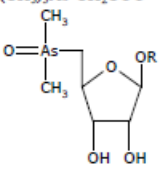
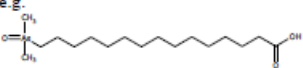


<b>ARSENIC</b>			
Metalloid			
<b>Chemical form</b>			
Table 1: Names, abbreviations, and chemical structures for main arsenic species found in food and some relevant human metabolites (Source : EFSA, 2009).			
Name	Abbreviation	Chemical structure <sup>(a)</sup>	Relevance/comment
Inorganic arsenic	iAs		Sum of As(III) and As(V).
Arsenite	As(III)	As(O) <sub>3</sub>	Trace to low levels in most foods; highly toxic.
Arsenate	As(V)	O=As(O) <sub>3</sub>	Trace to low levels in most foods; a major form in water; highly toxic.
Arsenobetaine Arsenosugars <sup>(b)</sup>	AB	(CH <sub>3</sub> ) <sub>3</sub> As <sup>+</sup> CH <sub>2</sub> COO <sup>-</sup> 	Major arsenic species in most seafoods; non-toxic.  Major (edible algae) or significant (molluscs) arsenic species in many seafoods.
Arsenolipids <sup>(c)</sup>		e.g. 	Newly discovered arsenic species present in fish oils and fatty fish; likely to be present in other seafoods as well.
Trimethylarsonio propionate	TMAP	(CH <sub>3</sub> ) <sub>3</sub> As <sup>+</sup> CH <sub>2</sub> CH <sub>2</sub> COO <sup>-</sup>	Minor arsenic species present in most seafoods.
Methylarsonate	MA	CH <sub>3</sub> AsO(O) <sub>2</sub>	Trace arsenic species of some seafoods and terrestrial foods; a significant human urine metabolite of iAs.
Methylarsonite	MA(III)	CH <sub>3</sub> As(O) <sub>2</sub>	Not usually detected in foods; detected in some human urine samples as a metabolite of iAs; a toxic species thought to be important for arsenic's mode of toxic action.
Dimethylarsinate	DMA	(CH <sub>3</sub> ) <sub>2</sub> AsO(O)	Minor arsenic species in seafoods and some terrestrial foods; the major human urine metabolite of iAs, arsenosugars and arsenolipids.
Thio-dimethylarsinate	Thio-DMA	(CH <sub>3</sub> ) <sub>2</sub> AsS(O)	A minor human urine metabolite of inorganic arsenic and arsenosugars.

### Contamination source

- Natural source

Being an element, arsenic occurs naturally in the earth's crust and it is a constituent of more than 200 mineral species, especially those including sulfide (Boyle and Jonasson, 1973). Concentrations of arsenic in various types of igneous rocks range from <1 to 15 mg/kg, with a mean value of 2 mg/kg. Similar concentrations (<1 to 20 mg/kg) are found in sandstone and limestone. Significantly higher concentrations of arsenic, of up to 900 mg/kg, are found in argillaceous sedimentary rocks including shale, mudstone and slates (EFSA, 2009).

Arsenic occurs naturally in the environment and is present in soil, ground water and plants.

- Anthropogenic sources

Anthropogenic sources of arsenic release to the environment include both industrial emissions, mainly non-ferrous mining and smelting and metal using industry and the production of energy from fossil fuels. Improvements of industrial processes have led to substantial decreases of the emissions of arsenic from the metal industry (EFSA, 2009).

Elemental arsenic has been, and is sometimes still, used as an alloying element in ammunition and solders, as an anti-friction additive to metals used for bearings, and to strengthen lead-acid storage battery grids. High-purity arsenic is used by the electronics industry for gallium-arsenide semiconductors for telecommunications, solar cells, and space research (USGS, 2006).

The main use of arsenic was for the production of wood preservatives, herbicides, and insecticides. In the EU, the use of arsenic substances and constituents in preparations intended to prevent the fouling by microorganisms, plants or animals are regulated in Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)<sup>1</sup>.

<sup>1</sup> Official Journal L 396, 30.12.2006, p. 1-849; (Regulation (EC) No 1907/2006 of The European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC).

Arsenic and arsenic containing compounds have been used as herbicides. Arsenic compounds have a long history in medicine. Organic arsenic antibiotics were extensively used in the treatment of diseases caused by spirochetes and protozoans (NRC, 1999).

#### **Analytical method**

Several analysis methods are available for the measurement of total arsenic and arsenic species in food and biological samples.

For determination of arsenic content in food, the sample preparation usually involves a mineralisation step and often also a derivatisation step (EFSA, 2009). The major categories of instrumental techniques for quantitative analysis are atomic absorption spectroscopy (AAS), atomic fluorescence spectroscopy (AFS), inductively coupled plasma atomic emission spectroscopy (ICP-AES), and inductively coupled plasma mass spectrometry (ICP-MS).

Following mineralisation, hydride generation atomic absorption spectroscopy and inductively coupled mass spectrometry (ICP-MS) are sensitive, reliable and commonly used methods for the determination of total arsenic (EFSA, 2009).

Separation of arsenic species is most commonly achieved by high-performance liquid chromatography (HPLC) (FAO/WHO, 2011). The chromatograph is coupled with a selective detector such as AAS, AFS or ICP-MS. HPLC/ICP-MS is the most common and useful method for the determination of arsenic species in foodstuffs (EFSA, 2009).

Methodological research in the last decade has been targeted to arsenic speciation. Quantitative extraction of arsenic species from food matrices is one of the main methodological problems, and efficiencies vary widely, depending on the nature of the matrix and the method used (FAO/WHO, 2011). There is a current need for validated and horizontal methods for selective extraction and determination of inorganic arsenic and for certified reference materials for inorganic arsenic in foods (FAO/WHO, 2011).

#### **Toxicity**

Each of the forms of arsenic has different physicochemical properties and bioavailability. In humans, soluble inorganic arsenic is rapidly and nearly completely absorbed after ingestion. Absorption of different organic arsenic compounds is generally greater than 70%. After being absorbed, arsenic is widely distributed to almost all organs and readily crosses the placental barrier. Biotransformation of inorganic arsenic in mammals includes reduction of pentavalent arsenic to trivalent arsenic and methylation of trivalent arsenic (EFSA, 2009).

Arsenic toxicity depends on the chemical form and its solubility and varies among animal species and with route of administration. Generally, trivalent arsenic is more toxic than the pentavalent forms (FAO/WHO, 2011).

The main adverse effects reported to be associated with long term ingestion of inorganic arsenic in humans are skin lesions, cancer, developmental toxicity, neurotoxicity, cardiovascular diseases, abnormal glucose metabolism, and diabetes. Neurotoxicity is mainly reported with acute exposure from deliberate poisoning or suicide, or at high concentrations in drinking water. Evidence of cardiovascular disease (Blackfoot disease, peripheral vascular disease, coronary heart disease, myocardial infarction and stroke) and diabetes in areas with relatively low levels of inorganic arsenic exposure is inconclusive. There is emerging evidence of negative impacts on foetal and infant development, particularly reduced birth weight, and there is a need for further evidence regarding the dose-response relationships and critical exposure times for these outcomes (EFSA, 2009).

#### **Acute toxicity**

Acute exposure to arsenic may have deleterious effects on human health. Reports on the acute and subacute exposure show that almost all physiological systems of the body can be affected, the gastro-intestinal, cardiovascular, renal and nervous systems and to a lesser extent, respiratory system, liver, skin and hematologic (system) (EFSA, 2009). ATSDR (2007) reported a lethal dose after acute ingestion of 100-300 mg (1-5 mg arsenic/kg body weight).

#### **Carcinogenicity**

Inorganic arsenic has been evaluated on a number of occasions by the International Agency for

Research on Cancer (IARC). In 1987, IARC has classified inorganic arsenic in group 1 as human carcinogen. In 2010, IARC concluded that arsenic in drinking-water causes cancers of the urinary bladder, lung and skin and that the evidence was “limited” for cancers of the kidney, liver and prostate.

Epidemiological studies have shown that exposure to arsenic through inhalation or drinking-water causes cancer of the lung, skin, and urinary bladder. Evidence suggests an association between exposure to arsenic in drinking water and the development of tumours at several other sites. However, various factors prevent a conclusion: analytical studies have provided only limited information to support an association with kidney cancer, causes of liver cancer can be difficult to elucidate in groups that are high-risk for hepatitis B, and data on prostate cancer and arsenic exposure are not consistent between countries (Straif et al., 2009).

On the basis of sufficient evidence of cancer caused by DMA in experimental animals, and because MMA is extensively metabolised to DMA, both compounds are classified as “possibly carcinogenic to humans” (Group 2B). Arsenobetaine and other organic arsenic compounds that are not metabolised in humans are “not classifiable” (Group 3).

Evidence from a wide range of studies has led to the conclusion that arsenic compounds do not react directly with DNA (FAO/WHO, 2011). Established mechanistic events are oxidative DNA damage, genomic instability, aneuploidy, gene amplification, epigenetic effects and DNA-repair inhibition leading to mutagenesis (Straif et al., 2009).

#### **Establishment of Health Based Reference Values**

The Joint FAO/WHO Expert Committee on Food Additives (JECFA) has established a provisional tolerable weekly intake (PTWI) of 15 µg/kg bw in 1988 (FAO/WHO, 1989).

New data had established that inorganic arsenic causes cancer of the lung and urinary tract in addition to skin, and that a range of adverse effects had been reported at exposures lower than the PTWI. Therefore the CONTAM Panel and the Committee of JECFA concluded that the PTWI of 15 µg/kg bw is no longer appropriate and withdrew it.

The CONTAM Panel modelled the dose-response data from the key epidemiological studies and also noted other reported dose-response modelling results. A benchmark response of 1% extra risk was selected because it could be within the range of the observed data. Because of the uncertainties in the exposure in the key epidemiological studies, the CONTAM Panel identified a range of values for the 95% lower confidence limit of the benchmark dose of 1% extra risk (BMDL<sub>01</sub>) for each endpoint. The lowest BMDL<sub>01</sub> values are for lung cancer. These data are from a study that is relatively small but has the advantage that the population is likely to have a nutritional and genetic background that is more similar to that of EU populations than those of the rural Asian populations, for which most of the epidemiological data are available. The CONTAM panel noted that the association was much stronger in smokers, consistent with inorganic As being a co-carcinogen, and could not determine whether there would be residual confounding after adjustment for smoking. In contrast, the data for skin lesions are from larger populations and show a high degree of consistency between studies. Arsenic exposure is considered to be a necessary but not sufficient cause of dermal lesions and given that the observations of dermal lesions mainly originate from rural Asian communities with high levels of arsenic in the water, it is possible that the findings were influenced by other factors such as nutritional status. The CONTAM Panel therefore concluded that the overall range of BMDL<sub>01</sub> values of 0.3 to 8 µg/kg b.w. per day should be used instead of a single reference point in the risk characterisation for inorganic arsenic (Table 2).

Table 2: Summary of potential reference points for inorganic arsenic (source EFSA, 2009)

Endpoint	Population	Reference point µg/L water	Reference point µg/kg b.w. per day
Dermal lesions	Bangladesh (Ahsan et al., 2006)	BMCL <sub>01</sub> : 23 <sup>(a)</sup>	BMDL <sub>01</sub> : 2.2-5.7 <sup>(b)</sup>
Dermal lesions	Bangladesh (Rahman et al., 2006a)	BMCL <sub>01</sub> : 5 <sup>(a)</sup>	BMDL <sub>01</sub> : 1.2-4.1 <sup>(b)</sup>
Dermal lesions	Mongolia (Xia et al., 2009)	BMCL <sub>01</sub> : 0.3 <sup>(a)</sup>	BMDL <sub>01</sub> : 0.93-3.7 <sup>(b)</sup>
Lung cancer	Chile (Ferreccio et al., 2000)	BMCL <sub>01</sub> : 14 (NRC, 2001)	BMDL <sub>01</sub> : 0.34-0.69 <sup>(c)</sup>
Bladder cancer	North East Taiwan (Chiou et al., 2001)	BMCL <sub>01</sub> : 42 (NRC, 2001)	BMDL <sub>01</sub> : 3.2-7.5 <sup>(b)</sup>
Skin cancer	USA (New Hampshire) (Karagas et al., 2002)	Change point <sup>(d)</sup> : 1-2	Change point: 0.16-0.31 <sup>(c)</sup>
Bladder cancer	USA (New Hampshire) (Karagas et al., 2004)	Change point: <i>ca.</i> 50	Change point: 0.9-1.7 <sup>(c)</sup>

b.w.: body weight; BMCL<sub>01</sub>: 95 % lower confidence limit of the benchmark concentration of 1 % extra risk; BMDL<sub>01</sub>: 95 % lower confidence limit of the benchmark dose of 1 % extra risk

(a): Calculated by CONTAM Panel for this opinion

(b): Extrapolated from the BMCL<sub>01</sub> assuming 3-5 L water and 50-200 µg/day inorganic arsenic in food per day, 55 kg b.w. (see Section 8.4.1.1)

(c): Extrapolated from the BMCL<sub>01</sub> assuming 1-2 L water and 10-20 µg/day inorganic arsenic in food consumed per day, 70 kg b.w. (see Section 8.4.1.1)

(d): The maximum likelihood change point before the trend becomes significant, which provides an indication of a no effect level rather than a BMDL (see Section 8.3.3.1)

The inorganic arsenic lower limit on the benchmark dose for a 0.5% increased incidence of lung cancer (BMDL<sub>0.5</sub>) was determined by the Committee of JECFA from epidemiological studies to be 3.0 µg/kg bw per day (2–7 µg/kg bw per day based on the range of estimated total dietary exposure) using a range of assumptions to estimate total dietary exposure to inorganic arsenic from drinking water and food (FAO/WHO, 2011).

#### Occurrence of arsenic in food

The highest total arsenic levels, measured in 15 European countries were found in following food commodities: fish and seafood, products or supplements based on algae, especially hijiki, and cereal and cereal products, with particularly high concentrations in rice grains and rice-based products as well as in bran and germ (EFSA, 2009).

The proportion of inorganic arsenic in food commodities other than fish and seafood was assumed by EFSA (2009) to vary from 50 to 100% of total arsenic, with 70% considered as best reflecting an overall average.

Concentrations of total arsenic and arsenic species (AsIII, AsV, AsB, MMA, DMA) were measured in 350 food samples collected on the Belgian market as part of the research project SPECAS (2010). The concentrations of total arsenic in marine fish were reported to range from 630 µg/kg (salmon) to 25.1 mg/kg (plaice) and in seafood from 104 µg/kg (scampi) to 16,9 mg/kg (crab). Freshwater fish contain significantly less arsenic than marine fish. The reported range was 30 µg/kg (eel) to 1700 µg/kg (trout). Mussel, shrimp and scampi were the only marine organisms in which inorganic arsenic was present in quantifiable amounts, with concentrations generally in the range 0.005–0.022 mg/kg whole weight (ww) (Ruttens et al., 2012, and the report of the SPECAS project). Overall, less than 1% of inorganic arsenic is present in marine fish and the organic fraction is mainly arsenobetaine (AsB). Marine algae can contain high concentrations of inorganic arsenic (128 – 142 µg/kg ww). Compared to fish, samples of plant origin contain low levels of total arsenic. However, the fraction of inorganic arsenic is higher. Among these samples rice contains the highest concentrations of arsenic, largely present under inorganic form. The report of the SPECAS project reported

concentrations of total arsenic in rice from 17 µg/kg to 250 µg/kg. The fractions of As<sup>III</sup> and As<sup>V</sup> in rice were respectively 64 ± 19% and 20 ± 16%. The other cereals and cereal products contained about 10 times less total As, but almost 100% of it was inorganic. Similarly, in potatoes, vegetables and fruits very low concentrations of arsenic were reported (0.34 – 24.8 µg/kg), with a high proportion of inorganic arsenic. Concentrations up to 25 µg/l of total arsenic were found in wine, of which 75% under inorganic form. Concentrations in other analyzed beverages (sodas, beer, milk) were low (<3.7 µg/L). Arsenic concentrations in meat (beef, pork, chicken, lamb) and meat products were also low (1.1 to 9.5 µg/kg). Food supplements mainly from algae can contain high concentrations of arsenic.

Several other recent studies have shown that rice, including rice-based baby-food, often contains elevated concentrations of arsenic, most of which is in the most toxic inorganic form (Lijung et al., 2011; Meharg et al., 2008, 2009; Signes-Pastor et al., 2008).

Arsenic concentrations in brown rice are higher than in white rice, indicating that arsenic is present in the bran fraction.

Depending on the type of food processing, temperature and time, changes in total arsenic concentration and arsenic species may occur. The arsenic content in cooking water seems to be of special importance because it determines whether the arsenic concentrations in the prepared food may be higher or lower compared to the raw product (EFSA, 2009).

Inorganic arsenic in drinking water may be a high dietary source in some parts of the world.

#### **Dietary exposure assessment**

In Belgium, intake of total arsenic for an adult of 70 kg was estimated to 1,04 µg/kg bw/day (Project SPECAS, 2010). The largest part of the intake was due to intake of arsenobetaine.

Mean intake of total arsenic was 0,91 µg/kg bw/day with the lower bound approach and was 1,19 µg/kg bw/day with the upper bound approach. Mean intake of inorganic arsenic was 0,11 µg/kg bw/day for the adult population in Belgium (Project SPECAS, 2010). Intake of MMA and DMA is negligible (Project SPECAS, 2010).

The national inorganic arsenic exposures from food and water across 19 European countries, using lower bound and upper bound concentrations, have been estimated to range from 0.13 to 0.56 µg/kg body weight (bw) per day for average consumers, and from 0.37 to 1.22 µg/kg bw/day for 95th percentile consumers (EFSA, 2009). The minimum and maximum dietary exposure varied by a factor of 2 to 3 across the 19 European countries, based on different dietary habits rather than different occurrence data (EFSA, 2009).

Exposure estimates of children under three years of age reported in two different studies show an inorganic arsenic intake ranging from 0.50 to 2.66 µg/kg bw/day. Dietary exposure to inorganic arsenic for children under three years old, including from rice-based foods, is in general estimated to be about 2 to 3-fold that of adults. These estimates do not include milk intolerant children substituting rice-drinks for formula of cows' milk (EFSA, 2009).

Children under three years of age are the most exposed to inorganic arsenic

Mean dietary exposure to inorganic arsenic reported in the US and other European and Asian countries range from 0.1 to 3.0 µg/kg bw/day (JECFA, 2010).

According to the research project SPECAS (2010), the food group "potatoes and pasta, including rice" provides the greatest contribution to exposure to inorganic arsenic (3.79 µg/day), followed by the group of beverages (wine) (1.3 µg/day). The group of "fish, crustaceans and bivalves" provides the greatest contribution to exposure to total arsenic (64.1 µg/day) and to AsB (50 µg/day).

The following food subclasses were identified by the CONTAM Panel (EFSA, 2009) as largely contributing to the inorganic arsenic daily exposure in the general European population: cereal grains and cereal based products, followed by food for special dietary uses, bottled water, coffee and beer, rice grains and rice based products, fish and vegetables.

According to the JECFA (2010), drinking water has an important contribution to dietary exposure to inorganic arsenic and depending on the total concentrations may also be a source of arsenic in food,

through the preparation of food and irrigation of crops particularly rice.

### Risk characterization

The Margin of exposure (MOE) approach has been used for risk characterization. The MOE is the ratio between BMDL and the dietary intake. Table 3 present MOE for several dietary arsenic exposure.

The estimated mean dietary exposure to inorganic As in Belgium (0.11 µg/kg bw/day) is below the range of BMDL<sub>01</sub> values for the general adult population. The estimated dietary exposures to inorganic arsenic for average (0.13-0.56 µg/kg bw/day) and high level adult consumers (0.37-1.22 µg/kg bw/day) in Europe are within the range of the BMDL<sub>01</sub> values (0.3-8 µg/kg bw/day) identified by the CONTAM Panel for lung and bladder cancer and for dermal lesions. Therefore there is little or no MOE and the possibility of a risk to some consumers cannot be excluded (EFSA, 2009).

Infants below 6 months of age fed on only breast-milk have very low intakes of inorganic arsenic. Infants fed only on cows' milk formula reconstituted with water containing arsenic at the average European concentration level have intakes of inorganic arsenic that are about 3-fold higher than those of breast-fed infants, but below the range of BMDL<sub>01</sub> values. Substitution of milk with rice-based infant formula might lead to a daily inorganic arsenic intake that is higher than for other consumers; however data on such formula were not submitted to EFSA. The estimated dietary exposures of children under three years of age (0.50-2.66 µg/kg bw/day) are about 2 to 3-fold higher than those of adults, due to their larger food consumption relative to their body weight. This does not necessarily indicate that children are at greater risk because the effects are due to long term exposure and the exposure estimates are also within the range of BMDL<sub>01</sub> values.

In the UK, children younger than 4.5 years are advised against consuming rice milk because of concern for high arsenic exposure (Food Standard Agency, 2009). In Denmark, children below 10 kg are advised against consuming rice milk for the same reason (Fødevarestyrelsen, 2009).

Table 3: MOE determined for several dietary inorganic arsenic exposure.

Population	Intake (µg/kg bw/day)		MOE			
	LB	UB	BMDL <sub>01</sub> : 0.3 µg/kg bw/day		BMDL <sub>01</sub> : 7.5 µg/kg bw/day	
Adult Belgium - mean (SPECAS, 2010)	0.11		3.1		68.2	
Mean consumer (EFSA, 2009)	0.13	0.56	2.6	0.6	57.7	13.4
High consumer (EFSA, 2009)	0.37	1.22	0.9	0.3	20.3	6.1
Children under 3 year (EFSA, 2009)	0.5	2.66	0.7	0.1	15.0	2.8
Adult - mean (JECFA, 2010)	0.1	3	3.4	0.1	75.0	2.5

### Legislation

Arsenic is not regulated so far under Commission Regulation (EC) No. 1881/2006 of 19 December 2006<sup>2</sup> setting maximum levels (MLs) for certain contaminants in foodstuffs.

Harmonized requirements for arsenic in drinking water are set by Council Directive 98/83/EC<sup>3</sup> on the quality of water intended for human consumption. This Directive stipulates that Member States shall set limit values of 10 µg/L for arsenic in water intended for human consumption.

Specific purity criteria concerning sweeteners, colours and other food additives are laid down in the three Commission Directives 2008/60/EC<sup>4</sup>, 2008/84/EC<sup>5</sup> and 2008/128/EC<sup>6</sup>. All Directives provide MLs of 3 mg/kg for arsenic as an impurity in several food additives.

Codex Alimentarius has set a number of standards for arsenic, such as maximum permissible concentrations for total arsenic in several food commodities.

<sup>2</sup> Official Journal L 364, 20.12.2006, p. 5-24.

<sup>3</sup> Official Journal L 330, 5.12.1998, p. 32.

<sup>4</sup> Official Journal L 158, 18.6.2008, p. 17-40.

<sup>5</sup> Official Journal L 253, 20.9.2008, p. 1-175.

<sup>6</sup> Official Journal L 6, 10.1.2009, p. 20-63.

<b>Recommendations</b>
<p><b>The CONTAM Panel of EFSA made the following recommendations (EFSA, 2009):</b></p> <ul style="list-style-type: none"><li>- Dietary exposure to inorganic arsenic should be reduced.</li><li>- In order to refine risk assessment of inorganic arsenic, there is a need to produce speciation data for different food commodities to support dietary exposure assessment and dose-response data for the possible health effects.</li><li>- Although several arsenic speciation methods have been reported, their suitability for a range of food samples and/or arsenic species needs to be established.</li><li>- There is a need for robust validated analytical methods for determining inorganic arsenic in a range of food items.</li><li>- Certified reference materials especially for inorganic arsenic in products such as water, rice and seafood are required. The production of such a material should be a priority to facilitate future surveys of the inorganic arsenic content of foods.</li><li>- Future epidemiological studies should incorporate better characterisation of exposure to inorganic arsenic including food sources.</li><li>- There is a need for more information on critical age periods of arsenic exposure, in particular in early life. Studies should include effects later in life of early life arsenic exposure.</li><li>- There is a need for improved understanding of the human metabolism of organoarsenicals in foods (arsenosugars, arsenolipids etc.) and the human health implications.</li></ul> <p><b>The Committee of JECFA (2010) made the following recommendations:</b></p> <ul style="list-style-type: none"><li>- There is a need for validated methods for selective extraction and determination of inorganic arsenic in food matrices and for certified reference materials for inorganic arsenic.</li><li>- There is a need for improved data on occurrence of different species of arsenic in, and their bioavailability from, different foods as consumed in order to improve the estimates of dietary and systemic exposure.</li><li>- Further information on the toxicity of arsenic species found in food is also required.</li><li>- The Committee recommended that future epidemiological studies of the health impacts of arsenic should incorporate appropriate measures of total exposure to inorganic arsenic, including from food and from water used in cooking and processing of food.</li><li>- Further, it is recommended that epidemiological studies not only focus on relative risks, but also analyse and report the data such that they are suitable for estimating exposure levels associated with additional (lifetime) risks, so as to make their results usable for quantitative risk assessment.</li></ul>
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