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Mineral Content of Some Medicinal Plants Used in the Treatment of Diabetes Mellitus in Yemen

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There are many hypoglycemic plants known through the folklore in Yemen and some of Arabic countries, some findings of several studies indicate that some of minerals as potassium, copper, zinc, sodium, and iron have hypoglycemia activity, in this study some of medical plants (*Aloe vera*, *Eugenia aramatica*, *Commiphora myrrha, Punica graneotum L*., *Nigelle sativa L., Portulaca oleracea L., Trigonella foenum L*., *Morus alba*, *Lupinus termis*, *Apium graveoleus L.and Cinnamomum verum*) which are used traditionally in Yemen to treat diabetic patients, these plants were tested to determine total ash and the content of these plants from Ca, Na, Zn, Ag, Cu, Fe and Pb. using atomic absorption spectroscopy. A total Ash content was 15.05 % as maximum level in *Trigonella foenum L* while the minimum level was 1.45 % in *Commiphora myrrha*, the limited concentration of Ca was 22000 ppm in *Nigelle sativa L. and* 3225 ppm in *Aloe vera*, and Na was high 3025 ppm in *Punica graneotum L*. and low 800 ppm in *Morus alba*, and Zn concentration ranged from 45,5 ppm in *Cinnamomum verum* to 6,5 ppm in *Apium graveoleus L*., Ag was 0,175 ppm in *Portulaca oleracea L.* and 0,025 ppm in *Nigelle sativa L.* and *Cinnamomum verum*. And it was absent in *Apium graveoleus L*., *Morus alba*, *Eugenia aramatica and Aloe vera*, The major value of Cu 20.75 ppm found in *Nigelle sativa L*. and the minor value 8.25 ppm in *Trigonella foenum L*. and Fe was raised in *Apium graveoleus L* 432.5ppm and increased in *Lupinus termis* 47,52 ppm. While Pb had the higher concentration 7 ppm in *Trigonella foenum L*. And the lower concentration 3ppm in Eugenia *aramatica*. These results indicate to the affectivity of these plants as antidiabetic plants where they will decrease serum glucose level when consumed in adequate quantities.

Keywords: *minerals; medicinal plants, Atomic absorption, spectroscopy, hypoglycemia activity.*

Introduction

Diabetes mellitus is a chronic disease which is a medical disorder characterized by persistently variable high blood sugar levels causing hypoglycemia and other complications of the kidney eye, and a variety of neuropathies. It arises either from inadequate biosynthesis, secretion, or action of the hormone insulin, an inadequate response by the body's cells to insulin, or a combination of these factors (Choudhury R. Paul et al. 2007).

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Plant based drugs have been in use against various diseases since time immemorial. The primitive man used herbs as therapeutic agents and medicament, which they were able to procure easily. The nature has provided abundant plant wealth for all living creatures, which possess medicinal virtues (Mushtaq et al. 2009).

There are many hypoglycemic plants known through the folklore but their introduction into the modern therapy system awaits the discovery of animal test system that closely parallel to the pathological course of diabetes in human beings. Hypoglycemic activity has been reported in many plants during the last twenty years (Anon ymous 1992).

Since time immemorial, diabetes has been treated with plant medicines such as Neem (*Azadirachta indica*) and Curry leaves (*Murraya koenigi*i), Bitter gourd or Karela (*Momordica charantia*) fruit, Fenugreek (*Trigonella foenum*), Gurmaar (*Gymnema sylvestre*). And Jaamun (*Syzygium cuminii*) seeds (Sivarajan VV and Balachandran I 1996).

Minerals are considered one of the more important components which play an important role in diabetes treatment.

In this study seven eleven Yemeni plant which used traditionally in the treatment of diabetes will be examined to determine their contents of total minerals (ash) and the concentration of seven important minerals(Ca, Na, Zn, Ag, Cu, Fe, Pb) by atomic absorption technique in these plants to determine their antidiabetic properties.

MATERIALS AND METHODS

Sample Collection

Plants were purchased from local markets in Sana'a -Yemen. The common and scientific names and the used part of the plants are given in Table 1.

Table 1. Common and botanic name and used parts of plants

Common name	Botanical name	Used parts
Aloe	Aloe vera	Leaf
Clove	Eugenia aramatica	Buds
Myrrh	Commiphora myrrha	oleo-gum resin from stem
Pomegrante	Punica graneotum L	Rind of fruit
Black cumin	Nigelle sativa L	Seed
Common purslane	Portulaca oleracea L	Seed
Fenugreek	Trigonella foenum L	Seed
White plnlberry	Morus alba	Leaf
Lupin	Lupinus termis	Seed
Celery	Apium graveoleus L	Seed
Cinnamon	Cinnamomum verum	The outer bark

Preparation of plant samples for analysis

Tow grams (2.0000 g) of the dried and milled (to 1 mm) sample weighed into a silica crucible and placed in a cold muffle furnace with the chimney vent open, and allowed to heat up to 450 °C. The vent was closed and maintained at this temperature overnight. The crucible then removed from the furnace and allowed to cool, then 15 drops HCl was added from a polythene Pasteur pipette. Using a fume cupboard, after that all of HCl gently evaporated off on a hotplate at moderate heat, and then the crucible and their content was removed and cooled (Faithful N.T. 2002).

Determination of mineral contents

The residue from the previous step dissolved the in 0.1 M HCl, and transfer quantitatively to a 10-ml volumetric flask. Make up trace element standards in 0.1 M HCl covering the expected ranges in the sample solutions and analyzed by atomic absorption spectrometer (AAS) technique using (spectrophotomètre d'absorption atomique. AI 1200. Aurora. Canada) according to the instrument manufacturer's instructions (Faithful N.T. 2002).

Calculation of mineral concentration

The sample solution is of 2 g in 10 ml, therefore the concentrations in μg/ml of the trace element should be multiplied by 5 to give the concentration in μg/g of the trace element in the dried sample (Faithful N.T. 2002).

RESULTS AND DISCUSSIONS

Mineral compositions of experiment plants are shown in Table (2).

A total Ash content was 15.05 % as maximum level in *Trigonella foenum L* while the minimum level was 1.45 % in *Commiphora myrrha*., the limited concentration of Ca was 22000 *ppm* in *Nigelle sativa L. and* 3225 ppm in *Aloe vera*, and Na was high 3025 *ppm* in *Punica graneotum L.* and low 800 ppm in *Morus alba*, and Zn concentration ranged from 45,5 ppm in *Cinnamomum verum* to 6,5 ppm in *Apium graveoleus L.*, Ag was 0,175 *ppm* in *Portulaca oleracea L.* and 0,025 *ppm* in *Nigelle sativa L.* and *Cinnamomum verum*. And it was disappeared in *Apium graveoleus L.*, *Morus alba*, *Eugenia aramatica and Aloe vera*, The major value of Cu 20.75 ppm found in *Nigelle sativa L.* and the minor value 8.25 *ppm* in *Trigonella foenum L.* and Fe was raised in *Apium graveoleus L.* 432.5 ppm and increased in *Lupinus termis* 47,52 *ppm*. While Pb had the higher concentration 7 *ppm* in *Trigonella foenum L*. and the lower concentration 3 *ppm* in *Eugenia aramatica*.

Table 2. The mineral compositions of plants

Plant	Ca (ppm)	Na (ppm)	Zn (ppm)	Ag (ppm)	Cu (ppm)	Fe (ppm)	Pb (ppm)	ASH %
Aloe vera	3225	1500	25.5	0.00	15	101.25	3.50	3.40
Eugenia aramatica	4600	1000	38.5	0.00	12	139.75	3.00	4.34
Commiphora myrrha	7115.6	1918	7.72	0.11	9.9	68.22	25.05	1.45
Punica graneotum L	4100	3025	9	0.075	9.25	174.75	5.00	5.10
Nigelle sativa L	22000	1225	36.5	0.025	20.75	239.25	5.00	12
Portulaca oleracea L	4000	1450	11.75	0.175	8.75	210.5	4.25	7.10
Trigonella foenum L	16250	1175	19.5	0.125	8.25	85.75	7.00	15.05
Morus alba	3600	800	10	00.00	11,75	65,5	6,5	2.20
Lupinus termis	6525	1053	32.67	0.27	9.18	47.52	4.86	3
Apium graveoleus L	14000	900	6.5	0.00	16	432.5	5.25	8
Cinamomum verum	6425	1425	45.5	0.25	18.75	162.25	6.25	6.85

The concentration of elements in the plants which are analyzed in the study decreases in the following order: Ca, Pb, Na, Cu, Zn, and Ag.

The order of plant according their minerals contents is as follows *Nigelle sativa L*, *Trigonella foenum L*, *Apium graveoleus L*, *Commiphora myrrha*, *Cinnamomum verum*, *Lupinus termis*, *Punica graneotum L*, *Eugenia aramatica*, *Portulaca oleracea L*, *Aloe vera* and *Morus alba*.

The results of the present study showed that the concentration of Ca, Cu and Fe. In Nigelle sativa L. was more than that in previous study in Turkey while the concentration of Zn was less than that in that study. And we note decreasing of Zn, CU and Fe concentration in Trigonella foenum L. and increasing of Ca concentration comparing with the pervious study (Ozcan M. 2004).

The role of inorganic elements like Zn, Cr, V, Fe, Cu, and Ni in the improvement of impaired glucose tolerance and their indirect role in management of diabetes mellitus are being increasingly recognized (NARENDHIRAKANNAN RT et al. 2005). Levine A. S et al (1983) has observed that there is tissue zinc deficiency in genetically obese, insulin-resistant diabetic mice. Failla M. L et al (1983) suggested that abnormal zinc metabolism play a role in the pathogenesis diabetes and/or its complications. The complexes of zinc and insulin in varying ratios are stored in pancreatic β-cells and released into the circulation via the portal vein (Scott D. A. and Fisher A. M. 1938). Enzymes that do not contain a trace element as an integral part but are activated by metals such as Cu, Fe, and Ni respond to in vitro addition of several transition elements with a dose-dependent activation (Speck J. F. 1949).

Copper is widely distributed in biological tissues, where it occurs largely in the form of organic complexes, many of which are metalloproteins and function as enzymes. Copper enzymes are involved in a variety of metabolic reactions, such as the utilization of oxygen during cell respiration and energy utilization (Aras NK. and Ataman OY .2006). Calcium is the major component of bone and assists in teeth development (Brody T. 1994). Iron is also required for the activity of certain enzymes involved in energy production and about 10 % of the body pool of iron is used in this way (Aras NK. and Ataman OY .2006).

Mean dietary intakes of children have been reported to be in the range 9–278 μg of lead per day and for adults 20–282 μg day_1. A typically high dietary intake (e.g. _500 μg of lead per day) was found in one Indian investigation (Aras NK. and Ataman OY .2006). According to our results the lead contains in the plants are adequate and in the save range.

Our results demonstrate that he concentration of Major elements and Micronutrients in all of experimented plants are in Sufficient or normal ranges according to reference and standards values (kalra Y P 1998). The importance of these elements cannot be overemphasized because many enzymes require them as cofactors (Akpanabiatu MI. et al 1998).

From the present study, it is concluded that the presence of various inorganic trace elements such as, zinc, copper, iron, potassium, and sodium in the plants could account for the hypoglycemic nature of these plants. Further, the data obtained on individual element concentration in each plant will be useful in deciding the dosage of herbal drugs prepared from these plant materials for the management of diabetes related metabolic disorders. And the present of these minerals in this plant in good balance to improve and maintenance of human health and to help meet daily mineral needs. In addition to these findings the results from the traditional use of these plants in Yemen gives affirmative assurances to the benefits of these plants in the treatment of diabetes.

Finally we conclude in this study that the plants which are examined in this work have potential antidiabetic activity when consumed in adequate quantities.

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