Identification and Nutritional Evaluation of Potential Indigenous Browse Species in Guba Lafto District, North Wollo, Ethiopia

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Abstract

The study was carried out in Guba lafto district, North Wollo zone of Amhara regional states of Ethiopia with the objective of identifying and nutritional evaluation of potential indigenous browse species. For the study the district was stratified in to three based on the altitude (low land, mid-high land and high land). Knowledgeable farmers of the three agro-ecologies were consulted to identify and describe major browse species of the areas. Foliage samples were collected and analyzed for their biomass yield and nutritional contents. Upon the study, 21 major browse species were identified, of which 14 species were trees and 7 species were shrubs. Among identified species Acacia seyal, Acacia brevispica, Acacia asak, Olea europaea, Ziziphus mauritiana, Dodonata viscosa were the most dominant species of the district. The average nutrient composition of browse species was not significantly different among the three agro-ecologies (p>0.05). But, there were significant differences among species of the same agro ecologies. Dodonata viscosa, Acacia asak, Grewia bicolor, Combretum molle, Dracentlystewedneri, Ziziphus Mauritana, Cordia africana, Acacia previspica, Croton macrostachyus, Salix suberrata, Helichrysumtrispinum, Croton dichgamus and Maesalanceolata had a greater CP content than the average CP content 20.40% reported in present study. Ash value ranged from 5.2-12.63%. Higher NDF content was observed in browses of low lands and mid-high lands (Grewia bicolor, 72% and Cordia africana 60.8%) respectively. Generally higher crude protein, low Ash, low NDF, low ADF and low ADL content was observed from highland. Lower CP, high NDF, high ADF and high ADL content was recorded from low land and mid-highland areas. The study result also indicated that the browse species identified could be used as protein supplement for dry seasons and therefore, detailed study on raising the species and further animal feeding experiment is required for better justification of their importance.

Keywords: Browse species; Guba lafto; Identification; Nutritional value; Indigenous

Introduction

In Ethiopia agriculture is the most important economic activity; accounting for about 50% of the Gross Domestic Product (GDP) of the country engaging more than 80% the population [1] and the sector generates 90% of export earnings [2]. Livestock which is an integral part of the agriculture contributes about 47% of agricultural economy [3]. This sub-sector adds significantly to the national food security and nutritional balance, provides raw materials such as milk and meat for the agro-processing industry, foreign exchange from the export of hides and skins, farm-yard manure, and draught oxen power for crop production.

Livestock in Ethiopia, as in many other parts of the world, is grazed on natural grass-based communal pastures, in land use systems that include forests, woodlands and swamps, and fallow lands. Many of the pasturelands located in these land use systems are declining in area because of conversion of land to crop agriculture and settlements [4-7]. Feeding of livestock in natural systems is therefore becoming a challenge and is partly limiting growth in the livestock sub-sector.

Seasonal availability of quality feed, high costs of supplementary concentrates and little knowledge about plantation of improved browse feed species also limits livestock productivity. The most contribution of browse species as animal feed is that it serves as a source of crude protein as well as ability of being green for longer time during the dry season [6,8]. Therefore, study on identification of indigenous browse plants feed types and their nutritive value, their spacial and temporal distribution is very important for sustainable feeding of livestock.

The first step in this direction is to generate information that will assist in making management decisions for pasture improvement leading to improved production from cattle. Such information includes knowledge of which species are currently exploited as fodder. Therefore, the present study was designed with the objective of identifying and evaluation of the nutritive value of potential indigenous Browse species of the district.

Materials and Methods
Description of the study area

The study was conducted in Guba lafto District, North Wollo zone of Amhara Regional state of Ethiopia. It is located at 9.11°, 14.59° North latitude and 36.31°, 39.81° East longitude and at distance of 520 km from Addis Ababa the capital city of Ethiopia. The District is bordered on the North Giddan District, North West by Meket district, North east by Kobbo district, South East by Habru district and in the West by Delanta and Wadila district. The district consists of 34 rural kebeles (The lowest administrative unit of Ethiopia) and 2 special urban administrative kebeles making a total of 36 kebeles.

Topography of the Woreda is made up of chain of mountains, hills, valleys and altitude ranging from 1379- 3809 meter above sea level (m.a.s.l), exposed for sever natural resource degradation mainly soil erosion and deforestation. Agriculture is predominant activity of livelihood characterized by both crop and livestock production [9].

Data collection

Selection of the study areas and sampling: Stratified random sampling was employed to select respondent households following kebeles (the smallest administrative unit of Ethiopia) and agro-ecology (highland, mid highland and low land) as unit of strata. For each agro ecology 2 kebeles were selected of which 30 households with a total of 240 were selected randomly. We used semi-structured interviews, guided questionnaires, and direct observations to collect the data on general household characteristics of the District. For the study and identification of indigenous browse plants three types of grazing land types; bushed grassland, at least two years fallowed grass land and river banks were included. Then we employed an ethnobotanical approach to document traditional knowledge associated with identification and use of indigenous multipurpose browse species (IMBS) by the local community of the District [6,10,11]. Accordingly, those plants listed as important for livestock feed were considered for assessment of their distribution in different grazing sites and for chemical analysis. Nine plots, each 10 m × 10 m and 50 m apart, arranged along a transect line was used to score the frequency of occurrence of the browse plants in each grazing site for each Kebele. The frequency of occurrence of each plant was determined by considering the number of plots in which it was recorded, as a percentage of the total plots in the respective grazing site. Foliage samples of the listed species were taken, then pressed by plant presser and preserved until sent for scientific identification at Addis Ababa University.

Determination of chemical composition

For chemical analysis fresh leaves and twigs of each browse species weighing about 300 g was collected and then oven-dried. The oven dried samples were ground in a Willey Mill to pass through 1mm sieve for the determination of chemical composition. Feed samples were analyzed for DM and ash using the method of [12]. Nitrogen was determined using the micro Kjeldhel method. Crude Protein (CP) was calculated as N × 6.25. Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Acid Detergent Lignin (ADL) Contents were analyzed according to Van Soest PJ [13].

Data analysis

The data were organized, summarized and analyzed using the SAS statistical package (SAS, 2001) [14]. For data involving frequencies, descriptive statistics were employed; whereas quantitative variables were analyzed using analysis of variance procedures and when the F-test showed significant differences, the Turkey test was used to separate group means.

Results

Livestock and constraints

The present study revealed three types of economic activities of the district. These were; Crop livestock production, only Livestock production and only crop production. Large number of surveyed households of the three agro-ecologies are engaged in crop livestock production which actually highest in highland areas, whereas, the largest livestock production was observed in lowland area (Figure 1). From participant observations and informal conversations we determined that cattle and other ruminant livestock are reared essentially, for economic reasons, i.e., to earn income from the sale of meat, dairy products, and hides and Skins, and the sale of live animals. Most of households keep oxen for their draught power. Livestock also feature highly in the cultural and social life of the Guba lafto district. Ruminant animals are killed during cultural rituals and local festivities such as weddings, and burials.

Major livestock production constraints are presented in figure 2. In the study district, livestock feed shortage was the major problem, especially in dry season. Among the constraints of livestock, feed shortage accounts about 61.7% in low land, 55% mid-highland and 48.3% high land areas. The study showed that the problem of feed shortage is followed by water shortage, animal diseases and predators in the district.

Identified indigenous multipurpose browse Species

Identified browse species: The list of indigenous multipurpose browse species identified with their vernacular and scientific names are indicated in table 1. Twenty one indigenous browse species were identified from the three agro-ecologies of the study area.
district of which eleven were found in lowland, nine in mid altitude and seven were identified in highland areas of the district. Most of browse plants identified from lowland and mid-high land areas were shrub type while, more tree species were observed in the high land.

**Distribution of identified browse species across types of grazing lands**

The frequency of occurrence of each plant species in different agro ecologies and three types of grazing lands of the study areas are presented in tables 2-4. The result indicate that the distribution of each species vary according to the type of grazing land and agro ecology. In highland *Helichrysum citrispinum* is the most frequently observed species on grazing area (12 individual/10 m²) and the list recorded (1 plant/10 m²) was *Salix subserata* from grazing land. On average ten *Acacia seyal* trees per 10 m² were observed in grazing lands of low land areas and on average 9 *Carissa edulis* per m² were observed around river bank areas of mid altitude. However *Salix subs errata* was the least frequently found species (Table 2).

**Chemical composition of identified browse feed resources**

The average CP, Ash, NDF, ADF and ADL contents of identified indigenous browse species is presented in below tables 5-7. The comparison among the species found in each agro ecologies didn't have shown impressive (P>0.05) differences in nutrient but, the differences were significant (P<0.05) among the species.

The CP content of the browse species ranged from 7.6% in *Euclearacemosa* to 37.8 in *Croton macrostachyus*. The overall average fiber NDF, ADF and ADL contents of selected indigenous browse species in different agro ecologies is presented in tables 5-8. The average NDF, ADF and ADL contents of identified indigenous browse species were comparable (P>0.05) along agro-ecologies but, wider (P<0.05) differences were recorded among the species.

However numerical difference was observed in *Euclea racemosa* in low land. This could be due to higher temperature of low land and time of harvest of sample as it was taken at dry season.

**Discussion**

The present study revealed feed shortage, water shortage, disease and predators as the major constraints of livestock production in Guba Lafto District. Among these feed shortages is said to be the first constraint especially during dry season in all agro-ecologies of the study areas. Similar problems of livestock production was reported in different agro-ecologies of the country [4-7] and elsewhere in
### Table 2: Distribution of browse species in grazing land type of lowland/10m².

| Browse species | RB/10m² | AHH/10m² | GA/10m² | Total |
|----------------|---------|----------|---------|-------|
| Acacia seyal   | 2       | 2        | 4       | 8     |
| Acacia asak    | 2       | -        | 3       | 5     |
| Combretum molle| -       | -        | 3       | 3     |
| Olea europea   | 1       | 2        | 2       | 5     |
| Dodonavia scosa| -       | -        | 4       | 4     |
| Carissa edulis | 3       | -        | 6       | 9     |
| Ziziphus mauritiana | 1 | 3       | 3       | 7     |
| Dracaena steudneri | - | -   | 4       | 4     |
| Grewia bicolor | -       | -        | 2       | 2     |
| Euclearamosia  | 3       | -        | 3       | 6     |
| Allophylus abyssinicus | - | -   | 2       | 2     |

RB=River Banks; AHH=Around Home Stead; GA=Grazing Area; m²= meter square

### Table 3: Distribution of browse species in grazing land type of mid-high land/10m².

| Browse species | RB/10m² | AHH/10m² | GA/10m² | Total |
|----------------|---------|----------|---------|-------|
| Dodonavia scosa | -       | 2        | 4       | 6     |
| Carissa edulis | 2       | -        | 5       | 7     |
| Ziziphus Mauritiana | - | 3       | 3       | 6     |
| Cordia Africana | -       | 2        | -       | 2     |
| Acacia seyal  | 3       | 2        | 3       | 8     |
| Acacia brevisca| -       | 2        | -       | 2     |
| Allophylus abyssinicus | 1 | -    | 2       | 3     |
| Ehretiacymosa | -       | 3        | 1       | 4     |
| Rhus glutinosa | -       | 1        | 1       | 2     |

RB=River Banks; AHH=Around Home Stead; GA=Grazing Area; m²= meter square

### Table 4: Distribution of browse species in grazing land type of highland/10m².

| Browse species | RB/10m² | AHH/10m² | GA/10m² | Total |
|----------------|---------|----------|---------|-------|
| Hagenia abyssinica | -       | 2        | -       | 2     |
| Salix subserata | -       | -        | 1       | 1     |
| Rhus glutinosa | -       | 1        | 3       | 4     |
| Helichrysum crispinum | - | 5   | 7       | 12    |
| Croton dichogamus | 2       | -        | 6       | 8     |
| Croton macrostachyus | 1      | 3        | 1       | 5     |
| Maesalanceola | -       | 3        | -       | 3     |

RB=River Banks; AHH=Around Home Stead; GA=Grazing Area; m²= meter square

### Table 5: Chemical composition of browse plants in low land areas of Guba lafto district.

| Browse species                  | DM (%) | Ash (%) | CP (%) | NDF (%) | ADF (%) | ADL (%) |
|--------------------------------|--------|---------|--------|---------|---------|---------|
| Allophylus abyssinicus         | 94     | 7.44±  | 14.92± | 40.40±  | 29.78±  | 6.66±   |
| Dodonavia scosa                | 95     | 6.31±  | 19.15± | 38.79±  | 27.36±  | 5.71±   |
| Ziziphus Mauritiana            | 96     | 9.37±  | 16.97± | 35.55±  | 25±     | 5.55±   |
| Euclearamosia                  | 96     | 6.25±  | 7.61±  | 56.31±  | 45.83±  | 11.23±  |
| Acacia seyal                   | 95     | 7.36±  | 27.3±  | 33.47±  | 23.15±  | 5.57±   |
| Carissa edulis                 | 95     | 8.42±  | 9.85±  | 56.72±  | 44.21±  | 11.15±  |
| Olea europea                   | 96     | 5.2±   | 8.44±  | 41.46±  | 31.25±  | 7.54±   |
| Acacia asak                    | 94     | 6.38±  | 28.18± | 46.36±  | 36.17±  | 7.68±   |
| Grewia bicolor                 | 93     | 6.45±  | 20.35± | 72.47±  | 60.21±  | 17.58±  |
| Combretum molle                | 95     | 6.31±  | 18.26± | 35.36±  | 25.26±  | 5.71±   |
| Dracaena steudneri             | 96     | 9.37±  | 24.19± | 38.46±  | 27.0±   | 6.82±   |
| Mean                           | 95.4±  | ± 0.7   | ± 0.7  | ± 0.7   | ± 0.7   | ± 0.7   |

Significance NS *** *** *** ***

DM=Dry Matter; CP=Crude Protein; NDF=Neutral Detergent Fiber; ADF=Acid Detergent Fiber; ADL=Acid Detergent Lignin; %=Percent; ***=significant at ≤0.001; NS=Not Significant

### Table 6: Chemical composition of browse plants in mid-high land areas of Guba lafto district.

| Browse species                  | DM (%) | Ash (%) | CP (%) | NDF (%) | ADF (%) | ADL (%) |
|--------------------------------|--------|---------|--------|---------|---------|---------|
| Allophylus abyssinicus         | 96     | 11.45±  | 10.4±  | 36.67±  | 25±     | 5.55±   |
| Dodonavia scosa                | 96     | 5.2±   | 17.43± | 31.24±  | 22.91±  | 5.58±   |
| Ziziphus Mauritiana            | 95     | 7.36±  | 28.55± | 27.12±  | 18.94±  | 3.41±   |
| Acacia seyal                   | 94     | 6.38±  | 22.87± | 40.36±  | 31.91±  | 7.78±   |
| Cordia Africana                | 96     | 12.5±  | 30.0±  | 60.08±  | 47.91±  | 12.36±  |
| Carissa edulis                 | 97     | 6.18±  | 8.75±  | 54.32±  | 41.23±  | 10.31±  |
| Rhus glutinosa                 | 97     | 6.18±  | 17.0±  | 33.45±  | 22.68±  | 4.47±   |
| Ehretiacymosa                  | 95     | 12.63± | 16.7±  | 51.28±  | 23.15±  | 4.47±   |
| Acacia brevisica               | 94     | 7.44±  | 19.8±  | 52.24±  | 40.42±  | 8.92±   |
| Mean                           | 95.6±  | ± 0.4   | ± 0.8  | ± 0.1   | ± 0.4   | ± 0.2   |

Significance NS *** *** *** ***

DM=Dry Matter; CP=Crude Protein; NDF=Neutral Detergent Fiber; ADF=Acid Detergent Fiber; ADL=Acid Detergent Lignin; %=Percent; ***=significant at ≤0.001; NS=Not Significant
Table 7: Chemical composition of browse plants in high land areas of Guba lafto district.

| Browse species          | DM (%) | Ash (%) | CP (%) | NDF (%) | ADL (%) |
|-------------------------|--------|---------|--------|---------|---------|
| Croton macrostachyus    | 93     | 9.67    | 37.83  | 40.31b  | 30.1a   | 6.72a  |
| Salix subserata         | 94     | 7.44a   | 22.78a | 53.46a  | 42.55a  | 10a    |
| Helichrysumcitrinipinum | 95     | 9.47    | 25.48a | 30.25a  | 21.0a   | 4.47a  |
| Hagenioabbyssinica      | 91     | 5.49    | 17.37a | 35.41a  | 24.17a  | 5.57a  |
| Croton dichogamus       | 91     | 5.49    | 29.1a  | 29.73a  | 19.78a  | 3.41a  |
| Maesalanceolata         | 93     | 11.82a  | 33.89a | 38.57a  | 27.95a  | 5.47a  |
| Rhusglutinosa           | 93     | 6.45a   | 17.19a | 38.86a  | 27.95a  | 5.46a  |

Table 8: Average Chemical composition of browse species along altitude.

| Altitude    | DM (%) | Ash (%) | CP (%) | NDF (%) | AF (%) | ADL (%) |
|-------------|--------|---------|--------|---------|--------|---------|
| Lowland     | 95 ± 0.4 | 7.17 ± 0.68 | 17.78 ± 0.7 | 45 ± 3.4 | 34.11 ± 3.1 | 8.29 ± 0.95 |
| Mid-high land | 95.6 ± 0.4 | 8.37 ± 0.76 | 19.06 ± 2.5 | 40.75 ± 3.7 | 30.5 ± 3.4 | 6.98 ± 1.1 |
| Highland    | 92.7 ± 0.9 | 7.98 ± 0.59 | 26.23 ± 0.1 | 38.08 ± 0.94 | 27.64 ± 0.9 | 5.87 ± 1.2 |
| Mean        | 94.63 | 7.78    | 20.40  | 41.79  | 31.22  | 7.23   |

Conclusion

Livestock production is the major economic activity of Guba Lafto District. To counter the long term impact of declining feed resources in the country and study area in particular indigenous multipurpose browse plants with higher CP and lower fiber contents recorded in Guba Lafto district could be used to improve the fibrous less nutritious feed resources of dry season.

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