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Nutritional Value of Some Newly Introduced and Tested Forage Plants in the Southeastern Regions of Algeria

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Abstract. In Algeria, the high prices of animal products are due to the cost of food, itself linked to the lack of food resources.A fodder deficit really exists, it is urgent to remedy it by relaunching new varieties adapted to our pedoclimatic conditions to cover the needs of farm animals throughout the year. It is in this context that our study takes place, the objective of which is to appréciate the nutritional value of fodder plants newly introduced and tested in the Algerian south-east, the region ofBiskra, it is about the two plants; Panicum maximum from the Poaceae family and Sesbania aculeata from the Fabaceae family. The determination of the chemical composition of these plants revealed significant energy and nitrogen values. It appears that panicum presents the highest values in CC, MM, ADF and NDF (37.60%, 17%, 55.32% and 70.54%, respectively).The study of CPArevealed that sesbania is in the same group with lucerne which makes it a food of good nutritional quality with energy values of UFmeat and UFmilk (1.04 and 1.01) and nitrogen values PDIE and PDIN (111.84 and 101.63) , respectively the highest.

Keywords. Food, Chemical composition, Fooder production, Energy value, Nitrogen value.

1. Introduction

Algeria is characterized by the diversity of climates and environments, this country has a huge protein deficit. It is practically impossible to improve livestock production if it is not provided with adequate food [1]. The improvement of animal production depends not only on genetic improvement and control of the health of livestock but also for many of the animal feed. For this, the breeder must strive to mitigate seasonal deficits by supplying quality complementary feed and/or fodder [2]. Feed represents the largest part of the operational costs of animal production, from 25 to 70% of the total cost of production [3].

Moreover, fodder and pastoral production are very limited and often represent a brake on the development of livestock farming [4]. this problem of feeding livestock comes down to the poverty of fodder supply due to the low sown areas, lack of water and the lack of mastery of cultivation techniques [5]. The solution lies in the quantitative and qualitative production of fodder which allows the breeder to manage the food intake of his livestock; the introduction of crops into the forage system

is organized according to the objectives of breeding, improving the performance of the herd and the management of all crops [2].

Generally, fodder is considered to be the essential link in any development of animal production and its lack constitutes a limiting factor. According to [6]; The use of new fodder species or cultivars, grasses and legumes adapted to Algerian conditions, could be of a decisive contribution and therefore cover the needs of animals throughout the year.

The main objective of this study is the determination of the nutritional value of two fodder crops (*Panicum maximum* and *Sesbania aculeata*) newly introduced in the Technical Institute for the Development of Saharan Agronomy "ITDAS", in the region of Biskra.

2. Material and Methods

The plant material used consists offour forage crops(Panicum, Sesbania, lucerne and Maize fodder) including two newly introduced crops(Panicum and Sesbania) and three cereal by-products (Wheat bran, Barley and Barley straw) tested and intended to feed the small ruminants in the experimental station technique ITDAS (Institute for the Development of Saharan Agronomy) in Biskra region, . The samples were oven-dried, crushed and stored for analysis.

The chemical analyses focused on the determination of dry matter (DM) ISO 6496:1999, mineral (MM) and organic matter (OM)Linden, 1981, total nitrogenous matter (TNM) NF EN ISO 5983/1, fat matter (FM) NA 1744, Crude Cellulose (CC) Fibertec and Wall Composition (NDF, ADF and ADL) Fiber tec Iso 6498:1998.

The estimate of the nutritional value of the two plants (energy value and nitrogen value) was made from their chemical composition using the INRA evaluation system which has proven its reliability [7]; It requires the successive calculation of raw energy (RE), digestible (DE), metabolizable (ME), net milk (NE_{milk}) and net meat (NE_{meat}) energies for the energy value. The nitrogen value was calculatedaccording to the digestible proteins in the intestine (PDI)system.This system requires the calculation of protein digestible in the intestine of food origin (PDIF), and protein digestible in the intestine of microbial origin limited by nitrogen (PDIMN), or by energy (PDIME) and fermentable organic matter (FOM).

2.1. Presentation of the Study Station

The study took place at the station of the Technical Institute for the Development of Saharan Agronomy "ITDAS" in the region of Biskra, Algeria. It covers an area of 11 ha.Itis located on the national road linking the town of TOLGA, about 7 km from the town of Biskra (Figure 01). with an altitude of 270 m and between 34°, 30 E longitude and 34°30' north latitude.

Figure 1. Geographical location of the study's station ITDAS Biskra, Algria.

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This institute has as foremost undertaking the control of the numerous agricultural development packages of the saharan zones affecting the numerous sectors amongst which; animal production and which focuses on the creation and adaptation of plant material and the valorization of nearby resources for animal feed.

2.2. Statistic Study

All our data underwent statistical analyzes ANOVA and CPA with the statistical software EXCEL STAT 2010 pro

3. Results and Discussion

3.1. Chemical Composition

The averages of chemical analyses results : DM, MM, OM, TNM, CC, FM, NDF, ADL and ADF as well as the digestibility of the organic matter d OM of the samples studied, are grouped together in table 1.

Table 1. Chemical Composition And Digestibility of The Organic Matter of The Samples Studied.

	Chimical composition (% DM)									**Digestibility of OM in %**
	DM	MM	OM	TNM	CC	FM	NDF	ADL	ADF	d OM
Panicum	24,90 ±1,36 f	17,00 ±0,62 a	83,00 ±0,62 f	10,12 ±0,39 c	37,60 ±0,45 a	0,06 ±0,03 c	70,54 ±0,66 a	17,65 ±0,36a	55,32 ±0,67 a	57,73 ±0,81e
Sesbania	28,45 ±0,28 e	08,73 ±0,03 d	91,27 ±0,30 c	16,14 ±0,31 a	20,65 ±0,05 d	0,09 ±0,01 c	44,75 ±0,13 e	14,14 ±0,80b	34,89 ±1,14 c	81,50 ±0,27a
Lucerne	21,72 ±1,25 g	12,87 ±0,56 c	87,13 ±0,57 d	13,92 ±0,36 b	15,60 ±0,41 e	0,09 ±0,03 c	37,76 ±0,60 f	05,50 ±0,33c d	21,09 ±0,61 e	78,27 ±0,74b
Maize fodder	47,00 ±1,36 d	03,70 ±0,62 e	96,30 ±0,62 b	08,73 ±0,39 d	22,80 ±0,45 c	0,06 ±0,03 c	56,14 ±0,66 c	02,65 ±0,36e	25,45 ±0,67 d	60,23 ±0,81d
Wheat bran	54,20 ±1,25 c	07,91 ±0,56 d	92,09 ±0,57 c	13,93 ±0,36 b	12,03 ±0,41 f	2,63 ±0,03 a	34,66 ±0,60 g	02,53 ±0,34e	14,55 ±0,61 f	77,83 ±0,75b
barley	91,80 ±1,25 b	02,70 ±0,56 f	97,30 ±0,56 a	10,85 ±0,36 c	03,10 ±0,41 g	0,56 ±0,03 b	48,82 ±0,60 d	05,24 ±0,33d	08,24 ±0,61 g	72,28 ±0,74c
Barly straw	94,30 ±1,25 a	14,62 ±0,56 b	85,37 ±0,57 e	03,85 ±0,36 e	35,65 ±0,41 b	0,08 ±0,02 c	68,26 ±0,60 b	06,00 ±0,33c	41,67 ±0,61 b	47,39 ±0,74f

DM: dry matter, MM : minéral matter , TNM : total nitrogenous matter, CC : Crude Cellulose, FM : fat matter, NDF : neutrale détergent fiber, ADL : acid détergent lignin, ADF : acid détergent fiber, d OM : Digestibility of organic matter.

The results obtained show that there isgreat variability between thestudied samples. The dry matter content varies between 21.72% and 94.30% respectively for Sesbania and barley straw. While the mineral content ranges between 02.70% DM in barley and 17% DM in panicum, which makes it the richest food in mineral and trace elements, this result is in agreement with those found by [8] who reported a mineral content of barley in the order of 2.6%. Regarding the organic matter, it corresponds to the strongest component which varies between 83% (panicum) and 97.30 (barley).

For total nitrogenous matter, we noted that barley straw and fooder maize have the lowest values (03.85% and 08.73% of DM) respectively. It is noted that the content of total nitrogenous matter in

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barley straw is comparable to that found by [9] reporting a rate of 4.16%. The results obtained by [10] concerning the content of total nitregenous matter in fodder maize are consistent with our results (8.3%). While the highest rates were recorded in sesbania followed by lucerne, wheat bran, barley and panicum (16.14%, 13.93%, 13.92%, 10.85% and 10.12%), respectively. Note that barley straw has the lowest content (03.85%).

Concerning the crude cellulose content, a great variability is also recorded inthe studied samples; the richest are: panicum (37.60% DM), this value is similar to that obtained in the work of [11] who reported a crude fiber content of panicum of 37.40%, followed by barley straw with a content of 35.65% DM and fodder maize comes in third place with a content of 22.80% DM. The results obtained show richness in parietal compounds linked to the mode of adaptation to the Saharan environment [12]. It is noted that barley has the lowest rate (3.10%), this content is consistent with that found by [13].

The digestibility of organic matter was recorded 81.50% of DM in sesbania and 47.39% in barley straw.

The composition of the wall, we noticedthat the panicum shows the highest rates of NDF, ADL and ADF with 70.54%, 17.65% and 55.32% respectively; followed by barley straw (68.26%, 6% and 41.67%); while the lowest is recorded in wheat bran followed by lucerne. According to [14]; The fiber content (NDF, ADF) is a discriminating criterion for the efficient use of plant resources even when they are very rich in protein. Fiber affects the organic matter digestibility of feeds differently depending on whether they are consumed by ruminants or non-herbivorous monogastric. The results of the analysis of the parietal compounds of barley that we obtained are slightly higher than those described by [15] who showed that the latter has low ADF and ADL contents (6.7% and 1.2%) whereas in the present study values of (8.24% and 5.24%) respectively were obtained. Furthermore, our results are in agreement with those described by [16] who reported similar values (7.7% of DM of ADF and 7.7% of DM of ADL).

The results obtained, illustrated by the series of box plots (FIGURE 02) show that there is great variability between the samples studied. Organic matter is the strongest component followed by its digestibility and by the rates of total walls NDF and ADF while the+ total nitrogenous matter is the weakest component followed by crude cellulose.

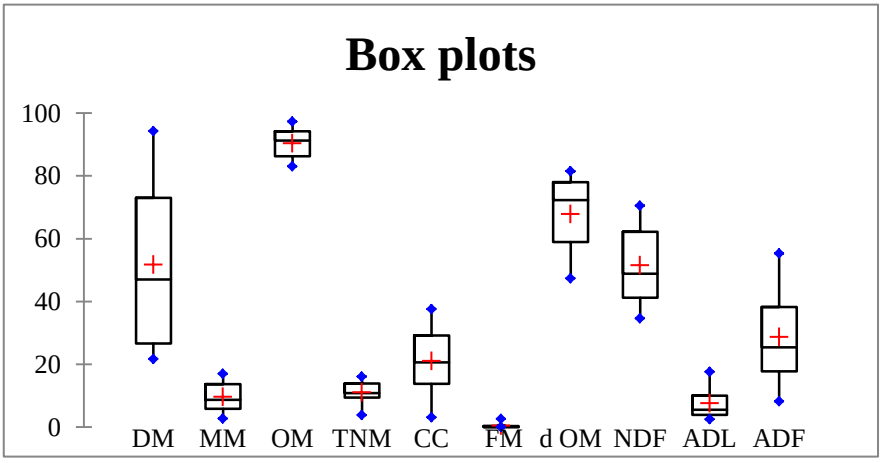

Figure 2. Box-plot of the different variables (chemical composition) of the samples studied.

The analysis of the results by the PCA illustrated in FIGURE 2 allowed us to characterize our samples in groups as follows:

- Panicum and barley straw constitute a homogeneous group that is characterized by high levels of crude cellulose, mineral matter, ADF and NDF; which could explain their low digestibility. [2], indicated that grass fodder has poorer nutritional qualities in hot countries because the plants are more fibrous, more lignified and therefore less digestible.
- Wheat bran and barley are characterized by high levels of organic matter and their digestibility.

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- Fodder maize is characterized by a high dry matter content.
- lucerne and sesbania constitute a homogeneous group that is characterized by a high rate of total nitrogenous matter. According to[2]; the high TNM content of legumes is associated with high protein degradability in the rumen.

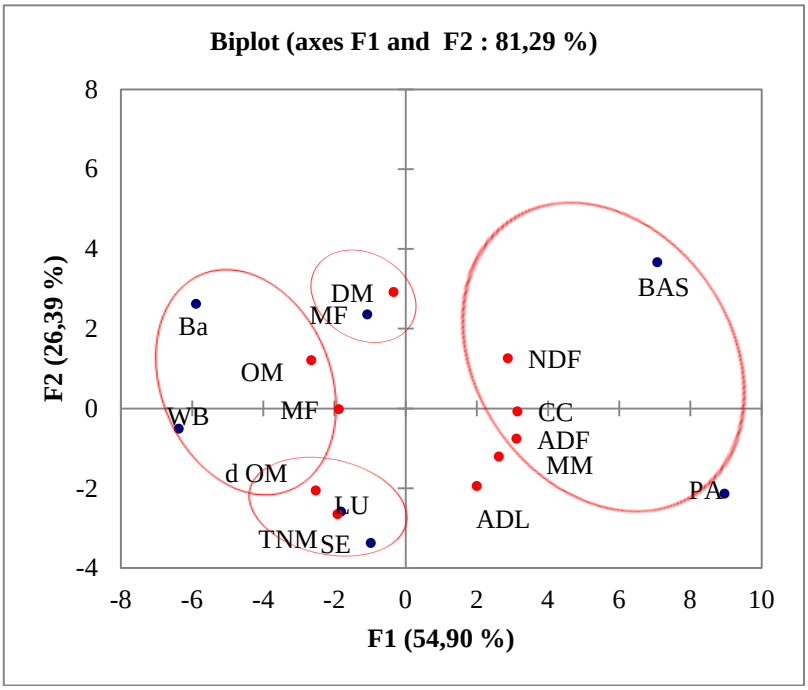

Figure 3. Projection of variables (chemical compositions) on the samples studied.

These results confirm the study of [17], who mentioned that legumes (Lucerne and Sesbania) are richer in the total nitrogenous matter than grasses (panicum, barley straw, wheat bran and barley).) as well as in certain minerals, they are poorer in total plant walls (NDF) but due to lower digestibility of NDF, the digestibility of the organic matter (d OM) of legumes is therefore, lower and consequently, their energy value is poor.

3.2. Nutritional Value

The results of the calculated nutritive value, estimating the energy values in (UF_{milk} / kg of DM and UF_{meat} / kg of DM), and nitrogen values in (PDIE g / kg of DM and PDIN g / kg of DM) are recorded in TABLE 2.

Table 2. Energy And Nitrogen Values of The Samples Studied.

	UF_{milk}	**UF_{meat}**	**PDIE**	**PDIN**
Panicum	0.57±0.005	0.48±0.004	70.93±0.333	64.04±0.824
Sesbania	1.04±0.004	1.01± 0.005	111.84±0.467	101.63±0.606
Lucerne	0.94±0.006	0.91±0.007	100.11±0.552	87.83±0.613
Maize fourragère	0.72±0.002	0.63±0.001	76.44±0.138	55.10±0.849
Wheat bran	1.00±0.015	0.96±0.018	103.38±1.765	87.93±2.461
Barley	0.96±0.032	0.91±0.037	93.71±3.814	68.50±4.987
Barleystraw	0.45±0.003	0.35±0.002	46.78±0.514	24.32±1.130

UF_{milk} : Unit fodder milk, UF_{meat} : Unit Fodder Meat, PDIE: protein digestible in the intestine of microbial origin limited by energy, PDIN: protein digestible in the intestine of microbial origin limited by nitrogen

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3.3. Energetic Value

According to the results obtained; it is noted that there is a certain variability between the foods studied. Sesbania presents the highest values in UF_{milk} and UF_{meat} (1.04 and 1.01) respectively, giving it an energy value for ruminants either equivalent or higher than that of cereals, followed by wheat bran (1 and 0.96), barley (0.96 and 0.91); lucerne (0.94 and 0.91) which also have high UF_{milk} and UF_{meat} values. While panicum and barley straw show the lowest values (0.57 and 0.48) and (0.45 and 0.35) respectively. Our results are superior to those found by [18] who recorded UF_{milk} and UF_{meat} values ranging from 0.25 UFL/kg DM and 0.23 UF_{meat}/kg DM for Fagonia glutinosa at 0.60 UF_{milk}/kg DM and 0.52 UF_{meat}/kg DM for Asteriscus graveolens.

According to [19]; the main factor of variation in the net energy content of foods is the variation in the digestibility of the gross energy, they contain and which is closely related to the digestibility of organic matter, which is in line with our results by the variation of d OM of our samples (47.39% noted in barley straw and 81% recorded in sesbania).

Algerian natural herbaceous fodder seems, overall, to be a good source of energy and protein. The contributions of certain species are at the same level or even better than certain cultivated fodder resources. Thus, 25% exceed 0.8 UF_{milk} and UF_{meat} and the total nitrogenous matter is worth 8.3% DM [20].

3.4. Nitrogen Value

The estimate of nitrogen value expressed in PDIE and PDIN shows that the values obtained from PDIE vary from 46.78 g/kg of DM noted in barley straw to 111.84 g/kg of DM noted in sesbania. Moreover, the values of PDIN vary from 24.32 to 101.63 g/kg DM, recorded respectively for barley straw and sesbania. These differences between the values obtained are directly linked to the variation in the chemical composition of the samples studied, particularly in terms of total nitrogenous matter [18].

Our results recorded for barley in PDIE and PDIN (93.71 and 68.50 g/kg DM) are close to the values found by [21] (79.6 and 100.3 g/kg DM).

In general, legumes contain more protein and mineralsthan grasses. These characteristics make legumes relatively attractive for farmers-breeders (legume-grass association). Indeed, given the constant increase in the cost of inputs, food self-sufficiency is increasingly considered by breeders. In this context, the production of a mixed legume/grass fodder makes it possible to reduce, on the one hand, the purchase of vegetable proteins such as soybean meal, and on the other hand the quantity of nitrogenous inputs.

Conclusion

From the results obtained through our study on the nutritional value of newly introduced fodder plants and cereal products intended for the feeding of small ruminant in Biskra region , south-eastern Algeria; it seemsthat chemical composition classifies the samples studied into 2 categories; Panicum and barley straw as coarse feed rich in crude fiber and parietal compounds while lucerne, sesbania, wheat bran and barley as concentrated energy feed rich in the total nitrogenous matter and organic matter. Managing the feed value of fodder by animal needs is guided by animal production objectives.

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