

## TRACE METAL CONTENTS OF COMMON SPICES

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Essential trace metals such as iron, copper, zinc, manganese, chromium, nickel and cobalt have been estimated in about two dozen commonly consumed spices and condiments, using atomic absorption spectrophotometry. The amount of iron is quite high in nearly all spices, followed by manganese and zinc. Chromium and copper are present in smaller quantities while nickel and cobalt occur in very small concentrations. Spices like caraway, parsley and cumin are rich in all trace metals. Turmeric, onion-seeds, dried ginger and poppy-seeds also contain appreciable amounts of trace metals. Other spices however contain low amounts of the trace metals.

## INTRODUCTION

Spices have been used as essential accompanying components in the diet, often to improve aroma, palatability and acceptability of food [11]. Some work on the chemical and proximal composition of spices is available, but their potential contribution to dietary mineral requirements, especially of trace metals, is less well-known as information on this aspect of spices is lacking on locally grown/ imported spices. Pakistan produces a substantial amount of some, if not all spices, used in daily culinary preparations. In the present study trace metals like iron, copper, zinc, manganese, chromium, nickel and cobalt have been evaluated in more than two dozen different spices and condiments, using atomic absorption spectrophotometry. The data can be gainfully used in planning national dietary standards.

## MATERIALS AND METHODS

1. *Collection of Samples.* All specimens were purchased from the local market. Care was exercised to buy good quality material.

2. *Reagents.* All reagents used in the present investigation were of Analar grade. Deionized water was used in the preparation of all solutions and standards. All glassware was carefully cleansed and rinsed with deionized water.

3. *Preparation of Samples.* All specimens were carefully cleaned. They were powdered in a glass pestle and mortar to a fine mesh and stored in glass bottles at room temperature.

4. *Estimation of Moisture.* (A.O.A.C, 1975). 2 g. sample was taken in a pre-weighed Chinadish. It was dried at  $130^{\circ} \pm 0$  in an oven for about one hour. After cooling to room temperature, the china dish containing the material was reweighed and the loss in weight was reported as moisture.

5. *Estimation of Ash.* (A.O.A.C, 1975). 10 g. powdered material was weighed in a china dish and ignited in a muffle furnace at  $550^{\circ}$  until a colourless or light-grey ash was obtained. About 2-3 ml conc.  $\text{HNO}_3$  were added to each cooled specimen and reignited for about an hr. to render it completely free of carbon. The specimen was cooled and reweighed and the loss was reported as ash.

6. *Digestion of Samples* [12]. A 5 g sample was taken in a 250 ml Pyrex beaker. About 50-60 ml conc.  $\text{HNO}_3$  was added in batches and the specimen were heated on an electric hot-plate, the beakers being partially covered with watch-glass to avoid loss of acid, till the contents were rendered free of carbon. Samples were cooled and 6-10 ml  $\text{HClO}_4$  were added to each and reheated for sometime. After cooling, the volume was made to 25 ml and solution filtered through Whatmann No. 42.

7. *Trace Metal Assay.* Atomic Absorption Spectrophotometer Model 856-AA, Jerrel & Ash Instrument Company, USA, was used for the purpose of estimating iron, copper, zinc, manganese, chromium, nickel and cobalt. Instructions for instrument setting, calibration and

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assay for specific trace metal, as laid down in the operational manual, were strictly followed.

### RESULTS AND DISCUSSION

About thirty different spices and condiments have

been analysed for trace metal contents, e.g. iron, copper, zinc, manganese, chromium, nickel and cobalt. The results have been presented in Table 1. The ranges of occurrence of various metals are as follows: Fe, 8.5-286.0  $\mu\text{g/g}$ .; Cu, 3.5-23.0  $\mu\text{g/g}$ .; Zn, 3.9-47.0  $\mu\text{g/g}$ .; Mn, 7.9-11.

Table 1. Showing Moisture, Ash and Trace Metal Contents of Spices of Different Families

Family	Botanical Name	English name	Local name	Moisture g%	Ash g%	Trace Metals on Dry Weight $\mu\text{g/g}$						
						Fe	Cu	Zn	Mn	Cr	Ni	Co
Lauraceae	<i>Cinnanomum verum</i>	Cinnamon	Darchini	10.5	3.0	67.2	4.9	11.4	65.8	9.9	1.1	0.6
	" "	Cinnamon- Leaves	Tezpat	7.5	3.4	56.1	10.9	34.0	101.6	14.4	4.2	1.1
	<i>Myristic fragrance</i>	Mac	Javatri	9.5	2.5	21.1	6.1	10.0	16.8	13.2	1.4	0.4
	" "	Nutmeg	Jaifal	7.5	3.5	45.5	20.9	27.0	11.5	16.4	1.2	0.6
Zingiberaceae	<i>Zingiber officinale</i>	Ginger (dried)	Sont	7.5	4.5	152.0	16.0	38.0	115.0	20.0	5.2	1.0
	" "	Ginger (fresh)	Adrak	15.5	8.5	41.8	10.9	29.0	106.0	12.5	2.0	0.9
	<i>Elettatria cardamom</i>	Cardamom	Alaichi	6.5	4.5	66.0	15.4	23.0	103.0	20.5	4.8	0.4
	" "	Cardamom (large)	Alaichi	10.5	5.0	42.0	11.8	28.0	66.2	29.5	1.2	0.8
Umbelliferaceae	<i>Coriandrum sativum</i>	Coriander	Dhania	10.5	7.0	112.0	12.7	34.0	18.0	28.8	2.4	0.9
	<i>Carum carvi</i>	Caraway	Zira (black)	6.0	10.0	286.0	13.8	47.0	33.8	15.5	7.0	1.0
	<i>Cuminum cyminum</i>	Cumin	Zira (white)	8.5	8.0	155.0	16.3	41.1	24.4	8.4	3.6	2.2
	<i>Foeniculum vulgare</i>	Fennel	Saunf	7.0	9.0	109.0	8.2	11.6	23.7	4.4	1.0	1.0
	<i>Carum copticum</i>	Parsley	Ajwain	3.5	16.0	178.0	9.1	43.0	33.1	30.5	3.5	0.7
Pipraceae	<i>Piper nigrum</i>	Black Pepper		8.5	4.5	140.0	20.0	35.7	45.5	1.4	2.4	0.4
	" "	White Pepper		11.5	1.5	95.0	9.1	16.1	19.5	1.2	0.7	0.3
Solanaceae	<i>Caspicum frutescens</i>	Chillie (Round)		7.5	6.5	46.4	4.2	17.4	14.8	3.5	1.5	0.8
	" "	" (Large)		7.0	6.0	54.9	5.1	15.0	14.0	3.0	1.0	0.5
Lillaceae	<i>Allium cepa</i>	Onion-seeds	Kalonji	4.5	18.0	235.0	18.2	34.0	19.4	4.8	4.0	2.5
	" "	Onion-white (Fresh)		7.5	2.5	8.5	3.5	15.0	7.2	3.6	2.5	2.0
	" "	Onion-Pink (Fresh)	Piaz	7.0	3.5	13.5	7.5	13.7	10.0	4.0	1.6	1.0
	" "	Garlic, Longpod	Lasan	6.0	3.0	129.0	9.7	15.3	13.0	3.5	1.7	0.6
	" "	Garlic, Smallpod	"	6.5	2.5	112.0	5.7	14.0	6.5	2.5	1.5	0.5
Myrtaceae	<i>Eugenia caruophyllus</i>	Clove	Long	6.0	5.5	45.5	7.2	30.0	100.0	3.0	2.4	0.7
Crucifereae	<i>Brassica compestris</i>	Mustard seeds	Sarson	4.5	6.4	93.1	5.5	15.1	20.1	2.8	1.5	0.6
	" <i>alba</i>	Rai seeds	Rai	3.0	2.0	95.0	8.1	27.0	21.6	18.6	3.6	1.1
Curcuma	<i>Curcuma longa</i>	Termeric	Haldi	6.0	2.1	121.2	16.3	22.0	33.8	72.8	3.8	1.0
Papilionaceae	<i>Trigonella foenumgraecum</i>	Medicago Seeds	Methi	3.5	16.0	63.0	23.0	17.0	13.0	6.0	2.5	0.6
Graminaceae	<i>Vertiveria zizanioides</i>	Poppyseeds,	Khash- khash	5.0	8.0	143.1	21.8	24.1	31.7	13.4	3.6	0.4
Raediaceae	<i>Sesamum medicum</i>	Sesame	Til	4.0	4.0	54.8	16.8	3.9	7.9	1.4	1.2	0.3
		Rock Salt		0.02	99.0	3.0	0.1	4.0	5.1	5.7	0.2	0.1
		Sea Salt		0.01	98.5	1.4	1.8	2.0	2.1	5.8	0.2	0.1
		Black Salt		0.03	98.0	1.7	0.2	2.3	4.1	2.9	0.2	0.1

5  $\mu\text{g/g}$ ; Cr, 1.2-72.8  $\mu\text{g/g}$ ., Ni, 0.7-7.2  $\mu\text{g/g}$ .; Co, 0.2-2.5  $\mu\text{g/g}$ .

It is seen that the range of occurrence is very wide for metals in various spices, in some cases the difference being more than 30-times. Iron seems to be most prominent in occurrence, followed by manganese, zinc and copper in decreasing order. Chromium in certain cases is quite abundant but generally occurs in low amounts while nickel and cobalt are present in very small amounts. Considering on family basis, *Umbelliferae*, *Papilionaceae*, *Curcuma* and *Zingiberaceae* are more conspicuous in containing trace metals in large amounts. Individually spices like caraway, parsley, cumin, turmeric, onion-seeds (*kalonji*), ginger-dried (*sonth*) and poppy-seed (*khashkhash*) contain more amounts of trace metals, although there are some bursts of occurrence for some metals in some cases, e.g. chromium in turmeric (92.8  $\mu\text{g/g}$ ).

Iron performs an important role both in plants and animals; hence Nature has been generous in supplying it abundantly in food materials. The amount of iron is quite high in nearly all spices except onions which have small amounts (8.5-13.5  $\mu\text{g/g}$ ). The highest concentration of iron is found in caraway (286.0  $\mu\text{g/g}$ ) followed by onion-seed (235.0  $\mu\text{g/g}$ ) and parsley (178.0  $\mu\text{g/g}$ ). Moderate amounts of iron are present in cumin (155.0  $\mu\text{g/g}$ ), dried-ginger (152.0  $\mu\text{g/g}$ ), poppy-seed (143.0  $\mu\text{g/g}$ ), black pepper (140.0  $\mu\text{g/g}$ ), garlic (129.0  $\mu\text{g/g}$ ) and turmeric (121.0  $\mu\text{g/g}$ ). Mustard, rai-seeds, Fennel and coriander also contain good amounts of iron ranging between 93.0-112.0  $\mu\text{g/g}$ . Red-chillies, sesamum, cardamom-leaves and medicago-seeds contain iron in the range of 42.0-66.0  $\mu\text{g/g}$ .

Fox and Bender [3] have reported 71, 32, 44 and 430  $\mu\text{g/g}$  iron in cardamom, clove, cinnamon and cumin respectively. The same workers have reported iron in fennel, turmeric, peppers, mustard, ginger and coriander as 123, 243, 73, 80, 407 and 89  $\mu\text{g/g}$  respectively. Data on trace metals in various spices and condiments reported by a number of earlier workers like McCance & Widdowson [9], Chaney [2], Sherman [14], Heinz [6] and Toscani and Raznikoff [16] differ for some but agree for most of the trace metals as obtained in the present work. Gopalan *et al* [4] have inferred a marked variation in the iron contents of different samples of the same species possibly as a result of different varieties, location, grinding procedures etc.

Manganese is an important cofactor in a number of enzymes, and probably for this reason, it ranks second in the matter of concentration in various spices and condiments. Larger amounts of manganese occur in ginger (both dried and fresh), clove, cardamom and

cinnamon-leaves being 115, 106, 108, 103 and 101  $\mu\text{g/g}$  respectively. Parsley, turmeric, black-peppers, caraway, cumin and cinnamon contain manganese in the range of 33-66  $\mu\text{g/g}$ . Lower amounts of the metal, not exceeding 10  $\mu\text{g/g}$ , are contained in several spices. Wenlock *et al* [18] has reported manganese in ginger-powder, black-pepper, white pepper, garlic-powder, turmeric, mustard, mace, red-chillies and curry-powder as 280, 39-90, 45, 10, 32-41, 5.2-7.9, 23, 23.5 and 42-54  $\mu\text{g/g}$  respectively, which differ for some but agree for several spices.

Zinc concentrations are relatively much less than iron and manganese. Zinc is more concentrated in caraway, parsley, cumin, and ginger, being in the amounts of 38, 43, 41 and 38  $\mu\text{g/g}$  respectively. Onion-seeds, coriander, cinnamon-leaves, cardamom and nutmeg have zinc in the range of 25-35  $\mu\text{g/g}$ . Several other spices and condiments contain zinc in amounts less than 20  $\mu\text{g/g}$ . In spices and condiments an average zinc content of 22.9  $\mu\text{g/g}$  has been reported by Schroeder [13].

Copper contents of spices are comparatively low and are rated fourth, probably because of secondary role copper plays in plants and animals. Poppy-seeds, nutmeg, black-pepper, onion-seeds, sesamum, cumin and turmeric contain copper in the range of 16-21  $\mu\text{g/g}$ . Other spices and condiments have copper varying between 5-15  $\mu\text{g/g}$ . McCance and Widdowson [9] have reported 9, 4 and 2  $\mu\text{g/g}$  of copper in peppers, ginger and mustard but quite a high value of copper for parsley (52  $\mu\text{g/g}$ ) has been given by the same workers. Schroeder [13] has given an average of 6.8  $\mu\text{g/g}$  for copper for various spices and condiments.

Chromium is present in quite good amounts in spices compared to several other types of food materials. In turmeric, chromium has been found to an extent of 72.8  $\mu\text{g/g}$ , which is rather a high value. Other spices like dried-ginger, cardamom-leaves, coriander small-cardamom nutmeg, rai-seeds etc. contain chromium in the range of 17-31  $\mu\text{g/g}$ . The rest of the spices analysed have chromium varying between 5-15  $\mu\text{g/g}$ . Schroeder [13] has reported an average value of 3.3  $\mu\text{g/g}$  of chromium for various spices and condiments. Toefer [17], Jones and Buckley (1977) and Stanstead [15] have given relatively low value of chromium for various spices. Both nickel and cobalt are quite low in all spices, rarely exceeding 5  $\mu\text{g/g}$  in concentration. Cobalt content is in fact less than 1  $\mu\text{g/g}$  in all spices. Ginger-dried, cardamom, caraway, cumin, parsley, onion-seeds and poppy-seeds have relatively more nickel. Schroeder [18] has reported an average value of 0.52  $\mu\text{g/g}$  for cobalt for various spices and condiments.

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