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Nutritive Value and Mineral Elements of Wild Astragalus meridioalis sensu auct. Seeds in South of Iran

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Abstract

Literature survey revealed that there was no biological investigation on Astragalus meridioalis sensu auct. seeds worldwide. The mature seeds of A. meridioalis was collected in August 2015 from Geno, Bandar Abbas, Hormozgan Province, Iran to evaluate their nutritional value and explore a new source for nutritional purposes .The digested seeds of A. meridioalis with the mixture of nitric acid and hydrochloric acid and per chloride acid (4 :2: 1) under the condition of the boiling point and the normal pressure, the contents of the seven mineral elements necessary to humanity, potassium, copper, zinc, iron, selenium , lithium and manganese in the seeds of A. meridioalis were determined by flame atomic absorption spectroscopy (FAAS) in Pharmaceutical sciences branch, Islamic Azad university , Tehran and the results were analyzed in statistics. The results revealed that the sequence of the content of metal elements is as follows in all samples: Zn >K > Fe > Cu> Mn >Ca>Na > Se > Li. The content of K, Zn, Fe and Cu in this seed is much richer than some other medicinal plants in this region. The high level of Zinc, Potassium and sufficient amount of suitable mineral element showing high Nutritive value of this seed and seem to be good for younger people, anemic people and common local food and diet for people in the region of Hormozgan province in the south of Iran.

Keywords: Astragalus meridioalis sensu auct., seed, Iran, Nutritive value, Mineral elements.

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Introduction

Plants have great importance due to their nutritive value and continue to be a major source of medicines as they have been found throughout human history (Balick et al., 1996). 30 to 40% of today's conventional drugs utilized in the medicinal & curative properties of diverse plants are operating in herbal supplements botanicals, nutraceuticals and drug (Shulz et al., 2001).

Astragalus L. (Fabaceae) is generally considered as the largest genus of vascular plants with an estimated 2500 to 3000 species. Astragalus species are widely distributed in temperate regions of the Northern Hemisphere. The greatest numbers of species are found in the arid, continental regions of western North America (400 species) and central Asia (2000 to 2500 species). Iran by the vast diversity of climate and abounding plant genetic resources is well-known as one of the richest in terms of national resources and natural talents (Tavili, 2014). Iran also has the world's most extensive derivation of astragal growth and over 804 species exist in Iran flora (Masumi & Ghahraman, 2006; Ghaderi et al., 2008).

Many Astragalus species are helpful as forage plants, to management erosion, as medicinal plants or as ornamentals (Hiroani et al., 1994 ; Baratta & Ruberto, 1997). The historical use of philosophically important plants is an interest to many tribal people and to the habitual public (Casey & Wynia, 2010). Local people from each zone use a variety of useful plants in their surroundings (Khajoei Nasab & Khosravi, 2014). Provincial people in Hormozgan province are using plant species in many different ways such as food, medicinal, decoration, fuel and other purposes. Also the results clarify why similar natural areas in Iran are mostly considered as explore resources and other ecosystem objectives are mostly ignored, since 92 % of the region's plants are utilized for feeding domestic animals. The Hormozgan province is located in the southern part of Iran with neighboring 1.000 km of coastline along the warm waters of the Oman Sea and the Persian Gulf, in correspondence with the Strait of Hormuz, at the entrance of the Persian Gulf. The inner part is mainly mountainous, including the southern tip of the Zagros Range. Several ecosystems are contained in the Zagros Mountains. Outstanding among them are the forest and forest steppe zones with a semi-arid climate and is home to a rich and complex flora (Sefidanzadeh et al., 2015; Zarei et al., 2015; Kermanshah et al., 2014; Abbasian et al., 2015; Moghanloo et al., 2015).

Living organism depends upon an interminable supply of large number of materials from food to integrate their life cycle. This supply is called as nutrition. The mineral nutrition is an important aspect, and it play pivoted role in human life for healthy growth. Such type of mineral is efficiently available in medicinal plants (Shivprasad et al., 2012). In conjunction with several organic compounds, it is now well to cure diseases as well as minerals are not maintaining energy, but they performance an essential role in many activities in the body (Malhotra, 1998). About 14 elements are essential to human health such as N, P, K, Ca, Mg, Na, Cu, Fe, Zn, Mn, Co, Si, Br, and Cr. The deficiency of such element generates some severe health problems. Human bodies daily need more than 100 mg of major minerals (N, P, K, Ca, Mg, Na) and <100 mg of minor minerals (Cu, Fe, Zn, Mn, Co, Br, Si, Cr) (Aslam et al., 2005; Rajangam et al., 2001).

Human beings require a number of complex organic compositions as supplementary caloric requirements to conformed the need for their muscular activities, carbohydrates, fats and proteins, while minerals and vitamins form approximately a smaller part, plant materials form a major portion of the diet; their nutritive value is important (Benton,1972; Indrayan et al., 2000). Human body comprises chemical compounds such as water, proteins, fatty acids, nucleic acids and carbohydrates; these in turn comprise elements such as carbon, hydrogen, oxygen, nitrogen and phosphorus and may or cannot contain minerals such as zinc, calcium, iron, magnesium etc. (Janssen et al., 2004; Govindan & Gricilda Shoba, 2015).

The interest in chemical constituents of various species of the genus Astragalus has been developing during the last years. Many species of Astragalus have been investigated chemically e.g., for flavonoids, non-protein amino acid, saponins, alkaloids, nitro compounds, mucilage, sterols, proline content, phenolics etc.(Bisby et al., 1994; Ebrahimzadeh et al., 1999; Ebrahimzadeh et al., 2000; Ebrahimzadeh et al., 2001; Niknam & , Ebrahimzadeh, 2002a; Niknam & , Ebrahimzadeh, 2002b; Niknam & Salehi Lisar , 2004). The main goal of current study was to determine mineral elements contents and nutritive value of A. meridioalis sensu auct. as in the past this name has been erroneously used to refer to Astragalus kirrindicus Bioss (http://www.theplantlist.org) and no data about this endemic plant in the south of Iran.

Experimental Section

Study area

The experiment was conducted in August 2015 from Geno, Bandar Abbas, Hormozgan Province, Iran: altitude 2200 m : (27°23'34" N 56°23'59" E, 100m). Specimen was identified by R. Asadpour and voucher was deposited in the Herbarium of Faculty of Pharmacy, Pharmaceutical Sciences Branch, Islamic Azad University (IAUPS) Tehran by Vocher No: 422-PMP/A. Hormozgan province district is situated in the southeast of Iran. More than 70% of the province is covered by mountains and hills thus it is a mountainous region (Kermanshah et al., 2014; Abbasian et al., 2015; Moghanloo et al., 2015; Amirpour Kumleh et al., 2016; Sabzian, 2008).

Site constituded by deciduous forest trees, Palm and pasture plants. Geno Mountain is a protected area, the Malaise trap was located in the southern slop between deciduous forest trees and pasture plants. This province is placed between northern latitude 25º 24' to 28º 57' and eastern longitude 53º 41' to 59º 15'. It occupies an area of 70697 km2 (Sabzian, 2008; www.doe.ir).

The study area (Bandar Abbas region in Hormozgan province) is located in northern costal zones of the Persian Gulf in south of Iran (Fig. 1). The extent of the study area was about 18,000 ha and was situated in mountain and hill area having eminence ranging from 860 m to 3,081 m. Annual rainfall is 214 mm, mean temperature is 24.33°C, average maximum temperature is 31.25°C, and average minimum is 17.35°C. The soils of the study area are mostly shallow and therefore are only suitable

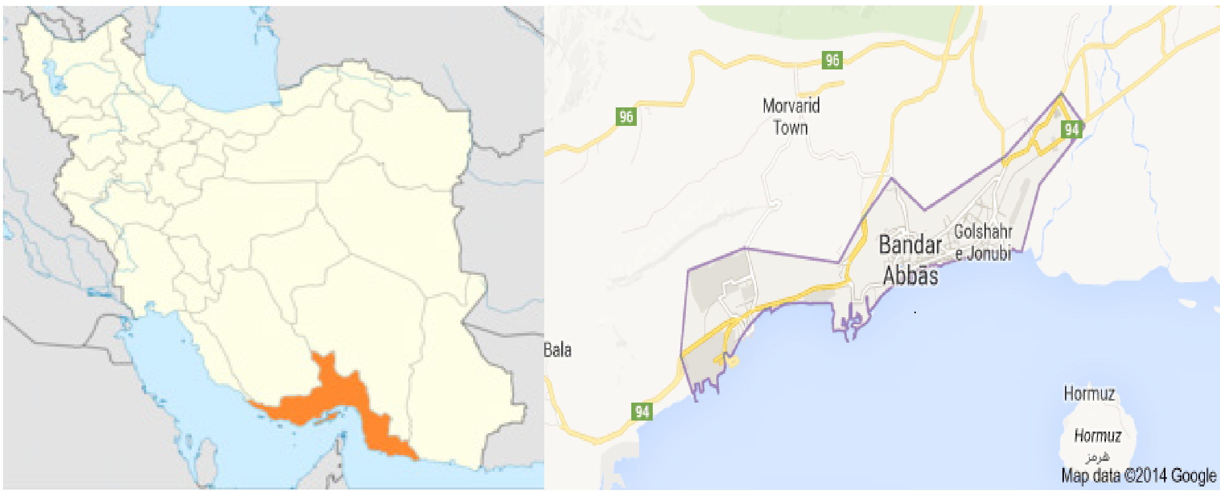

Figure 1: Location of A. meridioalis sensu auct. sample collection

as rangeland for herd grazing. According to the American system of soil taxonomy (Sefidanzadeh et al., 2015), the soils of the region are classified in as Entisols.

Plain part of the region includes much of the southern, eastern and northern part of the strip subsist of alkaline and saline soils contain large amounts of soluble salts such as chloride, sulfate and carbonate of Ca, Mg, sodium, and potassium (USDA, 1994; Zarei et al., 2015).

Sampling Method

The present study was carried out determining the nutritional value and study on some mineral and essential elements of A. meridioalis sensu auct seeds. A. meridioalis mature seed samples drying at (80 C°) for 2 h to a constant weight, the samples were separated and weighed individually. The dried samples were homogenized and grounded using a mortar.

Zinc, Manganese, Copper and Potassium Determination

All stock solutions and working standards were stored at 4°C and brought to room temperature (25 0C) before use. For Zinc, Manganese, Copper and Selenium concentration in A. meridioalis , powered seed samples were dried in oven for 48 hours at a temperature of 85°C. The samples were then ground and sieved through 0.5 mm sieve. The powdered samples then subjected to the acid digestion using concentrated nitric acid (65% Merck), Sulfuric acid (96.5% Merck) and per chloric acid (70% sigma). Analar grade hydrogen peroxide (about 30%) also was used for the digestion. Application of concentrated HNO3 along with thirty percent hydrogen peroxide H2O2 (Merck) for mineralization of samples to the complete digestion of samples (Aryapak& Ziarati , 2014; Ziarati, 2012a;Ziarati, 2012b; Ziarati et al., 2013; Amini Noori et al., 2016; Praveen, 2011) following Environmental Protection Agency (EPA) Method 3052 was done (Ziarati& Tosifi, 2014; Ziarati& Rabizadeh, 2013; AOAC, 1998; Ziarati et al., 2102).

10 gram of air-dried of each homogeneously A. meridioalis samples accurately weighed and 30.0 mL of the digestion mixture (2 parts by weight of nitric acid: 1 parts of Sulfuric acid & 4 parts by weight perchloric acid) and heated slowly by an oven and then rise the temperature. The remaining dry inorganic residues were dissolved in 30.0 mL of concentrated nitric acid and the solution used for the determination of trace and essential mineral elements. Blanks and samples were also processed and analyzed simultaneously. All the chemicals used were of analytical grade (AR). Standardized international protocols were followed for the preparation of material and analysis of heavy metals contents (Ziarati& Tosifi, 2014; Ziarati& Rabizadeh, 2013; AOAC, 1998; Ziarati et al., 2102; Sefidanzadeh et al., 2015). The samples were analyzed by Flame Emission Spectrophotometer Model AA-6200 (Shimadzu, Japan) using an air-acetylene, flame temperature: 2800°C, acetylene pressure: 0.9–1.0 bar, air pressure: 4.5–5 bar, reading time: 1–10 sec (max 60 sec), flow time: 3-4 sec (max 10 sec), using at least five standard solutions for each metal and determination of potassium content was followed by FDA Elemental analysis (ORA Laboratory Manual FDA, 2004). In order to verify of reliability of the measuring apparatus, periodic testing of standard solutions was performed. The accuracy was checked using quality control test for fungi and their substrate samples to show the degree of agreement between the standard values and measured values; the difference was less than 5%.

Iron Determination

The aliquot was passed through the atomic absorption spectrophotometer to read the iron concentration. Standards were prepared with a standard stock of 10 mg/L using ferrous ammonium sulphate where 3 - 60 ml of iron standard solution (10 mg /L) were placed in stepwise volumes in 100 ml volumetric flasks. 2 ml of hydrochloric acid were added and then brought to the volume with distilled water. The iron concentration of in the aliquot was determined by using the atomic absorption spectrophotometer in mg/L. The whole procedure was replicated three times (Sefidanzadeh et al., 2015; Zarei et al., 2015; Kermanshah et al., 2014; Abbasian et al., 2015; Moghanloo et al., 2015).

Calcium, Sodium and Magnesium Determination

5 ml of the aliquot were placed in a titration flask using a pipette and diluted to 100 ml with distilled water and latterly 15 ml of buffer solution, ten drops of Eriochrome black T indicator and 2 ml of triethanolamine were added. The mixture was titrated with Ethylene-Diamine-Tetra-Acetate (EDTA) solution from red to clear blue (Shivprasad et al., 2012; Malhotra, 1998; Sefidanzadeh et al., 2015; Zarei et al., 2015; Kermanshah et al., 2014; Abbasian et al., 2015; Moghanloo et al., 2015).

Selenium Determination

Stock standard solutions for selenium were 1000 g /mL solution. All reagents and standards were of analytical grade (Merck, Germany). The palladium matrix modifier solution was prepared by the dilution (10 g/ L) Pd(NO3)2 and iridium AA standard solution, 1000 g/ mL in 20% HCl , 0.1 % V/V nitric acid prepared by dilution trace pure 65 % nitric acid and 0.1 % Triton X-100 were used. Doubly distilled water was used in all operations. The samples were analyzed by Flame Emission Spectrophotometer Model AA-6200 (Shimadzu, Japan). The analyze performed according by Analytical Method ATSRD (Ziarati & Azizi , 2014; Masamba& Kazombo-Mwale, 2010).

Results and Discussion

The mean content of trace and essential mineral elements (mg/kg DW) in the mature dry seed of A. meridioalis samples is shown in table 1. The samples were analyzed by wet digestion method and standardized international protocols were followed for the preparation of material and analysis of mineral contents and analyzed by Atomic Absorption Spectrophotometer in Research Laboratory in Pharmaceutical Sciences Branch, Islamic Azad University.

Table 1- The Mean content (mg/kg DW± SD) composition of the mature dry seeds of A. meridioalis samples from Hormozgan Province, Iran

Minerals	Mean content ± SD* (mg/Kg DW)	Minerals	Mean content ± SD* (mg/Kg DW)
Sodium	12.43± 2.32	Boron	0.016 ± 0.013
Potassium	102.11 ± 8.56	Phosphor	4.564 ± 0.123
Calcium	15.36± 0.18	Iodine	5.26 ± 0.012
Magnesium	32.11 ± 2.62	Manganese	9.076 ± 0.012
Iron	96.54 ± 5.21	Sulphur	1.002 ± 0.002
Copper	52.42 ± 1.11	Fluorine	0.008± 0.001
Selenium	9.26 ± 0.082	Lithium	0.001 ± 0.0002
Zinc	120.14 ± 5.44	Molybdenum	0.001± 0.0001

**SD = Standard Deviation*

Mineral metallic analysis revealed the order Zn> K> Fe>Mn>Se>Ca>Na>Mg > Cu >Mo, Li in the seeds of of A. meridioalis samples from Hormozgan Province, Iran.

Copper has the role of assisting in the formation of haemoglobin, helping to prevent anemia as well as being involved in several enzymes. Iron is the central metal in the haemoglobin molecule for oxygen transport in the blood and is portion of myoglobin located in muscles. Manganese is one of the co-factors in a number of enzymes as is molybdenum. Selenium has several roles such as regulating the thyroid hormone as well as being part of an enzyme that protects against oxidation (Whitney & Rofles, 2002), Selenium has also been reported as assisting in deactivating heavy metals. Calcium is responsible for strong bones and teeth and accounts for ninety percent of the calcium in the body whereas the other one percent is circulating in fluids in order to ionize calcium. The metal's function is related to transmitting nerve impulses; contractions of muscles; blood clotting; activation of some enzyme reactions and secretion of hormones Magnesium has many roles including supporting the functioning of the immune system; assists in preventing dental decay by retaining the calcium in tooth enamel; it has an important role in the synthesis of proteins, fat, nucleic acids; glucose metabolism as well as membrane transport system of cells. Magnesium also plays a role in muscle contraction and cell integrity. Potassium and sodium work together in muscle contraction nerve transmission. Sodium is important in muscle contraction and nerve transmission Sodium ions are the main regulators of extra cellular fluid and volume (Abbasian et al., 2015; Sabzian, 2008)..Zinc is an essential trace element and plays an important role in various cell processes including normal growth, brain development, behavioral response, bone formation and wound healing. Zinc deficient diabetics fail to improve their power of sensitivity and it cause loss of sense of touch and smell (Guide to Naturopathy ; 1999; Jabeen et al., 2010).

The seeds of A. meridioalis are tiny but have great nutritive value. Potassium was higher in the studied mature seeds but they contained less sodium; Na and K. take part in ionic balance of the human body and maintain tissue excitability, carry normal muscle contraction, help in formation of gastric juice in stomach (Brody, 1999) , K help in release of chemicals which acts as nerve impulses, regulate heart rhythms, deficiency causes nervous irritability mental disorientation, low blood sugar, insomnia and coma (Gaeta & Hider, 2005). Iron sufficient in A. meridioalis , it make body tendons and ligaments, certain chemicals of brain are controlled by presence or absence of Iron, it is essential for formation of hemoglobin, carry oxygen around the body(Weight et al., 1994). Iron deficiency causes anemia, weakness, depression, poor resistance to infection (Hasling, 1993). Calcium is high in A. meridioalis seeds. Calcium play important role in building and maintaining strong bones and teeth also large part of human blood and extra cellular fluids. It is also necessary for normal functioning of cardiac muscles, blood coagulation, milk clotting and regulation of cell permeability (Smith, 1987). Calcium deficiency causes rickets, back pain, osteoporosis, indigestion, irritability, premenstrual tension and cramping of the uterus (Diaz-Gomez et al., 2003). The content of Zinc by 120.14 ± 5.44 (mg/kg DW± SD) is relatively high though the percentage of copper is very low in all samples. Cu was an important component of many enzyme systems such as cytochrome oxidase, lysyl oxidase and ceruloplasmin, an iron oxidizing enzyme in blood (Hambiadge, 2000). Cu deficiency has been associated with cardiac abnormalities in human and animal, cause's anemia and neutropenia (Hambiadge, 2000). Zinc maintain various reactions of the body which help to construct and maintain DNA, required for growth and repair of body tissues, important element of ligaments and tendons (Linder & Manria, 1991). Zinc deficiency causes clinical consequences, including growth dela, diarrhea, pneumonia, distributed neuropsychological performance and abnormalities of fetal development (Johns& Duquette, 1991). Phosphorous is medium by 4.564 ± 0.123 (mg/kg DW± SD). Phosphorous maintain blood sugar level, normal heart contraction dependent on phosphorous (Cooper, 1984) also important for normal cell growth and repair, needed for bone growth, kidney function and cell growth. It plays important role in maintaining body's acid-alkaline balance (Osuagwu & Edeoga, 2014).

Conclusion

Nutritive value of seeds of A. meridioalis was high on a dry matter (DM basis) this medicinal plant has good nutritive value, which supports its use as food, fodder and good source of various important nutrients for livestock. The high level of Zinc , Potassium and sufficient amount of suitable mineral element showing high Nutritive value. Seem to be good for younger people, anemic people and common local food and diet for people in the region of Hormozgan province in the south of Iran.

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Conflicts of Interest

None of the authors have any conflicts of interest associated with this study.

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