



Arsenic species in rice and rice-based products consumed by toddlers in Switzerland

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Key words

IC-ICP-MS; arsenic speciation; rice-based baby foods; risk assessment; exposure assessment

Aim of the study

This study was performed to:

- provide a validated analytical method that is capable of assessing all major arsenic species in rice and rice-based products at low limits of quantification;
- perform a survey of arsenic speciation in rice and rice-based products, especially baby foods, on the Swiss market;
- assess the risk for toddlers based on the collected data.

Material and methods

An ion chromatography-inductively coupled-plasma-mass spectroscopy method (IC-ICP-MS) was developed to separate the four following anionic arsenic species: As(III), As(V), MMA(V) and DMA(V). A total of 105 samples of baby foods with rice, rice cereals (flakes and crispies), rice crackers, milk rice, rice drinks and rice grains (white rice, and brown rice) were purchased from grocery stores, drugstores, pharmacies and health food stores, in the Berne area, Switzerland. Samples were prepared under mild acidic conditions to ensure species preservation and were analyzed with the validated method. Data were subjected to exposure assessment and risk assessment.

Results and significance

The concentration of total arsenic was related to the fraction of rice in the product: the more rice the product contained, the more arsenic (expressed as $\mu\text{g As kg}^{-1}$) was found:

Sample	N	Mean	Median	Range
Rice grains – brown	4	205	217	147 – 238
Rice grains – white	27	143	158	6.7 – 281
Baby foods – dry	12	83.2	88.9	13.0 – 138
Baby foods – ready-to-eat	9	14.2	15.5	5.2 – 33.1
Milk rice	6	14.9	12.7	10.9 – 24.9
Rice cereals	7	278	244	65.4 – 630
Rice crackers	25	168	154	46.6 – 361
Rice drinks	15	19.4	21.7	5.2 – 28.0

Predominant arsenic species found in rice and rice-based products, except for rice drinks, was As(III), with 60–80% of the total As content, followed by DMA(V) and As(V). MMA(V) was measured only at low levels (<3%).

It was found that there is little or no margin of exposure. Risk assessment, using the occurrence data and intake scenarios compared to reference benchmark dose lower limits (BMDLs) as established by the European Food Safety Authority (EFSA), demonstrated toddlers with a high consumption of rice based cereals and rice drinks are at risk of high inorganic arsenic exposure, for which a potential health risk cannot be excluded.

Based on the findings of this study, the Federal Food Safety and Veterinary Office issued dietary recommendations regarding rice and rice-based products consumption, in particular targeting risk groups.

Publications, posters and presentations

Guillod-Magnin, R.; Brüscheiler, B. J.; Aubert, R.; Haldimann, M. (2018) Arsenic species in rice and rice-based products consumed by toddlers in Switzerland, Food Additives & Contaminants: Part A, <https://doi.org/10.1080/19440049.2018.1440641>

Federal Food Safety and Veterinary Office (2018) Stoffe im Fokus – Arsen.
<https://www.blv.admin.ch/blv/de/home/lebensmittel-und-ernaehrung/lebensmittelsicherheit/stoffe-im-fokus/arsen.html>

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