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Investigation of the ziziphus spina christi (Sidr) and prosopis cineraria (Ghaf) as a priority fodder plant for arabian tahr by macro-mineral comparison analysis from the origin of Fujairah, UAE

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Abstract
Ziziphus Spina Christi and Prosopis Cineraria are important native plants of the United Arab Emirates flora that can cope up with harsh environmental conditions. These plants have the ability to tolerate salty soils, high temperatures, and drought environment which made it important to discover the why's behind that. The study focused on the better nutritional plamt for Arabian Tahr, which is endangered goat and native to UAE. The nutritional values of Ziziphus Spina Christi and Prosopis Cineraria were studied using proximate analyses set by international standard procedures (Association of Official Analytical Chemists, AOAC 2001.11, AOAC 920.39, AOAC 962.29, AOAC 942.05), state of the art techniques with instruments ie, ICP-OES, HPLC Gravimetry and Kjaldhal apparatus. The study scope is to determine the ability of the Ziziphus Spina Christi in comparison with Prosopis Cineraria to provide good energy sources of minerals such as potassium, calcium, and magnesium. Later, to identify which one is more beneficial to be included in Arabian Tahr's diet. The study concluded that the Prosopis Cineraria bears more neutritional values for Arabian Tahr as compared to Ziziphus Spina Christi. The Prosopis Cineraria comprise of higher values of magnesium, potassium, and calcium which is an important part of Arabian Tahr's diet.

Keywords: ziziphus spina christi, prosopis cineraria, native plant, Fujairah, micronutrients, high potassium, high calcium, heavy metals, arabian tahr

Introduction

In the east of the United Arab Emirates where the emirate of Fujairah is located; many native plants are considered the backbone of Fujairah's flora. Fujairah's environment includes harsh properties such as drought, mountainous terrain, water shortage, and salty soil which is non-favorable for agricultural purposes [1]. The Arabian Tahr or "Arabian Oryx" are mammals from the Arabitragus genus (Figure 1). They are highly seen in eastern Arabia, where the important aspect of UAE biodiversity is found, and in craggy cliffs places like the Al Hajar Mountains in the northern side of Oman and UAE, Jabal Hafeet, and Wadi Wurayah National Park. These mammals can survive high temperatures that could reach to 50ºC in summer, and they are selective when it comes to their diet [2]. The overgrazing, hunting, climate change, and competing with other goats for food sources, habitate loss and various other reasons caused endangerment to these animals. This provides a dire need of biodiversity restoration and rehabilitaions for the protection of these animals. One of the apporoach in this regard is providing habitat with suitable nutritions from the plant that is acceptable for arabian tahr as well.

Ziziphus Spina Christi and Prosopis cineraria are the native plants arabian tahr is feeding on. These native plants can withstand harsh environment including higher temperature, low precipitation and salinity [3]. Ziziphus Spina Christi or *Sedr* also known as Jujube; is a multi-branched tree with a trunk that can be divided or undivided at the ground (Figure 2). Sedr is considered one of the main nectar and pollen source for bees. Moreover, they are consumed by cattle and other animals found in the desert. Sedr honey is known to provide humans with a strong immune system and improve digestive issues, and similar honey topics and their health-related advantages are seen in [4].

Similarly, Prosopis cineraria or *Ghaf* (Figure 2), one of the important native plant and source of food for animals in desert which is one of the reason these plants needs protection and mass propoagation. The length of this tree ranges from 10 to 25 meters, and the roots can go deep to 30 meters underground. In addition, it is an evergreen, straight tree with no branch trunk [5].

Fig 1: Arabian Tahr, the endangered goat of UAE, Photo credit: Environment agency, *Abudhabi (https://www.ead.gov.ae/en/Discover-Our-Biodiversity/Mammals/Arabian-Tahr)*

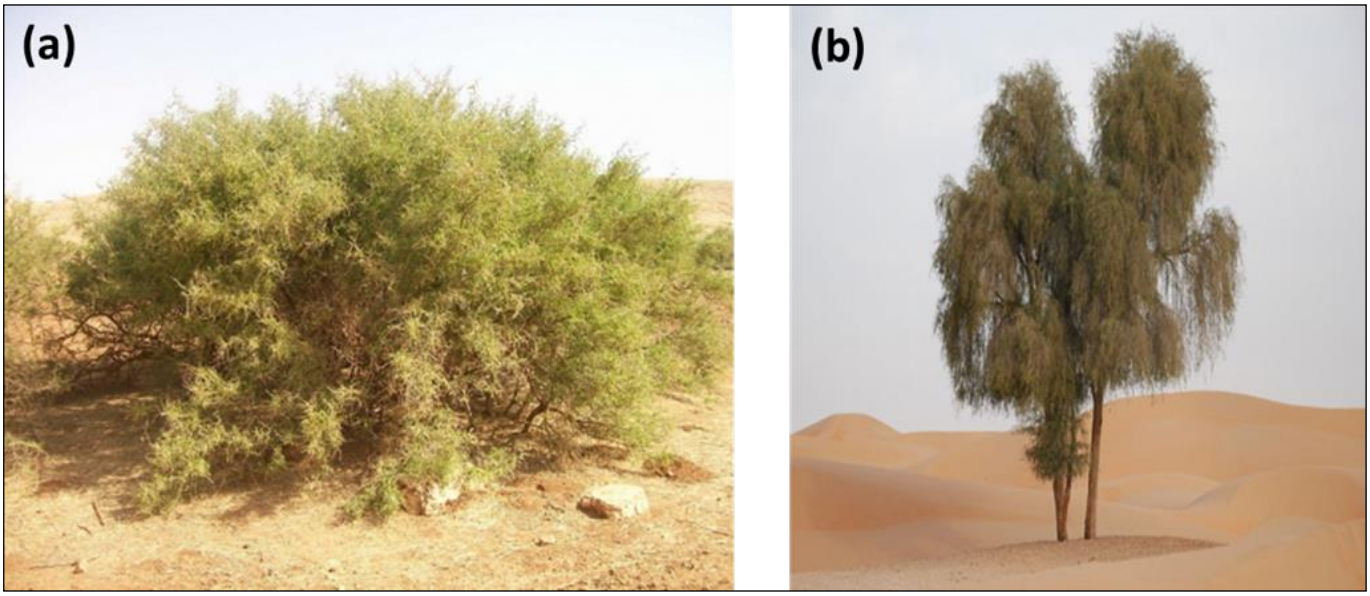

Fig 2: The native plants of UAE. (a) Ziziphus Spina Christi, (b) Prosopis cineraria

Keeping in mind the importance of arabian tahr diet and biodiversity restoration, our study focused on the provision of feed with prime nutrional values. Following the purpose, macro-mineral and nutrional comparison of Ziziphus Spina Christi and Prosopis Cineraria has been done.

Materials and Methods

Sample collection

The fresh plant leaf samples of Ziziphus Spina Christi and Prosopis cineraria have been collected from Al Taiba Farms, Fujairah, UAE. Each sample collected weighs about 500 grams and is kept in a plastic bag.

Chemical and nutritional analysis

Accurate analytical procedures were applied to obtain mineral and nutritional analysis of Ziziphus Spina Christi and Prosopis cineraria. The Dry Matter, crude protein, Crude Fat, crude fiber, ash, TDN, and total sugars were determined by international standard procedures as mentioned in Wesayef *et al*, "Macro-mineral concentration analysis of Acacia Ehrenbergiana (Salam) from the origin of Fujairah, UAE, with staple food items as a mineral-rich dietary supplement for arid and semi-arid lands of the world" and C. Naumann and R. Bassler, "Chemical Analyses of Animal Feed," VDLUFA-Verlag, Darmstadt, 2004, using Gravimetry, Kjaldhal method, soxhelt extraction, AOAC 962.09, AOAC 941.12, calculation and HPLC, respectively[6]. Phosphorus (P), Calcium (Ca), Zinc (Zn), Copper (Cu), Magnesium (Mg), Selenium (Se), and Manganese (Mn) have been determined by ICP-OES (inductively coupled plasma optical emission spectroscopy).

Results

The analysis exhibit the comparison between Ziziphus Spina Christi and Prosopis cineraria based on its nutritional compositions, minerals, and heavy metals content. Both the plants shows similar nutritional values with approximate beneficial properties of crude protein, crude fat, crude fiber, ash, total Sugar, and total digestible nutrients (TDN) (Table 1). For instance, Ziziphus Spina Christi shows nearly 10 % higher values of dry matter than Prosopis cineraria. Furthermore, the general mineral composition test showed that Prosopis cineraria have higher mineral content compared to Ziziphus Spina Christi. The values of Calcium (Ca) is higher in Prosopis cineraria (650.21 mg/100g) than in Ziziphus Spina Christi (444.26 mg/100g). In one study, unwashed Ziziphus Spina Christi leaves showed lower levels of Ca than washed ones, 1.34-2.8 mg/100g, and 1.12-2.7 mg/100g, respectively (Ahmed *et al*., 2022). As for Phosphorus (P), it is three times higher in Ziziphus Spina Christi (171.49 mg/100g) than in Prosopis cineraria (63.43 mg/100g). Extreme difference in Potassium (K) values showed mainly in Prosopis cineraria with a value of 552.32 mg/100g in Prosopis cineraria, However, Sodium (Na), and Magnesium (Mg) are higher in Prosopis cineraria in their content in mg/100g than Ziziphus Spina Christi with values of 94.53, 196.14, respectively. Macronutrients including Zinc (Zn), Copper (Cu), Manganese (Mn), and Selenium (Se) are found in minute quantity with values less than 2 mg/100g (Table 2; Figure 3). In this experiment, there were no heavy metals found in both native plant samples such as Cadmium (Cd), Nickle (Ni), and Lead (Pb), which assures the non toxicity of such heavy metals (Table 3).

Table 1: Nutritional values of Ziziphus Spina Christi and its comparison with Prosopis cineraria. Values mentioned in percentage (%)

Nutrients	Ziziphus Spina Christi	Prosopis Cineraria
Dry matter	75.92	59.65
Crude Protein	6.08	6.36
Crude Fat	<0.1	<0.1
Crude Fiber	16.82	14.52
Ash	4.38	4.66
Total Sugar	2.11	1.53
TDN	73.15	74.23

Table 2: Mineral contents (macronutrients) comparison of Ziziphus Spina Christi with Prosopis Cineraria. Values are in mg/100g.

Minerals	Ziziphus Spina Christi	Prosopis Cineraria
Calcium (Ca)	444.26	650.21
Phosphorus (P)	171.49	63.43
Sodium (Na)	41.30	94.53
Potassium (K)	109.95	552.32
Zinc (Zn)	1.13	0.69
Copper (Cu)	0.44	<0.1
Manganese (Mn)	1.77	1.72
Selenium (Se)	<0.1	<0.1
Magnesium (Mg)	139.28	196.14

Table 3: Heavy metal detection in Ziziphus Spina Christi and Prosopis cineraria (mg/kg).

Heavy metal	Ziziphus Spina Christi	Prosopis Cineraria
Cadmium (Cd)	-	-
Nickel (Ni)	-	-
Lead (Pb)	-	-

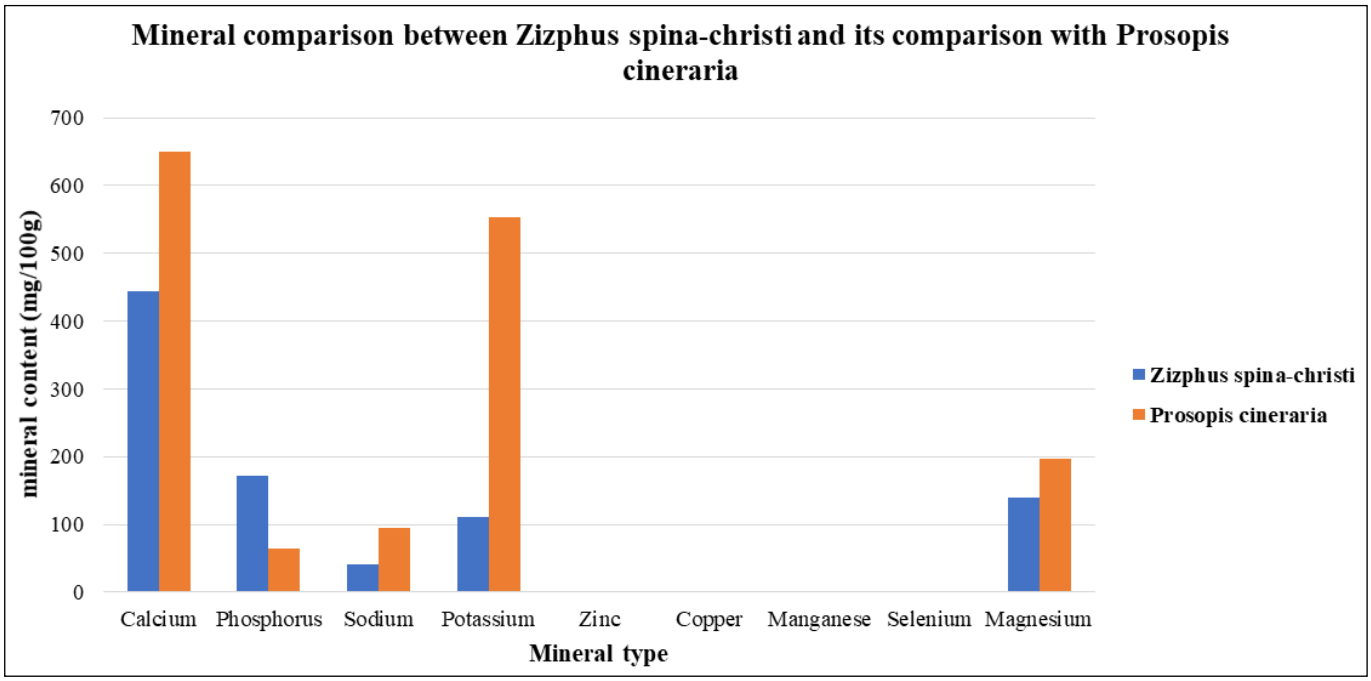

Fig 3: Mineral contents analysis and identification of Ziziphus Spina Christi and its comparison with Prosopis cineraria. Blue bars showed the values from plant Ziziphus Spina Christi, orange bar showed the values from plant Prosopis cineraria.

Discussion

From the results mentioned above, key finding emerged as the Prosopis cineraria comparatively have higher mineral content than Ziziphus Spina Christi according to their chemical analysis results. Prosopis cineraria's leaves are a good source of macro-minerals such as calcium (Ca), phosphorus (P), and potassium (K) as well as a few amounts of protein content. Each part of this tree is advantageous, such as fruit is a valuable protein source, the seeds are a good source of protein, and for leaves, the root, stem, and bark are used for medicinal purposes [7]. Moreover, The Prosopis cinerariafrom Fujairah origin has showed higher neutraceuticle values than the same specie from the origin of Pakistan with 2.43% and 0.41% less Ca and K, respectively [8]. We speculated the reason could be the environmental and soil conditions. By comparing the results, we hope to determine our conclusion which propose Prosopis cineraria is the fodder plant with prime nutrional values for the arabian Tahr. Therefore, more efforts are suggested to propagate this plant for the habitate restoration for arabian tahr. However, further research on the same topic might extend the explanations of health benefits of using this plant and its agro-economical prospect.

Conflicts of interest

The authors declare that they have no conflict of interest.

Author Contribution

The authors declare that they were responsible for all activities related to data collection, analysis and writing of the article. All authors read and approved the final version.

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