

## Potential of some halophytic plants as animal forage in Ha'il / Saudi Arabia

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### Abstract

Halophytic plants are existed in several regions of Saudi Arabia due to the presence of coastal saltmarshes along the Red Sea and the Arabian Gulf shores, and inland saltmarshes (Sabkhas). The future prosperity of feed resources in Saudi Arabia relies on the economic feasibility of using marginal and long-neglected resources such as halophytic plants. However, little is known about the nutritional value of halophytes of Saudi Arabia. Therefore, the main objective of the current study was to determine the nutritional potentiality of some-common halophytic species of (Qa'a El-Milh's, Ha'il, Saudi Arabia) sabkha: *Aeluropus lagopoides*, *Atriplex leuococlada*, *Mesembryanthemum nodiflourm*, *Tamarix nilotica*, *Salicornia strobilacea*, *Salsola imbricata*, *Salsola vermiculata*, *Seidlitzia Rosmarinus*, *Suaeda vermiculata* and *Zygophyllum coccineum*. Findings of the current study revealed that some species have high to reasonable contents of protein, fat, fiber, carbohydrates and minerals which make them potential resources as forages.

**Keywords:** halophytes, nutritional value, saltmarsh, sabkha, ha'il, Saudi Arabia

### 1. Introduction

Sabkha also sabkha (plural: Sabkhas) is an Arabic term for a coastal and inland saline mud flat on playas built up by the deposition of silt, clay and sand in shallow, sometimes extensive, depressions<sup>[3, 4]</sup>. Maybe because of their salty and instable soil, coastal and inland (sabkha) salt marshes were neglected in the past by settlers and developers but which is now valued for its wide range of functions in relation to nature conservation and supporting life in adjoining ecosystems<sup>[6]</sup>.

"Halophytes" is a term that refers to plants that can grow naturally in saline environments such as saltmarshes, salt spans and salt deserts<sup>[10]</sup>. Those plants are widely distributed throughout several regions of Saudi Arabia due to the presence of coastal saltmarshes along the Red Sea and the Arabian Gulf shores, and inland saltmarshes (Sabkhas). According to<sup>[8]</sup>. Halophytes have a wide range of utilizations including; animal feeds, vegetables, in drugs, sand dune fixation, wind shelter, soil cover, cultivation of swampy saline lands, laundry detergents, paper production and many other uses. However, the focus of the current paper will be on the nutritional value of some halophytes as animal feeds.

Livestock production is one of the major issues in the agriculture sector that plays very important role in the socio-economic of the people because it provides meat, milk and others products<sup>[11]</sup>. Nutritive quality of range varies from area to others, between seasons and growing stages and according to due to the seasonality of rainfall and periodic drought events. The potential of any feed to support animal production depends on the quality consumed by the animal and the extent to which the feed meets energy, protein, minerals and vitamin requirement<sup>[15, 18]</sup>. The nutritive value of pasture and range is greatly affected by seasonal changes. For example during dry periods, plants' moisture content, crude protein and total soluble sugars decrease and the plants

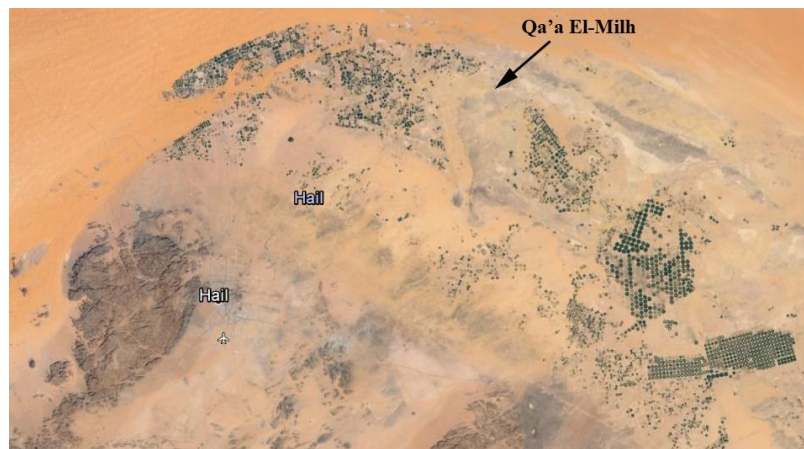
tend to be fibrous with high ash content and relatively poor nutritive value<sup>[7]</sup>.

Due to the occurrence of Saudi Arabia along the arid climate belt, it suffers from the scarcity and fluctuating quantity and quality of the year-round feed supply to grazing animals. Therefore, the future prosperity of feed resources in Saudi Arabia relies on the economic feasibility of using marginal and long-neglected resources. Halophytic plants are one of such resources. However, little is known about the nutritional value of halophytes of Saudi Arabia. Therefore, the main objective of the current study was to determine the nutritional potentiality of some-common halophytic species of (Qa'a El-Milh's, Ha'il, Saudi Arabia) sabkha: *Aeluropus lagopoides*, *Atriplex leuococlada*, *Mesembryanthemum nodiflourm*, *Tamarix nilotica*, *Salicornia strobilacea*, *Salsola imbricata*, *Salsola vermiculata*, *Seidlitzia Rosmarinus*, *Suaeda vermiculata* and *Zygophyllum coccineum*.

### 2. Materials and Methods

#### 2.1 Study area

Qa'a El-Milh's sabkha (the salt playa) is a natural depression north of Ha'il/Saudi Arabia, at an elevation of about 690 m above the sea level. Its location is considered as a sink for rainwater from the southern highlands of Aja Mountain and its contiguous plateaus. The famous Wadi El-Aderaa is the most important ephemeral stream that collects flooding water in the region and discharging this water into the depression. Qa'a El-Milh's sabkha is bordered from the north by AnNafud Sand Sea and from the south by a sandstone plateau. The climate of the region is arid with annual precipitation less than 150 mm and annual evaporation of more than 3000 mm. Due to the high evaporation rates; the floor of Qa'a El-Milh is extremely saline compared to the surrounding terrains. The study area aridity, salinity and topography are reflected on the type, distribution and abundance of its natural vegetation.



**Fig 1:** Satellite image for Qa'a El-Milh, Baga'aa district, Ha'il/Saudi Arabia

## 2.2 Samples collection

Ten plant species (*Aeluropus lagopoides*, *Atriplex leucoclada*, *Mesembryanthemum nodiflourum*, *Tamarix nilotica*, *Salicornia strobilacea*, *Salsola imbricata*, *Salsola vermiculata*, *Seidlitzia Rosmarinus*, *Suaeda vermiculata* and *Zygophyllum coccineum*) (Table.1) were collected in late spring of 2016 from Qa'a El-Milh's sabkha, Baga'aa district, Ha'il /Saudi Arabia.

**Table 1:** List of plant species collected from Qa'a, El-Milh, Baga'aa district, Ha'il /Saudi Arabia.

Plant species	Family	local name
<i>Aeluropus lagopoides</i>	Gramineae (Poaceae)	Akrash
<i>Atriplex leucoclada</i>	Chenopodiaceae	Raghal
<i>Mesembryanthemum nodiflourum</i>	Aizoaceae	Ghasool
<i>Salicornia strobilacea</i>	Chenopodiaceae	Salicornia
<i>Salsola imbricata</i>	Chenopodiaceae	Rotha
<i>Salsola vermiculata</i>	Chenopodiaceae	Rotha
<i>Seidlitzia rosmarinus</i>	Chenopodiaceae	Shenan or Doayd
<i>Suaeda vermiculata</i>	Chenopodiaceae	Suaeda
<i>Tamarix nilotica</i>	Tamaricaceae	Athl
<i>Zygophyllum coccineum</i>	Zygophyllaceae	Ratreet or Mulaih

Fresh plant specimens were collected and preserved in polyethylene bags. Then samples were transferred to the laboratory (Biology Department, Faculty of Science, University of Hail) for identification and further analysis. Samples were subjected to drying in the lab temperature for few days then in an oven at the temperature of 105 C° for 24 h. 50g of dry weight (DW) of each sample were packed in paper sacks. On each sack collection the site name, plant species name, and dry weight were recorded.

## 2.3 Laboratory sample preparation

Dry samples were thoroughly mixed and ground in hummer mill with stainless steel knives to pass through a 1 mm screen. The part of the mill were detached and well cleaned. After mixing, a 50 gram each sample was collected in plastic bag for chemical analysis.

## 2.4 Laboratory analysis

Proximate analysis plays an important role in assessing the suitability of plants species for different ruminant's requirement (Khan, *et al* 2014). Proximate analysis of chemical components including; Moisture (%), Ash content

(%) (The total mineral content), Crude protein (%) (The total protein in the sample including true protein and non-protein nitrogen), Crude fat % (Ether extract) (fat is an energy dense nutrient and contains 2.25X to 2.8X the energy found in carbohydrates), (%) Crude fiber (the residue of plant materials remaining after solvent extraction followed by digestion with dilute acid and alkali), Carbohydrates content (%), Ca and P/mg/l were determined according to [2].

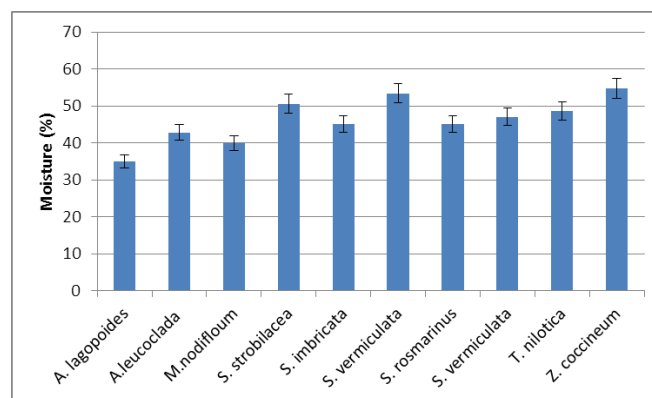
## 2.5 Statistical Analysis

The results were obtained by making three independent measurements and therefore presented as means provided with standard errors.

## 3. Results and Discussion

### 3.1 Moisture content (%)

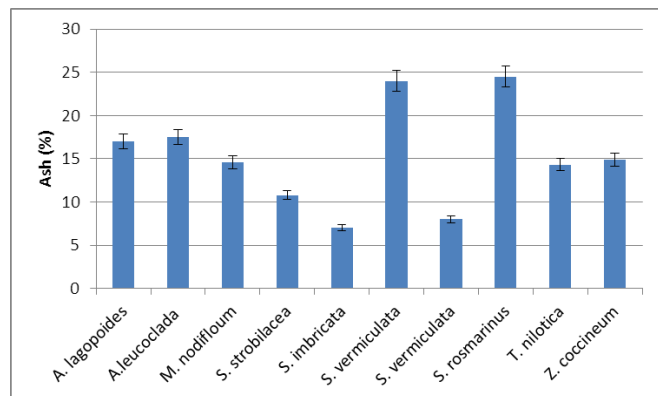
Figure (2) shows that the percentage of moisture content of the plants ranged from the lowest (35%) in *Aeluropus lagopoides* to the highest (54.72%) in *Zygophyllum coccineum*. Moisture result represented the largest single content among the proximate compositions of the fresh weight of the plants followed by ash content. Such result has been documented by Lu [14], when they conducted a similar study on the halophyte species *Salicornia bigelovii*. The high content of moisture of the plants in the current study could be attributed to their succulence ability of water as a mean of osmotic adjustment in order to survive in their saline habitat [12].



**Fig 2:** Percentage of moisture content of some plants of Qa'a El-Milh, Baga'aa district, Ha'il /Saudi Arabia. Data are expressed as mean  $\pm$  SE of replicate determinations (n=3).

### 3.2 Ash

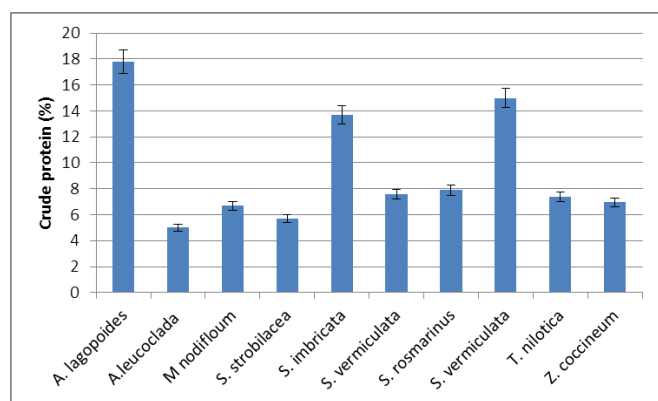
Figure (3) shows that the percentage of total ash content of the plants ranged from the lowest (7%) in *Salsola imbricata* to the highest (24.5%) in *Seidlitzia Rosmarinus*. The high content of ash is being observed as a typical characteristic of halophyte plants [8]. The differences between ash contents of various plant species could be explained by some factors including; degree of maturity of plants and soil properties [1].



**Fig 3:** Percentage of ash content of some plants of Qa'a El-Milh, Baga'aa district, Ha'il /Saudi Arabia. Data are expressed as mean  $\pm$  SE of replicate determinations (n=3).

### 3.3 Crude protein

Figure (4) shows that the percentage of crude protein content of the plants ranged from the lowest (5%) in *Seidlitzia Rosmarinus* to the highest (17.8%) in *Aeluropus lagopoides*. The species *Aeluropus lagopoides* has a high CP content which would make it a good protein supplements (17.8%) compared to Alfalfa (CP 18%) (Kamal Uddin, *et al* 2012). Also, there is a reasonable high content of crude protein of the species *Suaeda vermiculata* (15%) and *Salsola imbricata* (13.7%), however the rest of the rest of the species have a moderate CP content. Although, the protein content of species in the current study seems to be relatively high, a proportion of such protein is present in the form of non-protein nitrogen; therefore alternative sources of energy should be supplemented to animals diet for better utilization and efficiently digestion nitrogen [5].

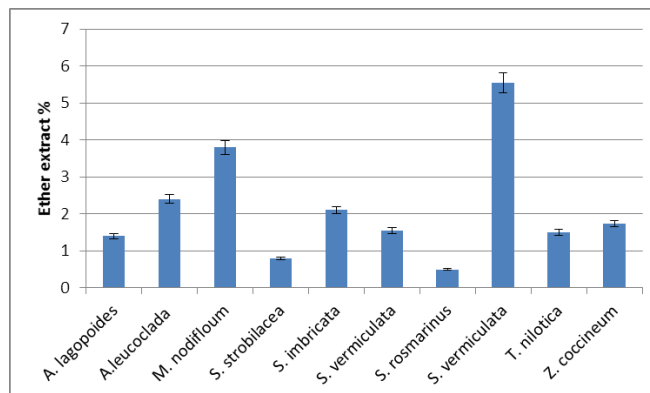


**Fig 4:** Percentage of crude protein content of some plants of Qa'a El-Milh, Baga'aa district, Ha'il /Saudi Arabia. Data are expressed as mean  $\pm$  SE of replicate determinations (n=3).

### 3.4 Crude fat

Figure (5) shows that the percentage of crude fat content of the plants ranged from the lowest (0.5%) in *Atriplex*

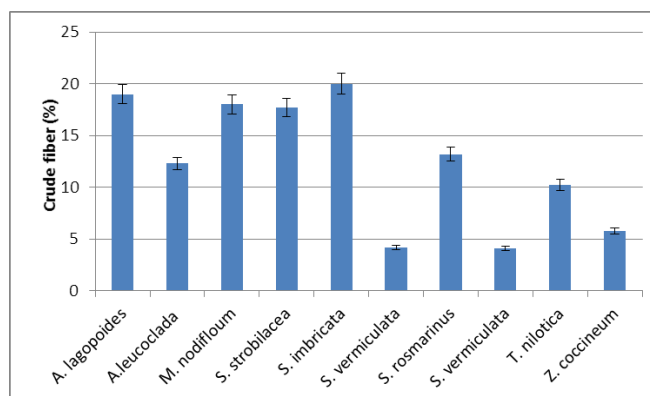
*leucoclada* to the highest (5.54%) in *Suaeda vermiculata*. The higher value of crude fat in some species of the current study such as *Suaeda vermiculata*, *Mesembryanthemum nodiflorum* and *Atriplex leucoclada* is an indication of higher energy storage in those plants which can be utilized by the animals for body maintenance and production [1].



**Fig 5:** Percentage of ether extract (crude fat) content of some plants of Qa'a El-Milh, Baga'aa district, Ha'il /Saudi Arabia. Data are expressed as mean  $\pm$  SE of replicate determinations (n=3).

### 3.5 Crude fiber

Figure (6) shows that the percentage of crude fiber content of the plants ranged from the lowest (4.1%) in *Suaeda vermiculata* to the highest (20%) in *Salsola imbricata*. The high content of fiber in species of the current study such as *Salsola imbricata*, *Aeluropus lagopoides*, *Mesembryanthemum nodiflorum* and *Salicornia strobilacea* might make them preferable selection by grazing animals. Attia-Ismail 2015 reported that forage species with high fiber content are usually better accepted by cattle than by sheep and goats.

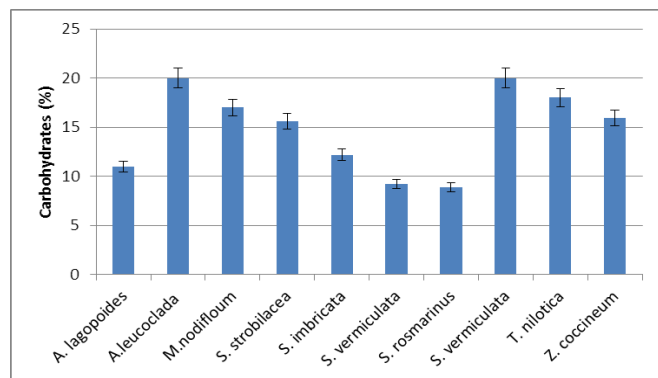


**Fig 6:** Percentage of crude fiber content of some plants of Qa'a El-Milh, Baga'aa district, Ha'il /Saudi Arabia. Data are expressed as mean  $\pm$  SE of replicate determinations (n=3).

### 3.6 Carbohydrates

Figure (7) shows that the percentage of carbohydrates content of the plants ranged from the lowest (8.9%) in *Seidlitzia rosmarinus* to the highest (20%) in *Atriplex leucoclada* and *Suaeda vermiculata* respectively. The variation of carbohydrates content of species of the current study could be attributed to seasonal changes as well as with phenological stages of plants. Also, grazing animals preferred forages as they can efficiently use cellulose and

hemi-cellulose because the microorganisms in their digestive system are capable of digesting them [9].

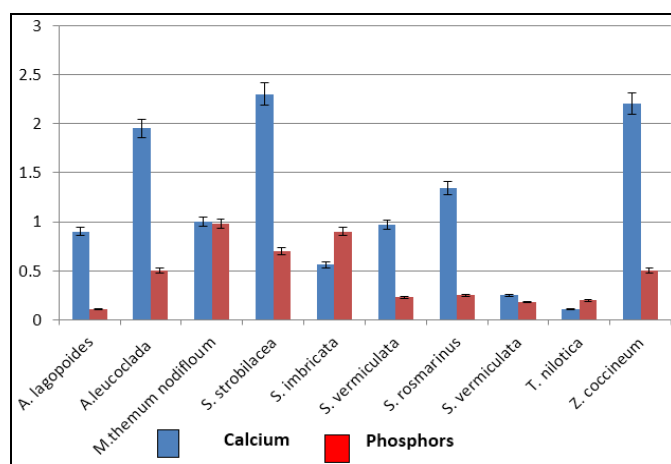


**Fig 7:** Percentage of carbohydrates content of some plants of Qa'a El-Milh, Baga'aa district, Ha'il/Saudi Arabia. Data are expressed as mean ± SE of replicate determinations (n=3).

### 3.7 Calcium/Phosphorus ratio

Figure (8) shows that Ca: P ratios ranged from the lowest 0.2:1 in *Tamarix nilotica* to the highest 8.2:1 in *Aeluropus lagopoides*.

The calcium (Ca) to phosphorus (P) ratio in the animal diet is important as they work closely together. They play a major role in proper growth and development of the skeletal system in animals. Calcium and phosphorus must be provided by cattle diet in the correct levels and ratio. Ideally cattle diet should contain a ratio of calcium/phosphorus in feed dry matter between 1.5:1 to 3:1, however cattle can tolerate a ratio up to about 7:1 [16]. Accordingly, apart from *Aeluropus lagopoides* and *Tamarix nilotica* most plants of the current study can provide a good source of calcium and phosphorus to grazing animals.



**Fig 8:** Percentage of Calcium/Phosphorus ratio content of some plants of Qa'a El-Milh, Baga'aa district, Ha'il/Saudi Arabia. Data are expressed as mean ± SE of replicate determinations (n=3).

### 4. Conclusion

Halophytic plants are existed in several regions of Saudi Arabia due to the presence of coastal saltmarshes along the Red Sea and the Arabian Gulf shores, and inland saltmarshes (Sabkhas). Plant species in the current study vary considerably in their chemical composition and nutritive value. Findings of the current study revealed that some species have high to reasonable contents of protein, fat,

fiber, carbohydrates and minerals which make them potential resources as forages.

### 5. Acknowledgement

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