Assessing the effects of seawater temperature and pH on the bioaccumulation of emerging chemical contaminants in marine bivalves

Emerging chemical contaminants [e.g. toxic metals speciation, flame retardants (FRs) and perfluorinated compounds (PFCs), among others], that have not been historically recognized as pollutants nor their toxicological hazards, are increasingly more present in the marine environment. Furthermore, the effects of environmental conditions (e.g. temperature and pH) on bioaccumulation and elimination mechanisms of these emerging contaminants in marine biota have been poorly studied until now. In this context, the aim of this study was to assess, for the first time, the effect of warmer seawater temperatures (Δ = + 4°C) and lower pH levels (Δ = - 0.4 pH units), acting alone or combined, on the bioaccumulation and elimination of emerging FRs (dechloranes 602, 603 and 604, and TBBPA), inorganic arsenic (iAs), and PFCs (PFOA and PFOS) in two estuarine bivalve species (Mytilus galloprovincialis and Ruditapes philippinarum). Overall, results showed that warming alone or combined with acidification promoted the bioaccumulation of some compounds (i.e. dechloranes 602, 604, TBBPA), but also facilitated the elimination of others (i.e. iAs, TBBPA). Similarly, lower pH also resulted in higher levels of dechloranes, as well as enhanced iAs, PFOA and PFOS elimination. Data also suggests that, when both abiotic stressors are combined, bivalves’ capacity to accumulate contaminants may be time-dependent, considering significantly drastic increase observed with Dec 602 and TBBPA, during the last 10 days of exposure, when compared to reference conditions. Such changes in contaminants’ bioaccumulation/elimination patterns also suggest a potential increase of human health risks of some compounds, if the climate continues changing as forecasted. Therefore, this first study pointed out the urgent need for further research on the effects of abiotic conditions on emerging contaminants kinetics, to adequately estimate the potential toxicological hazards associated to these compounds and develop recommendations/regulations for their presence in seafood, considering the prevailing environmental conditions expected in tomorrow’s ocean.
Bioaccessibility of contaminants of emerging concern in raw and cooked commercial seafood species: insights for food safety risk assessment

**General information**

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**Organisations:** National Food Institute, Research Group for Nano-Bio Science  
**Authors:** Alves, R. N. (Ekstern), Maulvault, A. L. (Ekstern), Barbosa, V. L. (Ekstern), Fernandez-Tejedor, M. (Ekstern), Rambla-Alegre, M. (Ekstern), Campàs, M. (Ekstern), Reverté, L. (Ekstern), Diogène, J. (Ekstern), Tediosie, A. (Ekstern),

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Bioavailability of emerging contaminants in seafood

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Can seafood safety be compromised in the ocean of tomorrow?

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Carryover of CH₃Hg from feed to sea bass and salmon

Contamination of food generally has a negative impact on the quality and may imply a risk to human health. Mercury (Hg) is one of the most hazardous compounds in our environment and is released from the earth’s crust by both natural and anthropogenic processes. The mercury species 'methylmercury' is highly toxic, because affects the function of enzymes, easily crosses the blood-brain and the placenta barriers and is toxic to the nervous system (especially the
developing brain). It bioaccumulates and biomagnifies through the aquatic food chain. Methylmercury is the most common mercury species in fish and humans are also mainly exposed to methylmercury from consumption of fish and other seafood. The aims of the present controlled fish feeding trials were to study the carryover from feed to fish fillets (at low spike levels (1x background level of methylmercury) and to determine toxicokinetic parameters. The study included Atlantic salmon (Salmo salar), which is one of the main farmed seafood product consumed in Europe and with production in Northern Europe as well as European seabass (Dicentrarchus labrax) produced in Southern Europe, where it is a highly consumed seafood product. The weight gain of the fish, their feed intake, feed and fish fillet contaminant level were determined to model the uptake and elimination of methylmercury. The toxicokinetics for feed with low levels of methylmercury (41-75 ng/g) showed high assimilation and low elimination. The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under the ECsafeSEAFOOD project (grant agreement n° 311820).
Effects of industrial processing on essential elements and regulated and emerging contaminant levels in seafood

Mitigation of contaminants in industrial processing was studied for prawns (cooked and peeled), Greenland halibut (cold smoked) and Atlantic salmon (cold smoked and trimmed). Raw prawns had significantly higher cadmium, chromium, iron, selenium and zinc content in autumn than in spring, while summer levels typically were intermediate. Peeling raw prawns increased mercury concentration but reduced the concentration of all other elements including inorganic arsenic, total arsenic, chromium, zinc, selenium but especially cadmium, copper and iron (p < 0.05), however interaction between seasons and processing was observed.

Non-toxic organic arsenic in raw Greenland halibut (N = 10) and salmon (N = 4) did not transform to carcinogenic inorganic arsenic during industrial cold smoking. Hence inorganic arsenic was low (<0.003 mg/kg wet weight) in both raw and smoked fillets rich in organic arsenic (up to 9.0 mg/kg for farmed salmon and 0.7 mg/kg for wild caught Greenland halibut per wet weight). Processing salmon did not significantly change any levels (calculated both per wet weight, dry weight or lipid content). Cold smoking decreased total arsenic (17%) and increased PCB congeners (10–22%) in Greenland halibut (wet weight). However PFOS, PCB and PBDE congeners were not different in processed Greenland halibut when corrected for water loss or lipid content.

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Exploration of the phycoremediation potential of Laminaria digitata towards diflubenzuron, lindane, copper and cadmium in a multitrophic pilot-scale experiment
The presence of contaminants in aquatic ecosystems can cause serious problems to the environment and marine organisms. This study aims to evaluate the phycoremediation capacity of macroalgae Laminaria digitata for pesticides (diflubenzuron and lindane) and toxic elements (cadmium and copper) in seawater with the presence or absence of mussels. The photosynthetic activity was monitored in the macroalgae to assess its "physiological status". The results showed that the presence of algae decreased diflubenzuron concentration in mussels by 70% after 120 h of exposure. Additionally, this macroalgae was efficient to reduce lindane, Cu and Cd in seawater; even though not was able to reduce...
these contaminants in mussels. The studied pollutants did not affect the physiological status of algae. This study reveals that the application of phycoremediation with macroalgae can be an useful and effective mitigation strategy to remove/decrease contaminant levels from the aquatic environment.

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**Authors:** Anacleto, P. (Ekstern), van den Heuvel, F. H. M. (Ekstern), Oliveira, C. (Ekstern), Rasmussen, R. R. (Intern), Fernandes, J. O. (Ekstern), Sloth, J. J. (Intern), Barbosa, V. (Ekstern), Alves, R. N. (Ekstern), Marques, A. (Ekstern), Cunha, S. C. (Ekstern)

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Oral bioaccessibility of toxic and essential elements in raw and cooked commercial seafood species available in European markets

The oral bioaccessibility of several essential and toxic elements was investigated in raw and cooked commercially available seafood species from European markets. Bioaccessibility varied between seafood species and elements. Methylmercury bioaccessibility varied between 10 (octopus) and 60 % (monkfish). Arsenic (> 64%) was the toxic element showing the highest bioaccessibility. Concerning essential elements bioaccessibility in raw seafood, selenium (73 %) and iodine (71 %) revealed the highest percentages. The bioaccessibility of elements in steamed products increased or decreased according to species. For example, methylmercury bioaccessibility decreased significantly after steaming in all species, while zinc bioaccessibility increased in fish (tuna and plaice) but decreased in molluscs (mussel and octopus). Together with human exposure assessment and risk characterization, this study could contribute to the establishment of new maximum permissible concentrations for toxic elements in seafood by the European food safety authorities, as well as recommended intakes for essential elements.

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Phycoremediation potential of brown macroalgae species Saccharina latissimi and Laminaria digitata towards inorganic arsenic in a multitrophic pilot-scale experiment

The presence of organic pollutants and toxic elements in aquatic ecosystems can cause serious problems to the environment and marine organisms and subsequently lead to adverse effects to human health following consumption of contaminated seafood. Hence, technological solutions for the reduction and mitigation of contaminants in the aquatic food production chain are called upon. The phycoremediation technology is a cost-effective algae-based approach that utilizes the ability of macroalgae to concentrate elements and compounds from the environment and to metabolize various molecules in their tissues. Arsenic (As) is a ubiquitous metalloid found in soils, groundwater, surface water, air, and consequently also in various food items. Arsenic is bioaccumulated in the marine food chain and total arsenic concentrations in the mg/kg range is usually found in marine organisms. The toxicity of arsenic depends on the chemical species, where inorganic arsenic is considered to be the most toxic form of arsenic. The aim of the present study was to evaluate the phycoremediation capacity of the two brown seaweed species Sugar kelp (Saccharina latissima) and Oarweed (Laminaria digitata) in a controlled multitrophic (water, algae, mussels) pilot experiment with exposure to inorganic arsenic. The results of the experiments indicated that of the two algae species used in the experiment, Laminaria digitata was more efficient for removal of arsenic from seawater and hence a better choice for phycoremediation practises towards this parameter.

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Accuracy of a method based on atomic absorption spectrometry to determine inorganic arsenic in food: Outcome of the collaborative trial IMEP-41

A collaborative trial was conducted to determine the performance characteristics of an analytical method for the quantification of inorganic arsenic (iAs) in food. The method is based on (i) solubilisation of the protein matrix with concentrated hydrochloric acid to denature proteins and allow the release of all arsenic species into solution, and (ii) subsequent extraction of the inorganic arsenic present in the acid medium using chloroform followed by back-extraction to acidic medium. The final detection and quantification is done by flow injection hydride generation atomic absorption spectrometry (FI-HG-AAS). The seven test items used in this exercise were reference materials covering a broad range of matrices: mussels, cabbage, seaweed (hijiki), fish protein, rice, wheat, mushrooms, with concentrations ranging from 0.074 to 7.55 mg kg(-1). The relative standard deviation for repeatability (RSDr) ranged from 4.1 to 10.3%, while the relative standard deviation for reproducibility (RSDR) ranged from 6.1 to 22.8%.

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Correlations between arsenolipids, organic and inorganic forms of arsenic, mercury and selenium in muscles and cephalothoraxes of Aristaeomorpha foliacea shrimp

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Determination of toxic elements (Pb, Hg, Cd, As) and fatty acids in muscles and cephalothoraxes in a Mediterranean and a northern rose shrimp: a comparative study of Parapenaeus longirostris and Pandalus borealis

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Exposure to lead from intake of coffee
Food and beverages is one of the primary sources of intake of and exposure to lead, with beverages accounting for almost 50%. Previous studies from Denmark have estimated that the intake of lead from coffee is very high and may contribute to up to 20% of the total lead intake from food and beverages. This estimate is, however, based on older, non-published data. In the current project extensive chemical analyses of coffee beans, drinking water and ready-to-drink coffee have been performed. The results hereof have been compared to calculations of the total intake of lead from food and beverages.

The results show that the intake of lead from coffee is considerably lower than previously estimated and account for 4.2% and 3.3% of the total lead intake from food and beverages for Danish men and women, respectively. It can generally be concluded that the intake of lead from coffee is low in comparison with other types of food, and that it does not constitute a substantial part of the total intake of lead with food and beverages.

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Toxic elements and speciation in seafood samples from different contaminated sites in Europe
The presence of cadmium (Cd), lead (Pb), mercury (THg), methylmercury (MeHg), arsenic (TAs), inorganic arsenic (iAs), cobalt (Co), copper (Cu), zinc (Zn), nickel (Ni), chromium (Cr) and iron (Fe) was investigated in seafood collected from European marine ecosystems subjected to strong anthropogenic pressure, i.e. hotspot areas. Different species (Mytilus galloprovincialis, n=50; Chamelea gallina, n=50; Liza aurata, n=25; Platichthys flesus, n=25; Laminaria digitata, n=15; and Saccharina latissima, n=15) sampled in Tagus estuary, Po delta, Ebro delta, western Scheldt, and in the vicinities of a fish farm area (Solund, Norway), between September and December 2013, were selected to assess metal contamination and
potential risks to seafood consumers, as well as to determine the suitability of ecologically distinct organisms as bioindicators in environmental monitoring studies. Species exhibited different elemental profiles, likely as a result of their ecological strategies, metabolism and levels in the environment (i.e. seawater and sediments). Higher levels of Cd (0.15-0.94mgkg(-1)), Pb (0.37-0.89mgkg(-1)), Co (0.48-1.1mgkg(-1)), Cu (4.8-8.4mgkg(-1)), Zn (75-153mgkg(-1)), Cr (1.0-4.5mgkg(-1)) and Fe (283-930mgkg(-1)) were detected in bivalve species, particularly in M. galloprovincialis from Ebro and Po deltas, whereas the highest content of Hg was found in P. flesus (0.86mgkg(-1)). In fish species, most Hg was organic (MeHg; from 69 to 79%), whereas lower proportions of MeHg were encountered in bivalve species (between 20 and 43%). The highest levels of As were found in macroalgae species L. digitata and S. latissima (41mgkg(-1) and 43mgkg(-1), respectively), with iAs accounting almost 50% of the total As content in L. digitata but not with S. latissima nor in the remaining seafood samples. This work highlights that the selection of the most appropriate bioindicator species is a fundamental step in environmental monitoring of each contaminant, especially in coastal areas. Furthermore, data clearly shows that the current risk assessment and legislation solely based on total As or Hg data is limiting, as elemental speciation greatly varies according to seafood species, thus playing a key role in human exposure assessment via food.
Bioavailability of cadmium: Results from in-vivo and in-vitro studies using cocoa and linseeds

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Bioavailability of cadmium from linseed and cocoa

The exposure of the European population to cadmium from food is high compared with the tolerable weekly intake of 2.5 μg/kg bodyweight set by EFSA in 2009. Only few studies on the bioavailability of cadmium from different food sources has been performed but this information is very important for the food authorities in order to give correct advises to the population.

The aim of this study was to investigate the bioavailability of cadmium from whole linseed, crushed linseed, cocoa and cadmium chloride in rats.

An experiment where 40 rats were divided into 4 groups and a control group and dosed with whole linseed, crushed linseed, cocoa and CdCl₂ for 3 weeks was performed. Linseed or cocoa made up 10% of the feed (by weight) and was added as a replacement for carbohydrate source. The rats were dosed for 3 weeks and the cadmium content in the rats' kidneys was measured by ICPMS as a biomarker for the exposure during the whole life. Efforts were made to keep unintended exposure as low as possible and the cadmium content was measured in whole feed and all individual feed components.

The total intake of cadmium during the lifetime of the rats was calculated and the percentage of the cadmium which could be measured in the kidney compared to the calculated total intake was as follows: Control 2.0 %, Crushed linseed 0.9 %, whole linseed, 1.5 %, cocoa 0.7 % and CdCl₂ 4.6 %.

Based on this study it could not be concluded that the bioavailability in rats form whole linseed is lower than for crushed linseed. It was concluded that the bioavailability of cadmium from cocoa was similar or maybe a little lower than the bioavailability of cadmium from linseed.

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Authors: Hansen, M. (Intern), Rasmussen, R. R. (Intern), Sloth, J. J. (Intern)
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Place of publication: Loen, Norway
Article number: P-28
Bioavailability of cadmium from linseed and cocoa: A LOUS follow-up project

In Denmark and EU the exposure of cadmium from food is at a level that is relatively close to the Tolerable Daily Intake (TDI). This report describes an investigation of the bioavailability of cadmium in selected food items known to contain high levels of cadmium. The purpose was to provide data which can be used to further qualify the estimated exposure of the population to cadmium via food. The background for carrying out this investigation was the results from a survey of cadmium and cadmium compounds (Environmental Project no. 1471) conducted by the Danish EPA under the LOUS-review.

The investigation was conducted as a feeding study in rats in combination with in-vitro studies simulating the conditions in the stomach of both rats and humans. The results of the investigation do, however, not provide a basis for changing the current advice to the public neither regarding the intake of whole or crushed linseed nor the intake of cocoa and chocolate.

Determination of iodine and iodine compounds in marine samples by ICPMS and HPLC-ICPMS

By now it is a well-known fact that iodine is an essential trace element for the growth and development of the human body. Because of iodine deficiency, some countries have added iodate to salt in order to increase the iodine intake. However, some people prefer iodine from more natural sources like seaweed and fish, which contain elevated levels of iodine (fish typically 1-10 mg/kg and seaweed up to 8000 mg/kg). These marine food items may contain different iodine species, which may have different bioavailability and toxicity, and hence there is an increased interest in developing analytical methods for determining the different iodine species.

For determining the total iodine concentration in marine samples five different extraction methods were compared. The most efficient and precise method was then used for determining the total concentration of iodine in seaweed and fish samples using inductively coupled plasma mass spectrometry (ICPMS).

Furthermore 32 marine samples were analyzed for contents of iodide, iodate, moniodotyrosine (MIT) and diiodotyrosine (DIT). The samples were extracted using the enzyme pancreatin followed by analysis with reversed phase high performance liquid chromatography (HPLC) coupled to ICPMS.

These studies may be a stepping stone for further studies that can clarify the cycle and implications of iodine species in relation to the use of marine food items as iodine sources.
Occurrence of Pre- and Post-Harvest Mycotoxins and Other Secondary Metabolites in Danish Maize Silage

Maize silage is a widely used feed product for cattle worldwide, which may be contaminated with mycotoxins, pre- and post-harvest. This concerns both farmers and consumers. To assess the exposure of Danish cattle to mycotoxins from maize silage, 99 samples of whole-crop maize (ensiled and un-ensiled) were analyzed for their contents of 27 mycotoxins and other secondary fungal metabolites by liquid chromatography-tandem mass spectrometry. The method specifically targets the majority of common pre- and post-harvest fungi associated with maize silage in Denmark. Sixty-one samples contained one or more of the 27 analytes in detectable concentrations. The most common mycotoxins were zearalenone, enniatin B nivalenol and andrastin A, found in 34%, 28%, 16% and 15% of the samples, respectively. None of the samples contained mycotoxins above the EU recommended maximum concentrations for Fusarium toxins in cereal-based roughage. Thus, the present study does not indicate that Danish maize silage in general is a cause of acute single mycotoxin intoxications in cattle. However, 31 of the samples contained multiple analytes; two samples as much as seven different fungal metabolites. Feed rations with maize silage may therefore contain complex mixtures of fungal secondary metabolites with unknown biological activity. This emphasizes the need for a thorough examination of the effects of
chronic exposure and possible synergistic effects.

**General information**

State: Published

Organisations: Department of Systems Biology, National Food Institute, Division of Food Chemistry

Authors: Storm, I. M. L. D. (Intern), Rasmussen, R. R. (Intern), Rasmussen, P. H. (Intern)

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**Total and inorganic As in seafood products caught in an environment facing a mining and industrial area in Sardinia (Italy)**

**General information**

State: Published

Organisations: National Food Institute, Division of Food Chemistry, Istituto Zooprofilattico Sperimentale Umbria, Servizio Veterinario IAOA USL 7 Carbonia

Authors: Orletti, R. (Ekstern), Sloth, J. J. (Intern), Rasmussen, R. R. (Intern), Carloni, C. (Ekstern), Griffoni, F. (Ekstern), Palombo, P. (Ekstern), Velieri, F. (Ekstern), Piras, P. (Ekstern)

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Main Research Area: Technical/natural sciences

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Determination of inorganic arsenic in food and feed – European initiatives in research and standardization of methods

The European legislation on trace elements concerning food and feed safety is based on total element concentrations expressed as maximum levels. However, information on the total content of an element does not always provide adequate information for evaluation of e.g. bioavailability and toxicity. These parameters may vary quite significantly depending on how the element is bound, i.e. its speciation, defined as the distribution of an element amongst defined chemical species in a system. The most important practical application of elemental speciation is in the area of toxicology and with the help of more detailed toxicological knowledge on the individual chemical elemental species should lead to more specific legislation.

The present lecture will use arsenic as an illustrative example, where inorganic arsenic is considered much more toxic than organic bound and analytical methods for selective determination of inorganic arsenic are required in order to perform a correct risk assessment of dietary exposure.

The lecture will provide the current status for recent and ongoing European initiatives and projects on methods for specific determination of inorganic arsenic in foodstuffs and feedingstuffs and expected future developments within this emerging scientific area will be discussed.
Inorganic arsenic - SPE HG-AAS method for RICE tested in-house and collaboratively

Arsenic (As) is a trace element present in the environment and consequently in various food items, e.g. rice, which may contain relatively high concentration of arsenic compared to other foodstuffs of plant origin. Rice contains most often three forms of arsenic: inorganic arsenic (iAs) and the methylated species monomethylarsonic acid (MA) and dimethylarsinic acid (DMA). Dietary intake of iAs is of special concern due to its carcinogenicity to humans, whereas DMA and MA are considered of less toxicological importance. Rice grains and rice-based products are staple foods in many countries and is one of the major contributors to the iAs exposure in many countries.

The work presented here describes the development, validation and application of a simple and inexpensive method for inorganic arsenic (iAs) determination in rice samples. The separation of iAs from organoarsenic compounds (MA and DMA) was done by off-line solidphase extraction (SPE) followed by hydride generation atomic absorption spectrometry (HG-AAS) detection. Water bath heating (90 °C, 60 min) of samples with dilute nitric acid and hydrogen peroxide solubilised and oxidized all iAs to arsenate (AsV). Loading of buffered sample extracts (pH 6±1) followed by selective elution of arsenate from a strong anion exchange SPE cartridge enabled the selective iAs quantification by HG-AAS, measuring total arsenic (As) in the SPE eluate. The in-house validation gave mean recoveries of 101–106 % for spiked rice samples and in two reference samples. The limit of detection was 0.02 mg/kg, and repeatability and intra-laboratory reproducibility were less than 6 and 9 %, respectively. The SPE HG-AAS method produced similar results compared to parallel high-performance liquid chromatography coupled to inductively coupled plasma mass spectrometry (ICP-MS) analysis. The SPE separation step was tested collaboratively, where the laboratories (N=10) used either HG-AAS or ICPMS for iAs determination in a wholemeal rice powder. The trial gave satisfactory results (HorRat value of 1.6) and did not reveal significant difference (t test, p>0.05) between HG-AAS and ICP-MS quantification. The iAs concentration in 36 rice samples purchased on the Danish retail market varied (0.03–0.60 mg/kg), with the highest concentration found in a red rice sample.
Methylmercury determined by HPLC-ICP-MS in marine food and feed: in-house method validation and inter-laboratory comparison

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SPE HG-AAS method for the determination of inorganic arsenic in rice—results from method validation studies and a survey on rice products

The present paper describes the development, validation and application of a method for inorganic arsenic (iAs) determination in rice samples. The separation of iAs from organoarsenic compounds was done by off-line solid-phase extraction (SPE) followed by hydride generation atomic absorption spectrometry (HG-AAS) detection. This approach was earlier developed for seafood samples (Rasmussen et al., Anal Bioanal Chem 403:2825–2834, 2012) and has in the present work been tailored for rice products and further optimised for a higher sample throughput and a lower detection limit. Water bath heating (90 °C, 60 min) of samples with dilute HNO3 and H2O2 solubilised and oxidised all iAs to arsenate (AsV). Loading of buffered sample extracts (pH 6 ± 1) followed by selective elution of arsenate from a strong anion exchange SPE cartridge enabled the selective iAs quantification by HG-AAS, measuring total arsenic (As) in the
SPE eluate. The in-house validation gave mean recoveries of 101–106 % for spiked rice samples and in two reference samples. The limit of detection was 0.02 mg kg−1, and repeatability and intra-laboratory reproducibility were less than 6 and 9 %, respectively. The SPE HG-AAS method produced similar results compared to parallel high-performance liquid chromatography coupled to inductively coupled plasma mass spectrometry (ICP-MS) analysis. The SPE separation step was tested collaboratively, where the laboratories (N = 10) used either HG-AAS or ICP-MS for iAs determination in a wholemeal rice powder. The trial gave satisfactory results (HorRat value of 1.6) and did not reveal significant difference (t test, p > 0.05) between HG-AAS and ICP-MS quantification. The iAs concentration in 36 rice samples purchased on the Danish retail market varied (0.03–0.60 mg kg−1), with the highest concentration found in a red rice sample.

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BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.363 SNIP 1.275 CiteScore 3.47
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Determination of Inorganic Arsenic in Rice by Anion Exchange HPLC-ICP-MS

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Authors: Sloth, J. J. (Intern), Herbst, M. B. K. (Intern), Hedegaard, R. S. V. (Intern), Rasmussen, R. R. (Intern)
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Development and validation of an SPE HG-AAS method for determination of inorganic arsenic in samples of marine origin
The present paper describes a novel method for the quantitative determination of inorganic arsenic (iAs) in food and feed of marine origin. The samples were subjected to microwave-assisted extraction using diluted hydrochloric acid and hydrogen peroxide, which solubilised the analytes and oxidised arsenite (As(III)) to arsenate (As(V)). Subsequently, a pH buffering of the sample extract at pH 6 enabled selective elution of As(V) from a strong anion exchange solid-phase extraction (SPE) cartridge. Hydride generation atomic absorption spectrometry (HG-AAS) was applied to quantify the concentration of iAs (sum of As(III) and As(V)) as the total arsenic (As) in the SPE eluate. The results of the in-house validation showed that mean recoveries of 101-104% were achieved for samples spiked with iAs at 0.5, 1.0 and 1.5 mg kg(-1), respectively. The limit of detection was 0.08 mg kg(-1), and the repeatability (RSD(r)) and intra-laboratory reproducibility (RSD(IR)) were less than 8% and 13%, respectively, for samples containing 0.2 to 1.5 mg kg(-1) iAs. The trueness of the SPE HG-AAS method was verified by confirming results obtained by parallel analysis using high-performance liquid chromatography coupled to inductively coupled plasma mass spectrometry. It was demonstrated that the two sets of results were not significantly different (P <0.05). The SPE HG-AAS method was applied to 20 marine food and feed samples, and concentrations of up to 0.14 mg kg(-1) of iAs were detected.

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Main Research Area: Technical/natural sciences

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Is it possible to agree on a value for inorganic arsenic in food? The outcome of IMEP-112

Two of the core tasks of the European Union Reference Laboratory for Heavy Metals in Feed and Food (EU-RL-HM) are to provide advice to the Directorate General for Health and Consumers (DG SANCO) on scientific matters and to organise proficiency tests among appointed National Reference Laboratories. This article presents the results of the 12th proficiency test organised by the EU-RL-HM (IMEP-112) that focused on the determination of total and inorganic arsenic in wheat, vegetable food and algae. The test items used in this exercise were: wheat sampled in a field with a high concentration of arsenic in the soil, spinach (SRM 1570a from NIST) and an algae candidate reference material. Participation in this exercise was open to laboratories from all around the world to be able to judge the state of the art of the determination of total and, more in particular, inorganic arsenic in several food commodities. Seventy-four laboratories from 31 countries registered to the exercise; 30 of them were European National Reference Laboratories. The assigned values for IMEP-112 were provided by a group of seven laboratories expert in the field of arsenic speciation analysis in food. Laboratory results were rated with $z$ and $\zeta$ scores (zeta scores) in accordance with ISO 13528. Around 85 % of the participants performed satisfactorily for inorganic arsenic in vegetable food and 60 % did for inorganic arsenic in wheat, but only 20 % of the laboratories taking part in the exercise were able to report satisfactory results in the algae test material.

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A novel speciation alternative for the determination of inorganic arsenic in marine samples

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Authors: Rasmussen, R. R. (Intern), Hedegaard, R. S. V. (Intern), Herbst, M. B. K. (Intern), Sloth, J. J. (Intern)
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A novel speciation alternative for the determination of inorganic arsenic in marine samples

Arsenic (As) is bioaccumulated from seawater to concentrations in the mg/kg range in marine animals. More than 50 naturally-occurring arsenic containing species, both inorganic and organic forms, have been identified in marine animals. The organic forms are mainly considered to be non-toxic, whereas inorganic arsenic is highly toxic and exposure may lead to severe adverse effects including cancer. Since seafood is the major dietary source for arsenic exposure in the European population, arsenic speciation analysis of marine samples is highly relevant for food safety. However, most data collected in the official EU food control today are reported as total arsenic. High Performance Liquid Chromatography Inductively Coupled Plasma Mass Spectrometry (HPLC-ICP-MS) is a useful but expensive tool for metal speciation analysis. Our novel, simple and inexpensive method for determination of inorganic arsenic in marine based food is based on microwave extraction, species separation by strong anion solid phase extraction (SPE) and hydride generation atomic absorption spectrometry (HG-AAS) detection. Separation organic arsenic compounds (e.g. MA, DMA and AB) and inorganic arsenic in the form of As(V) is possible due to different charges (pKa values) of the arsenic species at a specific pH. SPE method development and sample extraction was evaluated using HPLC-ICP-MS. No degradation or conversion of organic arsenic species such as AB, MA or DMA were observed under the chosen extraction conditions. In brief: The sample is heated with a hydrochloric acid and hydrogen peroxide solution (20 minutes at 90 °C with 0.06 M HCl, 3 % H2O2). Hereby the sample is solubilised and As(III) is oxidised to As(V). Inorganic arsenic is selectively separated from other arsenic compounds using strong anion exchange SPE. The procedure include first pre-condition of the column, then
loading of the buffered samples (pH 5.0-7.5), washing with 0.5 M acetic acid and finally elution of the sample from the column by 0.5 M HCl. The concentration of arsenic is determined by HG-AAS using external standards. The method SPE-HG-AAS was in-house validated by spiked and naturally incurred marine samples. Mean recoveries of the spiked samples were 101–104%. The limit of detection was determined to 0.08 mg/kg and was calculated as three times the standard deviation at intra-laboratory reproducibility conditions divided by the average recovery, both at the lowest spike level (0.5 mg/kg). The in-house reproducibility standard deviations were less than ±13% for samples containing 0.2 to 1.5 mg/kg inorganic arsenic. The results obtained by SPE-HG-AAS and HPLC-ICP-MS detection were not significantly different (95% confidence). Acknowledgement: Funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 211326.

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IMEP-32: Determination of inorganic arsenic in animal feed of marine origin: A Collaborative Trial Report
A collaborative study, IMEP-32, was conducted in accordance with international protocols to determine the performance characteristics of an analytical method for the determination of inorganic arsenic in animal feed of marine origin. The method would support Directive No 2002/32/EC of the European Parliament and the Council on undesirable substances in animal feed [1] where it is indicated that "Upon request of the competent authorities, the responsible operator must perform an analysis to demonstrate that the content of inorganic arsenic is lower than 2 ppm". The method is based on solid phase extraction (SPE) separation of inorganic arsenic from organoarsenic compounds followed by detection with hydride generation atomic absorption spectrometry (HG-AAS). The collaborative study investigated different types of samples of marine origin, including complete feed (unspiked and spiked), fish meal (unspiked and spiked), fish fillet (spiked) and a lobster hepatopancreas (unspiked). In total seven samples were investigated within the concentration range of 0.07 – 2.6 mg kg-1. The test samples were dispatched to 23 laboratories in 12 different countries. Nineteen participants reported results. The performance characteristics are presented in this report. All method performance characteristics obtained in the frame of this collaborative trial indicates that the proposed SPE-HG-AAS standard method is fit for the intended analytical purpose.

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In vitro cytotoxicity of fungi spoiling maize silage

Penicillium roqueforti, Penicillium paneum, Monascus ruber, Alternaria tenuissima, Fusarium graminearum, Fusarium avenaceum, Byssoschlamys nivea and Aspergillus fumigatus have previously been identified as major fungal contaminants of Danish maize silage. In the present study their metabolite production and in vitro cytotoxicity have been determined for fungal agar and silage extracts. All 8 fungal species significantly affected Caco-2 cell viability in the resazurin assay, with large variations for each species and growth medium. The 50% inhibition concentrations (IC50) of the major P. roqueforti metabolites roquefortine C (48μg/mL), andrastin A (>50μg/mL), mycophenolic acid (>100μg/mL) and 1-hydroxyeremophil-7(11),9(10)-dien-8-one (>280μg/mL) were high. Fractionating of agar extracts identified PR-toxin as an important cytotoxic P. roqueforti metabolite, also detectable in maize silage. The strongly cytotoxic B. nivea and P. paneum agar extracts contained patulin above the IC50 of 0.6μg/mL, however inoculated onto maize silage B. nivea and P. paneum did not produce patulin (>371μg/kg). Still B. nivea infected maize silage containing mycophenolic acid (∼50mg/kg), byssochlamic acid and other metabolites, was cytotoxic. In contrast hot-spots of P. roqueforti, P. paneum, M. ruber and A. fumigatus were not more cytotoxic than uninoculated silage.

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ISSN (Print): 0278-6915
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.96 SJR 1.322 SNIP 1.589
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.213 SNIP 1.426 CiteScore 3.44
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.042 SNIP 1.381 CiteScore 3.12
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.013 SNIP 1.52 CiteScore 3.26
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.135 SNIP 1.745 CiteScore 3.52
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.12 SNIP 1.593 CiteScore 3.36
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.921 SNIP 1.216
BFI (2009): BFI-level 1
Mercury speciation analysis in marine samples by HPLC-ICPMS

Mercury (Hg) is a naturally occurring element, which is found in the earth’s crust and can be released into the environment through both natural and anthropogenic processes. Mercury exists as elemental mercury (metallic), inorganic mercury and organic mercury (primarily methylmercury). Methylmercury is highly toxic, particularly to the nervous system, and the developing brain is thought to be the most sensitive target organ for methylmercury toxicity. Methylmercury bioaccumulates and biomagnifies along the food chain and it is the most common mercury species in fish and seafood. Human exposure to methylmercury is mainly from fish and other seafood consumption. A simple method for the determination of methylmercury in marine based foods and feeds has been developed and in-house validated. The applied HPLC-ICPMS method was inspired by Vallant et al (2007). Samples were extracted with 5 M hydrochloric acid by sonication. Hereby the protein-bound mercury species are released. The extracts were then centrifuged (10 min at 3170 x g) and the supernatant decanted (extraction step was repeated twice). The combined extracts were added 10 M sodium hydroxide to increase pH, following further dilution in the mobile phase and filtering prior to analysis. Analysis of mercury species were performed using HPLC-ICPMS equipped with a MicroMist nebuliser. Typical plasma conditions were 1500 W RF power, 15 l/min, 0.97 l/min and 0.17 l/min for plasma, carrier and makeup gas, respectively. Analysis was performed in the time resolved analysis mode monitoring the 202Hg, 198Hg, 35Cl (m/z) with 1 s (Hg) and 0.01 s (Cl) integration time per data point. Separation of inorganic mercury and methylmercury was obtained on a polymer-based cation-exchange column (150×2.1 mm id, 10 μm) using isocratic elution (0.2 ml/min at 40 °C). The mobile phase (pH=3) consisted of L-cysteine (0.5% w/w), pyridine (50 mmol/L), methanol (5% v/v) and formic acid (0.8% v/v). Total run time 10 min. External calibration standards (0–10 μg/L) were run before and after the samples in order to quantify the methylmercury species by peak height (m/z 202). The methylmercury method was validated by triplicate analysis of certified reference materials (DORM-2, TORT-2 and DORM-3) and 4 other fish and feed samples of marine origin, repeated on 3 different days. The limit of detection and quantification were 0.027 and 0.054 mg/kg, respectively. The limits were calculated as three and ten times the standard deviation at intra-laboratory reproducibility conditions of a natural fortified sample with low content (0.06 mg/kg) divided by average recoveries for certified reference materials. Mean recoveries of the reference materials were 94–102%. The in-house reproducibility standard deviations were less than ±12% for samples containing 0.15 to 4.47 mg/kg and less than ±20% for samples with 0.06 mg/kg. Vallant B, Kadnar R and Goessler W (2007) J Anal Atom Spectrom 22, 322–325. Acknowledgement: Funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 211326.
Mycotoxins in maize silage - detection of toxins and toxicological aspects

General information
State: Published
Organisations: Division of Food Chemistry, Department of Systems Biology, Division of Toxicology and Risk Assessment, National Food Institute, Center for Microbial Biotechnology
Authors: Rasmussen, R. R. (Intern), Binderup, M. (Intern), Larsen, T. O. (Intern), Rasmussen, P. H. (Intern)
Publication date: Sep 2010

Publication information
Place of publication: Kgs. Lyngby, Denmark
Publisher: Technical University of Denmark (DTU)
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
Source: orbit
Source-ID: 271215
Publication: Research › Ph.D. thesis – Annual report year: 2010

Fungi and their mycotoxins in maize and maize silage

General information
State: Published
Organisations: Center for Microbial Biotechnology, Department of Systems Biology, Division of Food Chemistry, National Food Institute
Authors: Storm, I. M. L. D. (Intern), Sørensen, J. L. (Intern), Rasmussen, R. R. (Intern), Thrane, U. (Intern)
Publication date: 2010
Event: Abstract from 32nd Mycotoxin Workshop, Kgs. Lyngby, Denmark.
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 265513
Publication: Research › Conference abstract for conference – Annual report year: 2010

Fungi and their mycotoxins in maize and maize silage

General information
State: Published
Organisations: Center for Microbial Biotechnology, Department of Systems Biology, Division of Food Chemistry, National Food Institute
Authors: Storm, I. M. L. D. (Intern), Sørensen, J. L. (Ekstern), Rasmussen, R. R. (Intern), Thrane, U. (Intern)
Publication date: 2010
Event: Poster session presented at 32nd Mycotoxin Workshop, Kgs. Lyngby, Denmark.
Main Research Area: Technical/natural sciences
Electronic versions:
2010 Poster 32nd Mycotoxin Workshop DTU_Rasmussen_Mycotoxins and other secondary metabolites in maize silage.pdf
Source: orbit
Source-ID: 272699
Publication: Research › Poster – Annual report year: 2010
Multi-mycotoxin analysis of maize silage by LC-MS/MS

This paper describes a method for determination of 27 mycotoxins and other secondary metabolites in maize silage. The method focuses on analytes which are known to be produced by common maize and maize-silage contaminants. A simple pH-buffered sample extraction was developed on the basis of a very fast and simple method for analysis of multiple pesticide residues in food known as QuEChERS. The buffering effectively ensured a stable pH in samples of both well-ensiled maize (pH7). No further clean-up was performed before analysis using liquid chromatography-tandem mass spectrometry. The method was successfully validated for determination of eight analytes qualitatively and 19 quantitatively. Matrix-matched calibration standards were used giving recoveries ranging from 37% to 201% with the majority between 60% and 115%. Repeatability (5-27% RSDr) and intra-laboratory reproducibility (7-35% RSDIR) was determined. The limit of detection (LOD) for the quantitatively validated analytes ranged from 1 to 739 μg kg⁻¹. Validation results for citrinin, fumonisin B-1 and fumonisin B-2 were unsatisfying. The method was applied to 20 selected silage samples and alternariol monomethyl ether, andrastin A, alternariol, citreoisocoumarin, deoxynivalenol, enniatin B, fumigaclavine A, gliotoxin, marcfortine A and B, mycophenolic acid, nivalenol, roquefortine A and C and zearalenone were detected.

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute, Center for Microbial Biotechnology, Department of Systems Biology
Authors: Rasmussen, R. R. (Intern), Storm, I. M. L. D. (Intern), Rasmussen, P. H. (Intern), Smedsgaard, J. (Intern), Nielsen, K. F. (Intern)
Pages: 765-776
Publication date: 2010
Main Research Area: Technical/natural sciences

Publication information
Journal: Analytical and Bioanalytical Chemistry
Volume: 397
Issue number: 2
ISSN (Print): 1618-2642
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.03 SJR 0.943 SNIP 1.039
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.064 SNIP 1.083 CiteScore 3.07
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.126 SNIP 1.222 CiteScore 3.26
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.229 SNIP 1.282 CiteScore 3.55
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.347 SNIP 1.282 CiteScore 3.51
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.363 SNIP 1.275 CiteScore 3.47
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.354 SNIP 1.236
Web of Science (2010): Indexed yes
Svampe og mykotoksiner i majsensilage: Ensilering af majs ogf græs

General information
State: Published
Organisations: Center for Microbial Biotechnology, Department of Systems Biology, Division of Food Chemistry, National Food Institute
Authors: Thrane, U. (Intern), Storm, I. M. L. D. (Intern), Andersen, B. (Intern), Rasmussen, R. R. (Intern), Sørensen, J. (Ekstern)
Publication date: 2010
Main Research Area: Technical/natural sciences

Publication information
Journal: Intern rapport Husdyrbrug
Issue number: 21
Original language: Danish
Electronic versions:
Source: orbit
Source-ID: 272702
Publication: Research › Journal article – Annual report year: 2010

Svampe og mykotoksiner i majsensilage

General information
State: Published
Organisations: Center for Microbial Biotechnology, Department of Systems Biology, Division of Food Chemistry, National Food Institute
Authors: Thrane, U. (Intern), Storm, I. M. L. D. (Intern), Andersen, B. (Intern), Rasmussen, R. R. (Intern), Sørensen, J. (Ekstern)
Pages: 46-48
Publication date: 2010
Main Research Area: Technical/natural sciences

Publication information
Journal: Bovilogisk
Issue number: 5
Fungal spoilage and mycotoxin contamination of maize silage

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute
Authors: Storm, I. M. D. (Ekstern), Rasmussen, R. R. (Intern), Nielsen, K. F. (Ekstern), Smedsgaard, J. (Ekstern), Thrane, U. (Ekstern)
Publication date: 2007
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 243505
Publication: Research › Poster – Annual report year: 2007

Restindhold af malakitgrønt i dambrugsfisk

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute
Authors: Rasmussen, R. R. (Intern)
Publication date: 2007
Main Research Area: Technical/natural sciences

Publication information
Journal: Dansk Kemi
ISSN (Print): 0011-6335
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Web of Science (2007): Indexed yes
Web of Science (2004): Indexed yes
Original language: Danish
Source: orbit
Source-ID: 243483
Publication: Communication › Journal article – Annual report year: 2007

Mycotoxins in maize silage in vitro cytotoxicity & LC-MS/MS quantification

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute
Authors: Rasmussen, R. R. (Intern)
Publication date: 2006
Event: Poster session presented at 4th Symposium on Food Microbiology, Helsingør, Denmark.
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 243504
Publication: Research › Poster – Annual report year: 2006

Results of the Danish monitoring of veterinary drug residues 1998 to 2002

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute
Authors: Rasmussen, R. R. (Intern)
Publication date: 2004
Event: Poster session presented at Euroresidue V, Noordwijkerhout, Netherlands.
Main Research Area: Technical/natural sciences
Source: orbit
Distribution of multiple pesticide residues in apple segments after home processing

The effects of washing, storing, boiling, peeling, coring and juicing on pesticide residue were investigated for field-sprayed Discovery and Jonagold apples. Residues of chlorpyrifos, cypermethrin, deltamethrin, diazinon, endosulfan, endosulfan sulfate, fenitrothion, fenpropathrin, iprodione, kresoxim-methyl, lambda-cyhalothrin, quinalphos, tolylfluanid and vinclozolin in the processed apples were analysed by gas chromatography. Statistical analysis showed that reductions of 18-38% were required to obtain significant effects of processing practices, depending on pesticide and apple variety. Juicing and peeling the apples significantly reduced all pesticide residues. In the case of detectable pesticide residues, 1-24% were distributed in the juice and in the peeled apple. None of the pesticide residues was significantly reduced when the apples were subject to simple washing or coring. Storing significantly reduced five of the pesticide residues: diazinon, chlorpyrifos, fenitrothion, kresoxim-methyl and tolylfluanid, by 25-69%. Residues of the metabolite endosulfan sulfate were increased by 34% during storage. Boiling significantly reduced residues of fenitrothion and tolylfluanid by 32 and 81%, respectively. Only a few of the observed effects of processing could be explained by the physical or chemical characteristics of the pesticides. No differences in effect of processing due to apple variety were identified.

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute
Authors: Rasmussen, R. R. (Intern), Poulsen, M. E. (Intern), Hansen, H. C. B. (Ekstern)
Pages: 1044-1063
Publication date: Nov 2003
Main Research Area: Technical/natural sciences

Publication information
Journal: Food Additives and Contaminants
Volume: 20
Issue number: 11
ISSN (Print): 0265-203X
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
BFI (2015): BFI-level 1
BFI (2014): BFI-level 1
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.667 SNIP 3.86
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.979 SNIP 1.549
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.949 SNIP 1.706
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.097 SNIP 1.051
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.974 SNIP 1.235
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.939 SNIP 1.326
Web of Science (2006): Indexed yes
Home processing and distribution of polyphenols and pesticides in apples

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute
Authors: Knuthsen, P. (Intern), Rasmussen, R. R. (Intern), Magnussen, E. L. (Ekstern), Ma, H. P. (Ekstern), Poulsen, M. E. (Intern)
Number of pages: 87
Publication date: 2003

Host publication information
Title of host publication: Abstracts books
Main Research Area: Technical/natural sciences
Conference: 1st International Conference on Polyphenols and Health, Vichy, France, 01/01/2003
Source: orbit
Source-ID: 239437
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Home processing of apples – the effect on pesticide residues

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute
Authors: Rasmussen, R. R. (Intern)
Event: Poster session presented at 1st International Symposium on Recent Advances in Food Analysis, Prague, Czech Republic.
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 243502
Publication: Research › Poster – Annual report year: 2003

Veterinære lægemiddelrester i fødevarer 2002: - resultater fra den danske kontrol med veterinære lægemiddelrester

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute
Authors: Rasmussen, R. R. (Intern)
Number of pages: 58
Publication date: 2003
Distribution of multiple pesticide residues in apple segments after home processing

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute
Authors: Rasmussen, R. R. (Intern)
Number of pages: 182
Publication date: 2002

Home processing and distribution of antioxidants and pesticides in apples

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute
Authors: Knuthsen, P. (Intern), Rasmussen, R. R. (Intern), Magnussen, E. L. (Ekstern), Ma, H. P. (Ekstern), Poulsen, M. E. (Intern)
Publication date: 2002

Host publication information
Title of host publication: Health promoting compounds in vegetables and fruit: Proceedings of workshop in Karrebæksminde
Editors: Brandt, K., Åkesson, B.
Main Research Area: Technical/natural sciences
Conference: Workshop in Karrebæksminde: Health promoting compounds in vegetables and fruit, Denmark, 01/01/2002
Source: orbit
Source-ID: 239436
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

Kobbers aktivitet og biotilgængelighed i mikrobiologiske vækstmedier: målt med en kobber-selektiv elektrode og en lux-biosensor baseret på Pseudomonas fluorescens

General information
State: Published
Organisations: Division of Food Chemistry, National Food Institute
Authors: Rasmussen, R. R. (Intern)
Number of pages: 65
Publication date: 1999

Publication information
Place of publication: Copenhagen, Denmark
Publisher: Den Kgl. Veterinær- og Landbohøjskole, Kemisk Institut
Original language: Danish
Projects:

**Udvikling af bæredygtige innovative fødevareingredienser på basis af ørredrestprodukter**

National Food Institute
Division of Industrial Food Research
Division of Food Chemistry
Period: 01/01/2014 → 31/12/2015
Number of participants: 11
Acronym: DANFomega
Project participant:
Nouard, Marie-Louise (Intern)
Nielsen, Henrik Hauch (Intern)
Sloth, Jens Jørgen (Intern)
Rasmussen, Rie Romme (Intern)
Berner, Lis (Intern)
Vu, Thi Thu Trang (Intern)
Hansen, Erik D. (Ekstern)
Ørum, Poul (Ekstern)
Barlach, Anders (Ekstern)
Project Manager, organisational:
Honoré, Lone (Ekstern)
Project Manager, academic:
Jacobsen, Charlotte (Intern)

Financing sources
Source: Public research programme (public)
Name of research programme: Grønt Udviklings- og DemonstrationsProgram (GUDP)
Amount: 10,940,907.00 Danish Kroner
Year of approval: 2014

**Udvikling af bæredygtige innovative fødevareingredienser på basis af ørredrestprodukter**

National Food Institute
Research Group for Bioactives – Analysis and Application
Research Group for Food Production Engineering
Research Group for Nano-Bio Science
Period: 01/01/2014 → 31/12/2015
Number of participants: 12
Acronym: DANFOMEGA
Project participant:
Barlach, Anders (Ekstern)
Honold, Philipp (Intern)
Sørensen, Ann-Dorit Moltke (Intern)
Nouard, Marie-Louise (Intern)
Jessen, Flemming (Intern)
Sloth, Jens Jørgen (Intern)
Rasmussen, Rie Romme (Intern)
Berner, Lis (Intern)
Vu, Thi Thu Trang (Intern)
**ECsafeSEAFOOD**. *Priority environmental contaminants in seafood: safety assessment, Impact and public perception*

Seafood has been recognised as a high-quality, healthy and safe food type and is one of the most important food commodities consumed worldwide. However, seafood, like other types of food, can also be a source of harmful environmental contaminants with potential to impact on human health.

ECsafeSEAFOOD will assess food safety issues related to priority contaminants present in seafood as a result of environmental contamination (including those originating from harmful algal blooms and those associated with marine litter) and evaluate their impact on public health. ECsafeSEAFOOD will provide scientific evidence to serve as a basis for further development of common food safety, public health and environmental policies and measures, by seeking to establish a quantitative link between the contamination of the marine environment and that of seafood.

[www.ecsafeseafood.eu](http://www.ecsafeseafood.eu)

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**Contaminants in food and feed: Inexpensive detection for control of exposure (CONffIDENCE)**

Safer food, through rapid and cost efficient tests for detecting chemical contaminants in food and animal feed, is the major goal of this project. It is co-ordinated by RIKILT, Institute of Food Safety, The Netherlands and the project consortium consists of 17 partners from 10 European countries. DTU Food is leader of WP3 on heavy metals, which focuses on the development of simplified and inexpensive methods for the determination of inorganic arsenic and methylmercury. Since seafood is the major dietary source for both arsenic and mercury in the European population, the project will focus on marine feed and seafood as sample matrices of interest. The methods developed at DTU Food are based on microwave assisted extraction techniques followed by solid phase extraction of the analyte of interest combined with detection with atomic absorption spectrometry (SPE-AAS). The method's performance will be evaluated in international collaborative trials and used in surveys on fish and fish feed.

[www.conffidence.eu](http://www.conffidence.eu)
Project participant:
Karp, Matti (Ekstern)
Hedegaard, Rikke Susanne Vingborg (Intern)
Rasmussen, Rie Romme (Intern)

Project Manager, organisational:
Sloth, Jens Jørgen (Intern)

Relations
Activities:
Arsenic compounds in foodstuffs –recent developments in speciation analysis and food safety assessment

Analysis of insulin binding by systematic amino acid scanning mutagenesis Importance of insulin B chain residues for receptor isoform binding

National Food Institute
Period: 01/05/2006 → 30/09/2010
Number of participants: 6
Phd Student:
Rasmussen, Rie Romme (Intern)
Supervisor:
Binderup, Mona-Lise (Intern)
Larsen, Thomas Ostenfeld (Intern)
Main Supervisor:
Rasmussen, Peter Have (Intern)
Examiner:
Jestoi, Marika Nadesta (Ekstern)
Purup, Stig (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Ansat eksternt
Project: PhD

Mycotoxins in maize silage to fed cattle
Maize silage is a widely used feed product at Danish cattle farms. Unfortunately growth of filamentous fungi is often seen on and in silage. This may result in mycotoxin contamination of the feed, which may harm the animals or result in toxins transferred to foodstuffs consumed by human. In this PhD project (2005 - 2010), the presence of mycotoxins in Danish maize silage are detected and evaluated by cytotoxicity testing: In vitro assays are applied to evaluate the toxicity of pure mycotoxins, extracts of fungi and silage. Mycotoxins in maize and silage will be quantitatively or qualitatively determined with existing and new chemical methods.

Department of Systems Biology
Division of Toxicology and Risk Assessment

National Food Institute
Aarhus University

Danish Plant Directorate
Danish Agricultural Advisory Service
Period: 01/12/2005 → 30/11/2008
Number of participants: 5
Project participant:
Larsen, Thomas Ostenfeld (Intern)
Thrane, Ulf (Intern)
Binderup, Mona-Lise (Intern)
Rasmussen, Peter Have (Intern)
Project Manager, organisational:
Rasmussen, Rie Romme (Intern)
Project
**Activities:**

**Effects of industrial processing on regulated and emerging contaminant levels in seafood**

**Period:** 26 Jan 2017

Rie Romme Rasmussen (Speaker)

National Food Institute

Research Group for Nano-Bio Science

**Description**

Abstract:

Contamination of food generally has a negative impact on the quality and may imply a risk to human health. Mercury (Hg) is one of the most hazardous compounds in our environment and is released from the earth’s crust by both natural and anthropogenic processes. The mercury species ‘methylmercury’ is highly toxic, because affects the function of enzymes, easily crosses the blood-brain and the placenta barriers and is toxic to the nervous system (especially the developing brain). It bioaccumulates and biomagnifies through the aquatic food chain. Methylmercury is the most common mercury species in fish and humans are also mainly exposed to methylmercury from consumption of fish and other seafood.

The aims of the present controlled fish feeding trials were to study the carryover from feed to fish fillets (at low spike levels (1x background level of methylmercury) and to determine toxicokinetic parameters.

The study included Atlantic salmon (Salmo salar), which is one of the main farmed seafood product consumed in Europe and with production in Northern Europe as well as European seabass (Dicentrarchus labrax) produced in Southern Europe, where it is a highly consumed seafood product.

The weight gain of the fish, their feed intake, feed and fish fillet contaminant level were determined to model the uptake and elimination of methylmercury. The toxicokinetics for feed with low levels of metylmercury (41-75 ng/g) showed high assimilation and low elimination.

Acknowledgments: The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under the ECsafeSEAFOOD project (grant agreement n° 311820).

Keywords: Season, Toxic elements, Halogenated organic contaminants, Cold smoking, Cooking, Peeling

co-authors: Weronica Håland(1); Bodil Katrine Larsen(2); Michiel Kotterman(3); Jens-Jørgen Sloth(1); António Marques(4); Kit Granby (1) (1) Technical University of Denmark (DTU), National Food Institute (2) Technical University of Denmark (DTU), National Institute of Aquatic Resources, Section for Aquaculture (3) Wageningen Marine Research (4) Portuguese Institute for the Sea and Atmosphere (IPMA), Division of Aquaculture and Upgrading.

Documents:

Rasmussen RR_Mitigation_ECsafeSEAFOOD presented 20170126 - campusnet

**Related event**

**Seafood Safety: New Findings & Innovation Challenges**

25/01/2017 → 26/01/2017

Brussels, Belgium

Activity: Talks and presentations › Conference presentations

**Seafood Safety**

**Period:** 25 Jan 2017 → 26 Jan 2017

Rie Romme Rasmussen (Participant)

National Food Institute

Research Group for Nano-Bio Science

**Description**

Final conference of the ECSafeSeaFood EU funded project.

Documents:

Seafood safety conference_Abstract book

Links:
Related event

**Seafood Safety: New Findings & Innovation Challenges**
25/01/2017 → 26/01/2017
Brussels, Belgium
Activity: Attending an event › Participating in or organising a conference

**Strategies for mitigation of contaminants in food**
**Period:** 4 Nov 2015
Rie Romme Rasmussen (Lecturer)
National Food Institute
Research Group for Nano-Bio Science

**Description**

Abstract:

Contamination of food generally has a negative impact on the quality and may imply a risk to human health. Mitigation measures can minimise the contaminant exposure by changes in the primary production, food processing or dietary recommendations. The best strategy depends on the specific problem. Here are three examples: There is a worldwide concern about dietary inorganic arsenic (iAs) exposure since long-term intake has been associated with a range of health problems, including skin lesions, cardiovascular diseases and some forms of cancer (EFSA 2014, FAO/WHO 2011). Food and drinking water are the main sources of exposure for the general population in Europe. The main source with the highest iAs concentration is rice. Changes in agricultural practice (environment, rice variety and color, and grain size), processing (polishing, boiling practice) and dietary recommendations (avoid rice crackers) can reduce the dietary exposure rice products (Sharma et al 2014). In fish fillet production the byproducts are at present turned into ensilage and sold as low priced animal feed. To increase the value of these byproducts high quality omega-3 fish oils and protein products intended for human consumption may be produced. Of cause it should comply with the existing EU maximum levels for heavy metals and dioxins. The aquaculture practice (feed, size, age, fat content) and byproduct fraction (intestine or head, tail and bone) influence the contamination level in the raw material. For removal of dioxins deodorization of fish oil at high temperature is recommended. Substituting marine oil in the feed with plant oil will not only decrease dioxins but also the omega-3 level significantly. Although pesticide residues seldom exceed the maximum residue limits (European Commission 2002) consumer awareness is high. Home processing can in some cases reduce the pesticide residues e.g. in apples by washing, boiling, peeling and juicing (Rasmussen et al 2002). The dietary risk assessment can be refined by taking into account changes in contaminant level during processing because of more accurate estimates of the actual consumer exposures. However the agricultural practice, pre-harvest interval from last application of pesticide to harvest, pesticide properties and weather will not only influence the residue level but also alter the effect of home processing practices.


Keywords: inorganic arsenic in rice, metals and dioxins in fish, pesticides in apples, mitigation, food processing

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co-authors: Tommy Licht Cederberg and Jens Jørgen Sloth from National Food Institute (DTU Food), Technical University of Denmark, Soeborg, Denmark

Documents:

Strategies for mitigation of contaminants in food_ RAFA 2015 Lecture 53 by RR Rasmussen et al

Related event

**7th International Symposium on Recent Advances in Food Analysis**
03/11/2015 → 06/11/2015
Prague, Czech Republic
Activity: Talks and presentations › Conference presentations
Methylmercury determined by HPLC-ICP-MS in marine food and feed: in-house method validation and inter-laboratory comparison

Period: 8 Nov 2013
Rie Romme Rasmussen (Lecturer)
National Food Institute
Division of Food Chemistry

Description
Abstract to RAFA 2013 submitted for the category: Industrial contaminants

Methylmercury determined by HPLC-ICPMS in marine food and feed; in-house method validation and interlaboratory comparison

Rie R. Rasmussen1, Maja E. Svendsen1, Heidi Amlund2, Martijn van der Lee3, Inge Rokkjær4 and Jens J. Sloth1*

1) National Food Institute (DTU Food), Technical University of Denmark, Soeborg, Denmark
2) National Institute of Nutrition and Seafood Research (NIFES), Bergen, Norway
3) RIKILT – Institute of Food Safety, Wageningen, The Netherlands
4) Danish Veterinary and Food Administration, Laboratory Aarhus (Chemical), Lystrup, Denmark
*) Corresponding author e-mail: jjsl@food.dtu.dk; Phone +45 35887625

Mercury (Hg) is one of the most hazardous compounds in our environment and is released through natural and anthropogenic processes. It occurs as elemental mercury (metallic), inorganic mercury or organic mercury. Inorganic mercury and the organic mercury compound, methylmercury, are the two major mercury species found in the environment. The toxicity is highly dependent on the chemical form and methylmercury is particularly toxic as it affects the functions of enzymes and is toxic to the nervous system (with the developing brain as most the most sensitive target).

Currently only total mercury in foodstuffs is regulated by the European Union but accurate estimation of methylmercury exposure is needed for better evaluation of food safety. European Food Safety Authority established in 2012 a maximum tolerable weekly intake at 1.3 µg/kg body weight for methylmercury. Fully validated and standardized methods for determination of organic mercury levels in foods are currently missing.

Here results from an in-house validation and an interlaboratory comparison study are presented for a simple HPLC-ICPMS method developed for methylmercury in marine based food and feed extracted with 5 M hydrochloric acid by sonication. The extraction step was carried out twice, the pH was increased and the extracts were diluted in mobile phase and filtrated (0.45 μm) prior to HPLC-ICP-MS analysis. Quantification of methylmercury (m/z 202) in the sample extracts was achieved by cation exchange separation (Hamilton PRP-X200, 150×2.1 mm, 10 μm) and calibration standards prepared in mobile phase. The mobile phase (0.20 ml/min) consisted of 0.5% (w/v) L-cysteine, 50 mM pyridine, 0.8% (v/v) formic acid, 5% (v/v) MeOH and had a pH 3.

The in-house validation included certified reference materials of marine origin (TORT-2, DORM-2 and DORM-3) and 4 other marine samples which were analysed in triplicates on 3 different days. The individual results were within the certified ranges. The limit of detection was 0.004 mg/kg and the in-house reproducibility standard deviations were less than ≤20% for samples containing 0.06 to 4.47 mg/kg.

The small-scale collaborative study included four different laboratories that analysed 6 different marine food and feed samples in duplicate on two different days. For some samples one outlying dataset were excluded from the evaluation as Cochran or Grubbs outlier (following ISO 5725-2). The results were in general satisfactory in the tested range (0.2-5.7 mg/kg). The reproducibility standard deviations were less than ≤13%, HorRat values below 0.9 and the overall means for the reference materials (DORM-3, TORT-2, CE464 Tunafish) were in agreement with the certified values.

Pitfalls for application of the method are; carry over between HPLC injections, calculations (exact extraction volume is critical for re-extraction) and careful interpretation of methylmercury certificates (which can be given as e.g. Hg, as CH3Hg or CH3HgCl).

Keywords: Metylmercury, speciation, HPLC-ICPMS, validation, interlaboratory comparison

Acknowledgement:
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Related event
Inorganic arsenic determined by SPE separation and AAS detection - a novel speciation approach

Period: 3 Nov 2011

Rie Romme Rasmussen (Speaker)
National Food Institute
Division of Food Chemistry

Description
Arsenic (As) is a naturally occurring element, which is found at concentrations in the mg/kg range in marine animals. The element is bioaccumulated from seawater. It has a very complex chemistry and more than 50 naturally-occurring arsenic containing species, both inorganic and organic forms, have been identified in marine animals. The organic forms are mainly considered to be non-toxic, whereas inorganic arsenic is highly toxic and exposure may lead to severe adverse effects including cancer. An accurate estimation of inorganic arsenic exposure is therefore highly relevant for evaluation of food safety. However, so far most of the occurrence data collected in the official EU food control are still reported as total arsenic. A simple and inexpensive method for determination of inorganic arsenic in marine based food and feed by hydride generation atomic absorption spectrometry (HG-AAS) after microwave extraction and separation by solid phase extraction (SPE) has been developed and validated. The SPE separation is based on the different charges (pKa values) of the arsenic species at specific pH, which allow selective elution of organic arsenic compounds (e.g. MA, DMA and AB) and inorganic arsenic in the form of As(V). The sample is heated with a hydrochloric acid and hydrogen peroxide solution (20 minutes at 90 °C with 0.06 M HCl, 3 % H2O2). Hereby the sample is solubilised and As(III) is oxidised to As(V). Inorganic arsenic is selectively separated from other arsenic compounds using strong anion exchange SPE. The procedure include first pre-condition of the column, then loading of the buffered samples (pH 5.0-7.5), washing with 0.5 M acetic acid and finally elution of the sample from the column by 0.5 M HCl. The concentration of arsenic is determined by HG-AAS using external standards. SPE method development and sample extraction was evaluated using a selective HPLC-ICP-MS detection method. No degradation or conversion of organic arsenic species such as AB, MA or DMA were observed under the chosen extraction conditions. The results obtained by SPE-HG-AAS and HPLC-ICP-MS were not significantly different (95% confidence). The method was validated by spiked and naturally incurred marine samples. The limit of detection was 0.08 mg/kg and the in-house reproducibility standard deviations were less than ≤13% for samples containing 0.2 to 1.5 mg/kg inorganic arsenic. The method has furthermore been tested in a collaborative trial on marine feed and food with a satisfactory result and is now in the process for CEN approval as a future European standard method. Acknowledgement: Funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 211326.

Documents:
L38 RAFA2011 Rie Romme Rasmussen_online.pdf

Related event

5th International Symposium on Recent Advances in Food Analysis
01/11/2011 → 04/11/2011
Prague, Czech Republic
Activity: Talks and presentations › Conference presentations

Nordic Baltic Fusarium Seminar: Occurrence of Fusarium toxins in Danish cereals and maize silage
Period: 23 Nov 2010 → 25 Nov 2010
Rie Romme Rasmussen (Speaker)
National Food Institute
Division of Food Chemistry

Description
Place: Ski, Norway

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations
**Mycotoxins in maize silage - Detection of toxins and toxicological aspects**  
Period: 20 Sep 2010  
Rie Romme Rasmussen (Speaker)  
National Food Institute  
Division of Food Chemistry  

**Description**  
PhD defence  
Place: Technical University of Denmark  
Documents:  
2010-09-20 PhD defence DTU _Rie Romme Rasmussen_Mycotoxins in maize silage - Detection of toxins and toxicological aspects.pdf  

**Related external organisation**  
Unknown external organisation  
Activity: Talks and presentations › Conference presentations  

**Detection of 27 secondary fungal metabolites in maize silage by rapid extraction and LC-MS/MS**  
Period: 17 Sep 2010 → 18 Sep 2010  
Rie Romme Rasmussen (Speaker)  
National Food Institute  
Division of Food Chemistry  

**Description**  
Place: University of Copenhagen, Denmark  
Documents:  
2010-08-17_18 10th Danish Analytical Chemistry Symposium University of Copenhagen_Storm and Rasmussen_Detection of 27 secondary fungal metabolites.pdf  

**Related event**  
10th Danish Symposium on Analytical Chemistry  
17/08/2010 → 18/08/2010  
Copenhagen, Denmark  
Activity: Talks and presentations › Conference presentations  

**Mycotoxins and other secondary metabolites in maize silage**  
Period: 14 Jun 2010  
Rie Romme Rasmussen (Speaker)  
National Food Institute  
Division of Food Chemistry  

**Description**  
Place: Technical University of Denmark  
Documents:  
2010 Presentation 32nd Mycotoxin Workshop DTU_Rasmussen_Mycotoxins and other secondary metabolites in maize silage.pdf  

**Related event**  
32nd Mycotoxin Workshop  
14/06/2010 → 16/06/2010  
Kgs. Lyngby, Denmark  
Activity: Talks and presentations › Conference presentations  

**Det Jordbrugsvidenskabelige fakultet: Svampe og mykotoksiner i majsensilage**  
Period: 25 Mar 2010
Rie Romme Rasmussen (Speaker)
National Food Institute
Division of Food Chemistry

**Description**
Place: Århus Universitetet, Danmark
Documents:
2010-03-25 Presentation Temamøde Aarhus University Thrane_Svampe og toksiner i ensilage.pdf

**Related external organisation**
**Unknown external organisation**
Activity: Talks and presentations › Conference presentations

**In vitro cytotoxicity of mycotoxins and fungal strains from Danish maize and silage**
Rie Romme Rasmussen (Speaker)
National Food Institute
Division of Food Chemistry

**Description**
Place: Istanbul, Turkey

**Related external organisation**
**Unknown external organisation**
Activity: Talks and presentations › Conference presentations

**Evaluation of mycotoxin hazard in maize silage by in vitro cytotoxicity testing and LC-MS/MS analysis**
Rie Romme Rasmussen (Speaker)
National Food Institute
Division of Food Chemistry

**Description**
Place: Kick of meeting DFFE project: Mycotoxin carry-over from maize silage via cattle into dairy products at Hindsgavl Slot, Denmark

**Related external organisation**
**Unknown external organisation**
Activity: Talks and presentations › Conference presentations

**Press clippings:**

**Cadmium i chokolade**
Rie Romme Rasmussen
23/02/2015

**Subject**
Cadmium i chokolade
National Food Institute, Division of Food Chemistry

**Media contribution (1)**

**Cadmium i chokolade**
23/02/2015
DR Videnskab, Television
Sidsel Miller Hansen