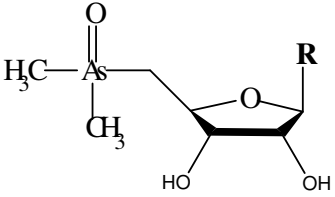
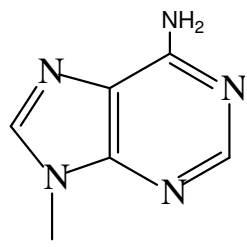
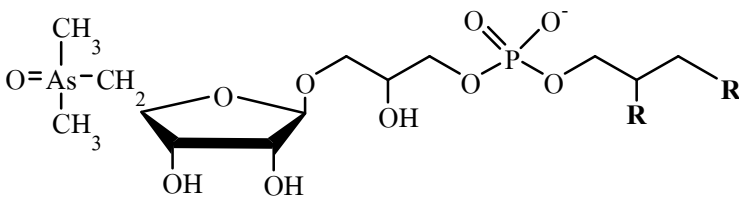


## APPENDIX A

## Appendix A-1 List of arsenic species characterized from biological tissues

No.	Name (IUPAC or common)	Formula
1	Arsenous acid (arsenite)	$\text{OH-As(OH)}_2$
2	Arsenic acid (arsenate)	$\text{O=As(OH)}_3$
3	Monomethylarsenic acid	$\text{CH}_3\text{AsO(OH)}_2$
4	Dimethylarsenic acid	$(\text{CH}_3)_2\text{AsO(OH)}$
5	Trimethylarsenic oxide	$(\text{CH}_3)_3\text{AsO}$
6	Tetramethylarsonium ion	$(\text{CH}_3)_4\text{As}^+$
7	Arsenobetaine	$(\text{CH}_3)_3\text{As-CH}_2\text{-COOH}$
8	Trimethyl (2-carboxyethyl) arsonium inner salt	$(\text{CH}_3)_3\text{As-CH}_2\text{-CH}_2\text{-COOH}$
9	Arsenocholine	$(\text{CH}_3)_3\text{As-CH}_2\text{-CH}_2\text{-OH}$
10	Dimethyloxarsylethanol	$(\text{CH}_3)_2\text{AsO-CH}_2\text{-CH}_2\text{-OH}$
11	Dimethylarsinylacetic acid	$(\text{CH}_3)_2\text{AsO-CH}_2\text{-CH}_2\text{-COOH}$
12	N-[4-dimethyl-arsinoyl] taurine	$(\text{CH}_3)_2\text{AsO(CH}_2)_3\text{CONH(CH}_2)_2\text{SO}_3\text{H}$
13	5-dimethylarsinoyl 2,3,4-trihydroxy pentanoic acid	$(\text{CH}_3)_2\text{AsOCH}_2(\text{CHOH})_3\text{COOH}$
14	5-dimethylarsinoyl 2,3-dihydroxy pentanoic acid	$(\text{CH}_3)_2\text{AsO(CH}_2)_2(\text{CHOH})_2\text{COOH}$
15	4-dimethylarsinoyl-2,3-dihydroxy butanoic acid	$(\text{CH}_3)_2\text{AsOCH}_2(\text{CHOH})_2\text{COOH}$
	<b>Dimethyl arsenoyl riboside (Arseno-sugar):</b>	 <p style="text-align: center;"><b>R=</b></p>
16	5-dimethylarsenoyl- $\beta$ -ribofuranose	H
17	5-dimethylarsenoyl- $\beta$ -ribofuranosol	OH
18	3-[5'-deoxy-5'-(dimethylarsenoyl)- $\beta$ -ribofuranosyloxy]-2-hydroxypropane sulphonic acid	$\text{OCH}_2\text{CHOHCH}_2\text{SO}_3\text{H}$
19	3-[5'-deoxy-5'-(dimethylarsenoyl)- $\beta$ -ribofuranosyloxy]-2-hydroxypropyleneglycol	$\text{OCH}_2\text{CHOHCH}_2\text{OH}$
20	3-[5'-deoxy-5'-(dimethylarsenoyl)- $\beta$ -ribofuranosyloxy]-2-hydroxypropyl hydrogen sulfate	$\text{OCH}_2\text{CHOHCH}_2\text{OSO}_3\text{H}$

No.	Name (IUPAC or common)	Formula
21	2-amino-3-[5'-deoxy-(5'-dimethylarsenoyl)-ribose] propane-1-sulphonic acid	$\text{OCH}_2\text{CHNH}_2\text{CH}_2\text{SO}_3\text{H}$
22	Methyl 5-deoxy-5-(dimethylarsenoyl)- $\beta$ -D-ribose	$\text{OCH}_3$
23	3-[5'-deoxy-5-(dimethylarsenoyl)- $\beta$ -ribofuranosyloxy]-2-acetic acid	$\text{OCH}_2\text{COOH}$
24	N-[5'-deoxy-5'-dimethylarsenoyl]- $\beta$ -ribose]oxycarbonyl] glycine	$\text{OCONHCH}_2\text{COOH}$
25	3-[5'-deoxy-5'-dimethylarsenoyl)- $\beta$ -ribofuranosyloxy]-2-hydroxypropanoic acid	$\text{OCH}_2\text{CHOHCOOH}$
26	Dimethylarsinyladenosine	
27	Arsenolipid	 <p style="text-align: center;"><math>\text{R} = \text{OCO}(\text{CH}_2)_{14}\text{CH}_3</math></p>

Source: Mcsheehy *et al.*, 2003

## APPENDIX B

### Appendix B-1 The lists of chemicals used

Chemicals	Sources
Argon gas (Ar) , High purity 99.999%	TIG, Thailand
Arsenic trioxide (As <sub>2</sub> O <sub>3</sub> )	Fluka, Switzerland
Arsenic pentaoxide (As <sub>2</sub> O <sub>5</sub> )	Riedel-deltaen, Germany
Ascorbic acid	Analytical Carlo ERBA, Milano
Cupric chloride (CuCl <sub>2</sub> )	Univar, Australia
Hydrochloric acid (HCl)	Lab-scan, Thailand
Hydrofluoric acid (HF)	Lab-scan, Thailand
Nitric acid (HNO <sub>3</sub> ) 69-70% w/v, AR grade	J.T. Baker, USA
Nitrogen gas (N <sub>2</sub> )	TIG, Thailand
Potassium iodide (KI)	J.T. Baker, USA
Perchloric acid (HClO <sub>4</sub> )	Panreac, (Barcelona), Espana
Sodium hydroxide (NaOH)	Merck, Germany
Sodium borohydride (NaBH <sub>4</sub> )	LabChem, Australia
Sodium thiosulfate (Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> )	Univar, Australia
Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> )	Lab-scan, Thailand
Virginia Tobacco Leaves (CTA-VTL-2)	Promochem Sp.zo.o, Poland

**Appendix B-2** The details of chemical preparations**Arsenite (As<sup>III</sup>) standard**

A 1000 mg l<sup>-1</sup> stock solutions was made up by the dissolution of 1.3203 g of reagent grade As<sub>2</sub>O<sub>3</sub> in 25 ml of 20% (m/v) sodium hydroxide solution, followed by neutralization with 20% (v/v) sulfuric acid and diluting to 1000 ml with 1% (v/v) sulfuric acid (Coelho *et al.*, 2002).

**Arsenite (As<sup>V</sup>) standard**

To prepare a 1000 mg l<sup>-1</sup> stock solutions, 4.16 g of reagent grade As<sub>2</sub>O<sub>5</sub> is dissolved in 1000 ml of de-ionized water (Coelho *et al.*, 2002).

**NaBH<sub>4</sub> solutions**

NaBH<sub>4</sub> solutions were prepared daily by dissolving appropriate amounts of powdered NaBH<sub>4</sub> in 0.1% (m/v) sodium hydroxide (Frank *et al.*, 2005).

**HCl solutions**

Solutions of HCl were prepared by adequate dilution of concentrated HCl (37% v/v) in de-ionized water (Coelho *et al.*, 2002).

**Preparation of calibration curve for FIAS 100-AAAnalyst 800**

The calibration curve of As<sup>III</sup> detection was performed at 2, 4, 6 and 8 μg l<sup>-1</sup> by diluting 0.2, 0.4, 0.6 and 0.8 ml of arsenite stock solution (100 μg l<sup>-1</sup>) to 10 ml with 5% v/v HCl.

The calibration curve of total arsenic detection was performed at 2, 4, 6 and 8 μg l<sup>-1</sup> by mixing 0.2, 0.4, 0.6 and 0.8 ml of arsenate stock solution (100 μg l<sup>-1</sup>) with 1 ml conc. HCl and 1 ml of 3% w/v KI/ascorbic acid. After 45 min, it was diluted to 10 ml with 5% v/v HCl.

## APPENDIX C

**Appendix C-1** Sampling point identified by using the global positioning system (GPS)

Villages/Points	Lemongrass		Turmeric	
	Longitude (X)	Latitude (Y)	Longitude (X)	Latitude (Y)
M.1/1	595027	904135	595706	904196
M.1/2	595065	904156	595801	904201
M.1/3	595050	903977	595582	904197
M.1/4	596094	904165	596108	904152
M.1/5	596172	904074	596382	904407
M.2/1	593377	904431	593394	904165
M.2/2	592827	904135	592865	904156
M.2/3	592830	904174	592840	904160
M.2/4	592471	904698	592522	904799
M.2/5	593612	905836	593615	905835
M.13/1	594754	903795	596047	903101
M.13/2	595282	903291	595623	902913
M.13/3	596340	903281	595228	903095
M.13/4	596120	903125	594974	903266
M.13/5	595240	903097	595480	902968

**Appendix C-2** Water content in Lemongrass and Turmeric

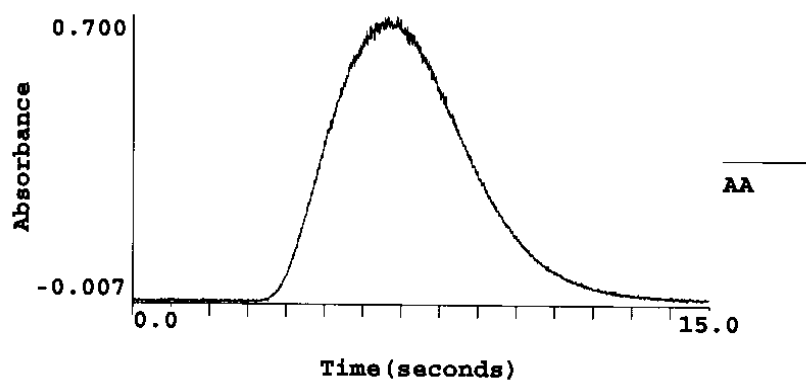
Villages/Points	Lemongrass			
	Wet weight (g)	Dry weight (g)	Water content (g)	% moisture
M.1/1	330	52.04	277.96	84.23
M.1/2	360	48.39	311.61	86.23
M.1/3	330	47.78	282.22	85.52
M.1/4	215	25.12	189.88	88.32
M.1/5	350	39.01	310.99	88.85
M.2/1	275	37.86	237.14	86.23
M.2/2	245	32.91	212.09	86.57
M.2/3	265	40.65	224.35	84.66
M.2/4	320	32.99	287.01	89.69
M.2/5	315	49.76	265.24	84.20
M.13/1	280	38.34	240.66	85.95
M.13/2	250	34.37	215.63	86.25
M.13/3	360	51.40	308.56	85.72
M.13/4	360	49.53	305.47	86.05
M.13/5	300	39.94	260.06	86.69
	Turmeric			
M.1/1	225	27.70	197.30	87.69
M.1/2	360	37.40	322.60	89.61
M.1/3	330	34.89	295.11	89.43
M.1/4	345	31.00	314.00	91.01
M.1/5	290	27.34	262.66	90.57
M.2/1	380	38.90	341.10	89.76
M.2/2	285	35.35	249.65	87.60
M.2/3	300	33.23	266.77	88.92
M.2/4	450	44.30	405.70	90.16
M.2/5	470	52.48	417.52	88.83

**Appendix C-2 (Continued)**

<b>Villages/Points</b>	<b>Turmeric</b>			
	Wet weight (g)	Dry weight (g)	Water content (g)	% moisture
M.13/1	240	34.40	205.60	85.67
M.13/2	300	35.31	264.69	88.23
M.13/3	300	35.24	264.76	88.25
M.13/4	280	47.02	232.98	83.21
M.13/5	175	27.98	147.02	84.01

## APPENDIX D

Appendix D-1 The typical peak of  $10 \mu\text{g l}^{-1} \text{As}^{\text{III}}$  standard solution.



Appendix D-2 The certified values for CRM (Virginia Tobacco Leaves; CTA-VTL-2)

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### CTA-VTL-2 Virginia Tobacco Leaves

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Produced in Poland from Virginia Tobacco leaves grown in Bulgaria and air dried before processing.

Certified values for

As ..... $0.969 \mu\text{g g}^{-1}$	Fe ..... $1083 \mu\text{g g}^{-1}$	Pb ..... $22.1 \mu\text{g g}^{-1}$
Ba ..... $42.7 \mu\text{g g}^{-1}$	Hf ..... $0.118 \mu\text{g g}^{-1}$	Rb ..... $48.6 \mu\text{g g}^{-1}$
Br ..... $14.3 \mu\text{g g}^{-1}$	Hg ..... $0.048 \mu\text{g g}^{-1}$	Sb ..... $0.312 \mu\text{g g}^{-1}$
Ca ..... $3.6 \text{ wt.}\%$	K ..... $1.03 \text{ wt.}\%$	Sm ..... $0.257 \mu\text{g g}^{-1}$
Cd ..... $1.52 \mu\text{g g}^{-1}$	La ..... $1.01 \mu\text{g g}^{-1}$	Sr ..... $110 \mu\text{g g}^{-1}$
Ce ..... $1.91 \mu\text{g g}^{-1}$	Li ..... $23.0 \mu\text{g g}^{-1}$	Tb ..... $0.022 \mu\text{g g}^{-1}$
Cl ..... $0.743 \text{ wt.}\%$	Mg ..... $0.510 \text{ wt.}\%$	Th ..... $0.378 \mu\text{g g}^{-1}$
Co ..... $0.529 \mu\text{g g}^{-1}$	Mn ..... $79.7 \mu\text{g g}^{-1}$	U ..... $0.163 \mu\text{g g}^{-1}$
Cr ..... $1.87 \mu\text{g g}^{-1}$	Mo ..... $2.01 \mu\text{g g}^{-1}$	V ..... $4.00 \mu\text{g g}^{-1}$
Cs ..... $0.515 \mu\text{g g}^{-1}$	Ni ..... $1.98 \mu\text{g g}^{-1}$	W ..... $0.233 \mu\text{g g}^{-1}$
Cu ..... $18.2 \mu\text{g g}^{-1}$	P ..... $2204 \mu\text{g g}^{-1}$	Zn ..... $43.3 \mu\text{g g}^{-1}$

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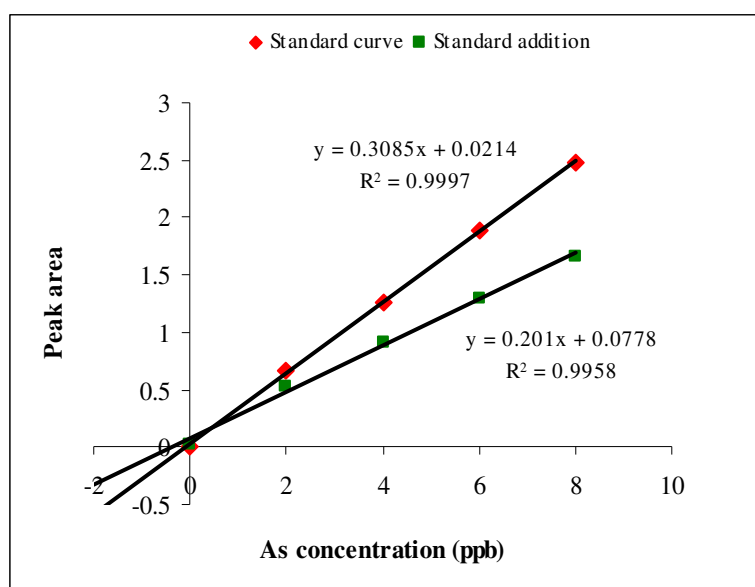


**Appendix D-3** The comparison between external calibration and standard addition method  
(FI-HG-AAS)

Std conc. ( $\mu\text{g l}^{-1}$ )	External calibration (peak area)					
	Replicate1	Replicate2	Replicate3	Average	STDV	%RSD
0	0.000	0.000	0.000	0.000	0.000	0.0
2	0.662	0.665	0.660	0.662	0.003	0.4
4	1.260	1.255	1.265	1.260	0.005	0.4
6	1.861	1.888	1.884	1.878	0.015	0.8
8	2.476	2.480	2.474	2.477	0.003	0.1

Std conc. ( $\mu\text{g l}^{-1}$ )	Standard addition (peak area)					
	Replicate1	Replicate2	Replicate3	Average	STDV	%RSD
0	0.027	0.028	0.024	0.026	0.002	7.9
2	0.521	0.524	0.530	0.525	0.005	0.9
4	0.904	0.917	0.922	0.914	0.009	1.0
6	1.280	1.290	1.300	1.290	0.010	0.8
8	1.640	1.648	1.670	1.652	0.015	0.9



## Group Statistics

FI-HG-AAS	Slope Mean	N	Std. Deviation	Std. Error Mean
Standard curve	0.308	3	0.001	0.001
Standard addition	0.201	3	0.002	0.001

Independent Samples Test (*t*-test,  $P < 0.05$ )

FI-HG-AAS	t-test for Equality of Means				
	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
	Lower	Upper			
Std. curve & Std. addition	0.104	0.111	87.504	4	0.000

**Appendix D-4** Concentrations of total arsenic and arsenic species in edible terrestrial plantsCollected from a vegetable market in Beijing, China (as  $\mu\text{g g}^{-1}$  dry weight)

Vegetable	As <sup>III</sup>	As <sup>V</sup>	MMA	DMA	Sum of As species	Total arsenic
Potato	0.009	0.013	ND <sup>a</sup>	ND	0.022	0.033
Sweet potato	0.005	0.034	ND	ND	0.039	0.062
Carrot	0.065	0.083	ND	ND	0.148	0.217
Radish	0.085	0.055	ND	ND	0.140	0.203
Taro	0.091	0.047	ND	ND	0.138	0.212
Onion	0.006	0.036	ND	ND	0.042	0.059
Garlic	0.006	0.027	ND	ND	0.033	0.047
Cauliflower	0.024	0.036	ND	ND	0.060	0.097
Broccoli	0.017	0.030	ND	ND	0.047	0.062
Cabbage	0.007	0.032	ND	ND	0.039	0.068
Chinese cabbage	0.037	0.059	ND	ND	0.096	0.132
Celery	0.006	0.022	ND	ND	0.028	0.036
Lettuce	0.045	0.065	ND	ND	0.110	0.139
Ginger	0.004	0.048	ND	ND	0.052	0.078
Tomato	0.006	0.012	ND	ND	0.018	0.029
Cucumber	0.016	0.026	ND	ND	0.042	0.077
Eggplant	0.060	0.072	ND	ND	0.132	0.186
Spinach	0.022	0.061	ND	ND	0.083	0.114

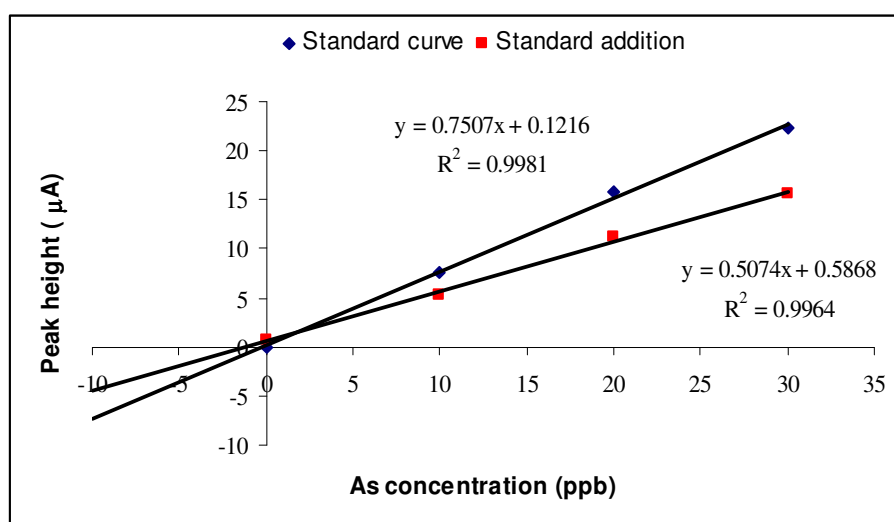
<sup>a</sup>ND: Not detected.Source: Zhao *et al.*, 2006

**Appendix D-5** The comparison between external calibration and standard addition method  
(SWCSV)

Std conc. ( $\mu\text{g l}^{-1}$ )	External calibration (peak height; $\mu\text{A}$ )					
	Replicate1	Replicate2	Replicate3	Average	STDV	%RSD
0	0.000	0.000	0.000	0.000	0.000	0.0
10	7.573	7.580	7.357	7.503	0.127	1.7
20	15.829	15.580	15.842	15.750	0.148	0.9
30	21.971	21.886	22.273	22.043	0.203	0.9

Std conc. ( $\mu\text{g l}^{-1}$ )	Standard addition (peak height; $\mu\text{A}$ )					
	Replicate1	Replicate2	Replicate3	Average	STDV	%RSD
0	0.625	0.702	0.622	0.650	0.045	7.0
10	5.431	5.439	5.043	5.304	0.226	4.0
20	11.606	11.043	11.132	11.260	0.303	3.0
30	15.223	15.131	15.579	15.311	0.237	2.0



## Group Statistics

SWCSV	Slope Mean	N	Std. Deviation	Std. Error Mean
Standard curve	0.744	3	0.008	0.005
Standard addition	0.499	3	0.010	0.006

Independent Samples Test (*t*-test,  $P < 0.05$ )

SWCSV	t-test for Equality of Means				
	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
	Lower	Upper			
Std. curve & Std. addition	0.223	0.266	31.757	4	0.000

**Appendix D-6** Statistical evaluations for total acid-digested As determination in edible plant samples by FI-HG-AAS and SWCSV

Group Statistics

Lemon grass	Method	Slope Mean	N	Std. Deviation	Std. Error Mean
M1/1	I <sup>a</sup>	0.239	3	0.023	0.013
	II <sup>b</sup>	0.351	3	0.025	0.014
M1/2	I	0.227	3	0.002	0.001
	II	0.289	3	0.030	0.017
M1/3	I	0.317	3	0.010	0.006
	II	0.294	3	0.035	0.020
M1/4	I	0.303	3	0.005	0.003
	II	0.333	3	0.038	0.022
M1/5	I	0.247	3	0.000	0.000
	II	0.341	3	0.005	0.003
M2/1	I	0.381	3	0.008	0.005
	II	0.348	3	0.021	0.012
M2/2	I	0.231	3	0.007	0.004
	II	0.152	3	0.002	0.001
M2/3	I	0.301	3	0.006	0.003
	II	0.331	3	0.002	0.001
M2/4	I	0.975	3	0.009	0.005
	II	1.078	3	0.032	0.018
M2/5	I	0.466	3	0.008	0.005
	II	0.437	3	0.034	0.019
M13/1	I	0.340	3	0.007	0.004
	II	0.368	3	0.011	0.006
M13/2	I	0.281	3	0.007	0.004
	II	0.258	3	0.004	0.002

<sup>a</sup> FI-HG-AAS method, <sup>b</sup> SWCSV

Lemon grass	Method	Slope Mean	N	Std. Deviation	Std. Error Mean
M13/3	I <sup>a</sup>	0.148	3	0.005	0.003
	II <sup>b</sup>	0.108	3	0.002	0.001
M13/4	I	0.175	3	0.008	0.005
	II	0.194	3	0.002	0.001
M13/5	I	0.200	3	0.004	0.002
	II	0.190	3	0.002	0.001
Turmeric	Method	Slope Mean	N	Std. Deviation	Std. Error Mean
M1/1	I	0.608	3	0.017	0.010
	II	0.528	3	0.001	0.001
M1/2	I	0.369	3	0.012	0.007
	II	0.341	3	0.018	0.010
M1/3	I	0.289	3	0.017	0.010
	II	0.334	3	0.001	0.001
M1/4	I	0.621	3	0.005	0.003
	II	0.633	3	0.023	0.013
M1/5	I	0.660	3	0.022	0.013
	II	0.648	3	0.013	0.007
M2/1	I	0.468	3	0.011	0.007
	II	0.483	3	0.032	0.018
M2/2	I	0.998	3	0.006	0.004
	II	0.908	3	0.058	0.034
M2/3	I	0.562	3	0.019	0.011
	II	0.566	3	0.006	0.004
M2/4	I	0.558	3	0.003	0.002
	II	0.556	3	0.012	0.007
M2/5	I	1.383	3	0.008	0.005
	II	1.607	3	0.039	0.023
M13/1	I	0.497	3	0.014	0.008
	II	0.454	3	0.022	0.013

Turmeric	Method	Slope Mean	N	Std. Deviation	Std. Error Mean
M13/2	I <sup>a</sup>	1.077	3	0.010	0.006
	II <sup>b</sup>	1.181	3	0.116	0.067
M13/3	I	0.590	3	0.006	0.004
	II	0.570	3	0.013	0.008
M13/4	I	0.397	3	0.004	0.002
	II	0.375	3	0.010	0.006
M13/5	I	1.873	3	0.005	0.003
	II	1.931	3	0.189	0.109

<sup>a</sup> FI-HG-AAS method, <sup>b</sup> SWCSV

Independent Samples Test (*t*-test,  $P < 0.05$ )

FI-HG-AAS & SWCSV (Lemon grass)	t-test for Equality of Means				
	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
	Lower	Upper			
M1/1	-0.166	-0.058	-5.780	4	0.004
M1/2	-0.110	-0.013	-3.552	4	0.070*
M1/3	-0.037	0.081	1.049	4	0.354*
M1/4	-0.091	0.032	-1.339	4	0.252*
M1/5	-0.102	-0.086	-33.123	4	0.000
M2/1	-0.004	0.069	2.497	4	0.067*
M2/2	0.067	0.091	18.855	4	0.000
M2/3	-0.039	-0.020	-8.900	4	0.001
M2/4	-0.156	-0.050	-5.416	4	0.006
M2/5	-0.027	0.084	1.434	4	0.225*
M13/1	-0.048	-0.007	-3.773	4	0.020
M13/2	0.009	0.037	4.706	4	0.009



M13/3	0.032	0.048	14.241	4	0.000
M13/4	-0.033	-0.006	-4.051	4	0.015
M13/5	0.003	0.018	3.969	4	0.017
FI-HG-AAS & SWCSV (Turmeric)	t-test for Equality of Means				
	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
	Lower	Upper			
M1/1	0.053	0.108	8.069	4	0.001
M1/2	-0.006	0.062	2.261	4	0.087*
M1/3	-0.072	-0.018	-4.564	4	0.010
M1/4	-0.050	0.026	-0.902	4	0.418*
M1/5	-0.029	0.053	0.791	4	0.473*
M2/1	-0.068	0.039	-.741	4	0.500*
M2/2	-0.004	0.183	2.658	4	0.056*
M2/3	-0.036	0.027	-0.414	4	0.700*
M2/4	-0.017	0.022	0.376	4	0.726*
M2/5	-0.289	-0.160	-9.681	4	0.001
M13/1	0.001	0.084	2.831	4	0.056*
M13/2	-0.290	0.083	-1.536	4	0.199*
M13/3	-0.004	0.043	2.321	4	0.081*
M13/4	0.005	0.038	3.589	4	0.023
M13/5	-0.362	0.245	-0.536	4	0.620*

\* No significant difference