

ICP-MS study on elemental profiling of rice in global markets

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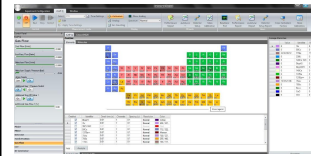
Introduction

- ~ Inorganic arsenic is a class-one, carcinogen whose predominant dietary exposure route to humans is through rice.
- ~ Paddy soil geochemistry readily mobilises inorganic arsenic from natural soil stores, & rice is efficient at capturing this mobilised arsenic
- ~ Regions with more rice in diet are at higher risk
- ~ Children especially susceptible in relation to 3-times higher food consumption rates on a body mass basis

ICP/MS

Thermo Scientific
iCAP Qc
Thermo Dionex IC
5000

- A full scan of elements (25+) analysed
- Pb Isotope analysis
- As species analysis



Full elemental scan

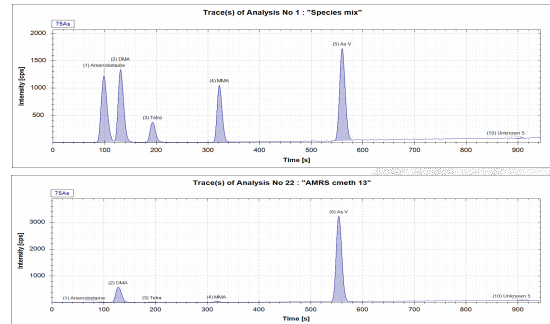
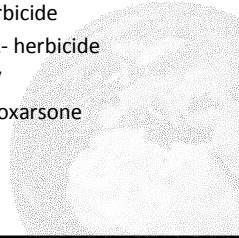
- ~ Nitric acid/Hydrogen Peroxide digestion - Microwave assisted 95°C
- ~ Rhodium as internal standard
- ~ KED (He in collision cell mode) for most elements
- ~ Eight point standard curve for each element [0-100ppb]
- ~ Sub ppb sensitivity for most elements

As species analysis

- ~ Nitric acid extraction- Microwave assisted 95°C
- ~ Ion Chromatography
- ~ KED (He in collision cell mode)
- ~ Five point standard curve [0-5ppb]

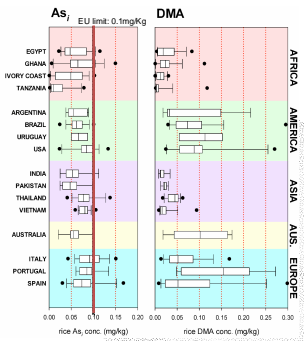
Arsenic species

- “ Arsenobetaine, AB- mainly found in aquatic sources
- “ Dimethylarsinic acid, DMA- herbicide
- “ Monomethylarsenic acid MMA- herbicide
- “ Inorganic arsenic, AsIII and AsV
- “ Others include Tetra, TMAO, Roxarsone

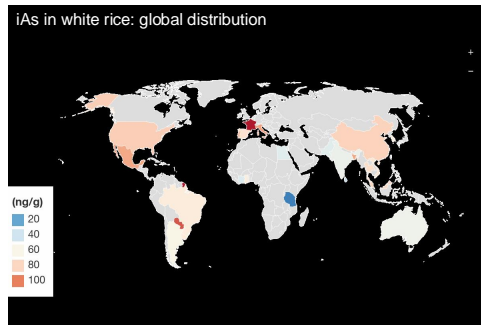


Global Survey:

- “ Many rice growing regions around the world
 - USA
 - Europe
 - ASIA
 - Australia
 - Africa
 - South America
 - Antarctica (not)
- “ 1643 samples so far
- “ Multi analytical approach
 - 1100+ Full elemental scans by ICP/MS
 - 1643 As speciation analyses
 - 1643 Full elemental scans by XRF



iAs in white rice: global distribution



Re-thinking rice cooking:

"percolation technology"



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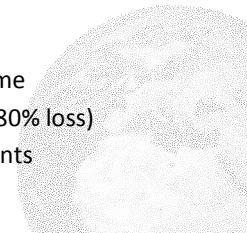
Cereal killers? More than half of rice products including Rice Krispies and Heinz baby rice exceed new EU limits for ARSENIC

- Experts warn some popular rice products contain high levels of arsenic
- Tests found 50% exceeded new recommended arsenic limits for children
- Scientists say high levels over time could lead to cancer or heart disease
- People in Britain consume five times more rice today than 40 years ago

By HELEEN SAYER FOR MAILONLINE

Other As removal techniques

- “ Pre-soaking
- “ Parboiling
- “ Large cooking water volume
- “ Greater loss of iAs (up to 80% loss)
- “ Minor loss of other elements



Quality control: Rice CRM- corrected

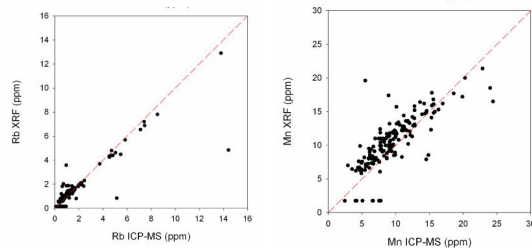
bias correction	2.1432	1.9695		2.4009			
certified	2.35	7.42	1282	559	19.2	1530	19.42
NIST 1568b Rice flour	Cu	Fe	K	Mg	Mn	P	Zn
	ppm	ppm	ppm	ppm	ppm	ppm	ppm
recovery	102.1%	101.7%	82.9%	102.2%	109.1%	86.7%	89.5%
count	150	150	150	150	150	150	150

Comparison to ICP/MS

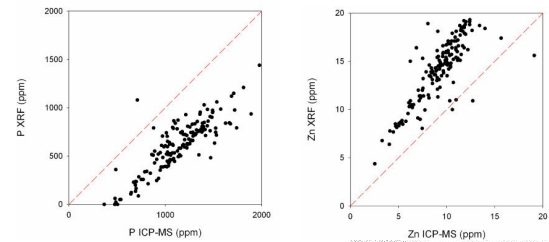
“ Once again CRMs are used in both methods.

- Reproducibility
- Recovery
- Method agreement

Rb and Mn show very good agreement between the two methods across a good range of concentrations



P and Zn show good agreement but P has a negative bias and Zn has a positive bias.



ICP vs XRF plus and minus

“XRF Advantages: speed of analysis, limited or no sample prep, wide range of elemental coverage, cheap, can be hand-held & used in factory/field

“XRF Disadvantages: no external calibration, high LOD- particularly for micro-elements, not well established

“ICP Advantages: very low LOD, very well established, excellent for trace elements, external calibration

“ICP Disadvantages: very expensive, poor for macro-elements, involved sample prep, needs high degree of training

Acknowledgements

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Thank you for your attention

