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Trace Elements in Medicinal Seeds

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Abstract

Moisture, ash and trace elements such as iron, cobalt, zinc, manganese and copper present in medicinal seeds, popularly used and available in Pakistan, were determined by Atomic Absorption Spectrophotometry. The highest moisture content was found in Cucumisativis (Kheira), while, the lowest was in Parsley (Ajwain). The highest content resulted from complete burning of Planpagomajorlill (Burtung). Carumcarvi (Caraway) was found to contain the highest amounts of trace elements determined, while Cichorimintybus (Wild Cichory) contained their lowest amount. Copper was found to be highest in Trigonellafoenumgracum (Medicago), while it was lowest in Planpagomajorlill (Burtung) and Cucumisativis (Kheira). Zinc, manganese and cobalt were found highest in Carumcarvi (Caraway), Cichorimintybus (Wild Cichory) and Cumin (Sufaid Zeera) and lowest in Phyllanothusmaderoslimm (Kanocha), Planpagomajorlill (Burtung) and Cichorimintybus (Wild Cichory).

Keywords: copper, zinc, cobalt, atomic absorption spectrophotometry

Introduction

The importance of trace elements for the normal functioning of the living body has been realized only recently. Many of these elements function as co-factors of enzymes that are responsible for key bio-chemical reactions necessary for the framework of different metabolic pathways which are essential for the supply of energy and raw material for the synthesis of functional biomolecules [1]. Thus, their excess or deficiency may lead to many physiological disorders. Govindon reviewed the role of trace elements in human health in 1973 [2].

It is now well appreciated that microelements are as important as are the vitamins whose physiological role has been well established. In fact, microelements become even more important in the context of the fact that the living body can synthesize some of the vitamins for itself but it is completely dependent on exogenous sources such as food and drinks for all requisite microelements.

Since the discovery of the importance of trace elements in functioning of the living body, extensive research has been carried out in different contexts. Research in this field has been further intensified by the development of Atomic Absorption Spectrometry that can estimate the traces of elements present in different samples. Major dimensions of research work in this regard have been the exploration of the functions of trace elements, their contents in foodstuffs and the development of the methods of their determination [3-5]. This research work is still in progress and reports continue to appear with reference to nutrition, disease and health [6,7].

The current study is about the determination of trace elements in medicinal seeds commonly used in Pakistan and subsequent defining of their physiological status in health and disease.

2. Experimental Setup

2.1. Samples

The samples of the medicinal seeds were collected from the local market of Lahore. Care was taken to buy good quality material. Most of the seeds were processed the same day. The samples were carefully cleaned, ground to fine powder and stored for prolonged periods in dry glass sample bottles.

2.2. Determination of Moisture

Moisture was determined by Oven Drying Method [3]. 10g of seed sample was taken in a pre-weighed china dish. It was then dried to a constant weight at 100^{o}C to 105^{o}C in an oven by repeated heating and weighing at the intervals of 1 hour. The dish along with the material was finally weighed after cooling and the loss in weight was reported as the percentage of moisture.

2.3. Determination of Ash

Ash was determined by igniting the oven-dried material from the 10g sample in a muffle furnace and reporting the weight of ash as the percentage of the starting sample [8]. The sample was placed in a muffle furnace and ignited at 550^{o}C for 12 to 16 hours till the ash was nearly white. Then 5 ml concentrated HNO_3 was added and the dish was again placed in the furnace to render it carbon free. The china dish was removed from the furnace, cooled in desiccators and weighed. The process was repeated to a constant weight. Ash was reported as the percentage of sample taken before drying and igniting as narrated above.

2.4. Determination of Trace Metals

The trace elements were determined by Atomic Absorption Spectroscopy [9]. The steps involved in the determination of trace metals are given below.

2.4.1. Digestion of the sample. To the ash obtained above, 5 ml of concentrated HCl was added and the mixture was evaporated to dryness. To the dried material, 2ml of HCl was added again. The dish was covered with a watch glass and heated for five minutes on a steam bath. The mixture was filtered through Whitman No. 42 into a 50 ml volumetric flask. The filter paper was washed with hot de-ionized water and the volume was finally made up to the mark.

2.4.2. Reading in the atomic absorption spectrophotometer. The solutions obtained from twenty different samples were read in Atomic Absorption Spectrophotometer. For different elements, different lamps were used. Side-by-side, the standards of different trace metal salt solutions were also read. The amount of different trace metals present in different samples was calculated by comparing the absorbance of the sample with the corresponding standard and the values were reported as the amount in μg per gram of sample.

3. Results and Discussion

The percentage of moisture and ash in the sample are reported in table 1 and the trace metal contents of different samples of medicinal seeds are reported in table 2.

The major objectives of the work reported here were the assessment of different medicinal seeds as sources of different trace metals and subsequent comparison of trace metal contents of the analyzed samples with the trace metal contents of the seeds already reported.

The results computed here (Table 2) indicate that medicinal seeds contain different trace metals in wide ranges such as the range of Fe is from 23.3 μg/g to 250.0 μg/g, of Cu is from 5.3 μg/g to 27.1.0 μg/g, of Mn is from 0.00 μg/g to 40.01 μg/g, of Zn is from 4.10 μg/g to 46.90 μg/g and of Co is from 0.2 μg/g to 2.8 μg/g.

Table 1. Percentage of Moisture and Ash in Medicinal Seeds

Sr. No.	English Name / Local Name	Botanical Name	Moisture g/100g	Ash g/100g
1	Mace/Jawatri	Myristica fragrance	9.6	4.6
2	Medicago Seeds/ Methi	Trigonellafoenumgracum	3.9	16.1
3	Parsley (Ajwain)	Carumcopticum	3.6	9.1
4	Fannel/Saunf	Foeniculumvalgare	7.0	8.5
5	Caraway/Kala Zeera	Carumcarvi	7.5	4.1
6	Cumin/SufaidZeera	Cumiumcyminum	9.5	5.4
7	Onion (Red)/Piaz	Allium sepa	5.9	8.1
8	BlackPepper/Kali Mirch	Paper nigrum	11.5	8.5
9	Rye	Brassica alba	3.7	4.6
10	Mustard/Sarsun	Brassica compestris	6.2	6.4
11	Sesum/Till	Sesammedicum	4.1	4.5
12	Khashkhash	Poversomiferumlinn	5.1	5.8
13	Carot /Gajar	Daucuscarota	9.8	6.6
14	Bartung	Planpago major linn	14.8	18.5
15	Rahan	Ocimumsonctumlinn	10.2	14.8
16	Kalongi	Nigella sativa	8.6	8.1
17	Kanocha Seeds	Phyllanthusmaderoselinn	9.8	5.1
18	Gircan Seeds/Kheira	Cucumissativis	18.5	6.5
19	Wild Chichory/Kasni	Cichoriumintibus	11.6	11.6
20	Soya	Anthermasowakurz	5.8	10.7

Table 2. Trace Metal Contents of Different Spices and Condiments

Sr. No	English Name	Botanical Name	Fe µg/g	Cu µg/g	Mn µg/g	Zn µg/g	Co µg/g
1	Mace/Jawatri	Myristica fragrance	25.8	7.30	13.25	26.9	0.60
2	Medicago Seeds/ Methi	Trigonellafoenumgracum	60.3	27.10	BDL	16.8	0.40
3	Parsley (Ajwain)	Carumcopticum	185.3	11.30	29.90	44.1	1.01
4	Fannel/Saunf	Foeniculumvalgare	110.0	9.80	26.10	11.8	1.20
5	Caraway/Kala Zeera	Carumcarvi	275.0	17.90	28.40	46.9	1.50
6	Cumin/SufaidZeera	Cumiumcyminum	165.0	12.50	27.25	15.8	2.80
7	Onion (Red)/Piaz	Allium sepa	10.9	14.98	0.00	31.1	1.20
8	BlackPepper/Kali Mirch	Paper nigrum	135.0	15.00	41.10	36.2	0.20
9	Rye	Brassica alba	98.1	5.60	21.90	27.5	BDL
10	Mustard/Sarsun	Brassica compestris	56.2	15.90	20.50	15.5	0.40
11	Sesum/Till	Sesammedicum	50.0	22.80	8.10	4.1	0.50
12	Poppy/Khashkhash	Poverformiferumlinn	20.1	10.50	30.9	24.8	0.20
13	Carot /Gajar	Daucuscarota	165.0	8.50	10.50	13.6	0.50
14	Bartung	Plantago major linn	10.8	Nil	Nil	BDL	BDL
15	Rahan	Ocimumsonctumlinn	59.01	7.90	13.50	44.5	2.80
16	Kalongi	Nigella sativa	245.0	14.50	20.10	35.1	1.50
17	Kanocha Seeds	Phyllanothusmaderoseinn	40.9	8.01	BDL	Nil	2.10
18	GircanSeeds/ Kheira	Cucumisativis	29.5	BDL	30.50	14.6	0.40
19	Wild Chichory/ Kasni	Cichorimintybus	Nil	13.50	40.01	7.5	Nil
20	Soya	Anthermasowakurz	10.6	20.50	19.50	16.9	1.20

The amount of iron is usually high in nearly all seeds. The highest amount of iron is found in caraway that is 275µg/g, which is followed by nigella sativa seeds (Kalongi) that is 245 µg/g. The others in descending order are parsley (185.3 µg/g), cumin and carrot (165.0 µg/g), black pepper (135 µg/g) and fennel (110.0 µg/g). Moderate amounts of iron are found in rye (98.1) medicago (60.3 µg/g), rahan (59.01 µg/g), mustard (56.2) and sesum (50.6 µg/g) seeds, respectively. Lower amounts of iron are also present in bartung and soya seeds. Other seeds contain iron in lower quantities that are below 50 µg/g.

In general, manganese follows iron in the content of different seeds. The highest amount is observed in black pepper (41.10 µg/g), wild chicory (40.01 µg/g) and garcon (30.5µg/g). Mace, fennel, poppy and garcon contain manganese in the range of 13.3 µg/g to 29.90 µg/g. The remaining seeds contain still lower amounts of manganese.

In general, the copper content of the analyzed seeds is less than 25 µg/g. Medicago seeds (27.1 µg/g) and sesam (22.9 µg/g) appear to contain the highest amounts of this metal. Cumin (12.50 µg/g), caraway (17.90 µg/g), soya (20.1 µg/g) and kalongi (14.5 µg/g) appear to be moderate sources of copper. Others contain relatively lower amounts of copper and thus are poor sources of this micronutrient.

Caraway (46.9 µg/g), rahan (44.5 µg/g) and parsley (41.1 µg/g) seeds appear to be rich in zinc, while mace (26.9 µg/g), poppy (24.8 µg/g), rye (27.5 µg/g) and black pepper (36.2 µg/g) come out to be moderate sources of zinc. Most of the seeds contain zinc in the range of 15 µg/g to 35 µg/g. Sesum, bartung and kanocha seeds contain negligibly small amounts of zinc.

Cobalt content in medicinal seeds are found to be in the range of 0.2 µg/g to 2.8 µg/g. Thus, cobalt content of medicinal seeds is far less as compared to other seeds.

The results for iron in cumin, caraway, black pepper and mace show that they contain 165 µg/g, 275 µg/g, 135 µg/g and 25.8 µg/g, respectively while the values reported by Fox and Bender in 1977 are 170 µg/g, 132 µg/g, 44.0 µg/g and 26.4 µg/g (10). This means that results for two seeds cumin and mace converge, while they widely differ for the other two that are caraway and black pepper. Similarly, the values for fennel, medicago, mustard and poppy are 110 µg/g, 60.3 µg/g, 66.2 µg/g, and 22.2 µg/g, respectively while those reported by the previously referred researchers are 105 µg/g, 55.6 µg/g, 70.2 µg/g, and 10.1 µg/g, respectively. The comparison indicates that these results are similar except for poppy where the ratio of values is nearly 2:1.

Copper in black pepper and fennel has been found to be 15.0 µg/g and 7.80 µg/g, respectively while the values reported by McCance and Widdosons in 1960 are 3.5 µg/g and 10.5 µg/g, respectively. The comparison indicates that the value for black pepper is lower and for fennel is higher.

According to this research, the values for manganese in black pepper and caraway are 41.10 µg/g and 28.40 µg/g, respectively while the values reported by Wenlock et al in 1973 for these seeds are 39.90 µg/g and 45.0 µg/g indicating convergence in case of black pepper and divergence in case of caraway. Similarly, the values for manganese in mace, cumin, and mustard in this research are 13.25 µg/g, 27.25 µg/g, and 20.5 µg/g, respectively while those reported by Wenlock et al in 1973 are 28.0 µg/g, 23 µg/g, 17.0 µg/g to 23.0 µg/g, respectively. So, there is considerable convergence in the values for manganese in cumin and mustard but divergence in the value for mace.

4. Conclusion

The conclusions drawn from the results and recommendations made on their basis are as follows,

- Iron is the most abundant element present in medicinal seeds. Thus, in order to treat iron deficiency diseases the seeds high in iron content such as caraway, parsley and carrot may be used provided the overall dose per day remains below 50mg. Otherwise, excess iron may accumulate in liver to cause haemochromatosis characterized by grey skin pigments and hepatic enlargement which ultimately results into heart failure.
- The amount of zinc in parsley, caraway, and rahan is high. So, these seeds can be used to overcome zinc deficiency. Human body contains 3.3g of zinc which is concentrated in liver, prostrate and bones. It is involved as a cofactor in the proper functioning of vitamins. Zinc deficiency is related to retarded growth of fetus that translates into low birth weight of infants.
- Manganese exerts beneficial effects against arteriosclerosis and prevents the development of this disease in animals and humans by activating enzymes such as blood and bone phosphatase and arginase. The medicinal seeds rich in this element such as black

pepper, wild chicory and poppy may be used to treat the said disease.

- Copper is the second important trace element after iron in nutrition due to its requirement in hemoglobin synthesis. Medicago, sesum, and soya containing high amounts of this element may be given to make up hemoglobin deficiency. Care should be taken that their excessive amount is avoided as an increased amount of copper in liver and urine may lead to Wilson's disease.
- Cobalt is an essential component of cynocobalamin (Vitamin-B12) whose deficiency may cause anemia. Hence, good sources of cobalt such as cumin and rahan may be used. The excess of cobalt, being toxic, must be avoided.
- Finally, it is recommended that where the results differ from those of other researches, some third party of researchers may repeat the analysis. Of course, the composition of soil where the seeds are grown should be taken into account in order to interpret the differences.

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