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Variation of the dry matter rates in the vegetations grazed by *Camelus dromedarius* in two regions of Biskra Governorate, Algeria: nutritional and production consequences

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Abstract

This study, carried out in April 2013 on two camelid's grazing areas in Biskra region, aims to determine the dry matter levels of some vegetations grazed by Camelus dromedarius. For each vegetation species, the parts grazed by the dromedary were harvested by "Hand Plucking Method", with 9 plant species for region A and 22 for region B. Laboratory analyzes were carried out according to the recommendations of the standard (AFNOR). Statistical analyzes were performed via SPSS 20 using a Kendall test ($p<0,05$) in a cross table between the variable (Region) and the variable (Dry matter rate) for 7 pairs of plant species identified simultaneously in both regions A and B. The results showed that the differences between the Dry matter rates are more or less considerable between the different plant species for the same region (A or B). The Kendall test showed no significant correlation between the variable (Region) and the variable (Dry matter rate). This study showed that Dry matter rates varied from one plant species to another, even within a single species. Thus, the daily food intake received by dromedaries in the study area would have a random nutritional value and would not guarantee a constant milk yield or animal health status suitable for the livestock. A determination of the mineral and organic composition of vegetations grazed by dromedary during all seasons, would allow designing a spatiotemporal map of the distribution and nutritional efficiency of the flora grazed by Camelus dromedaries in this region.

Keywords: Feeding of *Camelus dromedarius*, dry matter, nutritional deficiencies in dromedary, animal health, she-camel yield, therapeutic virtues of she-camel milk.

Introduction

In terms of quality control, the physicochemical analysis of a given feed reflects its overall nutritional quality. Among other things, it makes possible to discuss the properties of soils and irrigation water. The DM is the total sum of mineral matter (MM) and organic matter (OM)[1].

Thus, the rates of DM of the different vegetations grazed by the dromedary, would have a direct influence on the cases of deficiencies in MM and in OM in this animal; on the milk yield both in quantity and quality; on the health status of suckling she-camels with their newborns as well as the therapeutic virtues expected by she-camel milk consumers'.

Also, the congestion value of a forage depends on its content of DM; ingestibility increasing with this one[2]. On the other hand, obtaining a sufficient amount of DM per animal per day, depends on the average content of fodder courses in DM and the duration of grazing[3].

This study, conducted on two forage courses in Biskra region, aims to determine the DM rates of some vegetations grazed by the dromedary (*Camelus dromedarius*) in order to list the richest plant species in DM and allowing a better productivity; to figure out those which would be more beneficial to fill the thirst; and to study the variability of DM rates depending on the region.

Material and methods

Plant material: Samples of vegetations grazed by the dromedary were collected in a random manner. Only the parts grazed by the dromedary, which are put directly in numbered plastic bags, were harvested by "Hand Plucking Method".

The identification of plant species was carried out at the Center for Scientific and Technical Research on Arid Regions (C.R.S.T.R.A).

Vegetations of region A: Vegetal samples from region a came from the Doucen municipality located approximately at 80km in the West of Biskra, and characterized with agricultural and pastoral activities.

Vegetations of region B: Vegetal samples from Region B were collected from two municipalities; Oumache (North-West of Biskra) and Loutaya (North-East of Biskra). Both are located

about 20km from the center of the governorate of Biskra, and are agricultural and pastoral areas.

Methods: Samples and analyzes were carried out in April 2013, following the recommendations of the standard AFNOR[4]. Firstly, each empty porcelain tank was weighted (P0) on a sensitive scale, and initial weight was recorded. Then, a quantity of 1g of each sampled plant was weighted with its corresponding tank (P1). After identification with an indelible pen, the tanks were placed in a microbiological stove set at 105°C for 24 hours. This period past, the tanks were extracted to be weighed again (P2). The weight of DM was deduced for each analyzed sample plant by a simple subtraction operation while finally removing the initial weight of the empty tank, as well as the water content; DM (g) = (P1-P2) –P0.

Statistical analysis: Using SPSS 20 statistical software IBM[5], a Kendall test with $p<0,05$ was applied in a cross-tabulation between the variable region and the variable DM rate for plant species identified simultaneously in both regions A and B. The plant species included in this test are designated on Table-3. The results of the statistical test are shown in Table-4.

Results and discussion

Vegetations of region A: For region A, the highest rates of DM were recorded in tested vegetations according to a descending order in; *Zizyphus lotus* (67%), *Astragalus armatus* (59%), *Arthrophytum scoparium* (57%) and *Atriplex halimus* (53%). While the minimum values were recorded in increasing order for *Juniperus communis* (14%), *Rhamnus frangula* (18%), *Pergularia tomentosa* (20%) and *Salsola tetragona* (22%). Also, we detected that for region A, the differences between DM rates are considerable. The DM determination results for region A are shown in Table-1.

Table-1: Results of determination of DM rates in vegetations grazed by the dromedary in region A(%).

Scientific name	Dialect name	DM (%)
Astragalus armatus	Lekdad	59
Zizyphus lotus	Sedra	67
Pergularia tomentosa	Kalga	20
Juniperus communis	Arâar	14
Traganum nudatum	Damrane	51
Salsola tetragona	Belbel	22
Rhamnus frangula	Lak	18
Arthrophytum scoparium	Remth	57
Atriplex halimus	Ghetaf	53

Vegetations of region B: In region B, the highest levels of DM were recorded for the vegetations *Zypgophyllum album* and *Borago officinalis* (78%), followed by *Sueda fructicosa* and *Taraxacum laevigatum* (77%). The minimum values of DM rates were presented in this increasing order; *Artemisia herba-alba* and *Farsetia aegyptiaca* (11%), *Centaurea pungens* (16%), *Rhamnus frangula* (18%) and *Retama retam* (19%). Thus, it is noticeable that the differences between DM levels are also considerable in plants grazed by the dromedary, in study region. The results of determination of DM for region B are shown in Table-2.

Table-2: Results of determination of DM rates in vegetations grazed by the dromedary in region B(%).

Scientific name	Dialect name	DM (%)
Cynodon dactylon	Nedjem	42
Artémisia herba-alba	Chih	11
Traganum nudatum	Damrane	29
Marrubium deserti	Jâada	57
Taraxacum laevigatum	Talma	77
Nitraria schoberi	Ghardak	69
Salsola tetragona	Belbel	37
Zygophyllum album	Bougriba	78
Borago officinalis	Lechnaf	78
Zizyphus lotus	Sedra	39
Atriplex halimus	Ghetaf	58
Pergularia tomentosa	Kalga	75
Salsola bayosma	Djell	74
Centaurea pungens	Chouk	16
Limoniastrum guyonianum	Zeïta	61
Tamarix gallica	Tarfa	28
Sueda fructicosa	Souide	77
Haloxylon scoparium	Remth	58
Retama retama	Rtem	19
Farsetia aegyptiaca	El'Oud	11
Astragalus armatus	Lekdad	70
Rhamnus frangula	Lak	18

Table-3: Means of DM contents (%) of plant species used in Kendall test for regions A and B.

Scientific name	DM Région A (%)	DM Région B (%)
Astragalus armatus	59	70
Zizyphus lotus	67	39
Pergularia tomentosa	20	75
Traganum nudatum	51	29
Salsola tetragona	22	37
Atriplex halimus	53	58
Rhamnus frangula	18	18
Means	41,43	46,57

The application of Kendall test ($p<0,05$) showed no significant correlation between the variable region and the variable DM rate for 7 pairs of plants of the same species, taken from both regions A and B (Table-3). It was observed that the averages calculated for the DM rates in the 7 pairs of plant species are comparable with a slight superiority for region B relatively to region A.

Discussion: Analyzes carried out on the vegetations, result from a cross-sectional survey conducted within a short period of time. Thus, it was not possible to study the floristic diversity in both regions A and B, as well as the seasonal variability of DM rates. Generally, richest vegetations in DM are more beneficial with regard to the contributions in MM and OM. While the richest vegetations in water, would serve much more to fill the thirst of dromedaries (Tables-1 and 2).

According to Cuvelier and Dufrasne[3], in general, older vegetations have higher rates of DM and fibers. Indeed, plant development goes in parallel to cell's walls thickening, and therefore, the contents of cellulose and hemicellulose increase.

Even, if certain vegetations have a very low content of DM, this fact does not diminish their nutritional importance, especially for vitamins and trace elements necessary to fight against some pathologies affecting animals living in an arid environment, as camelids. This fact could be supported by a study conducted by Lyaktini *et al.*[6] in Morocco, which suggests a very significant correlation between a low serum vitamin A level and the risk of occurrence of scabies due to *Sarcoptes scabiei* in *Calemus dromedarius*. While, Abbas *et al.*[7] report that feeding and especially high-sulfate fodders, also play a role in decreasing blood levels of B1 vitamin. Also, according to Abbas *et al.*[7], polioencephalomalacia resulting in serious and sometimes fatal nervous disorders, which is due to thiamine deficiency, has sometimes been observed in racing camels in the United Arab Emirates.

During a survey carried out in peri-urban camel breeding by Mammeri *et al.*[8], in the region of Biskra, it was noted that dromedaries in study area, favor more two vegetations; *Tamarix gallica* and *Astragalus armatus*, even if their DM levels are not the highest (Tables-1 and 2).

In this context, and according to several studies conducted on the courses of the northern Algerian Sahara, it seems that the nutritional values are not organized according to the same hierarchy as the appetites of the plants by the dromedary, these being estimated via breeders' utterance. Species such as *Aristida pungens, Zilla spinosa, Traganum nudatum, Calligonum comosum and Anabasis articulata,* considered among the most palatable species in previous studies conducted in the Saharan environment [9, 10], have together less protein than the average. The apparent non-convergence between nutritional values and the selection of plants by the dromedary could be attributed to adaptation traits of dromedaries, capable of developing very particular behavioral and digestive faculties[11].

Chehma *et al.*[11] report, after studying the nutritional value of 21 spontaneous perennial plants from the northern Algerian Sahara, consumed by camels, that the great variability in the composition observed between plant species, is linked to their different ecotypes and to edaphic conditions (types of course). However, the most popular species of dromedary are rather rich in parietal compounds, poor in total nitrogenous matter and little digestible.

Table-4: Results of the application of Kendall test in a cross-tabulation between the variable region and the variable DM rate of the plants grazed by the dromedary.

Variables	N.O.V[1]	Tau-B de Kendall	Erreur standard asymptotique	T approximé	p*
REG A	7	-,429	,260	-1,651	,099
REG B	7	-,429	,222	-1,931	,053

*correlation is significant at ($p<0,05$), [1]Number of valid observations.

In a study conducted by Slimani[12] on the impact of dromedary feeding behavior on the preservation of the courses of the Algerian northern Sahara (regions of Ouargla and Ghardaïa), it turns out that the feeding diet has wide seasonal variations, in the meaning where it is composed of 06 species in autumn, 08 species in winter, 12 species in spring and 10 species in summer. It should also be noted that only one species: *Stipagrostis prungens* is preferred in all seasons, followed by the species *Anabasis articulata, Heliathemum lipii* and *Moltkia ciliata*, which are included in the dromedary diet during three seasons, with smaller quantities than the first species *(Stipagrostis prungens)*. Chehma *et al.*[11] suggest that in terms of guiding *Camelus dromedarius* on pasture, it seems important to seek to respect this nutritional balance between a suitable animal and its environment, without necessarily focusing all efforts to consume more rich fodders, but rather maintain a diversified use of pastoral resources.

During a study carried out by Koull[13] at the level of the wetlands of the North-East of the Algerian northern Sahara (regions of Ouargla and Oued Righ), the spatiotemporal analysis of the vegetations, showed that the density and the recovery of the species vary in space and time, in the sense that there are relationships between density and species overlap across seasons. The vegetation sampled reflects a disposition of dominant species along a gradient of edaphic factors including salinity and soil moisture. According to Bouallala[14], the production of aerial phytomass and the nutritional value of vegetations vary according to the courses and the seasons.

Favor of its adaptability, the dromedary is the only species of livestock to enhance and protect its environment, in addition to converting lean vegetation into vital products[15]. Many specialists report that its presence in a very harsh environment is an asset in the preservation and sustainable use of arid and semi-arid areas[16]. To this effect, we can estimate that the dromedary, by its feeding behavior, has a positive impact on the valuation, rational exploitation, preservation, distribution and proliferation of lean floristic cover of its Saharan ecosystem. This may place it first in relation to other livestock species, sheep and goats, respectively[12].

In the context of current climate changes, it must be borne in mind that, in general, the mechanisms of adaptation to the desert environment developed by plant flora, are in the direction of a high lignification and low digestibility for ruminants. Only the dromedary, via its characteristic digestive faculties, is able to exploit these plants effectively[11].

Also, several studies incriminate livestock in the current situation characterized by an increase in greenhouse effect gases, especially methane, responsible of a significant part of climate changes. The low methane emission observed in camelids is mainly related to their lower ingestion capacity[17].

Compared to ruminants, Richard[18] reports that the ingesting capacity of dromedaries placed in their natural breeding conditions, varies from 14 to 15g DM / kg of live weight (LW) for straw and poor forage. The values for straw are comparable to those for cattle in tropical regions; they are slightly higher than those observed in cattle in Europe (12g / kg of LW).

Whereas experiments directly comparing camelids and sheep show that the ingestion capacity is lower in the dromedary[19-23]. Thus, on average over three different diets, the ingestion was 12 g/kg of LW for the dromedary, and 25g/kg LW for the sheep[24]. In fact, the camelids ingest as much less DM than the fodder is of good quality. This suggests that the regulation of ingestion in camelids is as much metabolic as physical[25].

The average digestibility of OM is higher in camels (56.2%) than in sheep (52.4%) (five diets comparisons by Farid *et al.*[26] and Gihad *et al.*[23]). The combination of a greater microbial cellulolytic activity in the camelid digesta and a longer residence time of the food in the pre-stomachs, explains the exceptional digestive capacity of these animals[25].

Dromedaries drink less and urinate less than ruminants. According to Gihad *et al.*[23], they consume only 55 to 65 % of the water consumed by ruminants when they are reported per kg of DM ingested. Because of the low rate of water loss and the excellent resistance to dehydration, the camel can stay longer without drinking than any other domestic animal. The dromedary can ingest in very little time, very large quantities of water (10-20 l/mn)[27]. The frequency of watering is related to several factors (type of grazing courses, amount of DM voluntarily ingested, amount of available water). Thus, after long deprivation, the dromedary can ingest about 100 l of water in a single watering[28].

Conclusion

Based on the results of the determination of DM rates in a sample of vegetations grazed by *Camelus dromedarius* in regions A and B, it has been found that DM rates vary from plant species to another. Thus, the daily food ration received by dromedaries in the study area would have a random nutritional value and would not guarantee a constant milk yield or a suitable health status for the herd. Variation factors of DM rates in plants grazed by the dromedary, are very diverse; soil properties, season, climate, plant ecotype and age.

A more detailed analysis of the mineral and organic composition of the vegetations grazed by the dromedary in the region of Biskra, during all seasons and through all favorable courses for the dromedary, would make possible to conceive a spatiotemporal map of the distribution and the nutritional efficiency of the flora grazed by the dromedary in this region. Thus, ecopathological hypotheses could be emitted regarding the distribution in time and space of pathologies related to various dietary deficiencies identified in camel herds, especially that a field survey conducted by Mammeri[29], had elucidated the extent of pathologies affecting the teguments in *Camelus*

dromedarius in the region of Biskra (depilation, keratosis, scabies, ...).

Therefore, it would result some judicious recommendations regarding the nutritional status of camel herds, and this by proposing plans for prophylaxis and livestock therapy indicating deficiencies in daily fodders intake, mainly in DM, and incorporating necessary additives in ration (licking stones, vitamins and / or mineral solutions).

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