# Review of various animal health and food safety hazards derived from feed

First OIE/FAO-APHCA Regional Workshop on Feed Safety - Feed borne Disease Prevention

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# Outline

- Introduction: Feed production
- Examples of contaminant incidents and accidents
- Examples of hazards
  - Chemicals and toxins
    - Synthetic chemicals (including pesticides)
    - Natural chemicals
    - Elements (incl heavy metals)
    - Radionuclides
    - Marine toxins
    - Phytotoxins
    - Veterinary medicines
    - Restricted animal materials (RAM)
  - Biological agents
    - Bacteria, Viruses, Fungi, Protozoa, Helminths
    - Prions
    - Antimicrobial resistance determinants
- Prioritizing hazards
  - Risk profiles

# Compound Feed Production

| Mill MT | 2000 | 2004 | 2008 | 08/00 % |
|---|---|---|---|---|
| Australia | 8.1 | 8.5 | 8.2 | 1 |
| China | 57.0 | 63.1 | 106.6 | 88 |
| Indonesia | 4.5 | 6.0 | 8.1 | 80 |
| Japan | 24.1 | 23.9 | 24.5 | 1 |
| Korea (Rep) | 14.9 | 14.8 | 16.1 | 8 |
| Philippines | 4.4 | 5.9 | 6.3 | 43 |
| Thailand | 9.4 | 8.1 | 11.4 | 21 |
| Vietnam | 2.0 | 5.5 | 8.6 | 430 |
| USA | 142.0 | 147.0 | 154.5 | 8 |

Watt Publishing 2009, quoted by Meggison & Robertson,
Australasian Milling Conference April 2010

# Definitions

FAO/WHO. 2007. Codex Alimentarius principles for risk analysis

- **Hazard:** A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect
- **Exposure assessment:** The qualitative and/or quantitative evaluation of the likely intake of biological, chemical, and physical agents via food, as well as exposures from other sources if relevant
- **Risk:** A function of the probability of an adverse health effect and the severity of that effect, consequential to a hazard in food
- **Risk profile:** The description of the food safety problem and its context

# Examples of contaminant incidents and accidents

# Michigan's PBB Incident: Chemical Mix-Up Leads to Disaster

Carter, L. J. (1976). "Michigan's PBB Incident: Chemical Mix-Up Leads to Disaster." Science **192**(4236): 240-243.

# Mirex: An Unrecognized Contaminant of Fishes from Lake Ontario

Abstract. *A perchlorinated, cage-structured hydrocarbon, $C_{10}Cl_{12}$, also known as mirex or Dechlorane, has been identified in fish samples from the Bay of Quinte, Lake Ontario, Canada. The compound coelutes with polychlorinated biphenyls (PCB's) in residue cleanup procedures and under standard gas chromatographic conditions. Mirex has never been registered for use as an insecticide in Canada, nor does it appear to be in use in any area of the United States discharging water into Lake Ontario or its tributaries. It seems likely, therefore, that this compound is another widespread environmental contaminant of extremely high geochemical stability and as yet only superficially investigated biological activities. Under standard gas chromatographic conditions its peak is superimposed on that of the PCB's, and, as a result, the presence of mirex may have been unrecognized and it may therefore have been misinterpreted as a PCB isomer.*

Kaiser, K. L. E. (1974). "Mirex: An Unrecognized Contaminant of Fishes from Lake Ontario." Science **185**(4150): 523-525.

*Clinical Toxicology*, 43:595–596, 2005

ISSN: 0731-3810 print / 1097-9875 online
DOI: 10.1081/CLT-200068868

LETTER

# Pacific Volcanoes, Mercury Contaminated Fish, and Polynesian Taboos

# Toxic Polyneuropathy Due to Flour Contaminated with Tricresyl Phosphate in China

Wang, D., Y. Tao, et al. (1995). "Toxic Polyneuropathy Due to Flour Contaminated with Tricresyl Phosphate in China." Clinical Toxicology **33**(4): 373-374.

*Scandinavian Journal of Infectious Diseases*, 2010; Early Online, 1–7

**ORIGINAL ARTICLE**

# Contaminated water caused the first outbreak of giardiasis in Finland, 2007: A descriptive study

Environmental Toxicology and Pharmacology 25 (2008) 164–170

# The Belgian PCB/dioxin crisis—8 years later
# An overview

Adrian Covaci [a,b,*], Stefan Voorspoels [a], Paul Schepens [a], Philippe Jorens [c], Ronny Blust [b], Hugo Neels [a]

In January 1999, 50 kg polychlorinated biphenyls (PCBs) contaminated with 1 g dioxins were accidentally added to a stock of recycled fat used for the production of 500 tonnes animal feed in Belgium. Although signs of poultry poisoning were noticed by February 1999, the extent of the contamination was publicly announced only in May 1999, when it appeared that more than 2500 poultry and pig farms could have been involved. This has resulted in a major food crisis, known worldwide as the "Belgian PCB/dioxin crisis". The crisis was resolved by the implementation of a large food monitoring program for the seven PCB markers (PCBs 28, 52, 101, 118, 138, 153 and 180). When PCB concentrations exceeded the tolerance levels of 100, 200 or 1000 ng/g fat for milk, meat or animal feed, respectively, the 17 toxic polychlorinated dibenzodioxins and furans (PCDD/Fs) congeners were also determined. By December 1999, more than 55,000 PCB and 500 dioxin analyses were already done by Belgian and international laboratories. The highest concentrations of PCBs and dioxins and the highest percentage of affected animals were found in poultry. Several important consequences of the food crisis were: (1) the introduction in 1999 of norms for PCBs in feedstuffs and food in Belgium followed by the introduction in 2002 of European harmonized norms for PCDD/Fs in animal feed and food of animal origin; (2) the systematic national monitoring of food of animal origin; and (3) the creation of the Federal Agency for Food Safety in Belgium. The human health risk following this major incident was assessed with contradictory results. It was suggested that, since only a limited proportion of the food chain was contaminated, it is unlikely that adverse effects were inflicted in the Belgian population. However, another assessment suggests that neurotoxic and behavioural effects in neonates, together with an increase in the number of cancers, may be observed.

# ORGANO-HALOGEN PESTICIDE RESIDUE INCIDENTS

| | |
|---|---|
| 1976<br>Australia | Toxaphene contaminated fishmeal from South Africa incorporated into cat food in Australia resulting in toxicity and death. |
| 1981-2<br>Hawaii | Milk from dairy cattle consuming heptachlor-treated pineapple foliage contaminated the milk supply of Oahu for a period of 15 months. |
| 1980s<br>NSW | Cattle with MRL violations after grazing land previously treated with heptachlor to control pests of potatoes and maize |
| 1980s<br>WA | Cattle grazed on soils previously treated with dieldrin and aldrin to control pests of potatoes or soils in the vicinity of fruit trees or electricity poles treated with aldrin to provide protection from white ant invasion. |
| 1987-1991<br>Victoria | Residue concerns in cattle grazing land previously producing tobacco that had been treated with aldrin and dieldrin led to the quarantine of 35 herds. |
| 1994<br>NSW, QLD | Chlorfluazuron (CFZ) (Helix) residues detected in meat from cattle. Beef exports rejected by Japan and USA and around 3,000 beef operations quarantined. Contamination arose after drought feeding of cattle with cotton trash |

# ORGANOHALOGEN INDUSTRIAL CHEMICAL RESIDUE INCIDENTS

| | |
|---|---|
| 1947<br>USA | X-disease of cattle (hyperkeratosis)<br>Chlorinated naphthalenes added to lubricants to improve physical properties<br>Contamination of cattle feed and licking of axle grease on farm implements |
| 1957, 1960<br>USA | Chick oedema – toxic fat syndrome arising from TCDD contaminated fat in feed. |
| 1968<br>Japan | Chick oedema, – PCB contamination (by same factory that supplied rice oil leading to Yusho disease in humans) |
| 1969<br>USA | Chick oedema, – contaminated soapstock added to feed |
| 1973<br>Michigan | In early 1973, both PBB (sold under the trade name FireMaster) and magnesium oxide (a cattle feed supplement sold under the trade name NutriMaster) were produced at the same St. Louis, Michigan plant by the Michigan Chemical Company. A shortage of preprinted paper bag containers led to 10 to 20 fifty-pound bags of PBB accidentally being sent to Michigan Farm Bureau Services in place of NutriMaster. |
| 1976<br>France | Hyperkeratosis - chlorinated naphthalenes<br>Mass intoxication of cattle grazing in vicinity of a factory producing wax. |
| 1998<br>Germany | A routine monitoring programme in Germany detected unacceptable dioxin levels in milk and butter. The origin of the contamination was traced to the feeding of citrus pulp pellets, obtained from Brazil, and exported to supply a global market. |
| 1999<br>Belgium | In January 1999 500t of feed contaminated with approximately 50kg PCBs (with around 1g of dioxins) was distributed to farms in Belgium, the Netherlands, France and Germany. Chickens were observed manifesting the classical signs of oedema disease. Investigations of tissue samples revealed the presence of a PCB congener profile consistent with that of a commercial PCB mixture commonly found in transformers. The source was traced to a fat-rending company that used transformer oil in the manufacture of feeds. |

# ORGANOHALOGEN INDUSTRIAL CHEMICAL RESIDUE INCIDENTS

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|---|---|
| 2000<br>Germany | A routine monitoring programme in Germany detected unacceptable dioxin levels in a choline chloride premix used as an animal feed component. Investigations revealed that the pine sawdust used as the carrier was produced from pine treated with pentachlorophenol contaminated with PCDDs and PCDFs. |
| 2002<br>Germany | An anonymous telephone call alerted authorities in Germany to the presence of nitrofen (an organochlorine herbicide) in organic feed and tissues of animal origin. Ultimately it was determined that cross contamination of feed grain had taken place in a warehouse used to store obsolete plant protection compounds. Around 2 million eggs and 37,000 animals (chickens and turkeys) were destroyed. |
| 2002<br>Switzerland | Report of PCDD and PCDF contamination in feedstuffs attributed to kaolin used as an anti-caking agent. |
| 2003<br>Germany | Animal feed produced by a company in Thuringia was found to contain around 15 times the permitted level of dioxin. Over 100t of possibly contaminated feed could have been exported to the Netherlands. |
| 2004<br>India | High levels of dioxins were found in the milk of dairy cattle kept in the vicinity of a municipal waste dumping site. |
| 2004<br>Holland | Routine sampling of Dutch Milk revealed unacceptably high levels of dioxins. Investigations traced the source to potato peelings supplied by a McCain's potato processing plant. The peelings had become contaminated by marly clay during washing. Around 162 pig, cattle, sheep and goat farms in Holland were temporarily closed. |
| 2008<br>Ireland | During routine monitoring of Irish pork, elevated levels of polychlorinated biphenyls (PCBs) were found. Further investigations revealed the presence of dioxins and dioxin-like PCBs at levels up to 200 pg WHO TEQ / g fat |

# ORGANOHALOGEN INDUSTRIAL CHEMICAL INCIDENTS

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|---|---|
| 1961-1971 Vietnam | Nearly 19.5 million gallons of herbicide were sprayed on the Republic of Vietnam during the military exercise of Operation Ranchhand. The herbicides used included 2,4,5-T which contained dioxin as a contaminant. Large tracts of agricultural land and water courses would have received significant exposure. While exported food products appear to be free of unacceptable dioxin residues, elevated concentrations of TCDD (the dioxin characteristic of Agent Orange) have been found in some domestic food products (for example duck, chicken and fish, but not beef or pork). |
| 1968 Japan | Yusho: More than 1600 people affected from PCB and PCDF contamination of rice oil following leakage of heat exchanger. |
| 1976 Seveso, Italy | Seveso, Italy 10 July 1976 – batch reactor in a 2,4,5-trichlorophenol plant overheated and discharged its contents through a relief valve directly to the outside air. This accident exposed thousands of residents of Seveso (many of whom remain subject to epidemiological study) to TCDD and led to the introduction of significant changes in industrial law. |
| 1979 Taiwan | Yu Cheng – rice oil contaminated with PCDF. Discovered after an epidemic of chloracne and hyperpigmentation in oil consumers. |
| 1979 Billings, Montana | PCBs leaked from a damaged electrical transformer and contaminated animal feed which was distributed to 19 US states, Canada and Japan where it was fed to pigs, cattle and poultry. Routine residue surveillance identified the first case of PCB contamination in poultry in Utah leading to an intensive investigation that traced the source. Ultimately 800,000 chickens, 3.8 million eggs, 4000 pigs, 400t of animal feed and 600t of grease were destroyed. |
| 1997 USA | Elevated dioxin levels found in 2 of 80 poultry samples in a national survey. The pattern of dioxin congeners was similar to that found in an earlier residue detection in catfish. An intriguing investigation revealed that the source of the dioxin contamination was ball clay (mainly kaolin and illite clays), deposited in the Mississippi embayment more than 30 million years ago. |

# RADIONUCLIDE ACCIDENTAL RELEASE

| | |
|---|---|
| 1957<br>Kyshtym, Soviet Union | A major accident occurred on 29 September 1957 at the Chelyabinsk-40 military plutonium production facility when the cooling system failed. Major contaminants released included $^{144}Ce$, $^{95}Zr$, $^{95}Nb$ and $^{90}Sr$. Most fission products were deposited on the ground locally due to calm wind conditions allowing $^{90}Sr$ to enter the food chain and resulting in the destruction of 10,000t of agricultural produce in the first two years. |
| 1957<br>Windscale, UK | In October 1957 during routine release of stored energy from a graphite moderated nuclear reactor, operator error allowed fuel to overheat and a graphite fire to break out. Carbon dioxide extinguishers were ineffective and water was applied directly to the fire resulting in the release of 740 TBq $^{131}I$, 22TBq $^{137}Cs$, 8.8TBq $^{210}Po$ and lesser amounts of $^{106}Ru$ and $^{133}Xe$. Contamination of pastureland was widespread locally and the greatest immediate threat to human health was presented by $^{131}I$ in the milk from grazing dairy cattle, leading to the banning of local milk distribution for sale. Highest individual human doses were to the thyroids of children (approximately 100mGy) but no adverse radiation impact on public health has been detected. |
| 1966<br>Palomares, Spain | On January 16 1966 two B52 aircraft each carrying two thermonuclear devices containing $^{239}Pu$ collided when refueling over Spain, burst into flame and broke apart scattering the four weapons in the vicinity of Palomares. Two devices landed intact and were later recovered. The other devices detonated and exploded releasing plutonium locally, one in nearby mountains and the fourth on agricultural land. Dispersion of radioactivity was assisted by a 50km/hr wind and approximately 2.25km$^2$ of farmland was contaminated. |

# RADIONUCLIDE ACCIDENTAL RELEASE

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|---|---|
| 1968<br>Thule,<br>Greenland | A US Air Force plane, carrying four unarmed 1.1 megaton nuclear weapons, experienced an on-board fire and crashed while attempting an emergency landing near Thule. Approximately 1 TBq of radioactivity was released in the form of $^{239}Pu$, $^{240}Pu$, $^{238}Pu$ and $^{241}Am$ locally. Later investigations found plutonium levels in bivalves and crustacea to be increased 10 to 1,000 fold over pre-accident levels. |
| 1979<br>Three Mile Island,<br>Pennsylvania | Human error allowed a reactor core to overheat and partially melt releasing radioactive material through a relief valve and onto the containment room floor. Enormous financial losses were incurred but the containment vessel was not breached and virtually no radioactivity escaped. Although $^{131}I$ was detectable in milk, the levels were below the action threshold and the impact on the milk supply was minimal. The average dose to the general public within 80km was estimated to be 0.000015Sv, which can be compared with the natural annual background radiation dose of 0.003Sv. |
| 1986<br>Chernobyl,<br>Ukraine | On April 25/26 there was an accident at the civilian nuclear reactor facility at Chernobyl (first reported after detection of radioactive fallout in Sweden) which resulted in the largest accidental release of radioactivity ever experienced. The volatile radioactive elements $^{131}I$ and $^{137}Cs$ were spread over large areas of the former Soviet Union and Western Europe. The pattern of dispersion was complex and highest in areas where rainfall intercepted the radioactive plume. Less volatile elements, isotopes of strontium and plutonium were mainly deposited within 30 km of the reactor as small particles of radioactive fuel. Approximately 150,000 people were evacuated from land with $^{137}Cs$ deposition greater than 1,480kBq $m^{-2}$, to ensure that lifetime radiation dose from Chernobyl radiocaesium was less than 350mSv. Radiation protection, especially in relation to prevention of intake of radioiodine was inadequate and an astounding increase (up to 30 times) in thyroid cancers in children who were up to 18 years old at the time of the accident has been observed. Approximately 200,000 healthy foetuses were aborted in response to fear that radiation exposure may have been damaging. The foodchain was significantly impacted on a transcontinental scale and restrictions on foodstuffs were implemented across Europe, particularly to control exposure to the longer lived $^{137}Cs$. Thousands of square kilometres of land in Ukraine, Russia and Belarus cannot be used for agricultural production well into the future. The sale and slaughter of more than 4 million sheep on almost 9,000 holdings in the UK was affected and restrictions were applied to goat milk, reindeer, sheep meat, game animals and freshwater fish in parts of Scandinavia. |

# HEAVY METAL INCIDENTS

| | |
|---|---|
| 1956<br>Minamata, Japan | The Chisso Corporation, a petrochemical company, had been discharging heavy metal waste into the sea. Inorganic mercury catalysts were biomethylated in benthic sediments by methanogenic archaea. Methyl mercury was introduced into the food chain after absorption by plankton which in turn was consumed by fish through which biomagnification progresses. Piscivorous cats were first noticed to exhibit nervous signs and strange behaviour. Later fish, birds and then humans were affected. Over 1400 people died and around 20,000 were poisoned. |
| 1972<br>Iraq | Grain treated with methyl mercury as a fungicide and intended for planting was diverted to a flour mill and ultimately consumed as bread. To preclude unintended use, the grain had been dyed red and was packaged in containers with warning labels in English and Spanish. Unfortunately neither language was understood and 459 people were reported to have died. This episode followed other serious epidemics with treated grain in Iraq in 1956 and 1960. |
| 2005<br>Bangladesh | In the 1970s a safe water programme was undertaken by WHO and other philanthropic bodies to protect the population from water-borne diseases such as cholera, typhoid and dysentery that were the most important cause of childhood mortality. Tragically and ironically, though the tube wells installed provide clear and microbially pure water, the water now contains arsenic that had already resulted in more than 220,000 cases of chronic arsenic poisoning by the early 1990s and is continuing to expose 35-77 million inhabitants, constituting the largest mass poisoning of a human population in history. The WHO guideline for drinking water recommends <10µg/l arsenic. The Bangladesh standard for arsenic is <50 µg/l and tubewells have extreme concentrations greater than 500 µg/l. It has been estimated that the excess lifetime risk of death from liver, bladder and lung cancers has doubled. Preliminary assessments have not demonstrated that the arsenic content of local foods exceeds acceptable levels, with the exception of some sources of rice. |

# Examples of Hazards

From: owner-promed-ahead-edr@promed.isid.harvard.edu on behalf of ProMED-mail [promed@promed.isid.harvard.edu] Sent: Sun 11/07/2010 2:27 PM
To: promed-ahead-edr@promedmail.org
Cc:
Subject: PRO/AH/EDR> Aflatoxin, canine - Tanzania

AFLATOXIN, CANINE - TANZANIA
****************************
A ProMED-mail post
<http://www.promedmail.org>
ProMED-mail is a program of the
International Society for Infectious Diseases <http://www.isid.org>

Date: 9 Jul 2010
From: Dr. Giuseppe Di Giulio [edited]
<merlinovettz@habari.co.tz>

A total of 45 dogs have died so far, since the end of June 2010, in Arusha (Tanzania), due to aflatoxin contaminated maize or maize flour, but there are no reports of any human beings affected.

From: owner-promed-ahead-edr@promed.isid.harvard.edu on behalf of ProMED-mail [promed@promed.isid.harvard.edu] Sent: Mon 12/07/2010 12:18 AM
To: promed-ahead-edr@promedmail.org
Cc:
Subject: PRO/AH/EDR> Campylobacteriosis, E. coli O157, unpasteurized goat milk - USA: (CO)

CAMPYLOBACTERIOSIS, E. COLI O157, UNPASTEURIZED GOAT MILK - USA: (COLORADO)
**************************************************************************
A ProMED-mail post
<http://www.promedmail.org>
ProMED-mail is a program of the
International Society for Infectious Diseases <http://www.isid.org>

[1]
Date: Fri 9 Jul 2010
Source: The Denver Channel [edited]
<http://www.thedenverchannel.com/news/24195471/detail.html>

State health officials said tests show that raw goat milk from a Longmont dairy is responsible for sickening 30 people, including 2 children who are in the hospital. Health officials said Thursday [8 Jul 2010] that samples of unpasteurized milk from the Billy Goat Dairy tested positive for the strains of _Campylobacter_ and _E.
coli_ that have made the people sick.

# EFSA PANEL ON CONTAMINANTS IN THE FOOD CHAIN

http://www.efsa.europa.eu/en/panels/contam.htm

# SYNTHETIC CHEMICALS

- 3-MCPD esters
- Acrylamide
- Aldrin
- Brominated flame retardants (PBBs)
- Camphechlor
- Chlordane
- DDT
- Dioxins, furans and dioxin-like polychlorinated biphenyls (PCBs)
- Endosulfan
- Endrin
- Ethyl carbamate
- Gamma-HCH and other hexachloro-cyclohexanes
- Heptachlor
- Hexachlorobenzene
- Melamine
- Mineral oil
- Non dioxin-like polychlorinated biphenyls (PCBs)
- Perfluorooctane sulfonate (PFOS) perfluorooctanoic acid (PFOA) and their salts
- Polycyclic Aromatic Hydrocarbons (PAHs)

# Chemical Hazard Groups

- Overall, chemical contaminants can be divided into three major classes
  - (1) compounds rapidly metabolized and excreted eg acrylamide
  - (2) compounds with low level accumulation in the animal, eg lindane ($\gamma$-HCH )
  - (3) compounds with high accumulation in the animal. eg DDT

# Persistent Organic Pollutants

POPs

# Characteristics of POPs
## (Stockholm Convention Annex D)

**Toxicity**

- Toxicity data indicating potential for significant damage to human or environmental health.

**Persistence**

- Half life in water > 2 months
- Half life in soil > 6 months
- Half life in sediment > 6 months

**Bioaccumulation**

- Bioaccumulation factor (BCF) in aquatic species > 5,000
- Log Kow > 5

**Potential for Long-Range Environmental Transport**

- Concentration of chemical measured at level of potential concern in locations distant from source
- Monitoring data demonstrate long-range transport via air, water or migratory species
- Environmental fate properties (or models of fate) of chemical demonstrate potential for long-range transport.

## STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS

**The Initial Twelve POPs**

POPs in Annex A (Elimination), B (Restriction) or C (Unintentional Production)

22 May 2001

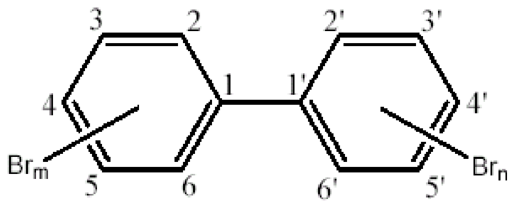
| POLLUTANT | DECISION | SPECIFIC EXEMPTION |
|---|---|---|
| **Organochlorine (OC) or Chlorinated Hydrocarbon Pesticides** | | |
| Aldrin | Eliminate | Local ectoparasiticide |
| Chlordane | Eliminate | Local ectoparasiticide, termiticide |
| DDT [1,1’-(2,2,2-trichloro-ethylidene)-bis(4-chlorobenzene)] | Restrict | Disease vector control |
| Dieldrin | Eliminate | Agricultural operations |
| Endrin | Eliminate | None |
| Heptachlor | Eliminate | Termiticide (esp subterranean) |
| Mirex | Eliminate | Termiticide |
| Toxaphene | Eliminate | None |
| **Industrial Chemicals** | | |
| Hexachlorobenzene* | Eliminate | Solvent in pesticide, intermediate in closed systems |
| Polychlorinated biphenyls (PCBs) | Eliminate (by 2025) | None |
| **Unintentional Anthropogenic Production** | | |
| Polychlorinated dibenzo-*p*-dioxins (PCDDs) | Prevent formation and release | None |
| Polychlorinated dibenzofurans (PCDFs) | Prevent formation and release | None |
| PCBs | Prevent formation and release | None |

* not to be confused with the OC ‘benzene hexachloride’ (BHC), the misnomer for $\gamma$-hexachlorocyclohexane or lindane

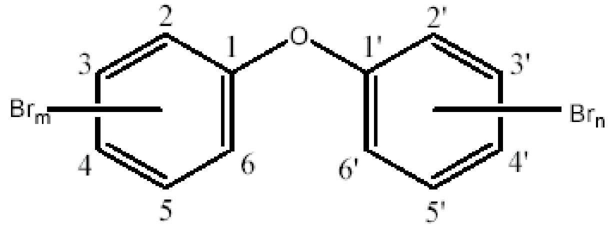
| 9 NEW POPs<br>At its fourth meeting held from 4 to 8 May 2009, the Conference of the Parties (COP), by decisions SC-4/10 to SC-4/18, adopted amendments to Annexes A (elimination), B (restriction) and C (unintentional production) of the Stockholm Convention to list nine chemicals as persistent organic pollutants<br>http://chm.pops.int/Programmes/NewPOPs/The9newPOPs/tabid/672/language/en-US/Default.aspx | | |
|---|---|---|
| **POLLUTANT** | **DECISION** | **SPECIFIC EXEMPTION** |
| Chlordecone | Annex A | None |
| Hexabromobiphenyl | Annex A | None |
| Hexabromodiphenyl ether and heptabromodiphenyl ether | Annex A | Use as articles containing these chemicals for recycling in accordance with the provision in Part IV of Annex A |
| Alpha hexachlorocyclohexane | Annex A | None |
| Beta hexachlorocyclohexane | Annex A | None |
| Lindane | Annex A | Use as a human health pharmaceutical for control of head lice and scabies as second line treatment |
| Pentachlorobenzene (PeCB) | Annex A | None |
| Perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOS-F) | Annex B | **Acceptable purposes**<br>**Specific exemptions** |
| Tetrabromodiphenyl ether and pentabromodiphenyl ether | Annex A | Use as articles containing these chemicals for recycling in accordance with the provision in Part IV of Annex A |

# INDUSTRIAL CHEMICALS AND UNINTENDED BYPRODUCTS

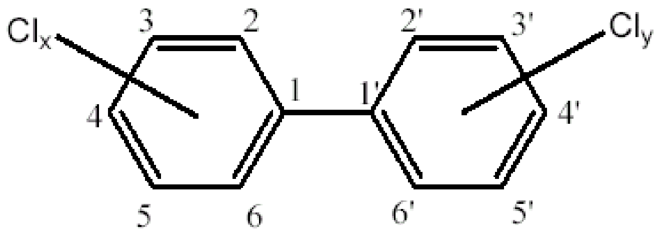
PBBs, PCBs, PCP, PCDDs, PCDFs, PAHs



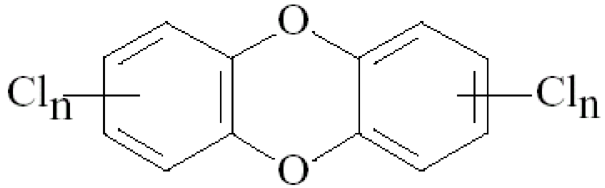

**PBBs**
(m+n =1-10)



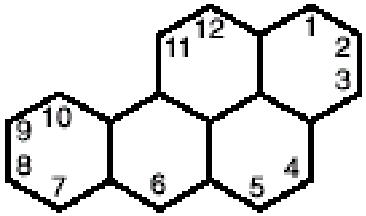

**PBDEs**
(m+n=1-10)



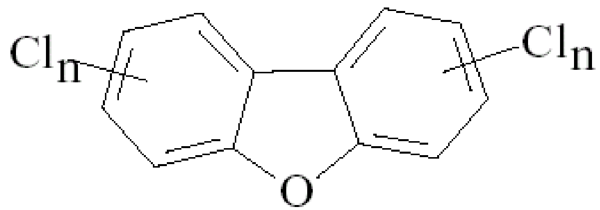

**PCBs**




**Dibenzo-p-dioxin**



**Polycyclic aromatic hydrocarbons (PAHs)**




**Dibenzofuran**

# NATURAL CHEMICALS

- Volcanic ash
- Nitrate
- Nitrite

# ELEMENTS

- Boron
- Fluorine
- Arsenic
- Cadmium
- Lead
- Mercury (and methylmercury)
- Tin (and organotins)
- Iodine

# Radionuclides

- **Caesium-137 and Caesium-134**
- **Iodine-131**
- **Strontium-90**

# MARINE BIOTOXINS

- Wax esters Gempylidae
- Azaspiracid group
- Ciguatoxin group
- Cyclic imines
- Domoic acid
- Okadaic acid
- Palytoxin
- Pectenotoxin group
- Saxitoxin group
- Yessotoxin group

# MARINE PHYCOTOXICOSES

| SYNDROME | TOXINS | ORIGIN | PRODUCING SPECIES |
|---|---|---|---|
| Paralytic Shellfish Poisoning (PSP) | Saxitoxin (STX) + closely related tetrahydropurines | Dinoflagellate | *Alexandrium spp* |
| Diarrhoeic Shellfish Poisoning (DSP) | Okadaic acid (OA)<br>Dynophysistoxins (DTXs), Pectenotoxins (PTXs), Yessotoxins (YTXs) | Dinoflagellate | *Dinophysis spp*<br>*Prorocentrum spp* |
| Amnesic Shellfish Poisoning (ASP)<br>Domoic acid poisoning (DAP) | Domoic acid (DA) [an excitatory amino acid] | Diatom | *Pseudo-nitzschia pungens* f. *multiseries*<br>*P australis* & other spp |
| Neurologic Shellfish Poisoning (NSP) | Brevetoxin & analogues | Dinoflagellate | *Gymnodinium breve [Karenia brevis]* |
| Azaspiracid Shellfish Poisoning (AZP) | Azaspiracid (Killary Toxin-3 or KT3) | Dinoflagellate | *Protoceratum crassipes* |
| Ciguatera Fish Poisoning (CFP) | Ciguatoxins (biotransformed [O]in fish from precursor gambiertoxins) | Dinoflagellate | *Gambierdiscus toxicus* |
| Potential Cyclic imines (CIs) shellfish poisoning | Cyclic imines (CIs): Spirolides (SPXs), gymnodimines (GYMs), pinnatoxins (PnTXs) and pteriatoxins (PtTXs) | Dinoflagellate | *Alexandrium ostenfeldii (SPZXs)*<br>*Karenia selliformis (GYMs)* |
| Palytoxin shellfish poisoning | Palytoxin (PlTX)-group | Dinoflagellate | *Ostreopsis* spp |

# MYCOTOXINS

- Aflatoxins
- Deoxynivalenol (DON)
- Ergot toxins
- Fumonisins
- Ochratoxin A
- Trichothecene
- Zearalenone

| MYCOTOXIN | MAIN PRODUCING FUNGI | MAIN FOOD COMMODITIES AFFECTED | LIVESTOCK RESIDUE POTENTIAL |
|---|---|---|---|
| Aflatoxins | Aspergillus flavus<br>Aspergillus parasiticus | Maize<br>Nuts<br>Rice<br>Wheat | Milk |
| Fumonisins | Fusarium verticillioides (formerly F moniliforme)<br>Fusarium proliferatum | Maize | |
| Ochratoxin A (OTA) | Aspergillus ochraceus<br>Penicillium verrucosum | Cereals (rye, barley, maize, wheat)<br>Coffee<br>Vine fruit (dried) | Pig offal<br>Meat<br>Milk<br>Eggs |
| Deoxynivalenol (DON) (vomitoxin) | Fusarium graminearum<br>Fusarium culmorum | Maize<br>Wheat | |
| Zearalenone | Fusarium graminearum<br>Fusarium culmorum | Maize<br>Wheat | |

Fink-Gremmels (2006) wrote “Although a certain carry-over of feedborne toxins into edible products seems unavoidable, the overall contribution of these toxin residues to human exposure remains low (with the given exception of AFM1 in milk used for infants).

# PHYTOTOXINS

- Ambrosia seeds
- Cyanogenic compounds
- Gossypol
- Pyrrolizidine alkaloids
- Ricin
- Saponins
- Theobromine
- Tropane alkaloids
- Glucosinolates

# VETERINARY MEDICINES

- Beta agonists (eg clenbuterol)
- Decoquinate
- Diclazuril
- Halofuginone
- Lasalocid
- Maduramicin
- Monensin
- Hormonal GPs
- Narasin
- Nicarbazin
- Robenidine
- Salinomycin
- Semduramicin
- Chloramphenicol
- Nitrofurans
- Fluroquinolones

# CYANOBACTERIA TOXIN POISONING (CTP)

| TOXINS | PRODUCING SPECIES |
|---|---|
| Saxitoxins (STX and neoSTX) | *Anabaena spp* (also *C. raciborskii)* |
| Cylindrospermopsin (CYN) | *Cylindrospermopsis raciborskii* |
| Anatoxin-a | *Anabaena spp; Oscillatoria (Planktothrix) spp; Cylindrospermum spp; Aphanizomenon spp; Microcystis spp* |
| Anatoxin-a(S) | *Anabaena spp* |
| Nodularin | *Nodularia spumigena* |
| Microcystins (MCYSTs) | *Microcystis aeruginosa; Anabaena spp; Oscillatoria (Planktothrix) spp* |

Algal blooms are a major source of natural toxin contamination of seafood and may also be a source of contamination of terrestrial agricultural products. Blue-green algae in inland waterways are potentially a major source of natural toxin exposure. However, most investigations so far have been focused primarily on direct hazards to the environment, human and animal health. Recent published research has demonstrated that toxins produced by the water-bloom forming cyanobacterium *Microcystis aeruginosa* could not be detected in the milk or meat of consuming cattle. While reassuring, the impact of higher levels of exposure or ingestion of other phycotoxins remains to be studied.

# BIOLOGICAL HAZARDS

- *Bacillus anthracis*
- *Clostridium botulinum*
- *Clostridium perfringens*
- *Listeria monocytogenes*
- *Mycobacterium* spp.
- *Salmonella enterica*
- *Campylobacter*
- *Enterococcus spp*
- *E coli*
- *Brucella*
- *Toxoplasma gondii*
- *Trichinella spiralis*
- *Cysticercus bovis*
- Prions (agents of the TSEs)
- Newcastle disease virus
- FMDv, CSFv, ASFv

# Towards Improved Diagnosis of Zoonotic Trematode Infections in Southeast Asia

**Maria Vang Johansen,*** **Paiboon Sithithaworn,**[†,‡]
**Robert Bergquist,**[§] and **Jürg Utzinger**[¶,#]



Johansen, M. V., P. Sithithaworn, et al. Towards Improved Diagnosis of Zoonotic Trematode Infections in Southeast Asia. Advances in Parasitology, Academic Press. **Volume 73:** 171-195

| Trematode | Sources of infection | Affected organs in humans |
| --- | --- | --- |
| Liver fluke | | |
| *Clonorchis sinensis* | Fish | Biliary system |
| *Opisthorchis viverrini* | Fish | Biliary system |
| *Opisthorchis felineus* | Fish | Biliary system |
| *Fasciola* spp. | Water plants | Liver and biliary system |
| Intestinal flukes | | |
| *Haplorchis* spp. | Fish | Small intestine |
| *Metagonimus* | Fish | Small intestine |
| *Phaneropsolus bonnei* | Dragon fly larvae | Small intestine |
| Echinostome | | |
| *Fasciolopsis buski* | Snail and tadpoles | Small intestine |
| Lung fluke | | |
| *Paragonimus* spp. | Crab and crayfish | Pleural cavity and lungs |
| Blood fluke | | |
| *Schistosoma japonicum* | Direct skin penetration | Intestinal vessel |
| *Schistosoma mekongi* | Direct skin penetration | Intestinal vessel |

# EXPOSURE TO CONTAMINATION

| ROUTE OF EXPOSURE | REPORTED EXAMPLES | IMPORTANCE |
|---|---|---|
| INGESTION | | |
| Water | o Arsenic, mercury and fluorides in water supply | Minor |
| Food / feed | Contaminant within compounded ration<br>o PBBs, dioxins, PCBs<br>Grazing/browsing contaminated area<br>o OCs, radionuclides, EDCs, Cd | Major |
| INHALATION | o PCB contaminated dust<br>o Radionuclides<br>o Dioxins in smoke<br>o PAHs in vehicle exhaust | Minor |
| DERMAL | o Topical application of organohalogen pesticide<br>o Contact with treated wood (eg pentachlorophenol) | Minor |

# Situations with potential for contamination

- Increased reliance on purchased fodder
- Feeding of unusual materials
- Loss of pasture cover, increasing likelihood of increased soil intake
- When livestock lose weight residue concentrations of fat-soluble compounds can increase.
- Grazing paddocks with a history of production of crops where organochlorine pesticides were frequently used (eg sugar cane, pineapples, fruit, potatoes, maize).
- Grazing in vicinity of timber yards, fences or power poles installed prior to 1987 and that may have been treated to control white ant or fungal attach.
- Grazing near sheep and cattle dips and spray races in use before 1965.
- Use of grain or hay stored in areas previously treated with OCs (sheds, silos, trucks).
- Use of feed that has been raked and baled in the field and containing soil.
- Failure to follow labelled directions, including withholding periods for grazing and fodder production
- Proximity to an industrial area with significant emissions.

# Soil Consumption

- When considering the potential for contamination it is salutary to recognise that grazing ruminants have been observed to ingest significant quantities of soil.  For example:
- Soil ingestion by sheep estimated as 100 to 400g per day, or up to 30% of dietary dry matter (36 to 144 kg per annum).
- Soil ingestion by cattle estimated at up to 18% of dietary dry matter or >1000g/d.

PREVENTIVE MEDICINE **26,** 599–602 (1997)
ARTICLE NO. PM970220

LEAD ARTICLE

# Review—Animal Waste Used as Livestock Feed: Dangers to Human Health

Eric R. Haapapuro, Neal D. Barnard, M.D.,[1] and Michele Simon, J.D., M.P.H.

*Physicians Committee for Responsible Medicine, 5100 Wisconsin Avenue, N.W., Suite 404, Washington, DC 20016*

NSW DPI

primefacts

PROFITABLE & SUSTAINABLE PRIMARY INDUSTRIES www.dpi.nsw.gov.au

JANUARY 2007 PRIMEFACT 311 (REPLACES AGNOTE DAI-181)

# Dangers in feeding waste material to livestock

# Risk Profiling

- Criteria to help select hazards of current importance in feed:
- (i) relevance of the hazard to public health;
- (ii) extent of the occurrence of the hazard;
- (iii) impact of the hazard on international trade in food and feed.

FAO/WHO 2007. Animal Feed Impact on Food Safety

# CONCLUSIONS

- Many possible hazards
- Can present hazards by source commodity, by species at risk etc
- New hazards emerging
- Risk = f(hazard/exposure)
- Risk profiling may aid risk prioritization to focus resources on most important hazards

2-06
22 March 2006

# Attachment 2
# A Risk Profile of Dairy Products in Australia

## Executive Summary
## Parts A and B

## DRAFT ASSESSMENT REPORT

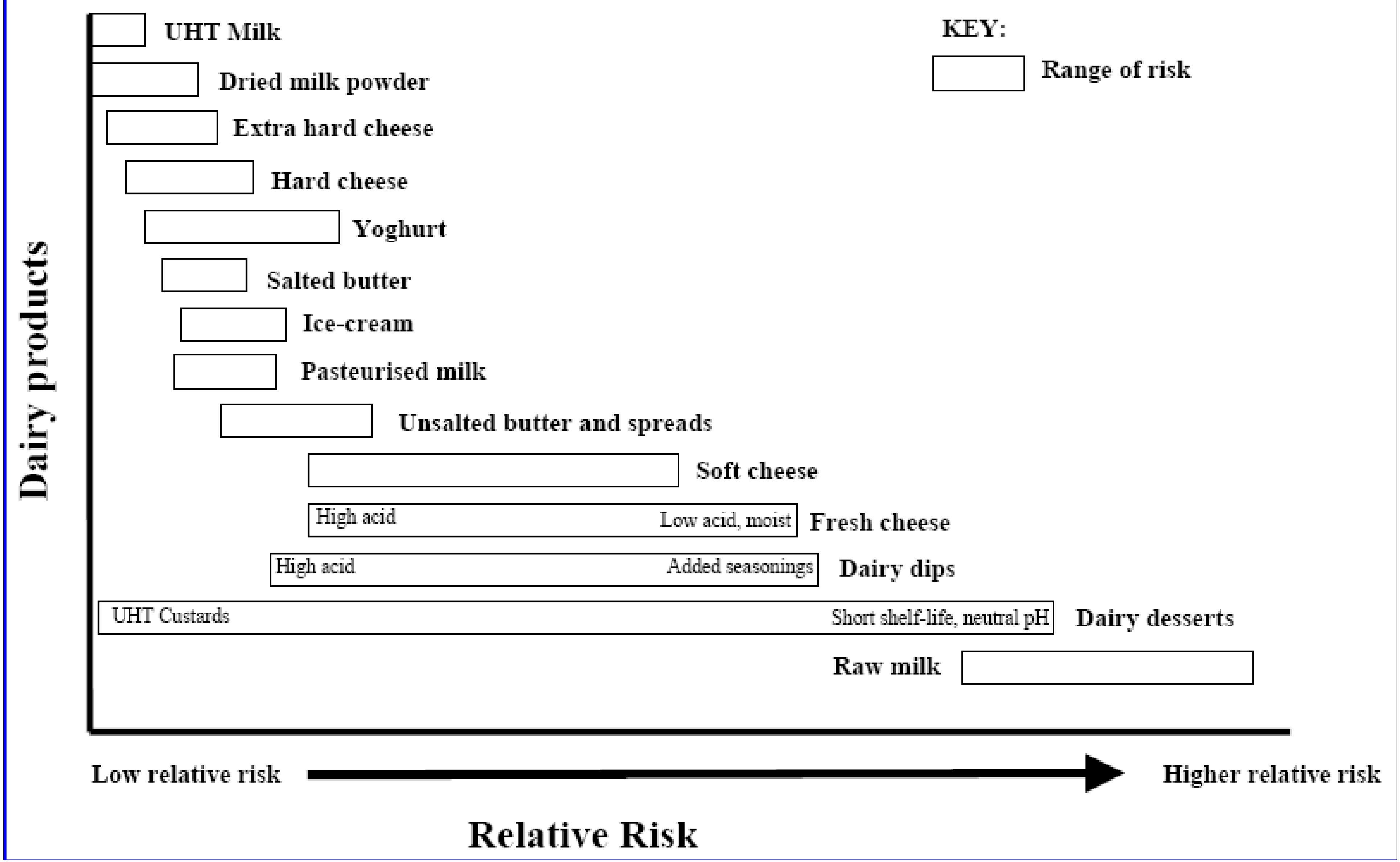
## PROPOSAL P296

## PRIMARY PRODUCTION AND PROCESSING STANDARD FOR DAIRY

## 5. HAZARD IDENTIFICATION/HAZARD CHARACTERISATION OF PATHOGENS

5.1 *Aeromonas* Spp.
5.2 *Bacillus* cereus
5.3 *Brucella* Spp.
5.4 *Campylobacter jejuni/coli*
5.5 *Clostridium* Spp.
5.6 *Coxiella burnetii*
5.7 *Corynebacterium ulcerans*
5.8 *Cryptosporidium*
5.9 *Enterobacter sakazakii*
5.10 Pathogenic *Escherichia coli*
5.11 *Listeria monocytogenes*
5.12 *Mycobacterium bovis*
5.13 *Mycobacterium avium subsp. paratuberculosis*
5.14 *Salmonella* Spp.
5.15 *Shigella* Spp.
5.16 *Staphylococcus aureus*
5.17 Streptococcus Spp.
5.18 *Yersinia enterocolitica*

# A Risk Profile of Dairy Products in Australia [FSANZ 2006]



# Through Chain Risk Profile for the Australian Red Meat Industry

## PRMS.038c

## PART 1: Risk Profile

Meat and Livestock Australia
Locked Bag 991
North Sydney NSW 2059

September 2003

ISBN – 1 740 363 71X

# MLA Risk Profile Report

**Section 3: Hazard Sheets**
**3.1: Microbiological Hazards**

- 3.1.0 Generic Factors Affecting Microbiological Hazards
- 3.1.1 *Campylobacter* jejuni/coli
- 3.1.2 *Clostridium perfringens*
- 3.1.3 Shiga toxigenic *Escherichia coli* (STEC)
- 3.1.4 *Listeria monocytogenes*
- 3.1.5 *Salmonella* spp
- 3.1.6 *Staphylococcus aureus*
- 3.1.7 *Yersinia enterocolitica*
- 3.1.8 Indicator organisms
- 3.1.9 *Aeromonas* spp
- 3.1.10 Antimicrobial Resistance
- 3.1.11 *M. avium* ss paratuberculosis
- 3.1.12 *Bacillus* spp
- 3.1.13 *Toxoplasma gondii*
- 3.1.14 BSE
  - 3.1.14.1 Brain emboli
  - 3.1.14.2 Rendering hazards
- 3.1.15 Occupational Zoonoses

# MLA Risk Profile Report

**3.2: Macrobiological Abnormalities**

3.2.1 Biological Gross Abnormalities and Physical Hazards (Foreign Contaminants)
3.2.2 Beef Measles (*Cys. bovis*)
3.2.3 Sheep Measles (*Cys. ovis*)
3.2.4 Hydatids
3.2.5 Sarcocystis
3.2.6 Plant Associated Toxins
3.2.7 Corynetoxins
3.2.8 Pyrrolizidine Alkaloids
3.2.9 Mycotoxins

# MLA Risk Profile Report

**3.3: Chemical Hazards**

3.3.0 Generic Factors Affecting Chemical Hazards
3.3.1 Hormones
3.3.2 Organochlorines
3.3.3 Organophosphates
3.3.4 Other pesticides
3.3.4.1 Macrocyclic lactones
3.3.4.2 Synthetic pyrethroids
3.3.4.3 Benzoyl ureas
3.3.5 Antimicrobial Residues
3.3.6 Cadmium
3.3.7 Other Chemicals
3.3.8 Processing Chemicals (abattoir)
3.3.9 Edible Tallow

Available online at www.sciencedirect.com

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Food Control 17 (2006) 712–718

FOOD CONTROL

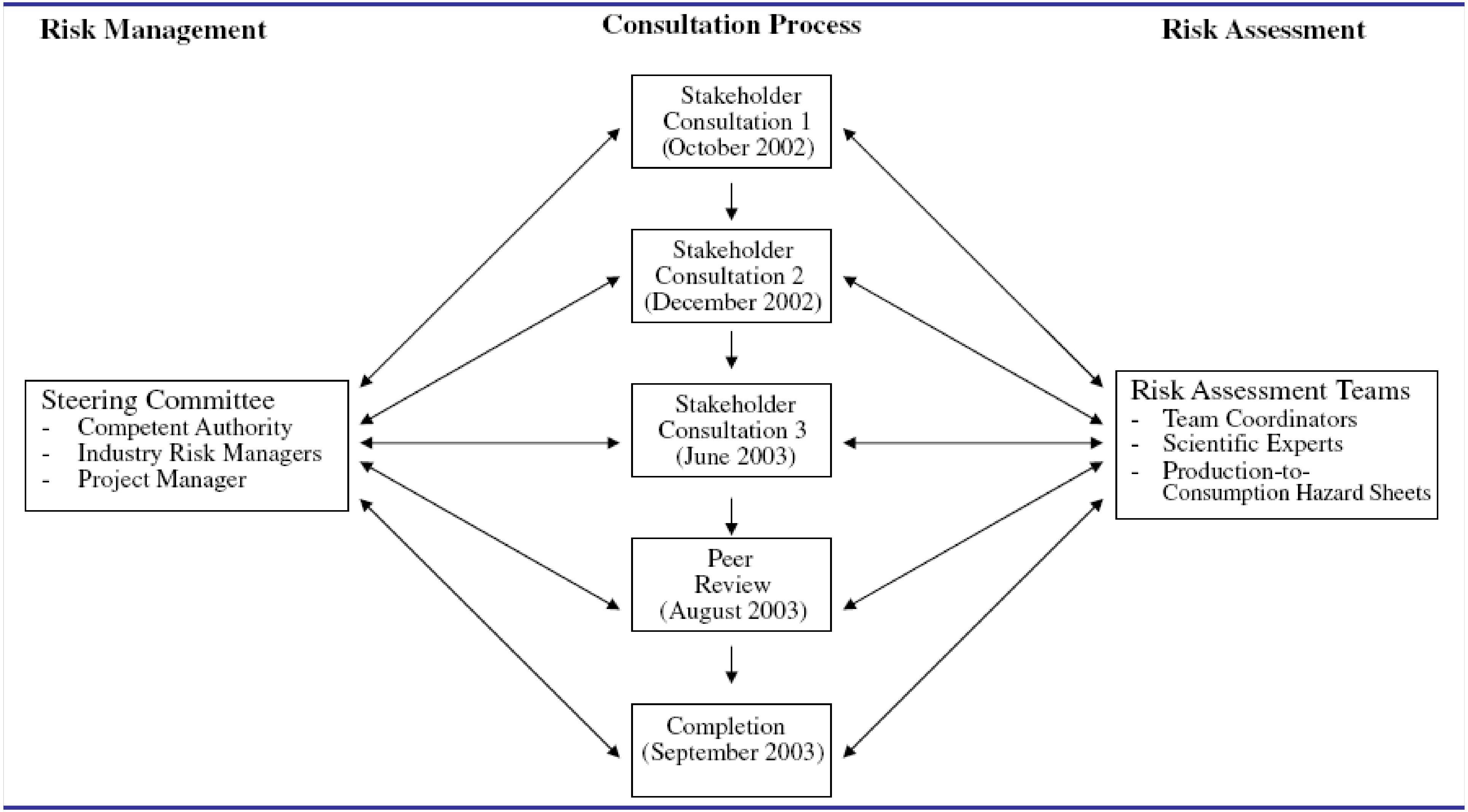
www.elsevier.com/locate/foodcont

# A risk profile of the Australian red meat industry: Approach and management

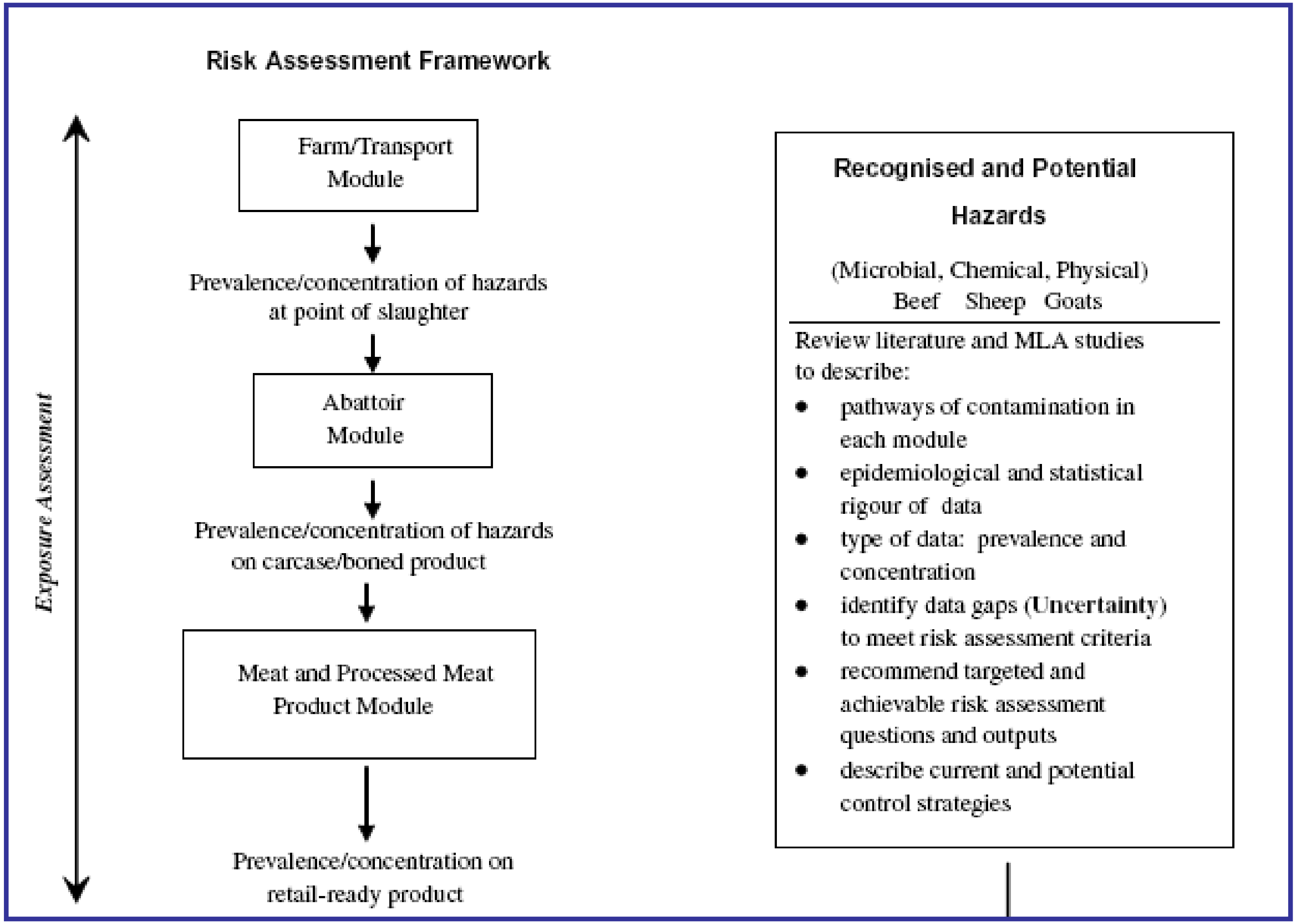
Andrew Pointon [a,*], Ian Jenson [b], David Jordan [c], Paul Vanderlinde [d], Jo Slade [a], John Sumner [b]

[a] *South Australian Research and Development Institute, G.P.O. Box 397, Adelaide, SA 5000, Australia*
[b] *Meat and Livestock Australia, Locked Bag 991, North Sydney, NSW 2059, Australia*
[c] *Wollongbar Agricultural Institute, NSW Agriculture, Bruxner Highway, Wollongbar, NSW 2477, Australia*
[d] *Food Science Australia, P.O. Box 3312, Tingalpa DC, Qld 4170, Australia*

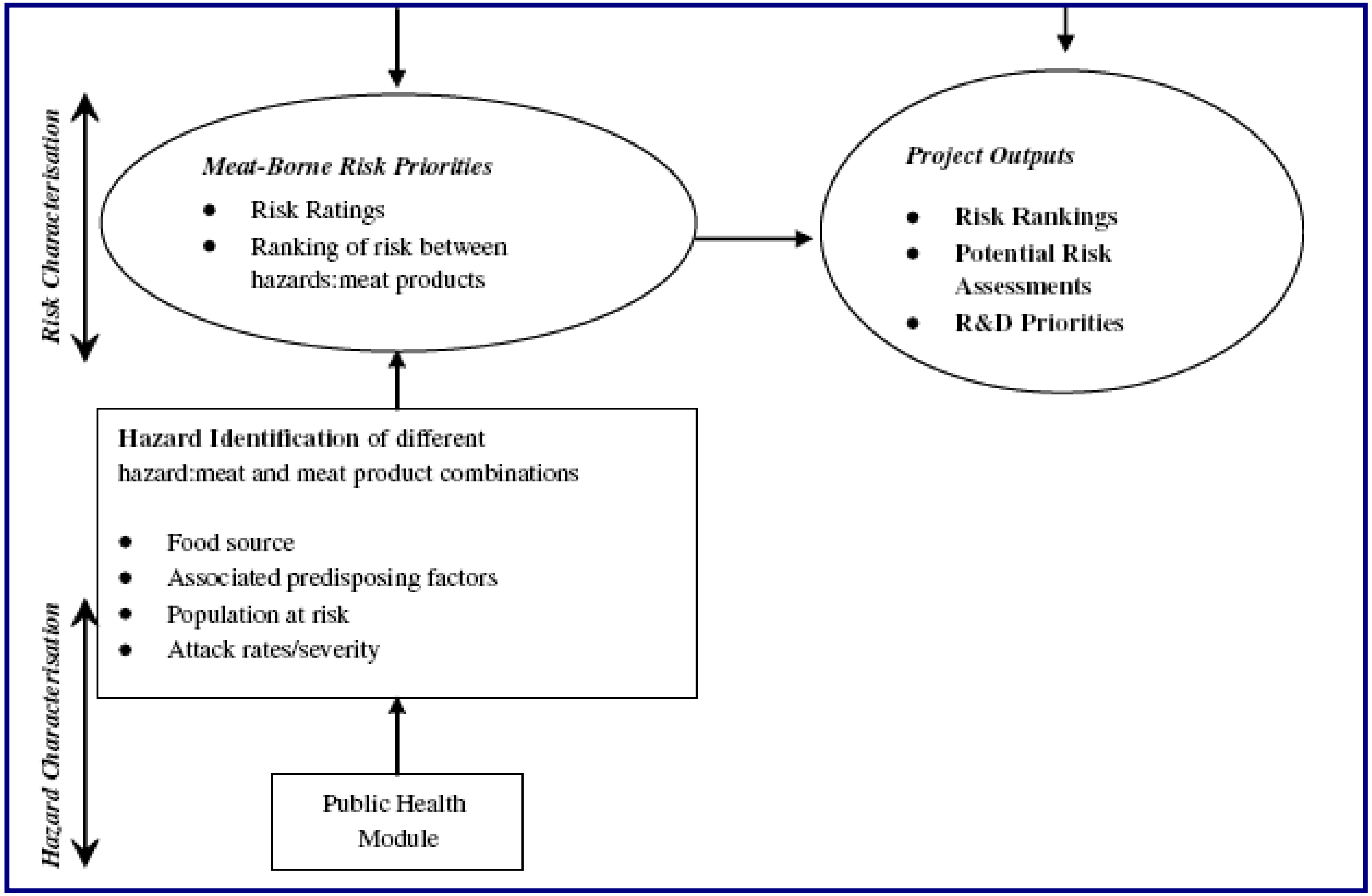
# Risk profile process



# Framework for profiling and managing risks associated with red meat borne food safety hazards (i)



# Framework for profiling and managing risks associated with red meat borne food safety hazards (ii)



Available online at www.sciencedirect.com

SCIENCE DIRECT

International Journal of Food Microbiology 105 (2005) 221–232

INTERNATIONAL JOURNAL OF Food Microbiology

www.elsevier.com/locate/ijfoodmicro

# A risk microbiological profile of the Australian red meat industry: Risk ratings of hazard–product pairings

John Sumner [a,*], Tom Ross [b], Ian Jenson [a], Andrew Pointon [c]

[a] *Meat and Livestock Australia, Locked Bag 991, North Sydney, NSW 2059, Australia*

[b] *Australian Food Safety Centre of Excellence, University of Tasmania, Private Bag 54, Hobart, TAS 7001, Australia*

[c] *South Australian Research and Development Institute, GPO Box 397, Adelaide, SA 5000, Australia*

Microbiological hazard risk rating for meat and meat products in Australia

| Product[a] | Identified hazard | Risk rating | |
|---|---|---|---|
| | | Qualitative | Risk Ranger[a] |
| Red meat entire cuts (steaks, chops, etc.) | *L. monocytogenes* | Low | Not done |
| | *S. aureus* | Low | Not done |
| | *Aeromonas* | Low | Not done |
| | *M. paratuberculosis* | Low | Not done |
| | *Bacillus* | Low | Not done |
| | *Yersinia enterolytica* | Low | Not done |
| | EHEC | Low | Not done |
| Processed meats | | | |
| Cured, cooked sausages, not requiring further cooking | *L. monocytogenes* | Low | 25 (Low) |
| | *S. aureus* | Low | Not done |
| Uncooked fermented meats | *L. monocytogenes* | Low | 12 (Low) |
| | *Salmonella* | Medium | 33 (Medium) |
| | EHEC | Medium | 33 (Medium) |
| Sous-vide | *C. botulinum* | Low | Not done |
| | *L. monocytogenes* | Low | Not done |
| Beef jerky | *Aflatoxin* | Low | Not done |
| Deli meats | *L. monocytogenes* | Medium | 36 (Medium) |
| Terrines | *L. monocytogenes* | Medium | 32 (Medium) |
| Meat products eaten cooked | | | |
| Fresh sausages | *L. monocytogenes* | Low | 11 (Low) |
| Hamburgers | EHEC | Low | 0 |
| Kebabs | *Salmonella* | Medium | 40 (Medium) |

AUSTRALIAN EGG CORPORATION LIMITED

# National Food Safety Risk Profile of Eggs and Egg Products

**A report for the Australian Egg Corporation Limited**

by
B. Daughtry, J. Sumner, G. Hooper, C. Thomas,
T. Grimes, R. Horn, A. Moses, A. Pointon

July 2005
AECL Publication No 05/06
AECL Project SAR-47

# Feed Supply Chain Quality Assurance Mapping

## Report 1 – Supply Chain Mapping and QA Risk Descriptions

**A report for the**

**Stock Feed Manufacturers' Association of Victoria**

**June 2009**

Food and Chemical Toxicology 47 (2009) 911–914

Contents lists available at ScienceDirect

Food and Chemical Toxicology

journal homepage: www.elsevier.com/locate/foodchemtox

# Early awareness of emerging risks associated with food and feed production: Synopsis of pertinent work carried out within the SAFE FOODS project

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Food and Chemical Toxicology 47 (2009) 1022–1039

Contents lists available at ScienceDirect

Food and Chemical Toxicology

journal homepage: www.elsevier.com/locate/foodchemtox

Review

# Indicators of emerging hazards and risks to food safety

Gijs A. Kleter *, Hans J.P. Marvin

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