VN0500019

VAEC-AR 03--10

APPLICATION OF ATOMIC ABSORPTION SPECTROPHOTOMETRY TO DETERMINE Cd, Cu, Pb, Zn, ... IN VEGETABLE SAMPLES IN DALAT

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ABSTRACT: Nowadays atomic absorption spectrometry has become valuable method for trace element analysis because high specificity; low detection litmus, easy to use; easy sample preparation, low investment and running costs... atomic absorption spectrometry is generally accepted as one the most suitable method for single – element analysis of trace elements in various kinds of materiel. In 2003, we applied flame - atomic absorption spectrometry for analyzing Ca, Cd, Cu, Pb, Zn... in vegetables and their extracted juices were collected form 11 locations of Dalat, including two kinds of vegetables (goods and safety) in both the summer and winter. Average concentration of Ca = 240 mg/kg wet, Cd = 0.035 mg/kg wet, Cu = 0.67 mg/kg wet, Mg = 131 mg/kg wet, Fe = 8.1 mg/kg wet, Mn = 3.1 mg/kgwet, Na = 3266 mg/kg wet, Pb = 0.345 mg/kg wet and Zn = 3.3mg/kgwet. In their extracted juices: Ca = 89 mg/kg wet, Cd = 0.008 mg/kg wet, Cu = 0.19 mg/kg wet, Mg = 43 mg/kg wet, Fe = 2.3 mg/kg wet, Mn = 0.61 mg/kgwet, Na = 971 mg/kg wet, Pb = 0.107 mg/kg wet and Zn = 0.65mg/kgwet.

INTRODUCTION

The concept of atomic absorption spectrometry (AAS) was proposed by Walsh in 1955. Walsh used hollow – cathode lamp as excitation source and combustion flame as atomizer. During the 1960s alternative atomization methods were developed. His idea was to present the analyze as an atomic vapor and to pass radiation of right wavelength to excite atoms from the ground state to an excited electronic level.

Nowadays atomic absorption spectrometry has become valuable method for trace element analysis because high specificity; low detection litmus, easy to use; easy sample preparation, low investment and running costs... atomic absorption spectrometry is generally accepted as one the most suitable method for single – element analysis of trace elements in various kinds of materiel. In this report, we applied atomic absorption spectrometry for analyzing Ca, Cd, Cu, Pb, Zn... in vegetable and their extracted juices

EXPERIMENTS

1. Apparatus:

- Atomic Absorption Spectrophotometer system connected to computer.
- Balance, micropipette, glassware, glass beakers. etc.

2. Reagents:

- All chemicals used were of analytical grade. Deionized water was obtained by processing distilled water in an ion exchange unit
- Hydrochloric acid (density 1.12 g/cc), Nitric acid (density 1.4 g/cc) Sulphuric acid (density 1.84 g/cc) etc.
- Standard Reference Material (SRM) Orchard Leaves 1571 and Pine Needle 1575 were obtained from the National Institute of Standards and Technology

(NIST) and used for quality control. Single-element solutions standards (1000 μg ml^{-1}) of lead, calcium and zinc were obtained from Spex CertiPrep, Inc. (Metuchen, NJ, USA).and Merck (Germany)

- All equipments used for sampling and storing were washed with soap and water, treated with dilute nitric acid and then thoroughly rinsed with deionized water.

3. Sample collection and preparation

More than 60 samples of 20 kinds of categories were collected from 11 locations of Dalat city. After being cleaned, the samples were dried at 60°C until the dried weight reached a constant value.

4. AAS method for determing Cd, Pb

Quantitive weight of 3-4 gram of each sample and Quantitative transfer the samples in different Soxhlet extractive system, add 10 ml nitric acid (density 1.4 g/cc) and 1 ml sulphuric acid (density 1.84 g/cc). Then the samples were soaked in acid for 20 minutes and digested on a hot plate using slow heating until the solution became clear. Generally it took 2-3 days for complete digestion then heated until dryness. Add 2 ml HNO_3 (1:1). Solution were transferred to 10ml measuring flask and diluted with water to make 10 ml

5. AAS method for determing Ca, Fe, Mn...

Quantitive weight of 1 gram of each sample were placed in 250ml beaker and dissolved in 5 ml nitric acid (density 1.4 g/cc), 5 ml chloric acid (density 1.17 g/cc) and 0.5ml H_2O_2. Then the samples were soaked in acid for 20 minutes and digested on a hot plate using slow heating until the solution became clear. Generally it took 8-10 hours for complete digestion then heated until dryness. Add 4 ml HNO_3 (1:1). Solution were transferred to 25 ml measuring flask and diluted with water to make 25 ml

Table 1: Mean concentration of Ca, Cd and Cu in vegetables and their extracted juices

	Tên mẫu	Ca		Cd		Cu	
		A	B	A	B	A	B
01	Mustard	316	144	0.024	0.006	0.22	0.074
02	Field cabbage	329	136	0.029	0.010	0.43	0.218
03	Cabbage	369	141	0.035	0.006	0.34	0.134
04	Chi. Cabbage	180	71	0.030	0.007	0.59	0.211
05	Salad	164	71	0.035	0.010	0.84	0.227
06	Corol	130	62	0.024	0.008	0.56	0.231
07	Spinach	731	324	0.026	0.012	0.59	0.228
08	Broccoli	333	108	0.055	0.011	0.86	0.117
09	Cauliflower	258	76	0.044	0.009	0.53	0.102

10	Watercress	264	122	0.033	0.012	1.28	0.419
11	Tomatoes	81	37	0.025	0.007	0.35	0.166
12	French bean	68	19	0.041	0.008	0.74	0.175
13	Green peas	63	16	0.037	0.011	0.98	0.333
14	Carrot	356	77	0.025	0.003	0.75	0.099
15	Tomatoes	124	16	0.048	0.006	0.58	0.065
16	beetroot	72	8	0.048	0.007	1.15	0.207
	Total mean	240	89	0.035	0.008	0.67	0.19

Table 2: Mean concentration of Fe, Mg and Mn in vegetable samples and their extracted juices

	Tên mẫu	Fe		Mg		Mn	
		A	B	A	B	A	B
01	Mustard	6.4	3.0	130	56	1.9	0.61
02	Field cabbage	9.3	4.8	200	75	3.4	0.63
03	Cabbage	11.2	4.2	148	58	3.2	0.71
04	Chi. Cabbage	10.4	1.2	169	67	2.2	0.68
05	Salad	4.5	1.9	102	41	3.4	0.70
06	Corol	5.2	1.5	76	32	3.6	0.82
07	Spinach	9.2	4.1	309	126	3.2	1.22
08	Broccoli	7.2	2.0	137	40	2.9	0.42
09	Cauliflower	6.5	1.5	91	24	2.2	0.34
10	Watercress	5.0	2.3	139	59	2.5	1.01
11	Tomatoes	4.9	2.4	87	36	1.1	0.41
12	French bean	6.4	1.6	51	12	9.1	0.92
13	Green peas	7.6	2.3	60	15	3.7	0.53
14	Carrot	12.0	2.3	202	24	1.8	0.12
15	Tomatoes	13.6	1.2	120	16	2.5	0.21
16	Beetroot	9.6	0.6	70	9	2.4	0.43
	Total mean	8.1	2.3	131	43	3.1	0.61

Table 3: Mean concentration of Na, Pb and Zn in vegetable samples and their extracted juices

	Tên mẫu	Na		Pb		Zn	
		A	B	A	B	A	B
01	Mustard	1413	575	0.382	0.152	2.2	0.52
02	Field cabbage	2067	891	0.585	0.205	2.8	0.74
03	Cabbage	3113	1269	0.433	0.159	1.7	0.35
04	Chi. Cabbage	2665	1119	0.495	0.183	2.6	0.59
05	Salad	2947	705	0.297	0.112	2.6	0.72
06	Corol	3069	1304	0.222	0.088	2.2	0.61
07	Spinach	5436	2301	0.444	0.178	2.4	1.08
08	Broccoli	3821	1079	0.401	0.109	4.8	0.87
09	Cauliflower	3685	764	0.266	0.067	4.3	0.76
10	Watercress	2380	1004	0.407	0.161	3.5	0.98
11	Tomatoes	1934	779	0.255	0.099	3.0	0.48
12	French bean	3747	794	0.149	0.034	3.8	0.76
13	Green peas	3311	843	0.175	0.041	3.9	0.91
14	Carrot	4231	985	0.591	0.065	2.6	0.25
15	Tomatoes	4242	654	0.350	0.043	5.1	0.52
16	beetroot	4202	470	0.205	0.024	4.7	0.59
	Total mean	3266	971	0.345	0.107	3.3	0.65

CONCLUSIONS

1. Atomic absorption spectrophotometry has become a valuable method for determination of trace –minor elements in vegetable samples. Precision and accuracy can be kept within 10-15%.
2. The concentration of Cd, Cu, Pb and Zn in vegetable samples which collected from Dalat is lower respective permissible limits according to Vietnam standard.

REFERENCES

1. STURGEON R. E. Future of Atomic Spectrometry for Environmental Analysis. J. Anal. At. Spectrom. 13, 351 - 361 (1998).

2. USERS MANUAL. CHEMITO - AA203. Atomic Absorption Spectrophotometer. Toshniwal instruments (India) limited (1994)
3. INSTRUCTION MANUAL. CHEMITO - AA203. Atomic Absorption Spectrophotometer. Toshniwal instruments (India) limited (1994)
4. SERVICE MANUAL. CHEMITO - AA203. Atomic Absorption Spectrophotometer. Toshniwal instruments (India) limited (1994)
5. WASH. A. The application of atomic absorption spectra to chemical analysis. Spectrochim. Acta, 7, (1955), p.p 108 –117.
6. WASH A. The development of the atomic absorption spectrophotometer. Spectrochim. Acta, part B54., (1999), p.p 43-52.