

<https://doi.org/10.48047/AFJBS.6.13.2024.80-89>



African Journal of Biological Sciences



Evaluation of feed consumption of ewes on pasture (Eastern Algeria)

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ABSTRACT

Understanding the interactions between animals and their grazing environment is crucial for the development of technical references in the management of pastoral ecosystems, which are widespread in Algeria. In this regard, our study focuses on analyzing the feeding behavior and voluntary intake of ten (10) sheep grazing in the Constantine region, located in the East of Algeria, For three years, during the four-month spring season. To achieve this, we estimated the botanical composition of the grazed pasture and the simulated bite intake of the animals using the hand-plucking method. The results show that sheep spend an average of 57% of their time grazing, 30% resting and moving, 10% rumination, and 03% drinking. Grasses constitute more than 36% of the forage consumed by the animals. On average, each sheep ingests 1382.4 g of dry matter per day while grazing. These data provide fundamental information for implementing feeding plans tailored to our sheep.

Keywords: Constantine, activity rhythm, pasture, voluntary intake.

1 INTRODUCTION

Despite the extensive nature primarily based on pastures, the Algerian sheep population continues to grow, reaching approximately 30.9 million heads in 2019 (FAO STAT, 2022). Ewes play a central role in this growth, with their numbers increasing from 16.7 million in 2015 to over 17 million in 2017, according to data from the Ministry of Agriculture and Rural Development in 2019. However, several authors have reported a decline in pasture productivity and biodiversity, including Salemkour *et al.* (2013), Rekik *et al.* (2014), and Hourizi *et al.* (2017).

For better spatiotemporal management of grazing sheep, especially in the Constantine region, it is essential to understand their feeding behavior to improve grazing and feeding strategies. However, monitoring animals to determine the plants consumed on pasture remains difficult but crucial for developing strategies for available forage resource development (Longo *et al.*, 2007). This information provides intervention means to farmers and environmental managers to influence animal feeding behavior according to their goals.

Our work aimed to characterize the feeding behavior of sheep raised in an extensive farming system and to better understand their dietary preferences in terms of types of food offered, quantities ingested, and feeding activities.

2 PRESENTATION OF THE STUDY AREA

The Constantine region, located in the heart of eastern Algeria, is characterized by plains and mountain ranges covering an area of 222,910 hectares. Forage production in this region is significant, reaching 91,308.5 quintals, of which 83,750 quintals come from natural forages, including meadows and fallow fields, as well as 7,558.5 quintals of artificial forages (DSA, 2017). In terms of livestock, the Constantine province currently has over 240,000 heads, including 51,000 cattle, 180,000 sheep, and 10,000 goats, according to the latest data from the Directorate of Agricultural Services (DSA, 2019).

From a climatic standpoint, the Constantine region enjoys a sub-humid Mediterranean climate characterized by an average annual rainfall of 525 mm. Precipitation typically ranges between 500 mm and 700 mm per year. Winters are cold, with temperatures dropping to as low as -6°C , while summers are very hot, with heat peaks reaching up to 47°C .

3 EXPERIMENTAL PROTOCOL

3.1 ANIMALS

The herd consists of 10 Ouled Djellal ewes, aged 8 months, with an average weight of 36 kg and an average body condition score of 2.6. The animals roamed freely on a natural permanent pasture covering an area of 3 hectares, harboring a diversity of plant species, without direct supervision from a shepherd and without the provision of supplemental feed. The observations were carried out consecutively over three years (2019, 2020, 2021), during the spring season, spanning a period of four months each year. Surveys are conducted monthly during this four-month period. The autumn, winter, and summer seasons were excluded from the study since the animals may receive supplemental feeding during these times. Our presented trial aims to determine the ingestion and behavioral responses of ewes under zero supplementation.

3.2 STUDIED PARAMETERS

3.2.1 FLORISTIC RICHNESS OF THE PASTURE FREQUENTED BY THE EWES

Phytosociological surveys were conducted randomly using the Braun-Blanquet method (1951) with one-square-meter quadrats placed in the middle of each plot. The number of surveys conducted depends on the visually determined diversity of the vegetative cover – the less homogeneous the cover, the more surveys are conducted, and vice versa. These surveys are conducted every month during the spring season of each year.

3.2.2 ACTIVITY RHYTHM AND FEEDING PREFERENCES OF GRAZING EWES

After identifying the ewes, we proceeded to monitor their behavior on the pasture through direct observation, with intervals of 30 minutes between each observation, following the method described by Meuret *et al.* (1985). This observation was conducted over a trial period of 10 days per month. Grazing duration extended from 6 am to 5 pm. Two observers were present simultaneously each day, from the entry to the exit of the pasture. All activities of the animal, whether resting, moving, drinking, ruminating, or grazing, were observed and recorded by video. Meanwhile, we conducted manual sampling of the plant species consumed by the ewes at the grazing site to assess their dietary preferences. This collection method, based on the one developed by Guerin *et al.* (1987), involves reproducing the quantity sampled by each ewe in a handful of vegetation, with the species then noted. This collection was repeated multiple times to obtain representative data.

3.2.3 COUNTING THE NUMBER OF BITES AND INGESTION WHILE GRAZING

The method of bite counts (bite-count technique (BC) is an approach based on direct observation of the animal while it grasps plants or plant parts, as described by Meuret (1985) and Kassily (2002). Following the method described by these authors, counting lasts for 5 minutes and is performed 6 times each day (3 in the morning and 3 in the afternoon) for a period of 10 consecutive days per month. To facilitate this observation, we recorded videos.

Each period of counting the number of bites is followed by manual sampling and weighing of samples corresponding to the different plant parts ingested by the animal, according to the hand-plucking method described by Le Du and Penning (1982).

Our observations allowed us to calculate:

- The number of bites (NB) recorded over a 5-minute observation period;
- The observed frequency of bites on the pasture (expressed as bites per minute of grazing) (FB); the weight of a bite (WB), expressed in grams of dry matter per bite, corresponding to the average amount of dry matter ingested per bite, by observing bites from a different animal each time.

Finally, we calculated the quantity of dry matter ingested (QI) per animal per day using the formula proposed by Meuret et al. (1985).

$$QI = (DG/DB) \times \Sigma (NB \times WB)$$

Knowing that:

DG= Total grazing duration (minutes/animal/day); DB= Total duration of bite-counting periods (minutes), NB: Total number of bites taken on vegetation during the bite-counting period (reported over a 5-minute observation period); WB: Average weight of a bite (g DM).

4. STATISTICAL STUDY

The data were analyzed using descriptive statistics (percentage, mean, standard deviation) using Minitab version 13 software.

5 RESULTS AND DISCUSSION

5.1 PREFERENCES AND DIETARY SELECTION OF EWES WHILE GRAZING

The phytosociological surveys conducted before grazing identified 18 plant species (Table 1), distributed among 7 botanical families. Grasses (Poaceae) and asteraceae each represent 28% of these species, followed by legumes (Fabaceae) which represent 22%.

Table 1 Herbaceous species preferred by ewes

Families	Species identified in pastures	Species preferred by ewes
Poaceae	<i>Lolium perenne</i> L.	+
Fabaceae	<i>Trifolium pratense</i> L.	+
Cyperaceae	<i>Scirpus sylvaticus</i> L.	-
Commelinaceae	<i>Callisia repens</i>	+
Brassicaceae	<i>Brassica tournefortii</i>	+
Poaceae	<i>Avena sativa</i>	+
Fabaceae	<i>Trifolium arvense</i> L.	+
Poaceae	<i>Bbrachiaria ramosa</i> L.	+
Poaceae	<i>Schizachyrium scoparium</i>	+
Asteraceae	<i>Silybum marianum</i> L.	+
Boraginacée	<i>Echium plantagineum</i> L.	-
Asteraceae.	<i>Leucanthemum vulgare</i> (Vaill.) Lam.	+
Asteraceae	<i>Leucanthemum ircutianum</i> subsp.	+
Fabacea	<i>Melilotus albus</i> Medik	+
Fabaceae	<i>Galactitostomentsus</i> Moench.	+
Poaceae	<i>Avena sterilis</i> L	+
Asteraceae	<i>Silybum marianum</i> L	-
Asteraceae	<i>Cirsium arvense</i> L	-

+: Species preferred by ewes -:Non-preferred species by ewes

The feeding behavior of ewes favored 14 plant species (Table 1),the Poaceae (36%) family remains preferentially selected by the animals compared to the Fabaceae(29%). with grasses dominating (36%) followed by legumes (29%).The predominance of Poaceae in the spectrum is explained by the fact that the majority of the woody forage in the region consists of grasses. Additionally, the floristic composition of the pastures also influences dietary selection. Our findings align with those of Bouazizi *et al.* (1999), who observed a stronger preference of sheep for perennial grasses. It is noteworthy that two species (*Silybum marianum* L., *Cirsium arvense* L.) were neglected by the ewes. This behavior may be attributed to the low palatability of these species. The sense of touch, whose importance has been established since the work of Arnold (1966), is utilized by grazing animals to detect and avoid thorny plants. However, in natural pastures, pastoralists take into account the availability and accessibility of the species for grazing to assess the palatability of a forage species (Sitou *et al.*, 2021). In general, ruminants manage to select a diet that meets their nutritional needs, thus ensuring some stability in the ratio between ingested proteins and energy (Kyriazakis and Oldham, 1993; Provenza *et al.*, 1996).

Furthermore, animals gain experience from a young age, especially by learning from their mother, and the feeding habits they develop throughout their lives influence their feeding behavior (Dumont and Boissy, 2001).

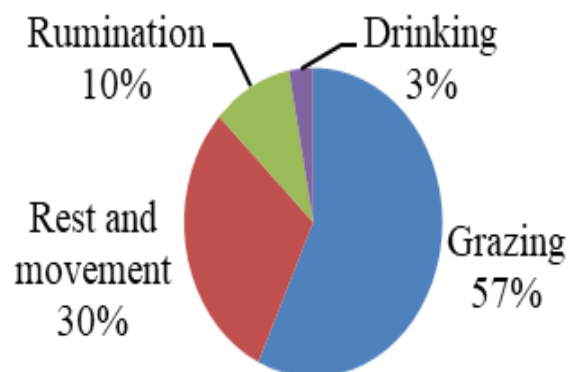
5.2 ACTIVITY RHYTHM OF EWES IN GRAZING

During the day, the animals graze on average for about 600 minutes. According to Balent *et al.* (1986), the duration of this activity is influenced by the length of the day but may be reduced in case of bad weather, delaying the animals' outing or disrupting their activity rhythm (e.g., in case of intense cold or rain).

Observation of ewes in the field showed that grazing, measured by effective grazing time (EGT), represents 57% of the total time spent grazing. On average, ewes graze for about 342 minutes. This duration is slightly higher than that reported by Mebirouk *et al.* (2014) for rams in Algeria (300 minutes) but exceeds that obtained by Van Mele *et al.* (1994) for goats in Malaysia (between 79.2 and 152.7 minutes). These results fall outside the range of grazing durations observed in adult ewes, as reported by Delagarde *et al.* (2001) (between 350 and 750 minutes). Several authors (Michiels *et al.*, 2000; Babatounde *et al.*, 2008) have emphasized the importance of time spent grazing, highlighting that animals need to graze for long periods to meet their nutritional needs.

It becomes increasingly crucial to rest in order to reach the peak of activity between 2 PM and 3 PM, which represents 10% of the grazing time. The rest of the time is dedicated to rumination, movement, and drinking (Figure 1). We presume that ewes spend more time grazing due to resource availability, which reduces their time spent moving and resting. According to our observations, rumination mainly occurs during the night.

Figure 1 Activity rhythm of ewes on pasture.



5.3 THE AVERAGE INGESTED QUANTITY

On average, a daily consumption of about 1382.4 g (table) is recorded. Although lower than that reported by Meuret *et al.* (1985) for dairy goats in summer grazing in Ardèche (2610 g DM/animal/day), this quantity exceeds that noted by Mebirouk *et al.* (2014) for rams in northeastern Algeria (1240 g/day). The frequency of bites observed on the pasture, expressed as bites per minute of grazing (FB), is approximately 24 bites per minute. This value falls within the range given by Chamberlain in Jarrige *et al.* (1995), which is 20 to 94 bites per minute for sheep.

Table 2 Key criteria observed during grazing ewes surveillance

Parameters	DG	CT	NB	WB	FB	QI
	600 ±4,40	30	144 ±8,30	0,60 ±11,30	24 ±2,20	1382,4 ±5,60

Knowing that:

DG= Total grazing duration (minutes/animal/day); NB: Total number of bites taken on vegetation during the bite-counting period (reported over a 5-minute observation period); WB: Average weight of a bite (g DM); CT: Counting time (min) :FB: Bite frequency (average number of bites per min).

6 CONCLUSION

Our study sheds light on the impact of pasture floral diversity on sheep behavior, particularly their tendency to selectively choose plants. In the Constantine region, located in eastern Algeria, we observed that sheep consumed a variety of 12 plant species, with a predominance of grasses (33%) and legumes (17%). However, our approach, which relies on phytosociological surveys, remains local and does not allow for establishing the exact order of dietary preferences towards the species.

This adaptation in their grazing habits reflects a strategy aimed at optimizing the use of available resources. Understanding how sheep voluntarily select their grazing diet is crucial for developing tailored feeding plans for our herds. A better understanding of the nutritional value of preferred plants could lead to more accurate predictions of sheep grazing choices in pasture settings.

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