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Trace Elements in Condiments Commonly Used in Pakistan

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Trace elements such as iron, cobalt, copper, manganese and nickel were determined in condiments popularly used and available in Pakistan, by atomic absorption spectrometry. The results indicated that spices such as caraway, parsley and cumin were rich in all the trace metals. Turmeric, onion seeds and dried ginger contained quite an appreciable amount of trace metals. The amount of iron was usually high in nearly all the spices. Caraway and onions were particularly rich source of this metal. Parsley, cumin and ginger contained moderate amount of iron, while ginger, cardamom and cinnamon were rich in manganese as these contained more than 100 µg/g of metal. Garlic contained less than 10 µg/g nickel and copper contents were very low in all the spices. These were usually in the range of 1-2 µg/g.

Key Words:Trace, Elements. Condiments, Pakistan.

INTRODUCTION

Different organisms require trace elements in minute quantities, as these are essential for the maintenance of normal growth and life of plants and animals. It is only for the last forty years or so that the importance of these elements has been fully appreciated. When vitamins were being discovered and their importance realized, the importance of trace elements remained in absurdity. It is now well appreciated that micro elements are as important as are the macro elements and vitamins. In fact, micro elements become even more important in the sense 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 micro elements.

Since the discovery of the importance of trace elements in vital phenomenon, an intensive research has been undertaken in different contexts. The major dimensions of the research work have been the exploration of functions of the trace elements, determination of their content in the foodstuffs and the development of the methods of their determination. An integrated view of these researches is encountered in textbooks of biochemistry and specialized books of nutrition. In earlier descriptions an important one may be "Essentials of Nutrition" by Sherman and Sherman[1]. Khan has described the functions of minerals including trace elements for human health[2], Smith wrote "Annual Review of Plant Physiology" with reference to the plants[3] and Bender *et. al*. have submitted a report on trends in prevalence and magnitude of vitamin and mineral supplement usage and correlation with health status[4]. Bender, in 2002, described nutritional functions of trace elements and their metabolism[5]. A bulk of analytical results on trace elements are documented in a series of books titled, "Composition of Foods" published by The Royal Society and some leading organizations of UK[6-8]. Important works on analysis of condiments for trace elements are of Fox and Bender[9] and Wenlock *et. al*[10].

Keeping in view the importance of trace elements for both plant and animals, a number of studies have been conducted in the past on their sources (particularly the plants and seeds) and are currently on the way.

The plants, herbs and seeds being in extensive use traditionally as natural cures in Asia, a significant contribution is also made from countries like India, Iran and Pakistan. In a recent study on availability of essential trace elements in medicinal herbs used for diabetes mellitus and their possible correlations has been carried by Garg *et al*[11]. The researchers have analyzed four plant parts (leaves, roots, fruits and seeds) of 20 samples of 16 antidiabetic herbs including three commercially marketed capsules for 6 minor and 21 trace elements by instrumental neutron activation analysis. They claim that "Cr and V (1-2 µg/g), Rb (10-40 µg/g), Cs (80-300 ng/g), Se (*ca.* 100 ng/g) and Zn (25-60 µg/g) play an important role in diabetes mellitus". Recently, an elemental study of different parts including leaves, seeds and fruits using atomic absorption spectrophotometer has been conducted by Zafar *et. al*[12]. A total

of 14 elements were estimated. Their concentrations were found to vary in different samples. Medicinal properties of these plant samples and their elemental distribution were correlated.

Following the same track, the work undertaken here was about the determination of the trace elements in condiments commonly used in Pakistan and subsequent defining of the nutritional status of these condiments to meet the requirements of the people of Pakistan.

EXPERIMENTAL

The samples of the medicinal seeds were collected from the local market of Lahore. Care was taken that the condiments obtained were healthy and fresh. Most of the seeds were processed the same day; however, the samples were preserved over prolonged periods in dry sample bottles.

Determination of moisture: Moisture was determined by Oven Drying Method[13]. 10 g of spice sample was taken in a pre-weighed china dish. It was then dried to a constant weight at 100-105 ºC in an oven by repeating heating and weighing at intervals of 1 h. The dish with the material was finally weighed after cooling and loss in weight was reported as percentage of moisture.

Determination of ash: Ash was determined by igniting the oven-dried material from 10 g sample in a Muffle Furnace and reporting the weight of ash as percentage of the starting sample[14]. The sample was placed in a muffle furnace and ignited at 550 ºC for 12-16 h 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 a desiccator and weighed. The process was repeated to a constant weight. The ash was reported as the percentage of sample taken before drying and igniting as narrated above.

Determination of trace metals: The trace elements were determined by atomic absorption spectroscopy[15]. The steps involved in the determination of trace metals are given below.

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, 2 mL HCl was added again. The dish was covered with a watch glass and heated for 5 min 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.

Reading in the atomic absorption spectrophotometer: The solutions obtained from 18 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 amounts of different trace metals present in different samples were calculated by comparison of the absorbance of the sample with the corresponding standard and the values were reported as amounts in µg per gram of sample.

RESULTS AND DISCUSSION

The percentages of moisture and ash in the samples under investigation are reported in Table-1 and the trace metal contents of different samples are reported in Table-2.

The major objectives of the work reported here, were the assessment of different unanalyzed condiments as source of different trace metals and their subsequent comparison with the trace metal contents of already analyzed reported.

The results computed here indicate that the spices contain different trace metals in wide ranges. For example, Fe is present from 23.3-273.0 µg/g, Cu is from 6.30-26.20 µg/g, Mn from 11.00-10.3 µg/g, Ni from 1.11-6.80 µg/g and Co from 0.5-2.1 µg/g.

The amount of iron is usually high in nearly all the spices. The highest amount of iron is found in caraway that is 272 µg/g. It is which is followed by onion seeds (piaz) that is 237 µg/g. Moderate amounts of iron are contained in parsley, cumin and dried ginger. These have 182.0, 160.0 and 160.1 µg/g, respectively. Lower amounts of iron are present in turmeric, coriander and pepper. These are 117.3, 116.3 and 147.0 µg/g, respectively. Other condiments contain iron in the range 40-70 µg/g.

TABLE-1
PERCENTAGE OF MOISTURE AND ASH IN THE CONDIMENTS

S. No.	English name/local name	Botanical name	Moistureg/100g	Ashg/(100g
1	Cinnamon/Darchini	*Cinnamomum verum*	1.25	2.30
2	Cinnamon/ Taze Pat	*Cinnamomum verum*	10.30	3.80
3	Cardamom/Moti Alaichi	*Amonum false*	9.30	4.60
4	Mace/Jovatri (Seeds)	*Myristica fragrance*	10.10	1.00
5	Nutneg/Jaiphul (Fruits)	*Myristica fragrance*	7.70	4.40
6	Karaway/Kala Zeera	*Carvum carvi*	9.80	6.30
7	Cumin/ Sufaid Zeera	*Cuminum cyminium*	10.10	6.00
8	Black Pepper/Kali Mirch	*Piper nigrum*	6.90	0.80
9	White Pepper/Sufaid Mir	*Piper nigrum*	6.90	1.30
10	Clove/Loung	*Eugenia cryaphyllus*	8.00	3.80
11	Red Chillies/Lal Mirch	*Capsicum frutescens*	25.60	4.40
12	Turmeric/Haldi	*Curcuma longa*	3.80	4.20
13	Coriander/ Dhania	*Corinderum sativum*	10.50	7.00
14	Ginger (Powder)/Adrak	*Zingibar officinale*	4.50	3.70
15	Fennel/ Saunf	*Foeniculum valgare*	7.30	8.90
16	Maticago (Seeds)/Methi	*Trigonella foenum graceum*	24.30	4.60
17	Parsley/ Ajwain	*Carum copticum*	6.50	9.90
18	Onion (Seeds)/ Piazi	*Allium sepa*	6.60	5.00

TABLE-2
TRACE METAL CONTENTS OF DIFFERENT SPICES AND CONDIMENTS

S. No.	English name	Botanical name	Fe (µg/g)	Cu (µg/g)	Mn (µg/g)	Ni (µg/g)	Co (µg/g)
1	Cinnamon	*Cinnamomum verum*	71.20	6.30	61.20	1.11	0.50
2	Cinnamon	*Cinnamomum verum*	50.40	9.10	103.70	4.00	0.90
3	Cardamom	*Amonum false*	43.10	12.80	50.10	1.20	0.80
4	Macei (Seeds)	*Myristica fragrance*	23.30	7.20	13.20	1.30	BDL
5	Nutneg (Fruits)	*Myristica fragrance*	42.70	17.90	11.00	1.41	0.80
6	Karaway	*Carvum carvi*	272.10	12.30	28.30	6.80	1.30
7	Cumin	*Cuminum cyminium*	160.00	15.10	27.10	3.10	2.10
8	Black Pepper	*Piper nigrum*	147.00	22.00	40.30	2.10	BDL
9	White Pepper	*Piper nigrum*	87.00	10.20	21.90	BDL	BDL
10	Clove/Loung	*Eugenia cryaphyllus*	43.10	7.30	103.20	2.50	BDL
11	Red Chillies	*Capsicum frutescens*	42.10	BDL	12.30	1.40	0.80
12	Turmeric	*Curcuma longa*	117.30	13.30	35.10	5.00	1.00
13	Coriander	*Corinderum sativum*	116.20	14.10	21.10	2.40	0.80
14	Ginger	*Zingibar officinale*	160.100	10.00	103.90	1.21	1.00
15	Fennel	*Foeniculum valgare*	107.00	7.90	25.70	BDL	1.10
16	Maticago (Seeds)	*Trigonella foenum graceum*	62.30	26.20	BDL	2.10	0.60
17	Parsley	*Carum copticum*	182.00	11.20	29.70	3.20	1.20
18	Onion	*Allium sepa*	237.00	16.70	18.60	4.30	2.10

Manganese follows iron with reference to the concentrations in different spices and condiments. The highest amount of manganese occurs in ginger, clove, cardamom and cinnamon. Their contents are 103.9, 103.2, 50.1 and 103 .70 µg/g, respectively. Cumin, cardamom, black pepper, turmeric and parsley contain manganese in the range 30-60 µg/g. Lower amounts of manganese are contained in other condiments. In most cases, manganese content was less than 100 µg/g.

Medicago seeds and black pepper appear to be rich in copper and contain 26.20 and 22.2 µg/g, respectively. Cardamom, nutmeg, cumin and onion seeds having contents of copper as 12.80, 17.90, 15.10 and 16.70 µg/g, respectively are moderate sources of this metal, while other condiments contain relatively lower amounts of copper.

Both nickel and cobalt contents in spices are in the range 1.0-30 µg/g. The cobalt contents, in fact, are much less and in most cases, these are even less than 1.0 µg/g.

Our results for iron in cardamom, cloves, cinnamon and cumin are 43.1 µg/g, 43.1 µg/g, cinnamon, 50.4 µg/g and cumin 160.0 µg/g while these values reported for the same spices by Fox and Bender in 1977 are 71.0, 32.0, 44.0 and 430.0 µg/g, respectively[9]. This shows that our findings are nearly in consonance for first three spices but differ widely for cumin. Fox and Bender also reported that fennel, turmeric, pepper, ginger and coriander powder contain iron as 123.0, 166.0, 73.0, 451.0 and 89.0 µg/g, respectively. The results obtained for iron in the work being reported here, are 107.0, 117.3, 147.0, 160.1 and 116.2 µg/g. Thus, our results agree approximately for fennel, turmeric, pepper and coriander, but not for ginger.

Here, copper in ground ginger and pepper has been found as 10.0 and 22.0 µg/g, while the values reported for these spices by McCance and Widderon[6] are 4.3 and 109.5 µg/g, respectively pointing out that our results are higher for ginger and pepper.

Black pepper and white pepper contain manganese as 40.30 and 21.90 µg/g, respectively, while the values reported by Wenlock *et al.*[10] are 39.90 and 45.00 µg/g indicating agreement in case of only one variety. The results here indicate that manganese content of ginger, mace, chilies and turmeric is 103.9, 13.2, 12.3 and 35.10 µg/g, respectively. Wenlock *et al.*[10] reported manganese content for these species as 280.0, 23.0 and 320-410 µg/g, respectively. These results for mace, chilies and turmeric are in good agreement but differ in manganese contents of ginger.

Conclusion

From the results reported and discussed above it may be concluded that spices such as caraway, parsley and cumin are rich in all the trace metals. Turmeric, onion seeds and dried ginger contain significant amount of trace metals. The amount of iron is usually high in nearly all the spices. Caraway and onions are particularly rich source of this metal. Parsley, cumin and ginger contain moderate amount of iron, while ginger, cardamom and cinnamon are rich in manganese as these contain more than 100 µg/g of metal. Garlic contains less than 10 µg/g. Nickel and copper contents are very low in all the spices. These are usually in the range of 1.0-2.0 µg/g. Most of results agree with those reported by the researchers from the western countries. Thus, the trace composition seems not to depend on the nature of the soil.

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