

보통의 식품첨가제의 SEM-EDS와 ICP-AES 분석

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SEM-EDS and ICP-AES Analysis of Common Food Additives

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요약. Cinnamomum Iners (Darchini, 자 바 계피), Elettaria Cardamomum (Elachi, 백두구, 소두구, 카다몬, 카도몬), Punica Granatum (Anar Dana, 석류), Curcuma Longa (Haldi, 터메릭, 투메릭, 심황, 울금, 울금은, 켈쿠마), Piper Nigrum (Kali Mirch, 페퍼, 페퍼블랙, 후추, 블랙 페퍼), Syzygium aromaticum (Loung, 클로브, 정향, 정향나무), Capsicum Annum (Laal Mirch, 붉은 고추), Mentha Arvensis (Pahari Podina, 박하), Curcuma Zedoaria (Kachur, 가쥬츠, 봉출, 아출, 커큐머 제도) Zingiber officinale (Adrak, 건강, 생강, 진저) 그리고 Garam Masala (매운맛, 혼합물)은 SEM-EDS와 ICP-AES의 도움으로 그 속의 금속 성분을 위해 본 연구에서 분석되어졌다. 작은 농도는 ICP-AES로 찾아냈고 주된 농도는 SEM-EDS로 찾아냈다.

주제어: SEM-EDS, ICP-AES, 향신료(맛을 위한 식품첨가제)

ABSTRACT. Cinnamomum Iners (Darchini, 자 바 계피), Elettaria Cardamomum (Elachi, 백두구, 소두구, 카다몬, 카도몬), Punica Granatum (Anar Dana, 석류), Curcuma Longa (Haldi, 터메릭, 투메릭, 심황, 울금, 울금은, 켈쿠마), Piper Nigrum (Kali Mirch, 페퍼, 페퍼블랙, 후추, 블랙 페퍼), Syzygium aromaticum (Loung, 클로브, 정향, 정향나무), Capsicum Annum (Laal Mirch, Red Pepper), Mentha Arvensis (Pahari Podina), Curcuma Zedoaria (Kachur, 가쥬츠, 봉출, 아출, 커큐머 제도) Zingiber officinale (Adrak, 건강, 생강, 진저) and Garam Masala (Hot Spice, a mixture) have been analyzed in the present work for their metallic components with the help of SEM-EDS and ICP-AES. Minor concentrations have been determined with ICP-AES and major concentrations with the help of SEM-EDS.

Keywords: SEM-EDS, ICP-AES, Spices (Food additives for taste)

INTRODUCTION

Role of metallic constituents of food is very much important for human health. Different workers have used SEM-EDS and ICP-AES for determination of metallic components.¹⁻³ ICP-AES analysis of Sumac fruits has shown potassium, calcium, magnesium and phosphorus to be the major metallic constituents.⁴ Relationship between the concentration of different metals emitted as pollutants from the factories and concentration of these metals in soil and plants have been reported.⁵ Heavy metals are generally present at very low levels in food materials. Due to their cumulative behaviour and toxicity they have a potential hazard for human beings and plants as well.⁶⁻⁷ SEM-EDS have been used as a powerful tool for the investigation of foreign contaminants in food. Mouse hair, portion of the insect fly, aluminum saw dust, fused silica, lead silicate, high lead

and borosilicate have been reported as foreign contaminants in different foods at different places.⁸

MATERIALS AND METHODS

Cinnamomum Iners (Darchini, 자 바 계피), Elettaria Cardamomum (Elachi, 백두구, 소두구, 카다몬, 카도몬), Punica Granatum (Anar Dana, 석류), Curcuma Longa (Haldi, 터메릭, 투메릭, 심황, 울금, 울금은, 켈쿠마), Piper Nigrum (Kali Mirch, 페퍼, 페퍼블랙, 후추, 블랙 페퍼), Syzygium aromaticum (Loung, 클로브, 정향, 정향나무), Capsicum Annum (Laal Mirch, Red Pepper), Mentha Arvensis (Pahari Podina), Curcuma Zedoaria (Kachur, 가쥬츠, 봉출, 아출, 커큐머 제도) Zingiber Officinale (Adrak, 건강, 생강, 진저) and Garam Masala (Hot Spice is a mixture) have been analyzed in the present work. All the samples were purchased from open market. These samples were shade dried, ground in

the form of fine powder and pulverized before analysis. All the samples were gold coated to make them conductive and to have a clear image of them. Micrographs of these samples were recorded using SEM JEOL model, 5910 LV with an accelerating voltage of 20 kV at high vacuum (HV) mode and secondary electron image (SEI). The semi quantification elemental analysis to find out the weight percentage of the elements were done using OXFORD INCA energy dispersive X-Ray spectrometer 7274 (EDS).

Inductivity coupled plasma analysis were carried out using an ICP-AES Thermo Jarell Ash instrument. Five readings were taken for each sample.

RESULTS AND DISCUSSION

Trace elements are estimated by determining the percentage abundance (%) of elements K, Ca, Si, P, Cl and S by

SEM-EDS. Concentrations of Al, Cu, Fe, Mg, Mn, Zn and Ni have been determined by ICP-AES. Concentrations of these elements sample wise have been reported in *Table 1*, *Table 2* and *Table 3*. SEM-EDS spectra are presented in *Fig. 1-7*.

SEM-EDS

Potassium is present in almost all spices. Maximum concentration of potassium was found in *Zingiber Officinale* (5.46%) and minimum potassium was present in *Cinnamomum Iners* (0.53%). Maximum concentration of Ca was present in *Garam Masala* (1.13%). Silicon was present in four samples. Maximum concentration of silicon was observed in *Garam Masala* (1.95%). Phosphorous and sulphur were present only in *Capsicum Annum* (0.33% & 0.36% respectively). Chlorine was present in five samples with maximum value of 0.76% in *Curcuma Longa*.

Table 1. % age Of elements in spices by EDS

Sample ID	Zingiber Officinale	Punica Granatum	Cinnamomum Iners	Garam Masala	Curcuma Longa	Curcuma Zedoaria	Piper Nigrum	Capsicum Annum
K	5.46	1.17	0.53	2.59	2.30	1.75	0.57	1.95
Ca	0.29	0.48	2.35	1.13	0.22	0.58	0.20	0.26
Si	0.23	-	-	1.95	0.55	0.84	-	-
P	-	-	-	-	-	-	-	0.33
Cl	0.68	0.36	-	0.57	0.76	-	-	0.41
S	-	-	-	-	-	-	-	0.36

Table 2. % age Of elements in spices by ICP-AES

Sample ID	Cinnamomum Iners	Elettaria ardamomum	Garam Masala	Punica Granatum	Curcuma Longa
Al	0.005	0.006	0.081	0.44	0.037
Cu	0.0006	0.001	0.002	0.006	0.001
Fe	0.007	0.008	0.055	0.41	0.029
Mg	0.074	0.146	0.52	0.155	0.76
Mn	0.035	0.002	0.008	0.004	0.008
Zn	0.002	0.003	0.005	0.034	0.006

Table 3. % age Of elements in spices by ICP-AES

Sample ID	Piper Nigrum	Syzygium Aromaticum	Capsicum Annum	Mentha Arvensis	Curcuma Zedoaria	Zingiber officinale
Al	0.011	0.021	0.011	0.032	0.029	0.013
Cu	0.002	0.002	0.003	0.005	0.0006	0.002
Fe	0.027	0.031	0.021	0.041	0.041	0.017
Mg	0.21	0.36	0.44	0.44	0.26	0.503
Mn	0.017	0.048	0.004	0.006	0.005	0.012
Zn	0.001	0.003	0.005	0.004	0.003	0.004
Ni	-	-	-	-	0.007	-

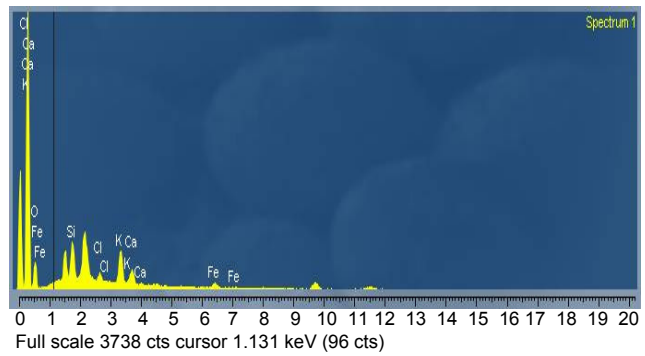
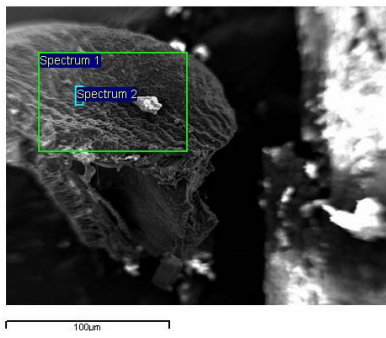


Fig 1. SEM-EDS of Garam Masala.

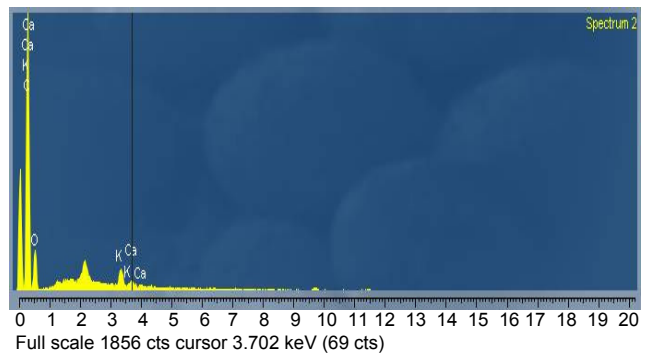
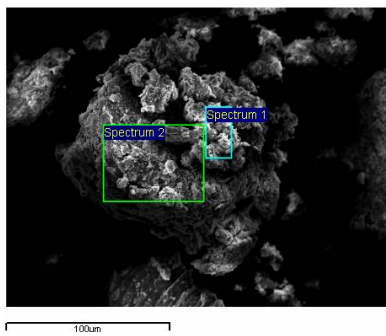


Fig 2. SEM-EDS of Curcuma Longa.

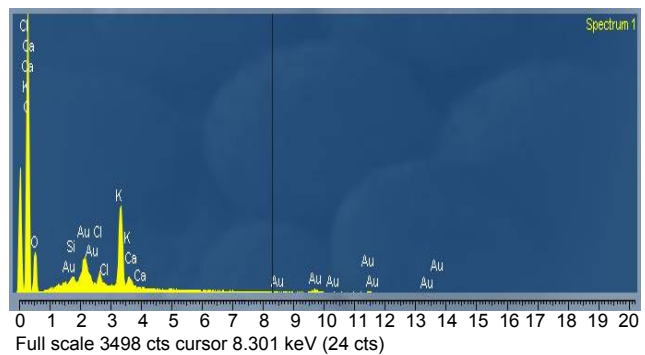
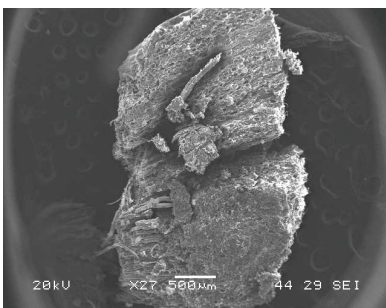


Fig 3. SEM-EDS of Zingiber Officinale.

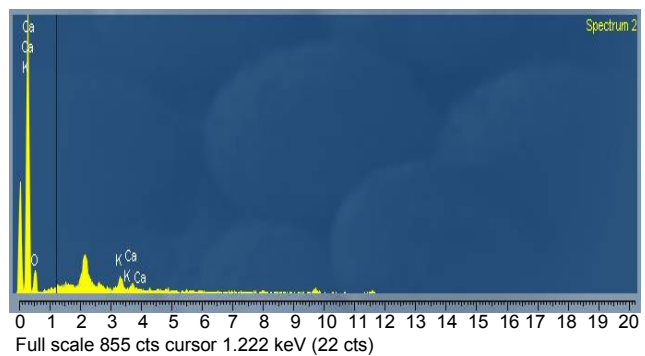
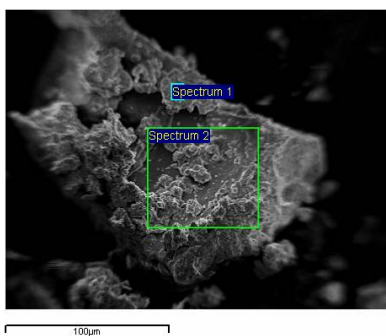


Fig 4. SEM-EDS of Punica Granatum.

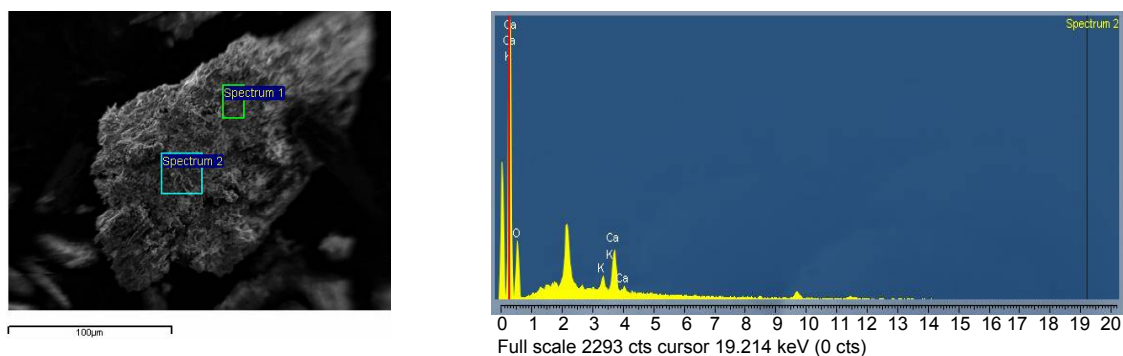


Fig 5. SEM-EDS of Cinnamomum Iners.

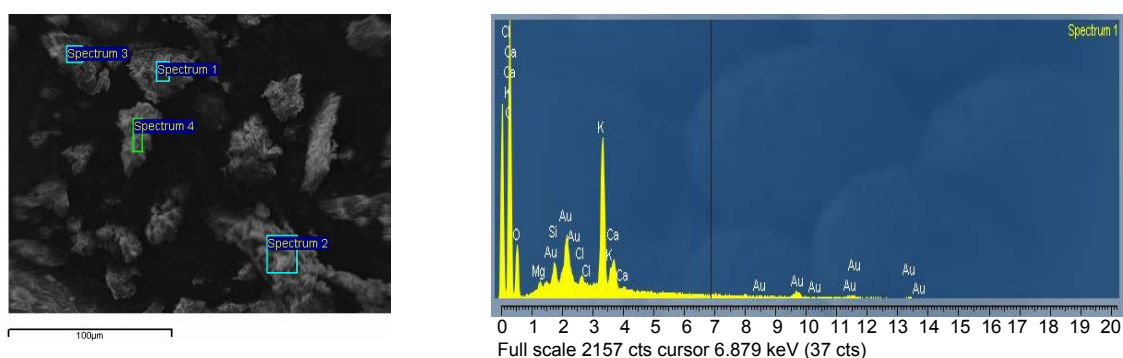


Fig 6. SEM-EDS of Piper Nigrum.

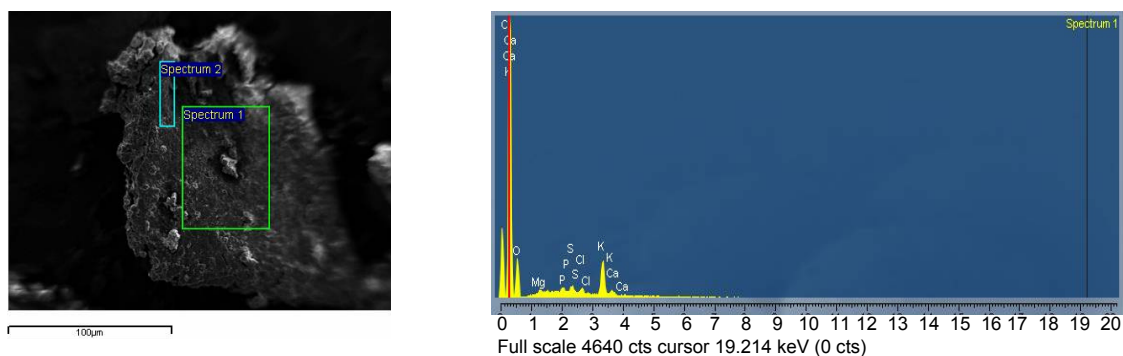


Fig 7. SEM-EDS of Capsicum Annum.

ICP-AES

Maximum amount of aluminium was observed in Punica Granatum (0.44%). All the other samples showed very low quantities of aluminium ranging from 0.005 - 0.081%. Copper and zinc are present at the level of triple fraction in all the samples except Punica Granatum which has 0.034% of zinc. Maximum concentration of iron was observed in Punica Granatum (0.41%) also. Comparatively higher concentrations of magnesium were present in almost all the samples with

a maximum value of 0.76% in Curcuma Longa. Manganese concentration was observed distributed randomly in different samples with maximum value of 0.035% in Cinnamomum Iners. Only Curcuma Zedoaria shows 0.007% nickel.

CONCLUSION

Concentration of potassium, calcium and magnesium have been found comparatively higher than aluminum, copper,

iron, manganese, silicon, and zinc. Phosphorous and sulphur were only present in *Capsicum Annum*. *Curcuma Zedoaria* has 0.007% nickel.

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