Risk assessment of formaldehyde present in food and drinking water

Formaldehyde occurs naturally in the environment and is ubiquitous in the environment. Formaldehyde occurs in very low levels in water as it is rapidly hydrated and therefore, predominantly is found as methylene glycol. Formaldehyde occurs naturally in food. Reported background levels vary considerable. Formaldehyde can also occur in food if released from melamine resin food contact materials. Being very reactive, formaldehyde is essentially present in food bound reversibly and irreversibly to different constituents. In humans, as in other animals, formaldehyde is an essential metabolic intermediate in the physiological one-carbon pool (central to many biological processes).

The general population is exposed to formaldehyde from many sources. The European Food Safety Authority has estimated that the contribution of formaldehyde from food does not exceed 100 mg/person/day. Drinking water is only a minor source of exposure.

The critical effects of formaldehyde following repeated oral exposure are considered to be the non-neoplastic histopathological changes observed in the forestomach and stomach (erosion, ulceration, inflammation and hyperplasia, most likely due to the irritative potential of formaldehyde) in experimental animals (long term studies drinking water). A NOAEL of 260 mg/l is considered.

Formaldehyde is genotoxic, with effects observed in vivo in cells from first site of contact tissues (i.e. nasal tissue); however, there is no evidence of genotoxicity locally in the gastro-intestinal tract. The weight of evidence indicates that formaldehyde is not carcinogenic by the oral route.

A tolerable concentration of formaldehyde in drinking water is estimated to 30 mg/l (rounded value) based on the NOAEL of 260 mg/l and assessment factors of 2.5 and 3.2 for interspecies and inter-individual variability, respectively, in toxicodynamics. Based on this tolerable concentration and an estimated (worst-case) concentration of formaldehyde in drinking water of 30 μg/l, no risk for adverse effects from intake of formaldehyde in drinking water is identified.

Based on the available data, a tolerable concentration of formaldehyde in food cannot be estimated. Therefore, the risk for adverse effects from intake of formaldehyde in beverages and foods could not be evaluated.
PFAS in paper and board for food contact - options for risk management of poly- and perfluorinated substances

Poly- and perfluorinated alkyl substances (PFAS) are used in paper and board food contact materials (FCMs) and they have been found to be highly persistent, bioaccumulative and toxic. The purpose of the Nordic workshop and of this report is to:

* create an overview of the use of PFAS in FCMs of paper and board and of the toxicity and migration into food of the various substances
* provide an overview of whether appropriate risk assessments for fluorinated substances exist as a basis for specific regulations or recommendations
* provide an overview of whether analytical methods suitable for analysing and regulating the substances are available
* discuss the possibility and structure of national regulations or Nordic recommendations for PFAS in FCMs of paper and board. Risk management to reduce the total content of organically bound fluorine in paper and board FCMs is supported.

The given report is published in continuation of a Nordic workshop on January 28th -29th 2015 on poly- and perfluorinated substances (PFAS) in food contact materials. Representatives from EU MS countries, US FDA, Canada and China, as well as manufacturers, retailers, compliance testing laboratories and academia were present in the workshop and contributed to the report.

General information
Publication status: Published
Organisations: National Food Institute, Research group for Molecular and Reproductive Toxicology, Division of Risk Assessment and Nutrition
Contributors: Trier, X., Taxvig, C., Rosenmai, A. K., Pedersen, G. A.
Number of pages: 111
Publication date: 2017

Six Open Questions about the Migration of Engineered Nano-Objects from Polymer-Based Food Contact Materials: A Review

The use of nanomaterials in food contact applications has created enormous interest in recent years. The potential migration of engineered nano-objects (ENO) from food contact materials (FCMs) is one of the most important concerns regarding potential human exposure to ENOs and health risks. Current research focusing on FCMs has often reached inconsistency regarding migration of ENOs. The scope of this critical review is to give a concise overview of the most relevant aspects of the subject, and to identify and discuss the major open questions in relation to migration of ENOs from FCMs. This includes the very fundamental questions whether ENOs can migrate from FCMs at all and what the potential release mechanisms of ENOs could be. The inconsistency of findings from experimental studies is highlighted based on the example of silver nanoparticle migration from polymer-based FCMs. Challenges in detection and characterization of ENOs in migration studies and the suitability of the most frequently used analytical techniques are discussed. Further, this review questions the suitability of standard food simulants and migration test conditions for FCMs as well as of conventional mathematical migration models. Considerations regarding the risk for the consumer associated with migrating ENOs from FCMs are discussed.

General information
Bisphenol A and its structural analogues in household waste paper

Bisphenol A (BPA) is an industrial chemical produced in large volumes. Its main use is associated with polycarbonate plastic, epoxy resins and thermal paper. In contrast to other applications, thermal paper contains BPA in its un-reacted form as an additive, which is subjected to migration. Receiving a significant amount of attention from the scientific community and beyond, due to its controversial endocrine-disrupting effects, the industry is attempting to substitute BPA in variety of applications. Alternative phenolic compounds have been proposed for use in thermal paper; however, information to what extent BPA alternatives have been used in paper is sparse. The aim of the present work was to quantify BPA and its alternatives (bisphenol S (BPS), bisphenol E (BPE), bisphenol B (BPB), 4-cumylphenol (HPP) and bisphenol F (BPF)) in waste paper and board from Danish households, thermal paper receipts, non-carbon copy paper and conventional printer paper. BPA was found in all waste paper samples analysed, while BPS was identified in 73% of them. Only BPB was not identified in any of the samples. BPA and BPS were found in the majority of the receipts, which contained no measurable concentrations of the remaining alternatives. Although receipts showed the highest concentrations of BPA and BPS, office paper, flyers and corrugated boxes, together with receipts, represented the major flux of the two compounds in waste paper streams.

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, National Food Institute, Division of Risk Assessment and Nutrition, Environmental Chemistry
Contributors: Pivnenko, K., Pedersen, G. A., Eriksson, E., Astrup, T. F.
Number of pages: 9
Pages: 39-47
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: Waste Management
Volume: 44
ISSN (Print): 0956-053X
Ratings:
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.764 SNIP 2.127
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
Original language: English
Keywords: EDCs, Bisphenol F, Bisphenol S, MSW, Hazardous substances
Electronic versions:
PostPrint_Davidsen_JoH_1_.pdf. Embargo ended: 31/12/2016
DOIs:
10.1016/j.wasman.2015.07.017
Source: PublicationPreSubmission
Source-ID: 112914115
Research output: Contribution to journal › Journal article – Annual report year: 2015 › Research › peer-review

Bisphenol A baserede polymerer i fødevarekontaktmaterialer (FKM): J. nr.: 2010-20-64-00238

General information
Publication status: Published
Organisations: National Food Institute, Division of Risk Assessment and Nutrition, Research group for Analytical Food Chemistry, Danish Veterinary and Food Administration
Contributors: Legind, C., Holm, M., Pedersen, G. A., Petersen, J. H., Jensen, L. K.
Number of pages: 7
Publication date: 2015

Publication information
Place of publication: København
Publisher: Ministeriet for Fødevarer, Landbrug og Fiskeri, Fødevaredirektoratet
Original language: Danish
Electronic versions:
Bisphenol_A_2013.pdf
Source: PublicationPreSubmission
Source-ID: 110669125
Migration of bisphenol A from polycarbonate plastic of different qualities: Environmental project No. 1710, 2015

The study covers a review of literature and available industry information regarding release of bisphenol A from polycarbonate and the parameters affecting this bisphenol A release. Moreover in part two of the study, different samples of polycarbonate was characterised and analysed in order to examine the potential correlation between material specific parameters and the release of bisphenol A. It is concluded, from industry information, that only highly pure reagent grade chemicals, including additives, should be used for all polycarbonate grades to reduce photodegradation and hydrothermal degradation of the polymer. No specific information was found about additives known to improve the hydrolytic stability of polycarbonate.

General information
Publication status: Published
Organisations: National Food Institute, Division of Risk Assessment and Nutrition, Department of Chemical and Biochemical Engineering, The Danish Polymer Centre, Research group for Analytical Food Chemistry
Contributors: Pedersen, G. A., Hvilsted, S., Petersen, J. H.
Number of pages: 51
Publication date: 2015

BPA_MST_project_No_1710_2015.pdf
URLs:
http://mst.dk/service/publikationer/publikationsarkiv/2015/maj/migration-of-bisphenol-a-from-polycarbonate-plastic
Source: PublicationPreSubmission
Source-ID: 110666868

'Mixture effects of chemicals' 'The Cocktail Project' Fødevarekemisk indsats under Fødevareforlig II 2011-2015

General information
Publication status: Published
Organisations: National Food Institute, Research group for Molecular and Reproductive Toxicology, Copenhagen Center for Health Technology, Group for Chemical Risk Assessment and GMO, Division of Risk Assessment and Nutrition, Research group for Analytical Food Chemistry, Technical University of Denmark
Number of pages: 78
Publication date: 2015

URLs:
Source: PublicationPreSubmission
Source-ID: 162440203

Kemiske stoffer fra fødevarekontaktmaterialer af trykt pap og papir: J. nr.: 2010-20-64-00229

General information
Publication status: Published
Organisations: National Food Institute, Division of Risk Assessment and Nutrition, Research group for Risk Benefit
Contributors: Pedersen, G. A., Greve, K., Lehmann, C.
Number of pages: 5
Low-dose effects of bisphenol A on early sexual development in male and female rats.

Bisphenol A (BPA) is widely detected in human urine and blood. BPA has been reported to impair many endpoints for reproductive and neurological development; however, it is controversial whether BPA has effects in the microgram per kilogram dose range. The aim of the current study was to examine the influence of BPA on early sexual development in male and female rats at dose levels covering both regulatory no observed adverse effect levels (NOAELs) (5 and 50 mg/kg bw per day) as well as doses in the microgram per kilogram dose range (0.025 and 0.25 mg/kg bw per day). Time-mated Wistar rats (n=22) were gavaged during pregnancy and lactation from gestation day 7 to pup day 22 with 0, 0.025, 0.25, 5 or 50 mg/kg bw per day BPA. From 0.250 mg/kg and above, male anogenital distance (AGD) was significantly decreased, whereas decreased female AGD was seen from 0.025 mg/kg bw per day and above. Moreover, the incidence of nipple retention in males appeared to increase dose relatedly and the increase was statistically significant at 50 mg/kg per day. No significant changes in reproductive organ weights in the 16-day-old males and females and no signs of maternal toxicity were seen. The decreased AGD at birth in both sexes indicates effects on prenatal sexual development and provides new evidence of low-dose adverse effects of BPA in rats in the microgram per kilogram dose range. The NOAEL in this study is clearly below 5 mg/kg for BPA, which is used as the basis for establishment of the current tolerable daily intake (TDI) by EFSA; thus a reconsideration of the current TDI of BPA appears warranted.
The project is following up on a previous survey under the Danish EPA’s LOUS-review (Environmental Project no. 1472).

**General information**
Publication status: Published
Organisations: National Food Institute, Division of Food Chemistry
Number of pages: 18
Publication date: 2014

**Publication information**
Place of publication: Copenhagen K
Publisher: Danish Ministry of the Environment
ISBN (Electronic): 978-87-93178-71-7
Original language: English
(Miljoprojekter; No. 1583, Vol. 2014).
Electronic versions:
978_87_93178_71_7.pdf
URLs:
Source: PublicationPreSubmission
Source-ID: 103300108
Research output: Book/Report › Report – Annual report year: 2014 › Commissioned › peer-review

**Survey of the occurrence of 2,5-Di-tert-butylhydroquinone in food contact materials: A LOUS 2012-2015 follow-up project**
This project is a survey of the occurrence of DTBHQ (2,5-Di-tert-butylhydroquinone) specifically in cosmetics and in paint, lacquer and varnish on the Danish consumer market.

The aim of the project is to clarify the possible use of the substance in cosmetics and in paint, lacquer and varnish intended for the consumers identified in the initial survey under the Danish EPA’s LOUS-review (Environmental Project no. 1477).

Based on literature search, contact to producers, importers and branches, the use of DTBHQ in these product categories evaluated to be scarce, with only one cosmetic product identified to contain the substance, and identification of possible use of DTBHQ in antifouling paint. Analysis of 5 antifouling paints revealed a very low concentration in one of the products.

The project is part of the Danish EPA’s LOUS project 2012-2015.

**General information**
Publication status: Published
Organisations: National Food Institute, Division of Food Chemistry
Number of pages: 21
Publication date: 2014

**Publication information**
Place of publication: Copenhagen K
Publisher: Danish Ministry of the Environment
ISBN (Electronic): 978-87-93178-73-1
Original language: English
(Miljoprojekter; No. 1585, Vol. 2014).
Electronic versions:
978_87_93178_73_1.pdf
URLs:
Source: PublicationPreSubmission
Source-ID: 103300098
Research output: Book/Report › Report – Annual report year: 2014 › Commissioned › peer-review
Are structural analogues to bisphenol A a safe alternative?

Bisphenol A (BPA) is often used in polycarbonate plastics, coatings of food and drink cans, and in thermal papers. Foods are thought to be a major human exposure route and human biomonitoring data suggest widespread exposure.

BPA is suspected of contributing to effects such as increased birth weight, behavioral changes in children, cardiovascular disease, and diabetes. Regulatory initiatives and increased public awareness, related to the potential adverse effects of BPA, has led to an incitement to find alternative compounds. Structural analogues of BPA are available on the market, some of which are found in foods and have been measured in humans. Due to the structural analogy there is an inherent risk that these compounds may lead to similar effects as BPA.

The aim of this study was to characterize the toxicological profile of BPA and the five analogues using in vitro assays assessing effects on ER, AR, aryl hydrocarbon receptor (AhR), retinoic acid receptor (RAR) and glucocorticoid receptor (GR) activation, effects on steroidogenesis, potential to cause oxidative stress (Nrf2 assay) and genotoxic potential (P53 assay).

Overall the qualitative effects were similar for the BPs tested; however differences in quantitative effects were observed in some cases. All BPs showed antiandrogenic and estrogenic potential and potential to affect steroidogenesis. The site of interference in steroidogenesis appears specific. Results obtained from Nrf2, p53, and AhR reporter gene assays showed that some or all BPs have the potential to activate these assays at high concentrations (LOEC > 50 μM).

General information
Publication status: Published
Organisations: National Food Institute, Division of Toxicology and Risk Assessment, Division of Food Chemistry, BioDetection Systems b.v.
Pages: 142-142
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Toxicology Letters
Volume: 221
Issue number: Supplement
ISSN (Print): 0378-4274
Ratings:
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.56 SJR 1.092 SNIP 1.185
Web of Science (2013): Impact factor 3.355
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Original language: English
DOIs:
10.1016/j.toxlet.2013.05.282
Source: dtu
Source-ID: n:oai:DTIC-ART:elsevier/390568072::31180
Research output: Contribution to journal › Conference abstract in journal – Annual report year: 2013 › Research › peer-review

Epichlorhydrin og bisphenol A i mat-kontaktmaterialer af epoxylakeret metal og/eller af plast

General information
Publication status: Published
Organisations: National Food Institute, Division of Food Chemistry
Contributors: Petersen, J. H., Pedersen, G. A., Foverskov, A., Cederberg, T. L.
Number of pages: 13
Publication date: 2013

Publication information
Place of publication: Søborg
Publisher: Danmarks Tekniske Universitet, Fødevareinstituttet
ISBN (Electronic): 978-87-92763-97-6
Original language: Danish
Electronic versions:
Bibliographical note
Der er tale om et projekt udført for Mattilsynet i Norge: Link til Mattilsynets omtale af rapporten:
http://www.mattilsynet.no/mat_og_vann/produksjon_av_mat/matkontaktmaterialer/ingen_funn_av_bisfenol_a_i_taateflasker_9744

hvor der også er mulighed for at downloade selve rapporten.

Der er dog sket et lille kiks ved konvertering til pdf-format, idet forfatterne er forsvundet fra titelbladet, ser jeg nu. Det er åbenbart en makro i DTU-skabelonen som ikke fungerer helt hensigtsmæssig.

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Som du ser nedenfor er Mattilsynet indforstået med at rapporten lægges hos os.

Source: dtu
Source-ID: u::8041

Per and polyfluorinated substances in the Nordic Countries: Use, occurrence and toxicology
This Tema Nord report presents a study based on open information and custom market research to review the most common perfluorinated substances (PFC) with less focus on PFOS and PFOA.

The study includes three major parts:
1) Identification of relevant per-and polyfluorinated substances and their use in various industrial sectors in the Nordic market by interviews with major players and database information
2) Emissions to and occurrence in the Nordic environment of the substances described in 1)
3) A summary of knowledge of the toxic effects on humans and the environment of substances prioritized in 2)

There is a lack of physical chemical data, analytical reference substances, human and environmental occurrence and toxicology data, as well as market information regarding PFCs other than PFOA and PFOS and the current legislation cannot enforce disclosure of specific PFC substance information.

General information
Publication status: Published
Organisations: National Food Institute, Division of Food Chemistry, Swerea AB, FORCe Technology, Matís Ltd., Nordic Institute of Product Sustainability, Environmental Chemistry and Toxicology, Norwegian Institute for Air Research, Aarhus University, Icelandic Food Research
Number of pages: 183
Publication date: 2013

Publication information
Publisher: Nordic Council of Ministers
Original language: English
(TeamNord; No. 542, Vol. 2013).
Electronic versions:
Per and polyfluorinated substances in the Nordic Countries.pdf
DOI's:
10.6027/TN2013-542
URLs:
Source: dtu
Source-ID: u::7856
Research output: Book/Report › Report – Annual report year: 2013 › Research › peer-review

Analysis of migration of polyfluorinated compounds from paper packaging into food matrices
General information
Publication status: Published
Organisations: National Food Institute, Division of Food Chemistry
Number of pages: 1
Publication date: 2012
Peer-reviewed: Yes
Event: Poster session presented at NordFluor Seminar on Per- and Polyfluoroalkyl Substances (PFAS), Åbo/Turku, Finland.
Electronic versions:
Poster til Åbo.pdf
Source: dtu
Source-ID: u::6619
Research output: Contribution to conference › Poster – Annual report year: 2012 › Research › peer-review

Enforcement of the Danish Bisphenol A restriction on Food Contact Materials and Articles for infants
In Denmark a national restriction was implemented in 2010 banning the use of bisphenol A (BPA) in any Food Contact Materials intended for children in the age 0-3 years. The ban includes BPA in baby bottles, baby cups, food cans for infant formulas and lids for glass containers with baby food. To enforce this regulation samples needed to be analysed using a stepwise test procedure to ensure that BPA was neither used as a starting substance in a polymer nor as an additive.

General information
Publication status: Published
Organisations: National Food Institute, Division of Food Chemistry
Contributors: Pedersen, G. A., Foverskov, A., Petersen, J. H.
Number of pages: 1
Publication date: 2012
Peer-reviewed: No
Event: Poster session presented at 5th International Symposium on Food Packaging, Berlin, Germany.
Electronic versions:
Enforcement_of_the_Danish_Bisphenol_A.pdf
Source: dtu
Source-ID: u::6224
Research output: Contribution to conference › Poster – Annual report year: 2012 › Research

Food contact materials and articles: Printing Inks: Check lists for compliance in industry and trade and control by food inspection

General information
Publication status: Published
Organisations: National Food Institute, Division of Food Chemistry, Norwegian Food Safety Authority, National Food Agency, Finnish Food Safety Authority, Public Health Authority of Hafnarfjörður and Kópavogur, Ministry of Agriculture and Forestry, Danish Veterinary and Food Administration
Number of pages: 56
Publication date: 2012

Publication information
Place of publication: Copenhagen
Publisher: Nordic Council of Ministers
Original language: English
Electronic versions:
Printing inks Nordisk rapport.pdf

Bibliographical note
2012:521TemaNord
Source: dtu
Source-ID: u::3836
Research output: Book/Report › Report – Annual report year: 2012 › Research › peer-review
Migration of Epoxidized Soybean Oil (ESBO) and Phthalates From Twist Closures into Food and Enforcement of the Overall Migration Limit

Nineteen samples of food in glass jars with twist closures were collected by the national food inspectors at Danish food producers and a few importers, focusing on fatty food, such as vegetables in oil, herring in dressing or pickle, soft spreadable cheese, cream, dressings, peanut butter, sauces and infant food. The composition of the plasticizers in the gaskets was analysed by gas chromatography with flame ionization detection (GC-FID) and gas chromatography-mass spectrometry (GC-MS). Epoxidized soybean oil (ESBO) and phthalates were determined in the homogenized food samples. ESBO was the principal plasticizer in five of the gaskets; in 14 it was phthalates. ESBO was found in seven of the food samples at concentrations from 6 to 100 mg kg\(^{-1}\). The highest levels (91-100 mg kg\(^{-1}\)) were in oily foods such as garlic, chilli or olives in oil. Phthalates, i.e. di-iso-decylphthalate (DIDP) and di-iso-nonylphthalates (DINP), were found in seven samples at 6-173 mg kg\(^{-1}\). The highest concentrations (99-173 mg kg\(^{-1}\)) were in products of garlic and tomatoes in oil and in fatty food products such as sauce barnaise and peanut butter. For five of the samples the overall migration from unused lids to the official fatty food simulant olive oil was determined and compared with the legal limit of 60 mg kg\(^{-1}\). The results ranged from 76 to 519 mg kg\(^{-1}\) and as a consequence the products were withdrawn from the
market.

**General information**
Publication status: Published
Organisations: Division of Food Chemistry, National Food Institute
Pages: 503-510
Publication date: 2008
Peer-reviewed: Yes

**Publication information**
Journal: Food Additives and Contaminants
Volume: 25
Issue number: 4
ISSN (Print): 0265-203X
Ratings:
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.096 SNIP 1.054
Web of Science (2008): Indexed yes
Original language: English
DOIs:
10.1080/02652030701519088
Source: orbit
Source-ID: 233227

Research output: Contribution to journal › Journal article – Annual report year: 2008 › Research › peer-review

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**Skrueålåg med PVC pakning afgiver blødgrævere**

**General information**
Publication status: Published
Organisations: Division of Food Chemistry, National Food Institute
Contributors: Fabech, B., Pedersen, G. A.
Publication date: 2005
Peer-reviewed: Unknown

**Publication information**
Journal: Plus Proces
Original language: Danish
Source: orbit
Source-ID: 237843

Research output: Contribution to journal › Journal article – Annual report year: 2005 › Communication

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**Totalmigration fra husholdningsgenstande og materialer af plast - en kontroikampagne**

**General information**
Publication status: Published
Organisations: Division of Food Chemistry, National Food Institute
Contributors: Pedersen, G. A., Petersen, J. H.
Publication date: 2005

**Publication information**
Original language: Danish
Source: orbit
Source-ID: 237842

Research output: Book/Report › Report – Annual report year: 2005 › Research

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**Migration testing of kitchen- and tableware**

**General information**
Publication status: Published
Organisations: Division of Food Chemistry, National Food Institute, Division of Toxicology and Risk Assessment
Contributors: Pedersen, G. A., Svendsen, G. W., Binderup, M., Petersen, J. H.
Publication date: 2004
Migration testing of kitchen- and tableware

General information
Publication status: Published
Organisations: Division of Food Chemistry, National Food Institute, Division of Toxicology and Risk Assessment
Contributors: Pedersen, G. A., Svendsen, G. W., Binderup, M., Petersen, J. H.
Publication date: 2004
Peer-reviewed: Yes
Event: Poster session presented at The 3rd International Food Packaging Symposium, Barcelona, Spain.
Source: orbit
Source-ID: 244786
Research output: Contribution to conference › Poster – Annual report year: 2004 › Research › peer-review

Toxicity testing and chemical analyses of recycled fibre-based paper for food contact

Food-contact materials, including paper, have to comply with a basic set of criteria concerning safety. This means that paper for food contact should not give rise to migration of components, which can endanger human health. The objectives of this pilot study were, first, to compare paper of different qualities as food-contact materials and to perform a preliminary evaluation of their suitability from a safety point of view, and, second, to evaluate the use of different in vitro toxicity tests for screening of paper and board. Paper produced from three different categories of recycled fibres (B-D) and a raw material produced from virgin fibres (A) were obtained from industry, and extracts were examined by chemical analyses and diverse in vitro toxicity test systems. The products tested were either based on different raw materials or different treatments were applied. Paper category B was made from 40% virgin fibres, 40% unprinted cuttings from newspapers, and 20% de-inked newspapers and magazines. Paper categories C and D were based on newspapers and magazines. However, paper D was de-inked, whereas C was not. To identify constituents of the papers with a potential to migrate into foodstuff, samples of the paper products were extracted with either 99% ethanol or water. Potential migrants in the extracts were identified and semiquantified by GC-1R-MS or GC-HRMS. In parallel to the chemical analyses, a battery of four different in vitro toxicity tests with different endpoints were applied to the same extracts: (1) a cytotoxicity test using normal human skin fibroblasts. The test was based on measurements of the reduction of resazurin to resorufin by cellular redox processes and used as a screening test for acute or general toxicity; (2) a Salmonella/microsome assay (Ames test) as a screening test for mutagenic and potentially carcinogenic compounds; (3) a recombinant yeast cell bioassay as a screening test for compounds with oestrogenic activity; (4) an aryl hydrocarbon (Ah)-receptor assay (CALUX assay) as a screening test for compounds with dioxin-like activity. In addition, the papers were tested for microbial content and, in general, the microbiological load was quite low. The following microorganisms were counted and identified on both surface and homogenized pulp samples: the total number of aerobic bacteria, the number of aerobic and anaerobic spore formers, the number of Bacillus cereus/thuringiensis, and the number of yeast and moulds. The chemical analyses showed a significantly higher amount and different composition pattern of chemicals extracted with ethanol compared with water. Analyses of the ethanol extracts showed a distinctly smaller number and lower concentrations of chemicals in extracts prepared from sample A compared with extracts of samples B-D. The compounds identified in B-D were similar, but the amounts were lower in B compared with C and D. In accordance with the chemical analyses, the water extracts were less cytotoxic than the ethanol extracts. The extract prepared from virgin fibres was less cytotoxic than the extracts prepared from paper made from recycled fibres, and extracts prepared from C was the most cytotoxic. None of the extracts showed mutagenic activity. No conclusion about the oestrogenic activity could be made, because all extracts were cytotoxic to the test organism (yeast cells). Ethanol extracts of A and B showed a negligible positive response in the Ah-receptor assay at the highest nontoxic concentration, whereas C and D showed a more pronounced effect with C being the most potent. A comparable weak effect of water extracts of samples B-D was.

General information
Publication status: Published
Organisations: Division of Toxicology and Risk Assessment, National Food Institute, Division of Food Chemistry, Sektion for Eksotiske Virussygdomme, Division of Virology, National Veterinary Institute, Division of Microbiology and Risk Assessment
Pages: 13-28
Publication date: 2002
Peer-reviewed: Yes

Publication information
Journal: Food Additives and Contaminants
The release of nickel and other trace elements from electric kettles and coffee machines

The release of nickel, chromium and lead from electric kettles to water under conditions simulating regular household use was investigated. Ten out of 26 kettles sold on the Danish market released more than 50 μg/l nickel to water, whereas neither lead nor chromium was released in any significant amount. Fifty μg/l of nickel in water was chosen as the threshold of action, because concentrations below this value were considered unlikely to provide outbreaks of eczema for those consumers suffering from contact allergy to nickel, who are also sensitive to the content of nickel in the diet. This first part of the study was followed up by a dialogue between the kettle producers and the Danish authorities, leading to a change of construction or design for those kettles that did not comply with the criteria. As a follow-up study another ten kettles were studied to check whether compliance was improved. Two of these ten kettles still released more than 50 μg/l nickel to water under the test conditions. These two kettles, however, were subsequently withdrawn from the market.

Coffee machines tested similarly did not release aluminium, lead, chromium or nickel in quantities of any significance.

General information
Publication status: Published
Organisations: Division of Food Chemistry, National Food Institute, Division of Toxicology and Risk Assessment
Contributors: Berg, T., Petersen, A., Pedersen, G. A., Petersen, J., Madsen, C. B.
Pages: 189-196
Publication date: 2000
Peer-reviewed: Yes

Publication Information
Journal: Food Additives and Contaminants
Volume: 17
Issue number: 3
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Characterization of national food agency shrimp and plaice reference materials for trace elements and arsenic species by atomic and mass spectrometric techniques

The National Food Agency (NFA) of Denmark has produced and characterized NFA Plaice and NFA Shrimp reference materials (RMs) for the control of the accuracy of trace element and arsenic species determinations in similar seafood samples. The physical preparation of the materials included dissection, drying, milling and sieving to collect the fraction of particles less than 150 μm in size. In this fraction the trace elements were homogeneously distributed using a 400 mg sample intake for analysis. The total trace element concentrations were determined by graphite furnace and cold vapour atomic absorption spectrometry, inductively coupled plasma mass spectrometry (ICP-MS) and isotope dilution ICP-MS. The contents of arsenobetaine and the tetramethylarsonium ion were determined by cation exchange high performance liquid chromatography (HPLC) coupled with ICP-MS, or coupled with ion-spray (IS) tandem mass spectrometry (MS/MS) for qualitative verification. Based on a rigorous statistical analysis of the analytical data using the DANREF software, it was decided to assign certified values for mercury, cadmium and arsenic in the NFA Shrimp, and mercury, selenium and arsenic in the NFA Plaice. Indicative values were given for selenium, lead and chromium in the NFA Shrimp, and arsenobetaine and the tetramethylarsonium ion in both RMs. It is recommended that the certified mean value and the standard deviation of the distribution of means are used to construct Shewhart control charts (x-charts) in order to evaluate the accuracy of a single as well as multiple determinations of a certified value in the RMs.
Speciation of four selenium compounds using high performance liquid chromatography with on-line detection by inductively coupled plasma mass spectrometry or flame atomic absorption spectrometry

An analytical method for the speciation of selenomethionine, selenocystine, selenite and selenate by high performance liquid chromatography (HPLC) with atomic spectrometric detection is presented. An organic polymeric strong anion exchange column was used as the stationary phase in combination with an aqueous solution of 6 mmol L⁻¹ of salicylate ion at pH 8.5 as the mobile phase which allowed the isocratic separation of the four selenium analytes within 8 minutes. The separated selenium species were detected on-line by flame atomic absorption spectrometry (FAAS) or inductively coupled plasma mass spectrometry (ICP-MS). The signal-to-noise ratio of the FAAS detector was optimized using a hydrogen-argon entrained-air flame and a slotted-tube atom trap (STAT) in the flame. The limit of detection (3 sigma) achieved by the HPLC-FAAS system was 1 mg L⁻¹ of selenium (100 μL injections) for each of the four selenium species. More powerful selenium detection was achieved using an ELAN 5000 ICP-MS instrument. Selenium was measured at m/z = 82. The ICP-MS signal intensity was enhanced by a factor of 3-4 after addition of 3% methanol to the chromatographic mobile phase and by using an increased plasma power input of 1300 W. The limit of detection achieved under these conditions was 1 μg L⁻¹ (100 μL injections). The HPLC-ICP-MS system was used for selenium speciation of selenite and selenate in aqueous solutions during a BCR certification exercise and for selenium speciation in the certified reference material, BCR No. 402 White Clover. Extraction experiments revealed that the selenium species in the biological material were extractable only in the presence of water in the extraction medium. The results indicated that selenate and a compound of unknown identity U were present in the plant sample.

Beverages as a source of trace element exposure

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