **the** potential protein source represented by tree forages during the dry season when grass carpet CP content is bellow 5 p100 and the CP ratio of dried grasses on browses is close to zero.

A. raddiana pods and leaves ***A. albida*** and C. *procera* leaves are specially high in CP (> 15 p100 in average).

Leguminous pods are not sensitive to phenological stage in term of CP content. That is in agreement with our first results (FALL, 1991). It was not the case for their leaves which CP level was negatively influenced by age.

CP content in *Calotropis* and ***Adansonia*** varied within a wide range. Those variations cannot be explained only by age effects. Variety pressure needs to be checked. ***Guiera*** **leaves** had the lowest CP content in all season of sampling.

Fiber content (NDF) were quite variable. The lowest level were recordered in Calotropis (27%) while the highest one were observed in Guiera leaves (72%).

Minera1 content of tree forages (see table 2) shows a globally low phosphorus content. Most of samples were bellow the critical level of 0.3 p100 and the Ca/P ratio were often bad exept for A. raddiana pods. So browses cannot supply P which is the most serious minera1 deficiency in the Sahel. Copper and Zinc are among the main minera1 umbalance in the Sahel. Browses bring only the minimum required (INRA, 1989): 4 to 7 ppm and 15 to 35 ppm respectively for copper and Zinc. So a minera1 mixture is advisable for minera1 deficiencies prevention in the Sahel.

DIGESTIBILITY OF TREE FORAGES

RATION DIGESTIBILITY: (Table 3)

The digestibility of rations involving A. raddiana pods and A. digitata leaves were the highest one (56 p100 in average), followed by ration with different level of Calotropis procera (50 p100 in average). Rations with Guiera leaves were the less digestible and that specie seemed to have a negative effect in the digestive tract. The higher was *Guiera* level in the ration the lower the digestibility. The ad libitum level caused mortality of 3 over on 6 sheeps. The tria1 was stopped after one week of adjustement.

The ration involving A. albida leaves was of low digestibility while the one with the pods was intermediate.

OM and CP digestibility had the same variation profile.

DIPPERENCIAL DIGESTIBILITY OF BROWSES:

Browse digestibility are presented in table 4. Although variations between trials were high, the same hierachy was recpected. Mimosacea pods were the most digested followed by ***Adansonia digitata*** and ***Calotropis*** procera leaves. Guiera and A. albida old leaves were of the lowest digestibility.

Variation between trials can be explained in part by plant age. ***Guiera*** leaves of june were more digested than that of March. Another variation factor involves ration composition. High level of ***Guiera*** does not seem to be accepted by sheep. It can be explained by a high level of tannins which fluctua-tes from 4 to 11 p100 DM (Kessler and Breman in preparation; IEMVT unpublished data).

In Calotropis leaves the between tria1 variations cannot be explained by the plant age in the current stage of our results. More investigations are needed to clarify the variety effect.

Finally the role of browse level could be a variation source. In the example of Adansonia leaves the same sample DM and OM digestibility varied within 20 points between 37 and 49 p100 of the ration. In case of a non toxic specie a hundred p100 browse diet is applicable to record information on intake and palatability. Current trials in LNERV give priority to the highest browse levels (50 to 100 p100).

So observed variations in the in vivo tria1 results, athought corresponding to litterature indications (see KESSLER and BREMAN review in preparation), suggest more precautions in sampling methods. One has to give large informations about variety sampling date and site to comment on the results.

**IN SACCO DEGRADATION OF TREE FORAGES:** (table 5 and 6; figure 1 and 2).

Legume pods had stable and good degradation profile. More of 70p100 of DM disappeared at 48 incubation time. A. albida leaves are variable and sensitive to age. Young leaves were highly degraded while old one were of poor intra-rumenal degradation (Fall, 1991). A. *raddiana* leaves and pods had a comparable and good degradation profile. Adansonia and Calotropis leaves are the most degraded sample (Deg 48h > 80p100) while guiera leaves were of poor degradation (Deg 48h < *40* p100).

Legume pods as well as Adansonia and Calotropis leaves of high rumen degradation are potential N source for ruminants.

Browse degradation profile is influenced by chemical composition. Cell wall components play a negative role (Bammualin et al., 1980 reported by Nitis, 1992.). Particularly N location into cell wall (Krishnamoorthy et al., 1982; Sanderson and Wedin 1989.). The major part of digestible **N** is located in cell solubles. ADFN is not important (less than 20p100 of total N) in tropical browses but it plays a significant (P<0.05) role in N degradability (Fall and Doreau 1993, in press). Our results confirm that as Guiera leaves, of highest ADF content, were the less degradable. Also the role of tannins is emphasized (Mc Leod, 1974.; Diagayete, 1981.; Reed et al., 1990. and Leinmuller et al., 1991.). Plant tannins depress browse digestibility. Differences in litterature reports can be explained in that the reaction tannins-proteins is governed by multiple factors such as tannin type, and level in feeds. Hydrolysable tannins can be modified by digestive enzymes and thus, do not depress CP digestion while condensed one precipitate with proteins forming indigestible complexes. Their effect in protein balance is negative.

Tanins level less 3 p100 (NITIS, 1992.)can give benefit in good quality proteins digestion by protecting them, for direct absorption in the small intestine. Above that level occurs a phenomenon of precipitation which makes them indigestible.
Tanin analysis are in progress in IEMVT for checking of their effect upon degradation.

INFLUENCE OF TREE FORAGES ON GROWING SHEEP PERFORMANCES:

Five trials were carried out to study secondary productivity of A, albida pods, *G. senegalensis, C. procera* and *A. digitata* leaves.

In tria1 5 (see table 7) G. senegalensis leaves were compared to *A. albida* pods. The average daily intake was close between the two groups and superior to the control one. *A. albida* pods group was significantly ($P<0.05$) higher in liveweight gain compared to *Guiera* one and the two groups were significantly different compared to the unsupplemented one which was at maintenance level. Guiera group were slightly higher in performance while A. albida pods ration allowed a semi-intensive growing. It can be compared to *Glyricidia sepium* which allowed a daily liveweight change (LWC) of 40g/day (Smith and Van Houter, 1987.) and *Albizia zygia, 800g* / day giving a LWC of 48g a day (Bouche1 et al., 1992.) while Konig et al. (1992) reportered a negative effect for *Atriplex nummularia* leaves at the level of 25 to 75 p100 of the diet in sheep performances wihch have lost 31 to 93g a day.

Guiera was compared to *C. procera* leaves in tria1 7 (see table 8). ***Calotropis*** group was superior in intake and animal performances.

Animal performances were higher for ***Guiera*** in tria1 5 compared to tria1 7. That result has been suprising as Guiera intake were superior in the last trial. It can be explained by the different nature of the basa1 diet made of early dry season bush hay of better quality compared to rice straw. A higher total DM intake (89 vs ***64*** g/Kg $P^{0.75}$) was also recordered.

***C. procera*** at the level of 1.5 p100 allowed semi-intensive growing of young sheep. Sundrying seems to alleviate eventual toxicity of that tree forage wihch is well consumed without any sign of toxicity.

Objectives of trial 3a, 3b and 8 (see tables 9, 10, and 11 respectively) were to study the influence of ***Adansonia digitata*** leaves on young sheep performances. We had many health problems in trial 3a; that's why a repetition was done in tria1 3b. Animal performances were 16 and 27g per day respectively for the level 100 and 200g per day. They were significantly superior ($P<0.05$) compared to the control group which was loosing 56g/day. The 300g level, expected to be higher, was close to the 200g one in term of liveweight change (21 vs 27g /day). The trial duration (70 days) might be a fimiting factor for maximum performance record as the liveweight curve was in ascending phase when it stopped. Those values are close to that of ***Alchomea cordifolia* (48** p100 of the diet) wich gave an average LWC of 25g (Kouonmenioc et al., 1992.)

CONCLUSION:

· Browses represents the only CP source available during the dry season for ruminants in pasture based systems of the dry tropics. Although their nutrient content can be high, the digestive utilisation may vary according to species, age, and plant part. ***A. albida*** and ***A. raddiana*** pods at the level of 15 to ***25*** p100 can achieve semi intensive fattening ( 16 to 30 g / day) in sheeps while C. ***procera*** and ***A. digitata*** leaves of higher nutrient content can be given to sheep up to 30 p100 level in the diet, in intensive fattening program. Current trials involve evaluation of intake and liveweight change of ration with higher proportion of tree forage for toxicity screening.

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## ACKNOWLEDGEMENTS:

The authors are indebted to Massamba Diop and Bernard Ahokpe for their technical support in feeding trial, to Bassirou Diaw for assistance in nylon bag studies and to M. Dione for the supply in plant material.

This work has been jointly funded by IFS (Grant N° B/1107-02) and EEC (ST2.A.75-IRL).

TABLE 1 CHEMICAL **COMPOSITION OF TREE FORAGES**

Mean **Value** g/ **Kg DM** (Range)

| SPECIES | PLANT-PART | N° | MS | MM | CP | NDF | ADF | Li |
|---|---|---|---|---|---|---|---|---|
| Acacia albida | Pods | 5 | 920 | 44 | 113 | | 385 | 221 |
| | | | (960-894) | (38-50) | (104-122) | | (388-390) | (120-275) |
| | Leaves | 4 | 918 | 99 | 152 | | 396 | 296 |
| | | | (896-955) | (88-109) | (128-194) | | (315-476) | (191-401) |
| Acacia roddiana | Pods | 7 | 913 | 61 | 176 | 471 | 341 | 144 |
| | | | (896-961) | (49-7 1) | (137-205) | (418-523) | (375-407) | (139-148) |
| | Leaves | 17 | 913 | 121 | 182 | 371 | 285 | 190 |
| | | | (864-959) | (98-180) | ('125-220) | (346-363) | (229-334) | (181-216) |
| Guiera senegalensis | Leaves | 30 | 915 | 75 | 109 | 615 | 517 | 98 |
| | | | (883-958) | (48-151) | (70-122) | (574-728) | (487-615) | (61-150) |
| Adansonia digitata | Leaves | 9 | 896 | 110 | 102 | 487 | 272 | 116 |
| | | | (872-928) | (56-1 39) | (52-138) | (521-452) | (157-360) | (61-171) |
| Calotropis procera | Leaves | 19 | 882 | 200 | 159 | 290 | 217 | 116 |
| | | | (854-908) | (68-242)<br>(379-151) | (242-68)<br>(68-242) | (276-302) | (199-241) | (81-109) |

Table 2: CHEMICAL COMPOSITION OF TREE FORAGES

Mean value
(range)

| rowse species | Ca g/Kg DM | P g/KgDM | CU ppm | Zn ppm | Na ppm | K ppm |
|---|---|---|---|---|---|---|
| cacia albida pods | 3.39 (2.4-4.4) | 1.63 (1.47-1.91) | 4.5 | 19.1 | 953 | 1.4 |
| cacia albida leaves | 17.51 (14.9-24.11) | 1.66 (1.33-2.01) | 7.3 (6.7-7.9) | 29.3 (27.5-31.2) | 832 (486-1178) | 1.1 (0.9-1.3) |
| .cacia raddiana pods | 8.12 (1.83-8.12) | 3.35 (1.82-8.74) | 3.4 (2.7-4) | 38.5 (29.7-50.9) | 41 (15-64) | 1.6 (1.2-1.8) |
| .cacia raddiana laves | 22.3 (15.3-31.7) | 1.67 (1.0-2.8) | 3.7 (2.2-6.7) | 29 (22.7-41.9) | 448 (116-947) | 1.2 (0.6-1.5) |
| uiera senegalensis | 15.2 (8.2-21.2) | 1.4 (0.5-1.8) | 10 (5.0-19.7) | 29 (13.7-64.3) | 315 (96-52 1) | 0.7 (0.3-1.1) |
| dansonio digitata aves | 24.9 (5.3-39.6) | 2.29 (1.0-6.10) | 8.6 (7.5-10.5) | 27.6 (25.9-3 1 .0) | 769 (449-1352) | 96 (84-65) |
| alotropis procera aves | 26.13 (13.8-49.4) | 2.2 (0-6-3.9) | 6.7 (4.0-8.0) | 36.4 (19.6-54.3) | 8771 (5833-12213) | 3.5 (2.0-6.9) |

TABLE 3: IN VIVO DIGESTIBILITY OF DIETS P. 100

| | DIET COMPONENT P. 100 | | | | | DIET DIGESTIBILITY P.100 | | |
|---|---|---|---|---|---|---|---|---|
| DIGESTIBILITY Nº | BROWSES | | GROUNDNUT CAKE | RICE STRAW | BUSH HAY | DM | OM | CP |
| 498 | Acacia albida old leaves | 50 | 1C | 4c | | 4o.c) | 42.9 | 26.4 |
| 499 | Acacia atbida nature fruits | 27 | 13 | 60 | | 53.4 | 57.3 | 69.8 |
| 16 | Acacia raddiana nature fruits | 52 | 11 | | 37 | 57.1 | 58.6 | 66.1 |
| 17 | Acacia raddiana nature fruits | 50 | 1C | | 40 | 55.5 | 57.3 | 61.4 |
| 500 | Guiera senegalensis leaves | 33 | 16 | 51 | | 43.9 | 47.8 | 52.1 |
| 4 | " | a | a | | 84 | | | |
| 6 | " | 8 | a | | a 4 | 49.1 | 47.7 | 58.7 |
| 5 | " | 16 | 8 | | 76 | | | |
| 7 | " | 15 | 8 | | 77 | 47.1 | 42.7 | 53.0 |
| 23 | " | 15 | 10 | | 75 | 52.7 | 55.4 | 51.4 |
| 18 | " | 42 | 12 | | 48 | 43.4 | 46.0 | 43.3 |
| 19 | " | 100 | | | | 10.3 | 10.8 | -70.0 |
| 20 | " | 75 | 25 | | | 35.7 | 35.7 | 25.4 |
| 3 | Calotropis procera leaves | 9 | 9 | | a2 | 50.9 | | |
| 2 | " | 11 | 10 | | 78 | 50.6 | | |
| 9 | " | 12 | 12 | | 76 | 48.7 | 50.5 | 65.8 |
| 22 | " | 16 | 11 | | 73 | 51.4 | 53.5 | 67.1 |
| 1 | " | 17 | 8 | | 75 | 55.9 | | |
| 10 | " | 20 | 12 | | 69 | 49.2 | 50.2 | 59.2 |
| 26 | Adansonia dtgitata leaves | 37 | 19 | 44 | | 62.7 | 66.1 | 67.1 |
| 27 | Adansonia digttata leaves | 49 | 10 | 41 | | 52.3 | 58.3 | 66.8 |

TABLE 4: BROWSE DIGESTIBILITY (DIFFERENCIAL METHOD OF CALCULATION)

| DIGESTIBILITY Nº | DATE | DIET COMPONENT P.100 BROWSES | | GROUNDNUT CAKE | RICE STRAW | BUSH HAY | BROWSE DIGESTIBILITY P.100 DM | OM | CP |
|---|---|---|---|---|---|---|---|---|---|
| 498 | | Acacia albida old leaves | 50 | 10 | 40 | | 28.0 | 31.2 | 14.0 |
| 499 | | Acacia albida nature fruits | 27 | 13 | 60 | | 65.9 | 70.7 | 100.0 |
| 16 | | Acacia raddiana nature fruits | 48 | 11 | | 37 | 62.1 | 64.0 | 77.3 |
| 17 | | Acacia raddiana nature fruits | 50 | 10 | | 40 | 61.2 | 63.2 | 69.2 |
| 500 | | Guiera senegalensis leaves | 33 | 16 | 51 | | 24.8 | 30.6 | |
| 4 | MARCH 88 | " | 8 | 8 | | 84 | 59.0 | 46.0 | 37.7 |
| 6 | MARCH 88 | " | 8 | 8 | | 84 | | | |
| 5 | MARCH 88 | " | 16 | 8 | | 76 | 40.6 | 18.6 | 33.0 |
| 7 | MARCH 88 | " | 15 | 8 | | 77 | | | |
| 23 | APRL 88 | " | 15 | 10 | | 75 | 70.6 | 68.0 | |
| 18 | APRIL 88 | " | 42 | 12 | | 48 | 33.3 | 40.7 | 29.3 |
| 19 | APRIL 88 | " | 100 | | | | 10.3 | 10.8 | -70.0 |
| 20 | APRIL 88 | " | 75 | 25 | | | 17.4 | 18.0 | 16.6 |
| 3 | APRIL 88 | Calotropis procera leaves | 9 | 9 | | 82 | | | |
| 2 | APRIL 88 | " | 11 | 10 | | 78 | | | |
| 9 | DECEM 88 | " | 12 | 12 | | 76 | 35.5 | 39.1 | 70.6 |
| 22 | JUNE 88 | " | 16 | 11 | | 73 | 59.8 | 52.5 | 67.6 |
| 1 | JUNE 88 | " | 17 | 8 | | 75 | | | |
| 10 | DECEM 88 | " | 20 | 12 | | 69 | 50.5 | 57.5 | 61.5 |
| 26 | SEPT 88 | Adansonia digitata leaves | 37 | 19 | 44 | | 70.5 | 71.0 | 100.0 |
| 27 | SEPT 88 | Adansonia digitata leaves | 49 | 10 | 41 | | 51.4 | 57.1 | 96.3 |

TABLE 5

IN SITU DM DEGRADATION OF TREE FORAGES

| TREE FORAGES | NO DIG | INCUBATION TIME (hours) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2 | 4 | 8 | 24 | 48 | 72 | 96 |
| Calotropis procera feuilles | 5 | 43.2 | 45.6 | 55.7 | 80.8 | 92.9 | 93.3 | 93.6 |
| Adonsonia digitata feuilles | 1 | 29.3 | 29.7 | 30.9 | 52.8 | 78.4 | 83.0 | 82.8 |
| Acacia raddiana feuilles | 3 | 34.7 | 35.1 | 36.7 | 50.6 | 66.9 | 72.4 | 73.3 |
| Acacia raddiana feuilles | 2 | 34.0 | 34.9 | 39.9 | 58.3 | 69.3 | 74.2 | 75.3 |
| Acacia albida feuilles | 2 | | | | 59.0 | 65.0 | 69.0 | |
| Acacia albida fruits | 1 | | | | 71.0 | 74.0 | 76.0 | |
| Guiera senegalensis feuilles | a | 29.2 | 31.4 | 31.3 | 34.8 | 39.6 | 41.2 | 44.3 |

* FALL 1991

TABLE 6 NITROGEN DEGRADATION IN TREE FORAGES P 100

| 'REE FORAGES | INCUBATION TIME (hours) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2 | 4 | 8 | 24 | 48 | 72 | 96 |
| *Calotropis procera* leaves | 61.7 | 63.2 | 73.0 | 89.6 | 96.6 | 97.2 | 97.5 |
| *Adansonia digitata* leaves | 21.1 | 25.0 | 26.1 | 44.6 | 80.5 | 85.9 | 85.6 |
| *Acacia raddiana* leaves | 21.6 | 21.3 | 21.7 | 39.9 | 67.5 | 76.3 | 78.7 |
| *Acacia raddiana* pods | 56.5 | 56.8 | 60.9 | 77.2 | 86.0 | 90.0 | 90.8 |
| *Acacia albida* leaves | | | 56.0 | 62.0 | 68.0 | 75.0 | |
| *Acacia albida* pods | | | 60.0 | 69.0 | 71.0 | 72.0 | |
| *Guiera senegalensis* leaves | 18.4 | 22.2 | 23.0 | 23.4 | 28.3 | 33.3 | 37.9 |

**TABLE 7: Influence of Acacia albida pods and Guiera senegalensis leaves on growing sheep performances**

| SHEEP LOTS | | I | II | III (control) |
|---|---|---|---|---|
| **ANIMAL DIETS: (Kg)** | | | | |
| Rice straw: | F | ad libitum | ad libitum | ad libitum |
| Peonut cake: | Cl | 0.1 | 0.1 | 0.125 |
| Acacia albida pods: | C2 | 0.2 | | – |
| Guiera senegalensis leaves: | C2 | | 0.2 | |
| **DRY MATTER INTAKE:** | | | | |
| g/head/day | F | 369 | 342 | 413 |
| | Cl | 90 | 91 | 118 |
| | c2 | 174 | 166 | |
| TOTAL: (g) | | 633 | 599 | 531 |
| TOTAL: g/KgPO .7 5 | | 63 | 64 | 54 |
| **LIVEWEIGHT:** | | | | |
| Starting: (Kg) | | 20.1 | 18.9 | 21.4 |
| End: (Kg) | | 23.1 | 20.8 | 21.0 |
| Average: (Kg) | | 21.6 | 19.8 | 21.2 |
| Total liveweight gain: (Kg) | | 3.0 | 1.9 | -0.4 |
| Daily liveweight gain: (g) | | 40.0 | 25.0 | -5.0 |

**TABLE 8: Influence of Calotropis procera and Guiera senegalensis leaves on growing sheep perfomances**

| SHEEP LOTS | | A | B | C control |
|---|---|---|---|---|
| ANIMAL DIETS: (Kg) | | | | |
| Bush hay: | F | ad libitum | ad libitum | ad libitum |
| Peanut cake: | Cl | 100 | 100 | 100 |
| Calotropis procera leaves: | c2 | – | 150 | |
| Guiera senegalensis leaves: | | 150 | | – |
| DRY MATTER INTAKE: | | | | |
| g/head/day | F | 716 | 824 | 743 |
| | Cl | 89 | 98 | 94 |
| | c2 | 105 | 126 | |
| TOTAL: (g) | | 910 | 1048 | 836 |
| TOTAL: g/Kg P0.75 | | 84 | 93 | 80 |
| LIVEWEIGHT: | | | | |
| Starting: {Kg) | | 22.0 | 22.6 | 2 1.6 |
| End: (Kg) | | 25.7 | 27.9 | 23.9 |
| Average: (Kg) | | 23.8 | 25.2 | 22.7 |
| Total liveweight gain: (Kg) | | 3.7 | 5.2 | 2.3 |
| Daily liveweight gain: (g) | | 40.0 | 59.0 | 25.0 |

**TABLE 9: Influence of Adansonia digitata leaves on growing sheep performances (trial N° 3a)**

| SHEEP LOTS | | I | II Control |
|---|---|---|---|
| **ANIMAL DIETS: (g)** | | | |
| Rice straw: | F | rd libitum | ad libitum |
| Peanut cake: | Cl | 75 | 150 |
| Adansonia digitata leaves: | c2 | 200 | 0 |
| **DRY MATTER INTAKE:** | | | |
| | F | 450 | 514 |
| g/head/day | Cl | 106 | 157 |
| | c2 | 191 | 0 |
| TOTAL: (g) | | 747 | 671 |
| TOTAL: g/KgP0 .7 5 | | 69 | 71 |
| **LIVEWEIGHT:** | | | |
| Starting: (Kg) | | 22.0 | 19.8 |
| End: (Kg) | | 25.7 | 20.0 |
| Average: (Kg) | | 23.8 | 19.9 |
| Total liveweight gain: (Kg) | | 3.7 | 0.2 |
| Daily liveweight gain: (g) | | 40.0 | 1.0 |

TABLE 10: Influence of Adansonia digitata on growing sheep performances (triai n°3b)

| SHEEP LOTS | | I | II | III control |
|---|---|---|---|---|
| ANIMAL DIETS: (g/head/day) | | | | |
| Rice straw: F | F | ad libitum | ad libitum | ad libitum |
| Peanut cake: | Cl | 100 | 100 | 100 |
| Adansonia digi tat a leaves: | c2 | 100 | 200 | 0 |
| DRY MATTER INTAKE: | | | | |
| g/head/day | C | 394 | 426 | 416 |
| | Cl | 91 | 92 | 93 |
| | C2 | 87 | 176 | 0 |
| TOTAL: (g) | | 572 | 694 | 509 |
| TOTAL: g/Kg P0.75 | | 56.1 | 66.7 | 55.7 |
| LIVEWEIGHT: | | | | |
| Starting: (Kg) | | 21.7 | 22.0 | 20.5 |
| End: (Kg) | | 22.6 | 23.5 | 17.7 |
| Average: (Kg) | | 22.1 | 22.7 | 19.1 |
| Total liveweight gain: (Kg) | | 0.9 | 1.5 | -2.8 |
| Daily liveweight gain: (g) | | 16.4 | 27.3 | -56.0 |

TABLE 11: Influence of Adansonia digitata on growing sheep performances (trial N° 8)

| SHEEP LOTS | | II |
|---|---|---|
| **ANIMAL DIETS:** (g/head/day) | | |
| Rice straw: | F | ad libitum |
| Peanut cake: | C1 | 150 |
| Adansonia digitata leaves: | C2 | 300 |
| **DRY MATTER INTAKE:** | | |
| | F | 309 |
| g/head/day | C1 | 124 |
| | C2 | 273 |
| TOTAL: (g) | | 706 |
| TOTAL: g/Kg P0.75 | | 75 |
| **LIVEWEIGHT:** | | |
| Starting: (Kg) | | 18.4 |
| End: (Kg) | | 19.9 |
| Average: (Kg) | | 22.5 |
| Total liveweight gain: (Kg) | | 1.5 |
| Daily liveweight gain: (g) | | 21.0 |

**Figure 3** - in situ degradation of Browses

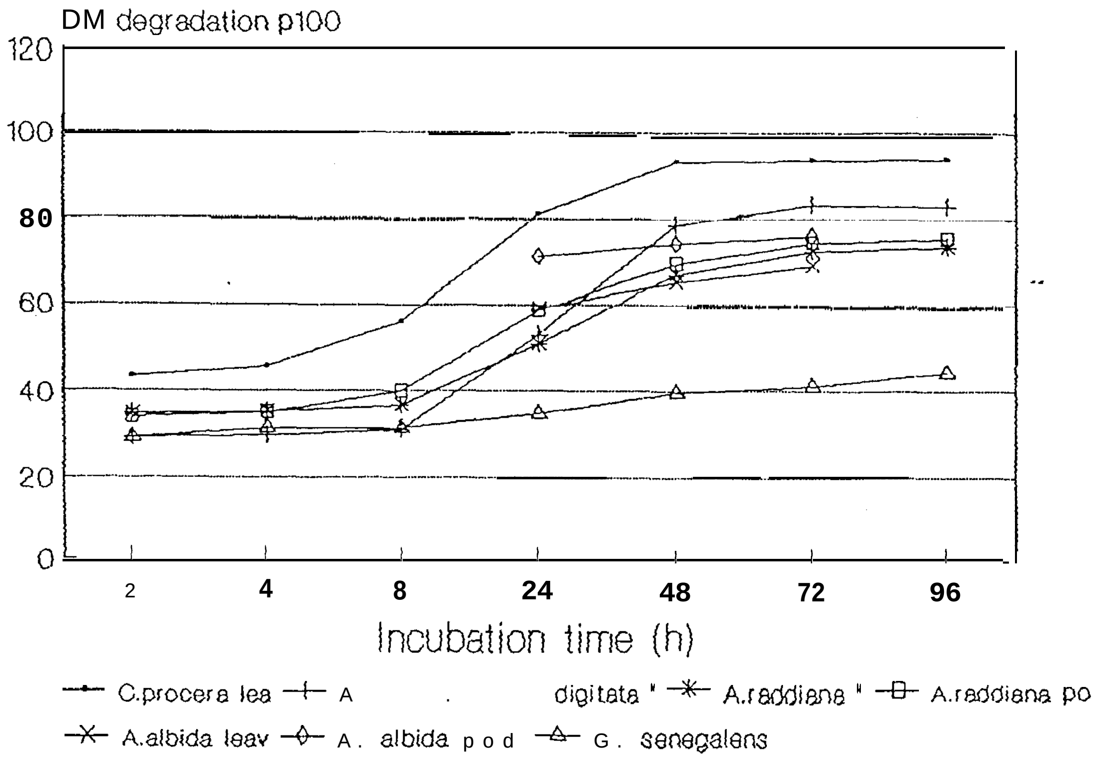


**Figure 4** - N degradation in browses