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ECOPHYSIOLOGICAL CHARACTERISTICS, DISTRIBUTION, AND NUTRITIONAL VALUE OF DESERT RANGE PLANTS IN QATAR

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صفات نباتات المراعي البيئية الفسيولوجية وقيمتها الغذائية وتوزيعها في المراعي الصحراوية في قطر

أسامة هنداوي سيد

أوضحت الدراسة أن تعدد الأنواع النباتية سببٌ هامٌ في امكان الرعي طوال العام رغم ضعف الاقتصاد المائي للمراعي الصحراوية في قطر وان هناك علاقة وثيقة بين ميكانيكية تثبيت ثاني أكسيد الكربون وتوزيع الأنواع النباتية على أشكال الأرض و تضاريسها المختلفة .

وتتميز الحوليات الشتوية والصيفية من نباتات الفصيلتين المركبة و البقولية بتنوع محتواها من الماء و المادة الجافة و القيمة الغذائية . وتنتمي شجيرات فصيلة الحمض المتشحمة إلى المستنقعات الملحية الساحلية وتكون ذات محتوى عال من الماء و الأملاح ، بينما تنتشر أعشاب الفصيلة النجيلية انتشاراً واسعاً في المروج الملحية وتمثل مصدراً هاماً للطاقة في غذاء حيوانات المراعي لارتفاع محتواها من الألياف .

Key Words: Ecophysiology, desert ranges, nutritional value

ABSTRACT

Despite the scarcity of water, desert ranges of Qatar can support a characteristic diversity of species and an all-year-round supply of feed. A correlation between carbon dioxide fixation mechanism, distribution of species, and physiognomy of the landscape was observed. Winter and summer annual forbs of the Asteraceae and Fabaceae have variable average contents of water, dry matter, and nutrients. Succulent shrubs of the Chenopodiaceae inhabit littoral salt marshes and have high average water and ash contents. Grasses of the Poaceae are widely distributed in salt meadows, depressions, and cultivated land. They have high contents of crude fibre, and are an important source of energy for the diet of range animals.

INTRODUCTION

The natural vegetation of Qatar includes many perennial as well as annual grazable range plant species, belonging to several higher plant families (Batanouny 1981). These species exhibit various life forms, growth habits, and photosynthetic attributes that are crucial for their distribution and establishment over the different landforms of the local relief.

The preference of livestock for different range plant species, the amount consumed daily, the available menu, and its nutritional value, vary considerably according to locality and season (Cook and Harris 1968). Moreover, the productivity of desert ranges is influenced by several factors (Bhattacharya 1986), of which scarcity and unpredictability of rain is by far the most important. This is the justification for studies of the ecophysiological characteristics affecting the distribution of components of such invaluable natural resources.

This paper presents preliminary information necessary for establishing a data base for the distribution, photosynthetic attributes, and nutritional value of range plant species in relation to the physiognomy of the landscape of desert ranges in the Qatari peninsula.

MATERIALS AND METHODS

Samples of 45 range plant species of the families Asteraceae (As), Chenopodiaceae (Ch), Fabaceae (Fa), and Poaceae (Po) were collected from four habitats (Hab):

cultivated lands (C), depressions (D), littoral salt marshes (L), and salt meadows (S). Samples were identified and sorted according to life form (LF) into broad-leaved forbs (F), grasses (G) and shrubs (S). Their growth habits (GH) as summer annuals (SA), winter annuals (WA) and perennials (P) were determined (Batanouny 1981, El-Ghazaly 1991).

The edible parts (EP), such as aerial parts of forbs and grasses (A), branches and leaf-browse of shrubs (B), and hay (H), were then separated and cleaned. The photosynthetic type (PT) was determined by using published $\delta^{13}C$ values and/or information about leaf anatomy (Sankhla *et al.* 1975, Mooney *et al.* 1977, Winter 1981, Ziegler *et al.* 1981, Batanouny *et al.* 1988). If no description was available in the literature, leaf anatomy (AN) was examined using a light microscope (Bolhar-Nordenkampf 1985) with respect to the Kranz syndrome (Laetsch 1974) and leaf sections were described (brown 1975) as Kranz (K) or non-Kranz (N). When available, the International Feed Number (IFN) was assigned to the species.

Water (W) and dry matter (DM) contents were determined after oven drying (80°C) to a constant weight. Dried material was prepared for chemical analysis by grinding to pass a 1 mm mesh sieve. The residue remaining after heating in a muffle furnace (500°C) overnight (Ash), and organic insoluble crude fibre (CF) were determined using the protocols recommended by the British Ministry of Agriculture, Fisheries, and Food (1981). Three separate samples of each species were processed and the data presented are means of three values. In all cases the standard errors were very small and were not included in Table 1.

RESULTS

Depressions are by far the richest of the habitats, having about half the recorded species, including both annual and perennial xeromorphic forms. Cultivated lands, salt meadows, and littoral salt marshes are next in order of richness with annual mesic weeds, perennial halophytic forms, and perennial succulent shrubs, respectively (Table 1). The numbers of summer annuals, winter annuals, and perennial species recorded were similar. Kranz cell anatomy and $\delta^{13}C$ values between -14.2 and -11.7‰, a combination characteristic of CO_2-fixation via the C_4-pathway, was observed in 40% of the recorded species. Other species had no Kranz cell anatomy and $\delta^{13}C$ values of -29.0 to -22.7‰, indicating CO_2-fixation via the C_4-pathway. There were a number of C_4 species in the Chenopodiaceae and a large percentage of C_4 species in the Poaceae.

Recorded members of the Asteraceae, Chenopodiaceae, and Fabaceae have similar average water contents, with members of the Asteraceae being rich in dry matter, and those of the Chenopodiaceae being rich in total ash (Fig. 1). Although members of the Poaceae have low average water contents they were richest in dry matter, which was mostly crude fibre (Fig. 1). In general, forbs and shrubs were rich in water, whereas grasses were rich in crude fibre (Fig. 2). Furthermore, dry grasses, recorded as hay, had substantially reduced water contents and slightly elevated ash contents (Table 1).

DISCUSSION

There is little correlation between the form of individual species and the presence of a C_3- or a C_4-pathway (Frey and

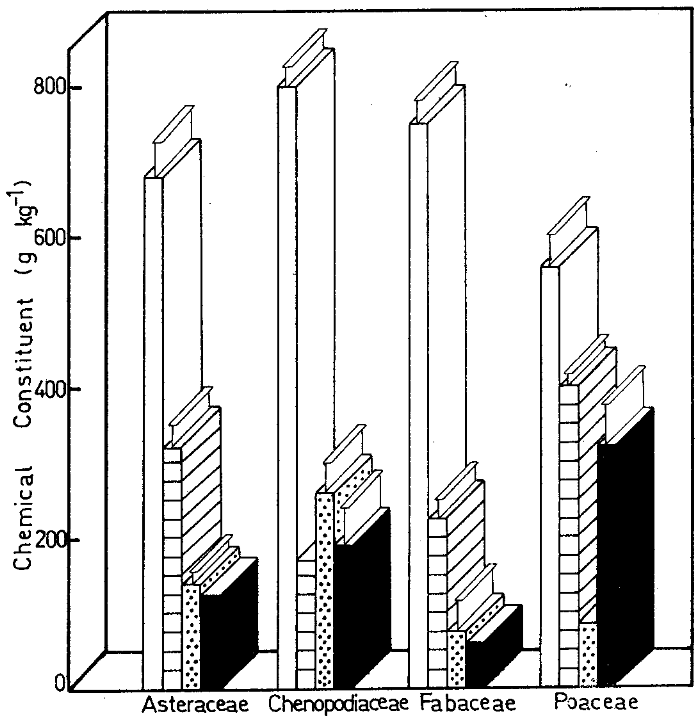

Fig. 1: Average chemical constituents (g kg^{-1}) of species of the Asteraceae, Chenopodiaceae, Fabaceae, and Poaceae in desert ranges of Qatar. (□ water content, ▤ dry matter, ⊡ ash, ■ crude fibre, ± standard error).

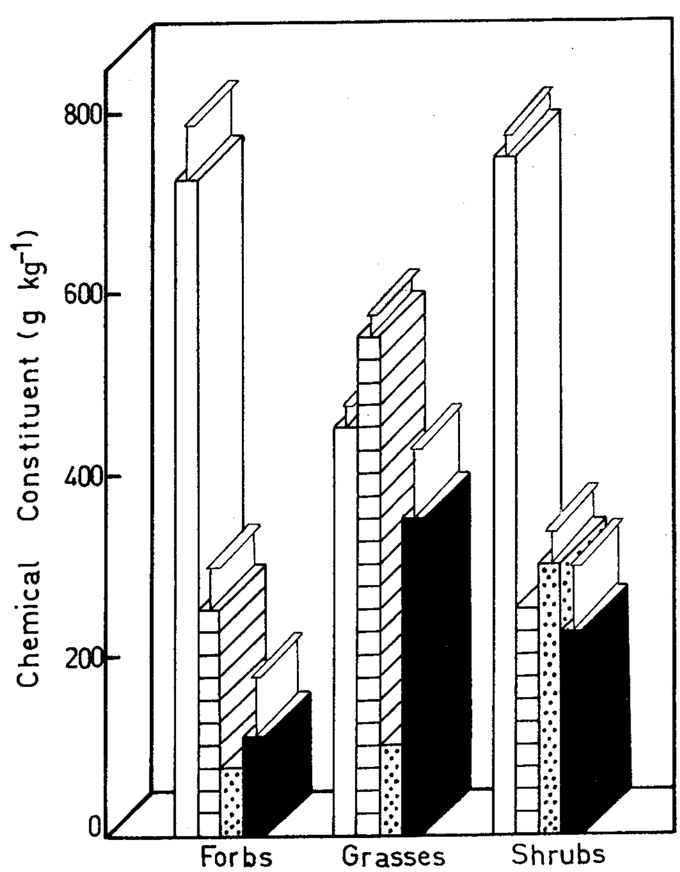

Fig. 2: Average chemical constituents (g kg^{-1}) of different life forms of plant species in desert ranges of Qatar. (□ water content, ▤ dry matter, ⊡ ash, ■ crude fibre ± standard error).

Table 1
Ecophysiological characteristics and chemical composition (g kg^{-1}) of some desert plant species in Qatar. (Refer to the section on Materials and Methods for explanation of symbol)

Species	F	HAB	LF	EP	GH	δ13C‰	PT	AN	IFN	W	DM	Ash	CF
Aaronsohnia factorovski	As	D	F	A	WA	-	-	N		650	350	60	150
Aeluropus lagopoides	Po	S	G	A	P	-13.3	C4	K		500	500	140	346
Aeluropus lagopoides	Po	S	H	H	-	-	-	-		50	950	300	320
Anabasis setifera	Ch	S	S	B	P	-12.8	C4	K		850	150	300	225
Artemisia incula	As	D	S	B	SA	-	-	N	2.28.536	200	800	100	278
Arthrocnemum glaucum	Ch	L	S	B	P	-26.7	C3	N		800	200	170	220
Astragalus corrugatus	Fa	D	F	A	WA	-27.5	C3	N		750	250	80	105
Atriples leucoclada	Ch	S	S	B	SA	-14.0	C4	K	2.27.610	800	200	140	240
Cassia italia	Fa	D	F	A	SA	-28.9	C3	N		750	250	50	166
Chenopodium album	Ch	D	F	A	SA	-26.6	C3	N	2.02.137	800	200	80	80
Chenopodium murale	Ch	C	F	A	SA	-24.3	C3	N		850	155	80	80
Chloris virgata	Po	C	G	G	SA	-	C4	K		450	550	60	300
Chloris virgata	Po	C	H	H	-	-	-	-		200	800	120	290
Chrysopogon aucheri	Po	D	G	A	P	-	C4	K		600	400	80	410
Chrysopogon aucheri	Po	D	H	H	-	-	-	-		200	800	100	390
Cynodon dactylon	Po	C	G	A	AP	-15.6	C4	K		500	500	80	290
Dactelothenium aegyptium	Po	D	G	A	SA	-12.2	C4	K		700	300	120	300
Dactelothenium aegyptium	Po	C	G	A	P	-11.9	C4	K		800	200	50	390
Echinochloa colonum	Po	C	G	A	SA	-11.9	C4	K	2.27.512	650	350	50	350
Eremopogon foveolatus	Po	D	G	A	P	-10.9	C4	K		600	400	50	350
Filago spathulata	As	D	F	A	SA	-	-	N		700	300	200	200
Francoeuria crispa	As	D	F	A	P	-	-	N		800	200	100	175
Halocnemum strobilacium	Ch	L	S	B	P	-25.6	C3	N		700	300	240	195
Halopeplis perfoliata	Ch	L	S	B	SA	-26.5	C3	N		900	100	540	225
Hordium glaucum	Po	D	G	A	WA	-	C3	N	2.27.879	650	350	70	350
Ifloga spicata	As	D	F	A	WA	-	-	N		600	400	220	250
Lasiurus hirsutus	Po	D	G	A	P	-11.7	C4	K		500	500	60	455
Launaea capitata	As	D	F	A	WA	-	-	N		800	200	180	130
Medicago laciniata	Fa	C	F	A	WA	-	-	N		750	250	80	127
Pennisetum divisum	Po	D	G	A	SA	-12.5	C4	K		700	300	100	270
Polypogon monspeliensis	Po	C	G	A	SA	-29.0	C3	N		800	200	160	370
Pulicaria undulata	As	D	F	A	P	-	-	N		650	350	210	150
Reichardia tingtana	As	D	F	A	WA	-	-	N		800	200	50	95
Rhanterium eppaposum	As	D	F	A	SA	-	-	N		750	250	70	80
Salsola baryosma	Ch	D	S	B	SA	-14.2	C4	K		850	150	400	267
Schanginia aegyptiaca	Ch	D	F	A	SA	-11.5	C4	K		850	150	210	115
Schismus barbatus	Po	D	G	A	WA	-22.7	C3	N		600	400	100	336
Seidlitzia rosmarinus	Ch	S	G	B	SA	-12.8	C4	K		800	200	300	147
Sonchus oleraceus	As	C	F	A	WA	-	-	N		900	100	60	75
Sporobolus arabicus	Po	S	G	A	P	-12.4	C4	K	1.28.056	500	500	160	373
Sporobolus arabicus	Po	S	H	H	-	-	-	-		100	900	100	350
Stipa capensis	Po	D	G	A	WA	-29.0	C3	N		600	400	140	342
Stipagrostis plumosa	Po	D	G	A	P	-12.9	C4	K		550	450	60	420
Stipagrostis plumosa	Po	D	H	A	-	-	-	-		100	900	100	390
Suaeda vermiculata	Ch	L	S	B	P	-14.2	C4	K		800	200	300	145
Trigonella anguina	Fa	D	F	A	WA	-	-	N		800	200	80	100
Trigonella hamosa	Fa	C	F	A	WA	-28.6	C3	N		800	200	80	95
Trigonella stellata	Fa	D	F	A	WA	-28.7	C3	N		750	250	60	117

Kurschner 1983), the pattern of species distribution is nevertheless affected. Littoral salt marshes with high water and salt contents are characterized by C_3 perennial halophytic succulent shrubs, whereas depressions with low water and salt contents have a mosaic of C_3 and C_4 annual and perennial xeromorphic forms. Salt meadows with low water and high salt contents represented transitions between littoral salt marshes and depressions in the physiognomy of the local relief and were inhabited strictly by C_4 species. This pattern of distribution is in agreement with the well-documented improved water use efficiency of C_4 species (Edward and Walker 1983).

Scarcity of water is a characteristic of desert ranges in Qatar. Perennial succulent shrubs of the Chenopodiaceae with high water and salt contents are preferred by camels (Gauthier-Pilters and Dagg 1981) and provide a satisfactory source of water and nutrients, particularly during the dry season. On the other hand, despite their low water contents, perennial grasses of the Poaceae and hay are rich in crude fibre and can be an important source of energy for the grazing animals. Winter and summer annuals of the Asteraceae and Fabaceae have high water contents, variable amounts of dry matter, and moderate amounts of ash and fibre. It is, therefore, concluded that despite changes in the nutritional value of the daily diet in different seasons, the diversity of plant species in desert ranges of Qatar can provide feed for livestock throughout the year.

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