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Prevalence and Nutritive value of some Arid Range Plant Species in Raniah Province of Makkah District

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Abstract

This study aimed to investigate the frequency of prevalence and nutritive value of range plant species in Raniah province of KSA. Deterioration of rangeland in the province was evident by the decreased appearance of valuable species like Rabla (*Plantago ovate*), and Thumam (*Panicum turgidum*) which were encountered in only 30% of the sampling sites. Results of proximate analysis showed significant variation ($P < 0.01$) in all components of the range species. The ash content, was higher in Funoon (*Arnebia hispidissima*), Makar (*Polycarpaea repens*) and Nassi (*Stipagrostis plumosa*) (43.39, 23.30 and 20.26%, respectively) compared to the Rhodes grass (*Chloris gayana*). The lowest proportions of ash were found in Alaga (*Scrophularia hypericifolia*) and Thayoum (*Penisetum divisum*) which were 7.67 and 9.73%, respectively. The crude protein % (CP) in all species was high compared to Rhodes grass (14.28% CP). However, in Funoon and Alaga it was 5.59 and 8.49 % respectively. Both Sabat (*Cenchrus ciliaris*) and Shouk Aljemal (*Alhagi graecorum*) had higher ($P <$ o.o1) Crude Fibre (CF) content (47.50 and 47. 07%, respectively) compared to the other species. The lowest CF% was observed in Rabla, Funoon, Thayoum and Makar with 24.97, 27.53, 27.52 and 28.53%, respectively. The highest Nitrogen Free Extract (NFE) was found in Thayoum (50.66%) leveling up the total carbohydrates in this species to 78.19%. Ether Extract (EE) content in was higher in Rabla (6.83+0.15%) and Thumam (2.40+0.27), but ranged between 1 and 2% in the remaining species. Rangeland rehabilitation program should be initiated by sowing or seeding drought resistant and valuable range species, like those of the Poaceae family. It is however necessary to raise the ecosystem conservation awareness among the local people in the province.

Keywords: Arid habitat, ecosystem, perennial shrubs, proximate analysis

1. Introduction

Most of the area in Saudi Arabia can be classified as arid or semiarid ecosystems where more than 74% of the total land mass is considered rangeland (Al Sakhan 1997). Grazing and agriculture have traditionally been the pattern of life for centuries. Before the turn of the century, rangelands offered most of the livestock needs when the country population was low and the hema system was existing. In the last few decades, livestock population in the country increased in association with an increase in human population. Over-grazing, over exploitation of rangelands, human activities, and poor management policies disrupted desert ecosystem causing dramatic changes in vegetation and soil leading to rangelands deterioration (Al Zaid *et al*., 2004).

The dominant rangeland vegetation is mostly represented by shrubs and perennial grasses. The importance of these plants as a source of nutrient for pastoral grazing animals cannot be overemphasized in the Kingdom of Saudi Arabia. Although the amount of forage, feed or fodder available to an animal is important, the quality will determine if the animal is taking in enough nutrients to maintain health, growth and reproduction. Therefore, knowledge of the nutritive value of rangeland plants is important for proper establishment of range animals and for evaluating the potentials of available nutrients. The forage feeding value varies in different conditions (Biondini *et al*., 2006; Graza and Fulbright, 2008; Low and Andrews, 2007; Dongmei *et al.*, 2005). The most important factor for the changes in the forage feeding value is the plant growth and phenological stages (Sulc *et al*., 2009; Ayan *et al*., 2010; White 2003). Water stress is usually the main physical limitation to forage yield. It has a considerable effect on forage growth, development and quality (Al Soqeer *et al*., 2012; Sasani *et al.*, 2004). The physical and chemical characteristics of soil present basic component of rangeland ecosystems are important to both, the kind and amount of forage produced and the type of management that is possible or appropriate.

The objectives of this study was to determine the prevalence frequency and nutritive value of some selected range plant species known to be consumed by livestock in Raniah Province of KSA during the active plant growth period (from November 2013 to April 2014). This study also helps identify the suitability of range species for promoting selective rehabilitation of the province arid habitat.

2. Materials and Methods

2.1 Study area

The study area pertains to Raniah Province of Makkah district (12° 30 N, 42° E) in the west part of Saudi Arabia extending over 62,000 km2. Raniah Province lies about 870 km south- west to Riyadh, 380 km west to Taif and 150 km north to Bishah. The province has similar meteorological and ecological attributes with the rest of the Arabian Peninsula. It is characterized by a hot arid desert type climate, with average annual rainfalls of 90 mm, maximum temperature between 34 and 45°C in summer and the minimum between zero and 20°C in winter with an average relative humidity of 22% (Al Faraj, 2003). The region has a mixture of natural vegetation, rangeland,

and localized farmlands.

2.2 Field survey and collection of range plants

A field survey was conducted by visiting ten randomly selected villages in Raniah Province. Pasture condition, grazing pressure and the relative abundance of the different range plants were assessed, for the neighboring rangelands, by direct observations during the field visits. The collected samples of whole plant-above ground biomasses were cleaned, sun dried over a couple of days to constant weights, powdered and stored. Samples of the same range plant species collected from all the sampling sites were pooled together before been subjected to chemical analysis.

2.3 Proximate Analysis

Samples of powdered and pooled rangeland species were subjected to Proximate analysis in the nutrition laboratory of the Animal Production Research Center, Kuku, Sudan, following the method of AOAC (1984). Each sample was chemically analyzed for three times to determine the crude protein, ether extracts, crude fiber, ash and nitrogen-free extracts (NFE). The NFE was calculated according to the following formula: NFE (in % DM) = 100 – (CP + CF +EE + Ash). where CP = crude protein, CF = crude fibers, EE = ether extract.

2.4 Statistical analysis

The Dry matter content, crude protein, ether extracts, crude fiber, ash and nitrogen-free extracts (NFE) of the range plants were compared with those of the Rhodes grass (*Chloris gayana*) as a control using one way analysis of variance (ANOVA). The Fisher's PLSD was used to separate the difference among the means. The data were analyzed using the StatView software (Version 9).

3. Results and Discussion

The rangeland in Raniah province can be described as poor, which is in consistence with the statement of Al Shareif (1999) that, the rangelands in KSA are poor in productivity (130 kg/ Hectar). The physical environment is the major limiting factor for the growth, productivity and survival of plants. Water stress is usually the main physical limitation to forage yield. It has a considerable effect on forage growth, development and quality (Al Soqeer *et al*., 2012; Sasani *et al.*, 2004). As in other arid zones, high rainfall variability is the norm between and within years causing large fluctuations in the productivity of rangelands. Although the average rainfall in most of the country is low, the whole regions may experience rainfall less than the average for few years leading to drought. Some years, the entire year's rainfall may consist of one or two torrential outbursts. This might surprisingly be sufficient to sustain vegetation growth.

The range plant species, known to be consumed by livestock species, were collected from the sampling sites. The most frequently encountered species are shown in table No. 1. These rangeland species were classified into three categories according to their frequencies of appearance in the sampling sites. Species in category A were encountered in all of the sampling sites, species in category B were encountered in 6 out of the ten sampling sites while those in category C were encountered in only three of the sampling sites. The majority of the species were shrubs and perennial grasses. At least four of the most frequently encountered plant belonged to the family Poaceae (Table, 1). In a study to evaluate palatability and nutritive value of range species Salih, (2000) found that the most palatable plants were those belonging to the Poaceae family among which was *Panicum turgidum* (Thumam). According to Selim and Marwa, (2009) *Panicum turgidum* is one of the widely distributed and most drought resistant grasses of the Egyptian desert. This species is an exceptionally important range plant due to its adaptability to grow in different environment and resist drought and soil salinity (Migahid and El Shourbagi, 1961). Unfortunately, such valuable species are losing their ecological importance and became threatened with extinction because of heavy grazing and drought. This is coupled with the appearance of less palatable and somewhat toxic species like Harmal (*Rhazya stricta*). Other palatable and succulent species showing trends of decreased frequency included Rabla (*Plantago ovate*) and Rotha (*Salsola villosa)* which were encountered in only 30% of the sampling sites. The expansion of animal production and deterioration of natural rangeland in the province has necessitated the concomitant dependence on subsidized commercial forage of very high quality such as Alfalfa (*Medicago sativa*), rhodes (*Chloris gayana*) and blue banic (*Panicum antidotale*) beside barley. While the associated economical impacts on the farmers have been well documented, far less have been done for rehabilitation of pastoral important plants. This can only be possible with awareness and participation of the local people in the province.

As shown in Table 2, the results of proximate analysis showed significant variation ($P < 0.01$) in concentration proportions of biochemicals (carbohydrate, fats and protein) and other contents (ash, fiber). There were highly significant differences in dry matter (DM) of grasses and shrubs. The ash content, which is an index of mineral contents in the rangeland plant, was significantly higher (43.39, 23.30 and 20.26%) in Funoon (*Arnebia hispidissima*), Makar (*Polycarpaea repens*) and Nassi (*Stipagrositis plumose*), respectively, compared to the ash content in Rhodes (*Chloris gayana*) which was 10.63%.

Table 1 Rangeland plants frequency and prevalence at ten sampling sites in Raniah province of Makkah District

Category	Scientific name	Common name	Family name	Life cycle
A	*Stipagrostis plumosa*	Nassi	Poaceae	Perennial
	Cenchrus ciliaris	Sabat	Poaceae	Perennial
	Haloxylon salicornicum	Rimath	Chenopodiaceae	Perennial
	Penisetum divisum	Thayoum	Poaceae	Perennial
	Alhagi graecorum	Shouk Aljemal	Fabaceae	Perennial
B	*Polycarpaea repens*	Makar	Caryophyllaceae	Perennial
	Arnebia hispidissima	Funoon	Boraginaceae	Annual
	Scrophularia hypericifolia	Alalga	Scrophulariaceae	Perennial
C	*Panicum turgidum*	Thumam	Poaceae	Perennial
	Plantago ovata	Rabla	Plantaginaceae	Annual

The lowest proportion of ash was found Alaga (*Scrophularia hypercifolia*) and Thayoum (*Penisitum divisum*) which were 7.67 and 9.73%, respectively. However, because the ash content is determined by ignition of a known weight of the sample at 550^{o}C until all carbon has been removed, the ash may contain materials of organic origin such as sulphur and phosphorus from proteins, and some loss of volatile materials in the form of sodium, chloride, potassium, phosphorus and sulphur will take place during ignition. The ash content is thus neither qualitatively nor quantitatively truly representative of the inorganic material in the food.

The crude protein (CP) content is calculated from the nitrogen content of the food, which converts to ammonia all nitrogen present except that in the form of nitrate and nitrite. This is not 'true protein' since the method determines nitrogen from sources other than protein, such as free amino acids, amines and nucleic acids, and the fraction is therefore designated crude protein. Except for Funoon (*Arnebia hispidissima*) and Alaga (*Scrophularia hypercifolia*) in which the CP content were 5.59 and 8.49 % respectively, the CP proportion in the other species was relatively good compared to the Rhodes grass (14.28% CP). The crud protein content of some grasses ranged from high (15-25%) to low (3-5%) (Pieterse *et al.*, 1989; and Pieterse *et al.*,1997). Van Niekerk (1997) indicated that grasses with high crude protein content, often produce lower yields. According to Al zaid *et al*., (2004) the nutrient value was relatively low due to the low protein content (4.2 %) and high crude fiber (30.2 %). Accordingly, Funoon (*Arnebia hispidissima*) with only 5.59% CP and 43.39% ash has lowest nutritive value among the examined rangeland species. Holecheck *et al*., (1998) reported high crude protein in actively growing forage compared to that at dormant stage. However, Bokhari *et al.* (1990) have reported that the crude protein in the green *Panicum turgidum*

Table 2 Some nutrient composition of the prevailing rangeland plants in Raniah province of Mekkah district

Rangeland Species	DM%	Ash%	CP%	CF%	EE%	NFE%
Rhodes (*Chloris gayana*)	93. 40+0.20^{a}	10.63+0.06^{a}	14.28+0.07^{a}	36.00+1.00^{a}	1.00+0.00^{a}	38.09+1.02^{a}
Nassi (*Stipagrositis plumose*)	93. 57+0.06^{b}	20.26+0.0^{b}	16.51+0.02^{b}	32.57+0.21^{b}	2.00+0.00^{b}	28.66+0.20^{b}
Sabat (*Cenchrus ciliaris*)	94. 47+0.15^{b}	13.74+0.07^{c}	11.77+0.03^{c}	47.50+0.20^{c}	1.00+0.00^{a}	25.99+0.11^{b}
Rimth (*Haloxylon salicornicum*)	93. 07+0.06^{c}	14.83+0.03^{d}	18.15+0.07^{d}	31.07+0.12^{b}	1.00+0.00^{a}	37.95+4.99^{a}
Thayoum (*Penisitum divisum*)	88. 43+0.15^{d}	9.73+0.04^{e}	11.07+0.07^{c}	27.53+0.35^{d}	1.00+0.00^{a}	50.66+0.33^{c}
Makar (*Polycarpaea repens*)	91. 93+0.06^{e}	23.30+0.00^{f}	11.61+0.01^{c}	28.53+0.25^{d}	1.99+0.01^{b}	37.56+5.41^{a}
Shouk Aljemal (*Alhagi graecorum*)	91. 63+0.07^{e}	11.39+0.01^{a}	10.95+0.05^{c}	47.07+0.12^{c}	2.09+0.18^{bc}	28.50+0.18^{b}
Funoon (*Arnebia hispidissima*)	90. 77+0.15^{ef}	43.39+0.01^{g}	5.59+0.04^{e}	27.53+0.25^{d}	2.01+0.12^{b}	21.46+0.41^{d}
Alaga (*Scrophularia hypercifolia*)	90. 37+0.57^{f}	7.67+0.01^{f}	8.49+0.01^{f}	46.90+0. 10^{c}	2.00+0. 00^{b}	34.94+0.09^{a}
Thumam (*Panicum turgidum*)	91. 10+0.46^{ef}	11.23+0.68^{a}	11.87+1.54^{c}	30. 70+4.70^{bd}	3.40+0. 27^{c}	42.80+6.26^{e}
Rabla (*Plantago ovate*)	89. 17+0.77^{d}	11.73+1.63^{a}	17.80+0.46^{d}	24.97+0.35^{d}	6.83+0.15^{c}	38.67+2.45^{a}
Rotha (*Salsola villosa*)	91. 00+1.00^{e}	15.20+0.30^{d}	16.50+0.27^{b}	31.23+1.08^{b}	2.37+0.55^{c}	34.70+1.21^{a}

Values (mean±SD) in the same column with different superscripts are significantly different ($P < 0.01$). DM = dry matter, CP = crude protein,
CF = crude fibre, EE = ether extract, NFE = nitrogen free extract.

reaches 9.5 % but only 4.2% in the dry samples of the same species. Protein shortages are of major concern to ruminant production systems. Each class of animal has a specific crude protein requirement per day. If this requirement is not met, growth and hence production can be seriously affected. Protein source are, however, expensive to buy, and the farmer would like to get as much as possible crude protein from the pasture itself (Van Niekerk, 1997). The carbohydrates in a feed sample are retrieved in two fractions of the proximate analysis, namely CF and NFE. The fraction, which is not soluble in a defined concentration of alkalis and acids, is defined

as crude fiber (CF). This fraction contains cellulose, hemicellulose and lignin. The phenolic polymers like lignin are almost indigestible that may hinder carbohydrate digestion. In ruminants, fibre fractions that provide energy are important as celluloses and hemicelluloses are easily digestible. When the sum of the amounts of moisture, ash, crude protein, ether extract and crude fibre (expressed in g/kg) is subtracted from 1000, the difference is designated the nitrogen-free extractives (NFE). The nitrogen-free extract fraction is a heterogeneous mixture of all those components not determined in the other fractions. It is made up primarily of readily available carbohydrates, such as the sugars and starches, it may also contain pectins, some organic acids and pigments. While analyzing the fiber contents of studied species, both Sabat (*Cenchrus ciliaris*) and Shouk Aljemal (*Alhagi graecorum*) had significantly ($P < o.o1$) higher fiber content (47.50 and 47. 07% CF, respectively) than Rhodes grass (36% CF) and the other plant species. The lowest CF% were observed in Rabla (*Plantago ovate*), Funoon, Thayoum and Makar with 24.97, 27.53, 27.52 and 28.53 CF%, respectively. According to the result from the present study Thayoum (*Penisitum divisum*) showed significantly ($P < 0.01$) higher proportion of NFE (50.66%) than Rhodes grass (38.09%). Since the carbohydrates in a feed sample are retrieved in two fractions (CF, NFE), the total carbohydrates in Thayoum plant would level up to 78.19% of its DM content.

The Fats and lipids fraction is determined by subjecting the food to a continuous extraction with petroleum ether for a defined period. The residue, after evaporation of the solvent, is the ether extract. In addition to lipids, EE contains organic acids, alcohol and pigments. The EE content in Rabla (*Plantago ovate*) was higher (6.83+0.15%) followed by Thumam (2.40+0.27). In the remaining plant species the EE proportion ranged between 1 and 2%. In his study about the Arab and middle east tables of food composition, Kearl *et al*. (1979), reported that the EE content of Thumam (*Panicum turgidum*) ranges between 0.6 and 1.5 which is similar to the result obtained in the present study. Al Noaim *et al* (1991) reported that in *Panicum turgidum* the EE content was 1.8%.

4. Conclusion and Recommendation

The rangeland in Raniah province is poor and deteriorating due to drought and improper management. However, the nutrient compositions of the existing rangeland species are within the normal range of their kind. The expansion in animal production and deterioration of natural rangeland in the province has necessitated the concomitant dependence on subsidized commercial forage of very high quality such as Alfalfa (*Medicago sativa*), rhodes (*Chloris gayana*) and blue banic (*Panicum antidotale*) beside barley. While the associated economical impacts on the farmers have been well documented, far less have been done for rehabilitation of pastoral important plants. It is recommended that rangeland rehabilitation program should be initiated by sowing and seeding plant species resistant to drought and soil salinity like those belonging to the Poaceae family. This cannot be achieved without the awareness and participation of the local people in the province.

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