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Analysis of minerals and heavy metals in some spices collected from local market.

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Abstract: *Herbs and spices are sources of many bioactive compounds that can improve the taste of food as well as affect the digestion metabolism. Along with that they may also contain some substances as pesticides , heavy metals and which have harmful effect on the body.*

In this work, five of the most popularly used spices and herb were studied to determine Pb , Cd , As ,Hg , Mn , Cu , Co , Se , Ni , Cr content in them .This was analysed using Atomic Absorption Spectrophotometer(AAS). The results were compared with the safety standards (WHO). The average concentration of heavy metals as Pb detected ranged from 3.3ppm-4.59ppm , Cd ranged from 0.04pm-0.4 ppm . concentration of As was from 0.7ppm -1.5ppm , concentration of Se ranged from Negligible to 2.26 ppm . Mn ranged from 28.73 ppm-562.6 ppm , Ni was found to range between 2.82 ppm – 5.76 ppm , (Cu) was found to be in a range of 2.30 ppm – 19.69 ppm in C.Zeylanicum , Myristica fragrans , Ocimum sanctum , Syzygium aromaticum and Cinnamomum tamala and most of them were well within the permissible limits.
Key words*: AAS , ,Heavy Metals, Spices*

I. Introduction

In the last few decades only due their medicinal effect, the use of spices and other herbs has increased markedly in most regions of the world including Europe & N.A. Indian food consists of variety of vegetables and curries.[1]Like the cuisine of many cultures, it is the spices in Indian food that makes its dishes distinctive , palatable , aromatic and acceptable. They are derived from buds, barks , rhizomes ,fruits ,seeds ,and other parts of the plant. The bulk of the dry material of spices contains carbohydrates and organic compounds having different functional groups.[2-5]

Spices have been recognized to have some medicinal properties due to antioxidant and antimicrobial action. Many spices have been found to possess anti diabetic ,anti inflammatory , and anti-hypersensitive capacity.[6-7]Several attempts have been made to determine the macro and the micro nutrient content in spices and herbs from all over the world. [8]. Only a small fraction of the many biochemicals found in plants are responsible for the quality of spiciness, many classes are hardly ever found in spices, as their taste is either unpleasant or they are not safe at all.[9]Even though spices are essential they may contain some toxic chemicals as accumulation of heavy metals derived from the surroundings of their production , processing and storage conditions.

Although a few spices are of global importance, many are used as condiments locally in the regions of their natural occurance. The addition of spices that may be contaminated with trace and heavy metals to food as a habit may result in accumulation of these in human organs and lead to different health problems.
The widespread contamination of spices and herbs with heavy metals in last two decades has increased the scientific interest as it has the harmful effect on human health..T his has lead the researchers to study the effect of heavy metals on food , air and water and to determine their permissibility for human consumption.[10]. Several studies were done to determine the concentration of heavy metals in spices .[11] and to study their harmful effects. Heavy metals beyond the permissible limits affects the human health and my lead to illness of human foetus ,preterm labour and mental retardation in children. Adults may suffer from fatigue, high blood pressure and kidney troubles.

The objective of this work is to estimate the levels of heavy metals that is Lead , Cadmium ,Arsenic , Selenium , Manganese , Nickel and Copper that may be present in the selected spices available in local markets of Nagpur region. The levels of investigated heavy metals were compared with the recommended levels by the international organizations as FAO and WHO.

II. Materials and Methods

2.1.Sample collection and processing

The experimental material consists of 5 spices: cloves, cinnamom , nutmeg , tejpat and tulsi. Samples were purchased from the local market in Nagpur, Maharashtra , India. They were classified according to their

English name , scientific name and the used part of the plant.(Table 1). After cleaning the spices were dried in shade and powdered. The powdered materials were directly subjected to analysis.

Table 1.
Scientific and common names of the studied spices

Common name	Scientific name	Family	Used parts
Cloves	Syzygium aromaticum	Myrtaceae	Bud
Dalchini	C.zeylanicum	Lauraceae	Bark
Tejpat	C.tamala	Lauraceae	Leaves
Nutmeg	Myristica fragrans	Myristicaceae	Seed
Tulsi	Ocimum sanctum	Labiateae	leaves

2.2. Reagents and standards

Analytical grade nitric acid , hydrochloric acid and hydrogen peroxide (Merck ,India) were used as received. Standard sample solutions of Cd , Pb , As ,Se , Mn , Ni , Cu were obtained from Merck.

2.3 Experimental procedure;-

To determine heavy metal concentration ,a wet digestion of the dried samples was done according to the method described by Jones and Case (1990) using conc.H_2SO_4 and 30% H_2O_2 mixture. To a 0.5 g of dry – ground sample placed in 100ml beaker , 3.5 ml of 30% H_2O_2 was added .The content of the beaker was heated to 100^{o}C , and the temperature was gradually increased to 250^{o}C, and left at this temperature for 30 minutes .The beaker was cooled and again 1ml of 30% H_2O_2 was added to the digestion mixture and the contents were reheated again. The digestion process was repeated many times till clear solution was obtained. The clear solution was transferred into 50ml volumetric flask, and completed to the mark with double distilled water. A blank digestion solution was made for comparison. A standard solution for each element to be analysed was prepared and used for calibration .Metal measurement was performed with S2 series model double beam Atomic Absorption Spectrophotometer , and deuterium background correction . Hollow cathode lamps of Pb , Cd , As , Se , Mn , Ni , Cu were used at specific wavelength of every metal .Measurements were done against metal standard solution.

III. Results and Discussion:

The contents of Pb , Cd , Se, As, Hg, Cu, Mn ,Ni , Cu in above mentioned different spices were compared with the maximum permissible limit (MPL) on the basis of the National Food Standards. Herbs and spices belong to a group of condiments, so the levels of minerals and heavy metals were compared with the suitable safety standards as determined by the Maximum Permissible Limit(MPL), applied to “other food and condiments” .

Table 2: Maximum Permissible Limit values for Pb , Cd ,As , Se , Mn , Ni , Cu (in ppm)

Sr. no.	Name of heavy metal	MPL(in ppm)
1	Lead	5.0
2	Cadmium	0.2
3	Arsenic	1.0
4	Selenium	2.0
5	Manganese	2.0
6	Nickel	1.63
7	Copper	3.0

Heavy metals(Pb , Cd , As , Se , Mn , Ni , Cu) analyses have been performed on 5 local spices and the result has been presented in table 3.

Table 3:-Content of Pb , Cd , As , Se , Mn , Ni and Cu in spices and herbs samples(in ppm)

Sr.no	Sample name	MPL (in ppm) →	Lead(Pb) (in ppm) 5 ppm	Cadmium(Cd) (in ppm) 0.2 ppm	Arsenic(As) (in ppm) 1.0 ppm	Selenium(Se) (in ppm) 2.0 ppm	Manganese (Mn) (in ppm) 2.0 ppm	Nickel(Ni) (in ppm) 1.63 ppm	Copper(Cu) (in ppm) 3.0 ppm
1	Dalchini		4.22	0.42	1.32	2.09	562.6	2.82	**2.30**
2	Nutmeg		3.86	0.15	1.53	2.26	264	3.01	**7.90**
3	Tulsi		4.59	0.11	1.34	0.92	184.76	5.76	**6.24**
4	Cloves		3.34	0.06	0.78	ND	28.73	3.72	**16.3**
5	Tejpatta		3.58	0.04	0.79	ND	97.66	4.84	**19.69**

ND-Not Detected

Lead – It is found to be the most toxic environmental pollutant .It reacts with many biomolecules and severely affects the nervous , reproductive , gastrointestinal , renal , cardiovascular and immune system as well as many developmental processes.[12] The lead contents in different samples are shown in table (Table 3) . The concentration of lead varied from 3.34ppm in cloves , 3.58ppm , in tejpatta , 3.86 ppm in nutmeg , 4.22 ppm in dalchini to 4.59ppm in tulsi. These values are below the MPL as recommended by FAO/WHO (1984) and can be considered as tolerable.

Cadmium –Its content to a lesser extent is classified as human carcinogenic.[13]Therefore increase in this content in food is always harmful l. As the table 3 shows the Cadmium contents in all the 5 experimental samples, it is seen that all the samples were under the maximum permissible limit (0.2ppm) as recommended by FAO/WHO 1984) except the dalchini sample. The concentration of cadmium ranged from 0.15 ppm in nutmeg ,0.06ppm in cloves , 0.04ppm in tejpatta to 0.11 in Tulsi .The concentration of cadmium in dalchini was found to be 0.42ppm.(Table 3)This high level of cadmium might be due to the use of cadmium containing fertilizers or from the practice of growing this crops on the soil amended with sewage sludge.

Arsenic - The concentration of arsenic ranged from 1.32ppm in dalchini , 1.34ppm in tulsi to 1.53ppm in nutmeg which exceeded the MPL for arsenic.(Table 3)The concentration of arsenic in cloves(0.78ppm) and tejpatta (0.80ppm) are well within the MPL.(Table 3)The high level of Arsenic can be due to the use of certain fertilizers and pesticides. Higher concentration of Arsenic in food/spices can cause harmful effect on skin , lungs , liver and bladder. Its lower effects can cause nausea , vomiting or even damage to the blood vessels.

Selenium - The concentration of Selenium in different experimental samples is shown in Table 3. As revealed by the analytical data high concentration of selenium was found in dalchini and nutmeg i.e 2.09ppm and 2.26ppm respectively. These values are greater than the values prescribed in MPL for Selenium. The samples of cloves and tejpatta did not showed any significant concentration of selenium while the concentration of selenium in tulsi was well within the limits. High blood levels of selenium can cause selenosis which includes gastrointestinal upsets, hair loss, white blotchy nails, garlic breath odour , fatigue etc.[14].

Copper-The copper content in above mentioned 5 spices ranged from 2.39 ppm in cloves to 19.69 ppm in tulsi . The maximum permissible limit set by FAO/ WHO (1984) in edible ssplants was 3.00ppm. When this limit only in case of cloves. Rest all the spices and herb contained Cu above the limit. However for spices , the permissible limits for copper set by China and Singapore were 20 ppm and 150 ppm respectively (WHO 2005) . According to Bowen (1966) and Allarvay (1968) the copper range in agricultural products should be between 4- 15 ppm. [Pakistan Feb 2010]. On one hand Cu plays a role in the oxidative defence system on the other hand chronic Cu toxicity can result in severe poisoning.[15].

Nickel:- Clove showed accumulation of 2.6 ppm which is lowest , whereas Tejpatta has maximum accumulation of 5.76 ppm (Table 2 & 3). The permissible limit set by FAO/WHO (1984) in edible plants was 1.63 ppm . All the above studied spices accumulate Nickel above this , limit But WHO (2005) limits particularly for spices have not yet been established for Nickel. Its toxicity is not very common occurance as its absorption by the body is very low (Onianiava et al. zone).[16]

Manganese :- The range of Mn varied with values between 28.73 ppm in Nutmeg to 562.6ppm in cloves. The permissible limit set by FAO/WHO (1984) in edible plants was 2 ppm. When compared , in the studied spices, it is found that all plants accumulate Manganese above this limit.

IV. Conclusion

The results in table 3 showed that there is no risk from the daily use of the above mentioned spices if taken in limited quantity. Human needs for spices is very few grams per day and there is no risk of using these spices under study in the food stuff. But some results obtained indicates that spices and herbs used in food may contain some toxic metals in relatively high level. Therefore they should be under continuous monitoring.

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