Chemical Composition of Forage Species from the Gadoudhe Range, in Fabidji Rural Municipality (Niger)

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ABSTRACT—*This study was conducted in the rural commune of Fabidji in the Gadoudhe range. It assessed the chemical composition of the forage species of the said range; which is a fallback area par excellence for the animals of the commune.*
33 natural herbaceous and woody forage species of the Gadoudhe range were collected and characterized by determining the chemical composition. Thus, the TNM contents of the forage resources of the range are < 10%. At the herbaceous level, the species richest in TNM are represented by Pupallia lappacea, Zornia glochidiata, Citrillus lanatus and Mollugo nudicaulis. For woody plants, Maerua crassifolia is the richest species. The natural herbaceous fodder studied is rich in crude cellulose (CC). More than 50% of the herbaceous plants have their CC contents higher than 30%. As for natural woody fodder, 66% of the species have their CC levels between 18 and 22%. The results of the determination of the chemical composition of the fodder reveal higher MM contents in natural herbaceous plants than in woody plants. Natural herbaceous fodder is less rich in fat than woody fodder.
The results of the dosage of MM, CC, fat, and TNM of natural herbaceous and woody fodder of the Gadoudhe course made it possible to assess the forage quality of each species studied.

Keywords— Chemical composition, Forage species, Gadoudhé range, Fabidji, Niger

1. INTRODUCTION

In the Introduction section, present clearly and briefly the problem investigated, with relevant references. The main results should be enunciated.

Feeding livestock is a multidimensional and recurring problem for livestock farmers. They must meet the nutritional needs of maintenance and production of animals by optimizing feed costs and avoiding waste and pollution. Feed represents the largest part of the operational costs of animal production, from 25 to 70% of the total production cost [19]. The quality of forage resources is an important factor in the ruminant feeding system. It is also an important parameter in the development of livestock farming. Natural ecosystems are full of forage potential that provides most of the feed for ruminant livestock in low-income countries [21].

According to [4], ruminants obtain 90-95% of their food from fodder, covering between 70 and 80% of their energy needs.

From a nutritional point of view, fodder is characterized by its nutritional value (energy value, nitrogen value, mineral content, vitamins, etc.) and by its ingestibility, which is the quantity of dry matter voluntarily ingested by a ruminant that receives this fodder at will [9].

But these natural ecosystems dedicated to pastoralism where pastoralists have a priority right of use are subject to several threats. Among other threats, the expansion of cultivated lands following population growth which, according to

[13], doubles every 25 years in Niger.

In the Sahel in general and in Niger in particular, the demographic growth of livestock is coming up against strong land pressures which are leading to a reduction and progressive degradation of pastoral resources.

However, the expansion of crops is far from being the only threat to pastoral resources. Recent statistics published by the Niger Chambers of Agriculture Network (RECA) and the Association for the Revitalization of Livestock Farming in Niger (AREN) estimate that 33,828 hectares of pastoral land were subject to illegal land registrations between 2008 and 2014. In addition to these losses, there are 53,875 hectares of fenced ranches in the middle of pastoral areas, under the cover of the right to property granted on the pastoralists' homelands [12].

The rural commune of Fabidji is not spared from these threats. It is characterized by a lack of pastoral spaces compared to the size of its livestock. The Gadoudhe course, which constitutes the main course of the commune, is suffering the full brunt, in addition to land pressure, of the impacts of the increase in the frequency of climatic hazards on the production and quality of biomass. It is facing an advanced degradation of its ecosystem as evidenced by the quantity of its qualified fodder which is estimated at 283.61 kg DM/ha corresponding to a carrying capacity of 0.041 UBT/ha [10]. In a local context marked by a desire to secure and restore land to limit the loss in quantity and quality of available fodder, knowledge of the chemical composition of the fodder species of the course is undeniable for the sustainable management of said course. However, the chemical composition of the species present on the route has never been the subject of investigation.

This is why this study seeks to know if the knowledge of the chemical composition of the species makes it possible to assess the forage quality of the species of the range.

The overall objective of this study is to evaluate the chemical composition of the forage species of the Gadoudhe range, a fallback area par excellence for the animals of the rural commune of Fabidji.

The specific objectives assigned to this study aim to:

-Collect samples of forage species from the Gadoudhe course;

-Determine the chemical composition of the forage species of said course.

2. MATERIALS AND METHODS

2.1. Materials

2.1.1. Presentation of the study area

The rural commune of Fabidji (where the Gadoudhe route is located) was created by law n°2002-014 of June 11, 2002 establishing communes and establishing the names of their capitals, amended and supplemented by ordinance n°2009-002/PRN of August 18, 2009. It is located in the center-west of the department of Boboye (Dosso region) between 12°25' and 13°10' North latitude and 2°30' and 2°57' East longitude.

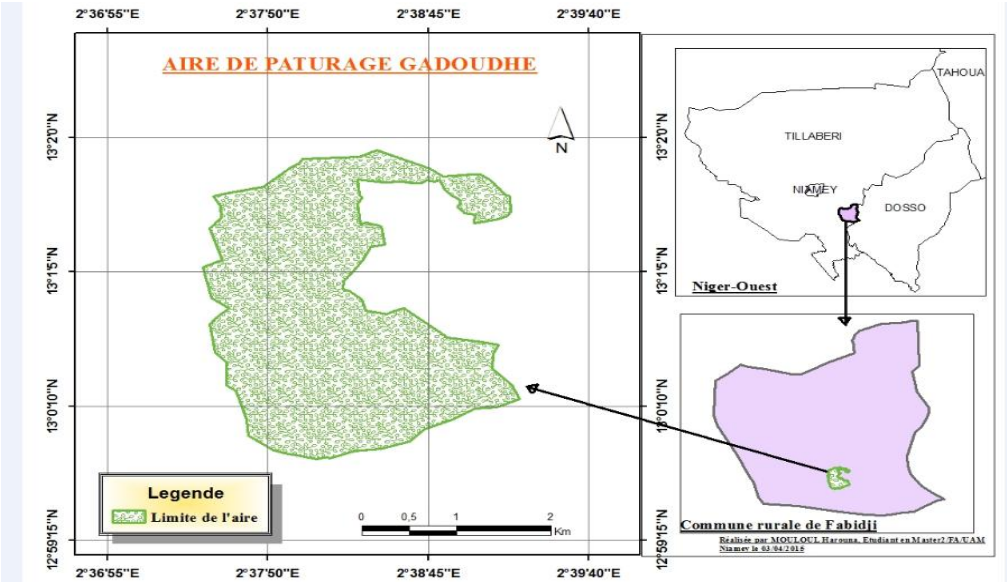

Figure 1: The Gadoudhe route

2.1.2. Plant material

The plant material consists of 33 forage species, representing the floristic richness of the Gadoudhe course.

2.1.2.1. Collection and analysis equipment

2.1.2.1.1. Collection equipment

The sample collection equipment consists of:

-A scale with a capacity of 1000g, for weighing the samples;

-Biodegradable plastic bags, for packaging the samples;

-Pruning shears for cutting;

-A3 envelopes, for packaging the dried samples;

-An information collection sheet.

2.1.2.1.2. Analytical equipment

The equipment used in the animal production laboratory of the National Institute of Agronomic Research of Niger is as follows:

-reagents;

-a mortar, pestle, sieve and plastic pots for grinding and conditioning samples;

-a precision balance for weighing the samples to be analyzed;

-an oven for drying samples and determining the DM;

-a muffle furnace for incinerating samples to determine the MM;

-a mineralizer for mineralization to convert organic nitrogen into mineral nitrogen;

-a distiller for determining the TNM;

-glassware.

2.2. Method

2.2.1. Sample collection

33 samples of homogeneous natural forage species were identified and collected, including 9 woody plants and 24 herbaceous plants. For woody plants, the leaves were collected, while for herbaceous plants, the full cutting method was applied, consisting of cutting all the plant material on the ground at ground level. Each sample of woody species was collected on 3 plants, including 1 located at the northern end of the route, 1 in the middle and the last at the southern end of the route. And each sample of herbaceous species was collected on the same grassy carpet where the cutting began. For herbaceous plants, the cuts were made at the time of the growth phase - development, flowering, fruiting or maturity. As for woody plants, they were made at the time of leafing. The samples were packaged in biodegradable bags at the course level, dried in the shade and sent to the Animal Production and Nutrition Analysis laboratory of the National Institute of Agronomic Research of Niger for analysis.

2.2.2. Determination of chemical composition

The determination of chemical composition involved the analysis of dry matter (DM), mineral matter (MM), total nitrogenous matter (TNM), fat and crude cellulose (CC).

2.2.2.1. Determination of analytical dry matter (% ADM)

- **Principle**

The principle consists of placing 2 g of sample in an oven maintained at 105°C until a constant weight is obtained. All the water evaporates and the dry residue after drying is called the dry matter (DM).

- **Calculation formula**

The analytical dry matter content of the sample is calculated by the formula:

% ADM = [(P2 – Pv) / (P1 – Pv)] x 100

P1: weight of the crucible before drying (g)

P2: weight of the crucible after drying (g)

Pv: weight of the empty crucible (g)

2.2.2.2. Determination of total ash or mineral matter (MM) contents

When the sample is subjected to incineration in a furnace at 550°C for about 6 hours, the organic matter is consumed and the residual matter represents the weight of the minerals (ash) in the sample (A.O.A.C, 1990). After calcination, the crucibles will be cooled in a desiccator to be weighed (AOAC, 1999).

The total ash content of the sample is calculated by the following formula:

% TA = [(P2 – P0) /P1] *100

P0: weight of the empty crucible

P1: sample weight (5g)

P2: weight of the crucible + dry matter (g)

2.2.2.3. Determination of crude cellulose (CC)

- **Principle**

The CC content is determined according to the WEENDE method. The principle consists in determining the cellulosic residues obtained after a double acid and alkaline hydrolysis, containing a variable fraction of lignin and hemicelluloses.

- **Formula and calculation**

The crude cellulose content is obtained by the following formula:

% CC = [(P2 – P3) / P1] x 100

P1: sample weight (g)

P2: crucible weight + cellulose + mineral matter (g)

P3: crucible weight + mineral matter (g)

2.2.2.4. Determination of total nitrogenous matter (TNM)

- **Principle**

Total nitrogen is determined by the Kjeldhal method. Organic nitrogen is transformed into ammoniacal nitrogen (ammonium sulfate) by mineralization with concentrated sulfuric acid in the presence of a catalyst (selenium). The ammoniacal nitrogen is then displaced by a strong base and the released ammonia is determined using a 0.2 N sulfuric acid solution.

- **Formula and calculation**

Nitrogen (%) = [[[H2SO4] *14*(V-V0)] /Pe*1000] *100

% TNM = Nitrogen (%) x 6.25

V: volume in ml of H2SO4 used for the test

V0 = volume in ml of H2SO4 used for the control

Ts: test sample

2.2.2.5. Determination of fats

- **Principle**

Lipids are compounds that are soluble in organic solvents (petroleum ether, hexane).

The principle consists of extracting a test sample with hexane by percolation, followed by removal of the solvent by distillation, then drying the residue in an oven and weighing.

b) Formula and calculation

%Fat = [(P3 – P2) /P1] *100

P1: sample weight (5g);

P2: weight of the empty flask;

P3: weight of the flask + fats.

3. RESULTS

24 samples of natural herbaceous fodder and 9 samples of natural woody fodder were collected in the Gadoudhe range. For each sample collected, the family, species, phenological stage and green weight as well as the chemical composition were determined.

3.1. Nominal list of natural herbaceous and woody fodder collected in the Gadoudhe range

The scientific name of each species, green weight and phenological stage are presented in Tables 1 and 2. The phenological stage of the collected natural herbaceous fodder varies from growth-development to maturity, that of the woody was leafing.

3.1.1. Nominal list of natural herbaceous fodder

Table 1: Nominal list, green weight and phenological stage of natural herbaceous fodder collected in the Gadoudhe range

Family	Species	Phenological stage	Green weight (g)
Fabaceae	*Zornia glochidiata*	Maturity	500
	Aeschynomene indica	Fruiting	500
	Tephrosia purpurea	Fruiting	500
Malvaceae	*Sida cordifolia*	Bloom	500
Commelinaceae	*Commelina bengalensis*	Maturity	500
Rubiaceae	*Mitracarpus scaber*	Bloom	500
Amaranthaceae	*Pupallia lappacea*	Bloom	500
	Pandiaka involucrata	Bloom	500
Poaceae	*Aristida mutabilis*	Maturity	500
	Cenchrus biflorus	Maturity	500
	Pennisetum pedicellatum	Bloom	500
Acanthaceae	*Monechma siliatum*	Bloom-fruiting	500
Cyperaceae	*Fimbristylis spp*	Bloom	500
	Cyperus amabilis	Fruiting	500
Molluginaceae	*Mollugo nudicaulis*	Bloom	500
Convolvulaceae	*Ipomoea asarifolia*	Growth development	500
	Merremia pinnata	Fruiting	500
	Jacquemontia tamnifolia	Bloom-fruiting	500
Caryophyllaceae	*Polycarpea spp*	Bloom	500
Caesalpinaceae	*Cassia mimosoides*	Bloom	500
Cucurbitaceae	*Cucumis melo*	Bloom-fruiting	500
	Cucumis prophetarum	Bloom-fruiting	500
	Citrillus lanatus	Bloom	500
Euphorbiaceae	*Phyllanthus pentandrus*	Fruiting	500

3.1.2. Nominative list of natural woody fodder

Table 2: Nominative list, green weight and phenological stage of woody plants collected in the Gadoudhe course.

Family	Species	Phenological stage	Green weight (g)
Combretaceae	*Combretum nigricans*	Hardwood	500
	Combretum glutinosum	Hardwood	500
	Combretum micrantum	Hardwood	500
Rubiaceae	*Gardiena erubesens*	Hardwood	500
Capparidaceae	*Maerua crassifolia*	Hardwood	500
Mimosaceae	*Albizzia chevalieri*	Hardwood	500
	Acacia macrostachya	Hardwood	500
Caesalpinaceae	*Cassia sieberana*	Hardwood	500
Anacardiaceae	*Sclerocarya birrea*	Hardwood	500

3.2. Chemical composition of natural herbaceous and woody plants collected in the Gadoudhe course

3.2.1. Chemical composition of natural herbaceous plants collected in the Gadoudhe course.

The chemical composition of natural herbaceous fodder species collected in the Gadoudhe course was determined by laboratory analysis tests. The result obtained is recorded in Table 3.

Table 3: Chemical composition of natural herbaceous plants collected in the Gadoudhe course.

Family	**Species**	**Phenological stage**	**DM (%)**	**%DM**			
				MM (%)	CC (%)	Fat (%)	TNM (%)
Fabaceae	*Zornia glochidiata*	Maturity	95,8±0,01	10,6±0,35	31,2±0,10	2,4±0,00	13,2
	Aeschynomene indica	Fruiting	95,0±0,12	6,0±0,05	45,5±0,10	6,0±0,00	5,5
	Tephrosia purpurea	Fruiting	96,3±0,00	4,6±0,20	33,2±0,19	1,3±0,00	10,2
Malvaceae	*Sida cordifolia*	Bloom	95,4±0,017	8,0±0,02	42,0±0,78	1,0±0,00	8,5
Commelinaceae	*Commelina bengalensis*	Maturity	96,1±0,18	23,8±0,19	25,7±0,32	1,5±0,00	6,4
Rubiaceae	*Mitracarpus scaber*	Bloom	95,3±0,28	10,4±0,15	33,4±0,45	2,5±0,00	6,5
Amaranthaceae	*Pupallia lappacea*	Bloom	95,9±0,04	20,3±0,03	26,7±0,15	1,0±0,00	14,2
	Pandiaka involucrata	Bloom	97,0±0,01	13,3±0,22	31,0±0,43	2,3±0,00	8,7
Poaceae	*Aristida mutabilis*	Maturity	97,1±0,04	6,0±0,03	45,3±0,01	0,7±0,00	5,0
	Cenchrus biflorus	Maturity	97,0±0,04	9,3±0,19	40,6±0,89	0,9±0,00	6,4
	Pennisetum pedicellatum	Bloom	95,1±0,12	11,8±0,17	38,0±0,49	11,9±0,00	5,8
Acanthaceae	*Monechma siliatum*	Bloom-fruiting	94,5±0,02	10,4±0,08	30,1±±0,27	1,6±0,00	6,1
Cyperaceae	*Fimbristylis spp*	Bloom	95,0±0,05	6,3±0,25	29,2±0,24	2,3±0,00	4,7
	Cyperus amabilis	Fruiting	96,3±0,66	6,5±0,09	25,3±0,73	1,0±0,00	6,2
Molluginaceae	*Mollugo nudicaulis*	Bloom	96,2±0,19	17,2±0,74	23,2±0,90	1,1±0,00	12,4
Convolvulaceae	*Ipomoea asarifolia*	Growth development	95,7±0,07	18,6±0,22	24,2±0,10	2,4±0,00	9,9
	Merremia pinnata	Fruiting	95,9±0,02	6,4±0,15	26,3±0,46	4,9±0,00	7,4
	Jacquemontia tamnifolia	Bloom-fruiting	95,3±0,01	8,5±0,06	25,7±0,49	9,0±0,00	7,0
Caryophyllaceae	*Polycarpea spp*	Bloom	95,7±0,04	7,0±0,10	32,8±0,81	2,9±0,00	5,0
Caesalpinaceae	*Cassia mimosoides*	Bloom	96,2±0,01	4,7±0,10	30,6±0,23	1,8±0,00	10,5
Cucurbitaceae	*Cucumis melo*	Floraison-fructification	95,2±0,08	24,1±0,01	20,5±0,19	2,6±0,00	10,0
	Cucumis prophetarum	Bloom-fruiting	94,0±0,01	22,4±0,01	25,3±1,73	1,8±0,00	10,0
	Citrillus lanatus	Bloom	95,3±0,09	12,9±0,03	15,5±0,23	4,6±0,00	13,3
Euphorbiaceae	*Phyllanthus pentandrus*	Fruiting	94,0±0,02	4,5±0,04	31,0±0,93	6±0,00	5,4

MS: dry matter; MM: mineral matter; CC: crude cellulose; TNM: total nitrogenous matter.

The chemical composition of the natural herbaceous fodder of the Gadoudhe course was assessed by the dosage of the following classic parameters: DM, MM, Fat, CC and TNM. Table 3 shows that the dry matter content of the samples studied varies from 94.0±0.01% to 97.0±0.04%, with a significant proportion of samples (87.5%) exceeding 95%.

There is a very high variability in the mineral matter (MM) contents of the herbaceous plants of the Gadoudhe course. These vary from 4.6±0.20% to 24.1±0.01% with 50% of the herbaceous plants having MM contents greater than or equal to 10%. The highest MM rates were recorded for herbaceous species such as *Pupallia lappacea*, *Commelina* bengalensis, *Cucummis melo* and *Cucummis prophetarum* with respectively 20.3±0.03; 23.8±0.19; 24.1±0.01; 22.4±0.01.

The crude cellulose content of the herbaceous samples studied varies from 20.5±0.19% to 45.5±0.10%. The results of the analyses show three essential groups according to the crude cellulose contents:

-the group of herbaceous plants with contents between 20 and 30%, representing 41.6% of the samples studied;

-the group of herbaceous plants with contents between 30 and 40%, representing 37.5% of the samples studied;

-the group of herbaceous plants with contents greater than 40%, representing 16.6% of the samples studied.

The highest CC contents were obtained with *Sida Conrdifolia* (42.0±0.78%), *Aristida Mutabilis* (45.3±0.01%), Cenchrus biflorus (40.6±0.89%), *Aeschynomene Indica (45.5±0.10%), Pennicetum pedicellatum* (38.0±0.49%) and the lowest with *Cucumis melo* (20.5±0.19%).

The variation in fat content was relatively low (from 0.7±0.00% to 2.9±0.00%) from one species to another for more than 70% of the species studied. The highest rates were recorded with *Citrillus lanatus* (4.6±0.00%), *Merremia pinnata* (4.9±0.00), *Aeschynomene Indica* (6.0±0.00%), *Phylanthus pentandrus* (6±0.00%), *Jacquemontia Tomnifolia (*9.0±0.00%) and *Pennicetum pedicellatum* (11.9±0.00%). More than 66% of the samples studied have a TNM rate lower than 10%.

This rate shows that the natural herbaceous fodder of the Gadoudhe range is poor if we stick to the range (TNM > 10% and NDF < 30% is equivalent to good quality fodder) given by Bouazza (2012) and ignoring the NDF content. The range species richest in TNM are represented by *Pupallia lappacea* (14.2%), *Zornia glochidiata* (13.2%), *Citrillus lanatus* (13.3%), *Mollugo nudicaulis* (12.4%). *Fimbristylis spp* (4.7%) represents the species poorest in TNM.

3.2.2. Chemical composition of natural woody plants collected in the Gadoudhe range

Table 4 presents the chemical composition of woody fodder species collected in the Gadoudhe range. The study focused on 5 classic parameters namely dry matter (DM), mineral matter (MM), crude cellulose (CC), fats and total nitrogenous matter (TNM).

Table 4: Chemical composition of natural woody plants collected in the Gadoudhe route

Family	**Species**	**Phenological stage**	DM (%)				
			DM (%)	MM (%)	CC (%)	Fat (%)	TNM (%)
Combretaceae	*Combretum nigricans*	Hardwood	96,0±0,13	5,6±0,18	21,2±0,31	1,6±0,00	5,9
	Combretum glutinosum	Hardwood	94,0±0,03	3,4±0,06	21,3±0,10	8,5±0,00	7,9
	Combretum micrantum	Hardwood	95,2±0,07	8,4±0,06	21,3±0,10	8,2±0,00	5,0
Rubiaceae	*Gardiena erubesens*	Hardwood	97,0±0,11	5,3±0,04	22,7±0,21	2,6±0,00	7,0
Capparidaceae	*Maerua crassifolia*	Hardwood	95,4±0,01	9,0±0,91	20,3±0,01	1,2±0,00	14,7
Mimosaceae	*Albizzia chevalieri*	Hardwood	96,0±0,03	4,6±0,02	35,1±0,13	7,7±0,00	8,6
	Acacia macrostachya	Hardwood	95,8±0,18	6,3±0,43	18,0±0,15	2,2±0,00	8,7
Caesalpinaceae	*Cassia sieberana*	Hardwood	94,5±0,01	3,7±0,07	31,2±0,13	2,9±0,00	8,1
Anacardiaceae	*Sclerocarya birrea*	Hardwood	93,5±0,01	5,6±0,07	12,1±0,11	12,1±0,11	4,3

MS: dry matter; MM: mineral matter; CC: crude cellulose; TNM: total nitrogenous matter.

The results of the analyses show a low variation in dry matter content (93.5±0.01% to 97.0±0.11%). More than 66% of the woody species studied have DM contents greater than 95%.

The mineral matter (MM) contents of the samples studied vary from 3.4±0.06% to 9.0±0.91%. The species richest in mineral matter are *Maerua crassifolia* (9.0±0.91%) and *Combretum micrantum* (8.4±0.06%) while the least rich species are represented by *Combretum glutinosum* (3.4±0.06%) and *Cassia sieberana* (3.7±0.07%).

The natural woody fodder of the Gadoudhe range is characterized by generally homogeneous crude cellulose (CC) and fat contents. CC contents vary from 12.1±0.11% to 35.1±0.13% with a significant proportion (over 66%) of woody plants having CC levels between 18 and 22%. The highest concentrations are obtained with *Albizzia chevalieri (*35.1±0.13%) and *Cassia sieberana* (31.2±0.13%) while *Sclerocarya birrea* is characterized by the lowest content (12.1±0.11%), which makes it the range species with the lowest CC content. As for the fat content, the richest forage resources are: *Combretum micrantum* (8.2±0.00%), *Combretum glutinosum* (8.5±0.00%), *Albizzia chevalieri* (7.7±0.00%), *Sclerocarya birrea* (12.1±0.11%).

The total nitrogen mater content (TNM) of the woody species of the Gadoudhe range is between 7 and 8%. The species poorest in TNM are represented by Combretum nigricans (5.9%), *Combretum micrantum* (5.0%), *Sclerocarya birrea* (4.3%) representing 33% of the samples collected. The species richest in TNM is *Maerua crassifolia* with a rate of 14.7%. The woody fodder of the Gadoudhe range having a TNM rate overall lower than 10%, can be considered as poor fodder.

4. DISCUSSION

The chemical composition of forage species is a key indicator for assessing the forage quality of a pasture. According to the work carried out by [5] a fodder is of good quality if it is characterized by MAT values >10% of DM and NDF levels <30%, poor if it contains MAT contents <10% and NDF contents>50%.

The results of chemical analyses carried out in the laboratory on the forage resources of the Gadoudhe range revealed dry matter contents of forage grasses that vary between 94.0±0.01% to 97.0±0.04% with a significant proportion of samples (87.5%) exceeding 95%. These values are similar to those obtained by [15] in Algeria on *Cymbopogon schoenanthus* (87.43%), *Cynodon dactylon* (91.11%), *Cypreus conglomeratus* (93.2%), Aristida plumosa (91.07%), Panicum turgidum (93%). However, they are higher than those obtained by [3] in Benin on herbaceous species palatable to ruminants on natural rangelands in northeastern Benin. This difference could be explained by the method of grinding the collected samples, which consisted of pounding them using a mortar and pestle. This grinding method causes the samples to lose a certain amount of water. The age of the foliage can influence the DM content through lignification and an increase in the cellulose content.

MM rates ranged from 4.6±0.20% to 24.1±0.01%. The highest rates were recorded in herbaceous species such as *Pupallia lappacea, Commelina bengalensis, Cucummis melo* and *Cucummis prophetarum* with 20.3±0.03%; 23.8±0.19%; 24.1±0.01% and 22.4±0.01%, respectively. These values are similar to those obtained by [15] on *Cymbopogon schoenathus* (12.57%), *Cynodon dactylon* (17%), Cyperus conglomeratus (13.28%), Medicago littoralis (22.8%) and [2] on *Cynodon dactylon, Tamarix africana, Cyperus conglomeratus, Hedysarum coronarium,* forage species palatable to ruminants in arid and semi-arid areas of Algeria. Similarities also exist between our results and those obtained by [6] (5.36% to 22.92%) in Agadez in Niger on whole herbaceous plants consumed by the dromedary.

Fat contents obtained during the analyses show less pronounced variations (from 0.7±0.00% to 2.9±0.00%) between species for more than 70% of the species studied. The highest rates were recorded for *Citrillus lanatus* (4.6±0.00%), *Merremia pinnata* (4.9±0.00), *Aeschynomene Indica* (6.0±0.00%), *Phylanthus pentandrus* (6±0.00%), *Jacquemontia Tomnifolia* (9.0±0.00%) and *Pennicetum pedicellatum* (11.9±0.00%). [2] obtained similar values for *Cynodon dactylon* (1.39%), *Cypreus conglomeratus* (1.53%), *Hedysarum coronarium* (2.11%) during a study conducted on the chemical composition of spontaneous plant resources of fodder interest used in Algeria. Our values are, moreover, supported by the results of studies carried out in Benin by [3] who obtained means by groups of species varying between 1.12±0.02% to 2.26±0.39%.

As for the CC content, it is characterized by a great disparity. The contents vary from 20.5±0.19% to 45.5±0.10%. The grouping of species according to the contents makes it possible to constitute 3 essential groups. The group of herbaceous plants whose CC content is between 20% and 30% representing 41.6% of the samples studied, the group of herbaceous plants whose CC content is between 30 and 40%, representing 37.5% of the samples studied and finally the group of herbaceous plants whose CC content is greater than 40% representing 16.6% of the species studied.

Our results are once again comparable to those of [3]. This variation in CC content can be explained by the nature of the soil of the course. Indeed [20] reported CC contents of the order of 402.9 ± 5.3g/kgMS for steppe soils and 386.9 ± 30.7g/kgMS for hydromorphic soils for DM contents greater than 80%. The age of the plant is among the explanatory factors for the CC content. The vegetative cycle of the herbaceous plants collected in the Gadoudhe course oscillates between flowering and maturity. [9] demonstrated a correlation between the decrease in the digestibility of grasses linked

to the vegetative cycle and the increase in CC content. Crude cellulose with total nitrogenous matter constitutes an indicator which allows the quality of a fodder to be assessed.

The TNM contents of the herbaceous plants of the Gadoudhe range vary from 4.7% to 14.2%. More than 66% of the samples studied have a TNM rate of less than 10%. These results are close to those obtained by [7] in Niger on *Zornia glochidiata* tops (10±0.15%) and Cenchrus biflorus straw (8±0.04%). However, they are lower than the values obtained by [1] on a mixture of grasses (14.36%) and a mixture of legumes (20.91%). According to the results of a study carried out in 2012, Bouazza concluded that a fodder is of good quality if its TNM content is greater than 10%. This shows that the herbaceous fodder of the Gadoudhe range is of inferior quality.

Aerial fodder constitutes the second component of the Fabidji livestock feed base. It is an alternative in the context of recurring fodder deficit resulting from climate change. Analysis of the chemical composition of woody fodder species in the Gadoudhe range reveals dry matter (DM) rates varying between 93.5±0.01% and 97.0±0.11%. These values are higher than those obtained by [18] on 320 woody samples with contents varying between 170 to 636 g/kg DM. Here too, the grinding method could well explain this discrepancy.

The MM contents of the set of 9 samples studied vary from 3.4±0.06% to 9.0±0.91%. This demonstrates that the collected natural woody fodders are rich in MM. The species with high MM contents are *Maerua crassifolia* (9.0±0.91%) and *Combretum micrantum* (8.4±0.06%). According to [23] and [16], the richness in mineral elements and vitamins are very important qualities of shrub and tree fodders. These values are close to the results obtained by [15] in Algeria with 75% of the samples studied exceeding 8% and 25% exceeding 21%.

The other parameters (CB, fat and TNM) recorded quite variable contents. Indeed, the CB rate varies from 12.1±0.11% to 35.1±0.13, the fat from 1.2±0.00% to 12.1±0.11% and the TNM from 4.3% to 14.7%. The highest fat concentrations are recorded with *Combretum micrantum* (8.2±0.00%), *Combretum glutinosum* (8.5±0.00%), *Albizzia chevalieri* (7.7±0.00%) and *Sclerocarya birrea* (12.1±0.11%). As for the TNM, the contents vary from 4.3% to 14.7%. The highest TNM concentration is obtained with *Maerua crassifolia* (14.7%). Species such as *Combretum nigricans, Acacia macrostachya, Gardiena erubesens, Combretum micrantum, Combretum glutinosum, Albizzia chevalieri, Cassia sieberana and Sclerocarya birrea* are characterized by TNM concentrations below 10%. They can be assimilated to poor natural woody fodder. These results show a significantly less significant dispersion compared to natural herbaceous fodder [15]. These contents are similar to the values (4.11 to 14.64%) obtained by [22]. According to [14], TNM contents decrease with age from the first leafing. Such regularity in the evolution of contents explains the fact that the phenological stage and the season are found as factors of variation of TNM.

Fodder trees and shrubs are known to be heterogeneous and have nutritional characteristics that vary depending on the plant species, organ and age of the plant [11]. In addition, this variation is also a function of other parameters such as the drying method in the case of olive leaves [8], [17] and the season.

5. CONCLUSION

33 natural herbaceous and woody forage species from the Gadoudhe range were collected and characterized by determining the chemical composition.

Overall, the TNM contents of the range's forage resources are < 10%. In terms of herbaceous plants, the species richest in TMN are represented by *Pupallia lappacea, Zornia glochidiata, Citrillus lanatus and Mollugo nudicaulis.* For woody plants, *Maerua crassifolia* is the richest species. The natural herbaceous forages studied are rich in crude fiber (CC). More than 50% of the herbaceous plants have CC contents greater than 30%. As for the natural woody forages, 66% of the species have CC levels between 18 and 22%. The results of determining the chemical composition of the forages reveal higher MM contents in natural herbaceous plants than in woody plants. Natural herbaceous fodder is less rich in fat than woody fodder.

Ultimately, the results of the dosage of MM, CC, fat, and TNM of natural herbaceous and woody fodder of the Gadoudhe course made it possible to determine the forage quality of each species studied.

6. REFERENCES

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