



## Evaluation of the use of arid-area rangelands by grazing sheep: Effect of season and supplementary feeding

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### ABSTRACT

Twenty-four one-year-old male Abu-duleik local sheep were used to evaluate the use of natural rangelands under arid conditions. Dry and wet seasons were considered, each with twelve different animals divided into two treatments. Animals grazed the natural plants with (GS) or without (G) concentrate supplement. Esophageal fistulae were established in another eight two-year-old male to study the botanical composition of forages sheep consumed. Another sixteen one-year-old male were maintained in metabolic cages to determine the marker fecal recovery to be used in calculating feed intake and digestibility. The results of the grazing experiment revealed that average daily gain was –154 and 38 g/d in dry season, and 33 and 119 g/d in wet season, for G and GS, respectively. Forage intake was significantly ( $P < 0.05$ ) higher in wet than in dry seasons (99.5 vs. 56.0 g DM/kg  $BW^{0.75}$ /d, respectively) and that the supplementation did not significantly affect forage intake (75.2 vs. 80.3 g DM/kg  $BW^{0.75}$ /d, for GS and G, respectively). A significant interaction ( $P < 0.01$ ) between season and supplementation indicated that dry matter digestibility was similar between treatments in the wet season (73.4% vs. 71.0%, for GS and G, respectively) but greater for supplemented animals in the dry season (70.6% vs. 53.8%, respectively). Similar results were observed for organic matter and crude protein digestibilities. The supplementation did not affect the digestibility of neutral detergent fiber in the wet season but improved it in the dry season. A similar trend was observed for the acid detergent fiber digestibility. The results of the total digestible nutrients (TDN) and digestible crude protein (DCP) intake indicated that sheep can meet their energy and protein requirements by only grazing during the wet season, but their maintenance requirements were not met during the dry season. The plasma total protein concentration was higher ( $P < 0.05$ ) in the wet than in the dry season and increased with supplementation. A similar trend was observed for the plasma urea, rumen ammonia and volatile fatty acids (VFAs) concentrations, which were significantly increased in the wet seasons compared to the dry season and were greater for supplemented animals. The opposite was observed for the plasma creatinine levels. Hence, it is concluded that the nutritive value of natural rangelands is higher in wet than in dry seasons and that the concentrate supplementation is essential to maintain animals during the dry season, providing the minimum level of ammonia and VFAs required for maintaining rumen microbial activity and fermentation for grazing sheep in arid region.

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## 1. Introduction

Sheep are considered to be one of the most important grazing animals that can affect the social and economic status of people inhabiting arid and semi-arid regions. Grazing natural forages provide the least expensive source of nutrients. However, many factors affect the efficiency of utilizing these resources, such as the stocking rate, animal species and breed, production and physiological state (Beker et al., 2009; Askar et al., 2013), season of the year, and supplementary feeding when practiced (El-Shaer, 2010). Supplementation may be necessary to meet the nutrient requirements of grazing animals and improve their performance (El-Shaer and Kandil, 1990) or maintain animals during the dry season (Pimentel et al., 2011). Supplementation can enhance the digestible feed intake and improve the balance of nutritional components to maximize the efficiency of forage utilization (El-Shaer, 2010). It may reduce forage intake and fiber digestion (Garcés-Yépez et al., 1997) depending on the level of supplementation and the total intake, but it decreases the time spent grazing and the associated energy cost of activity (Beker et al., 2009) which can be appreciable. Consequently, the efficiency of nutrient utilization is positively modified.

Pasture evaluation requires accurate estimates of the feed intake, composition, and digestibility. Feed intake estimation and feed utilization help to determine the stocking rate and grazing period in a particular area, which prevents over grazing. Internal markers are often used to estimate forage intake and digestibility (Dove and Mayes, 2005; Goetsch et al., 2010; Askar et al., 2013), while the total fecal output is collected in fecal bags or estimated by external markers. Many factors may affect the choice of a suitable internal marker. Fecal recovery of markers vary, the appropriate marker need to be validated and chosen based on the proposed diet and current environmental condition at the experimental area (Askar et al., 2012). Furthermore, some blood metabolites may be used to monitor the nutritional state of animals, such as the blood total protein and its fractions (Sahoo et al., 2009), and blood urea (Hammond et al., 1994) and creatinine (Xue et al., 1988).

Natural rangelands of the study area, Ras Hederba Valley, Egypt, are characterized by poor protein content of less than 7% CP, negatively affecting the animals' feed consumption and maintenance of its body mass, particularly in dry seasons. It is postulated that a concentrate supplement rich in protein is necessary to maintain animals throughout the year, so more during the dry season. The present investigation addressed the nutritive value of natural rangeland forages in Ras Hederba Valley determined by estimating the intake and nutrient digestibility of grazing sheep, taking into consideration the effects of the season and high protein concentrate supplementary feeding. Blood and rumen metabolites reflecting the nutritional state of the animal were also studied. The findings help to make appropriate decisions and facilitate seasonal management changes, such as stocking rate, pasture access and supplementary feeding, to enhance animal production while preserving the fragile dry pastoral system.

**Table 1**

DM contents and chemical composition of *Panicum turgidum* and concentrate supplement (% DM basis).

Constituents	<i>Panicum turgidum</i>		Concentrate supplement
	Summer (Dry)	Winter (Wet)	
Dry matter	57.1	44.2	94.5
Organic matter	88.6	93.6	91.0
Crude protein	5.65	5.50	17.38
Ether extract	1.20	1.82	2.26
Neutral detergent fiber	88.0	89.7	47.5
Acid detergent fiber	54.2	46.9	14.5
Acid detergent lignin	19.8	14.6	5.62
Acid insoluble ash	7.72	2.82	1.08

## 2. Materials and methods

The study was carried out in the Ras Hederba Valley region at the Shalateen research station of the Desert Research Center, some 1300 km south east of Cairo, the capital of Egypt, at latitude 22,00,720 N and longitude 36,48,955 E. The area is bordered by Sudan to the south and the red sea to the east. It is an arid region with average annual precipitation of only 58.5 mm/year mostly as erratic showers in November and December. The average ambient temperatures of the study area were 35 and 22 °C, and humidity values were 37% and 43% for the summer (dry) and winter (wet) seasons, respectively (The Egyptian General Meteorological Authority). Water resources are meager and available only to nomadic inhabitants and their animals from shallow wells. Therefore, settled agriculture activities are absent and grazing of sheep, goats and camels is the primary activity. According to Allam et al. (2007) and Raef (2012), only three plant species are found, namely *Panicum turgidum*, *Lycium shawii*, and *Acacia tortilis*. Their determined abundances (95.9% and 97.7%, 3.7% and 1.4%, and 2.6% and 2.4%) and plant densities (0.455 and 0.296, 0.007 and 0.003, and 0.004 and 0.003 plant/m<sup>2</sup>, respectively for *P. turgidum*, *L. shawii*, and *A. tortilis*, and in the wet and dry seasons) indicated that *P. turgidum* is the dominant plant species in the study area during the wet and dry seasons. The fresh and dry biomass yield of *P. turgidum* was determined prior to the start of each period of the current experiment. They were 2.96 and 1.46 Ton/acre (4200 m<sup>2</sup>) in the wet season and 2.05 and 1.25 Ton/acre in the dry season, respectively. Plants were cut approximately 5 cm above ground, hence these figures might be an over estimate of forage yield.

### 2.1. Animals and grazing treatments

Twenty-four 1-year old male Abu-Duleik sheep were used to determine the nutritive value of natural rangeland forages by estimating their intake and digestibility. Twelve animals were used in each of dry and wet season. Animals in each season grazed the natural rangeland plants, mainly *P. turgidum*, and either received the concentrate supplement (GS) or did not (G). The diet of animals in the GS treatment group was supplemented daily with the pelleted commercial concentrate mixture at a level to meet the maintenance energy requirements (Kearl, 1982). The supplement was individually offered at sunset in separated troughs and it consisted of 25% barley grain, 26% cottonseed meal, 31% wheat bran, 10% rice bran, 4% molasses, 2.5% limestone, 1% common salt, and a 0.5% mineral and vitamins premix to achieve approximately 68% TDN and 17% CP with almost 25% of ruminal non-degradable protein (Chiba, 2009). The chemical compositions of *P. turgidum* and the concentrate supplement are shown in Table 1. In each season, the animals were allowed to adapt for one month to grazing the open rangeland area. Four animals per treatment were then fitted with fecal bags and allowed to adapt for three more days before collecting the fecal matter for seven days. The animals were weighted at the beginning and end of the experiment. In summer, the experiment ran for 46 days (May 30–July 15) while in winter it lasted 48 days (January 12–March 1).

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