Emerging Food Safety Issues and Theirs Implication for Indonesian Food Industries

Presented at
FOODREVIEW SEMINAR
Emerging FOOD SAFETY Challenges
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• FOODREVIEW Indonesia

Food Safety?

“... access to nutritionally adequate and SAFE food is a right of each individual.”

[FAO/WHO World Declaration on Nutrition 1992]
“... access to nutritionally adequate and SAFE food is a right of each individual.“
[FAO/WHO World Declaration on Nutrition 1992]

Food security exists when all people, at all times, have physical and economic access to sufficient, SAFE and nutritious food to meet their dietary needs and food preferences for an active and healthy life
[FAO. 1996]

A condition and/or effort such that foods do not contain biological, chemical or physical hazards at level that can cause adverse effects on human’s health
Food Safety?

Managing food safety: From Farm to Table

- Emerging Hazards?
- Emerging Risk?

associated with new practices (new farming practices, new ingredients, new processing technology, new trade practices, new “behaviour”, new science, new method, etc)
Food Safety? Emerging Risks?

• Emerging Contaminants
  • Acrylamide.
  • Monochloropropanediol (3-MCPD).
  • Food Contact Materials.
  • Allergen
  • Microbial Pathogen → will not be covered!

• Emerging Issues from International Trade

• Emerging “regulation” : US- Food Safety Modernization Act

ACRYLAMIDE

• 27.06.2002 WHO Expert Consultation

• „The consultation recognized the presence of acrylamide in foods as a major concern in humans based on the ability to induce cancer and heritable mutations in laboratory animals
Petersen, B. Acrylamide: Formation, Exposure, Possible Reduction Strategies. Materials and conclusions have been drawn from the October 2002 JIFSAN workshop, the FAO/WHO report on acrylamide, and presentations at the US FDA Food Advisory Committee meetings (Dec 2002, Feb 2003).

- Tidak hanya “kentang goreng”
- Mekanisme:

![Diagram of acrylamide formation](attachment:acrylamide_diagram.png)
ACRYLAMIDE

- Tidak hanya “kentang goreng”
- Faktor2 Kritis:

  • Free asparagine
  • Free reducing sugar (e.g. glucose, fructose)
  • Low water activity
  • Product temperature > 100°C

ACRYLAMIDE

- Tidak hanya “kentang goreng”
- Produk bakery:

  • Kandungan asparagine pada tepung sangat beragam
  • Data dari 26 contoh tepung terigu
    France, Poland, UK, Belgium, Finland, Czech rep. and Italy (2002 Harvest) adalah sbb:

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<th>Asparagine</th>
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</table>

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ACRYLAMIDE

![Graph showing the relationship between baking time and acrylamide levels at different temperatures.](image1)

ACRYLAMIDE

![Graph showing the relationship between color and acrylamide levels.](image2)

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3 MCPD

- 3 MCPD = 3-monochloropropane-1,2-diol.
  - formed in foods by the reaction of chloride with lipids
- 3-MCPD has been shown to be a carcinogen in laboratory animal studies
- European Commission's Scientific Committee on Food (SCF): Tolerable Daily Intake (TDI) = 2µg/kg body weight/day
- In the EU, maximum levels of 0.02 mg/kg for free 3-MCPD in hydrolysed vegetable proteins and soy sauce were established in 2001.
- The maximum levels have been applied since April 2002 and are integrated into the Commission Regulation (EC) 1881/2006.

Faktor2 kritis:

- Asam *(Chloride)*; pH
- Lipida
- $a_w$
- Suhu
  - Belum diketahui dgn pasti
  - Acid-HVP
3 MCPD

• Tidak hanya pada kecap & HVP

3-MCPD in food other than soy sauce or hydrolysed vegetable protein (HVP)

Jus Baar, Retobil de la Calle, Philip Taylor

Abstract: This review gives an overview of current knowledge about 3-monochloropropane-1,2-diol (3-MCPD) formation and detection. Although 3-MCPD is often mentioned in regard to soy sauce and acid-hydrolysed vegetable protein (HVP), and much research has been done in that area, the emphasis here is placed on other foods. This contaminant can be found in a great variety of foodstuffs, and is difficult to avoid in our daily nutrition. Despite its low concentration in most foods, its carcinogenic properties are of general concern. Its formation is a multivariate problem influenced by factors such as heat, moisture, and content of certain fatty acids depending on the product.

3-Chloropropane-1,2-diol Fatty Acid Esters in Potato Products

Z. ZELINKOVÁ, M. DOLEZAL and J. VELIŠEK

Department of Food Chemistry and Analysis, Institute of Chemical Technology Prague, 166 28 Prague, Czech Republic. E-mail: zuzana.zelinkova@vut.cz

Abstract: The occurrence of 3-chloropropane-1,2-diol fatty acid esters (bound 3-MCPD) in French fries and potato chips is reported. These products belong to the group of foodstuffs with high amount of 3-MCPD esters. Bound 3-MCPD was determined in all analysed samples in following concentrations: pre-frying French fries 27–64 µg/kg, French fries (dried product) 300–924 µg/kg and potato chips 250–2000 µg/kg. Potato oil used for frying potato chips was analysed as well and the bound 3-MCPD levels ranged from 654 to 1020 µg/kg. 3-MCPD esters are formed in these products as a consequence of the processing technique. Especially frying oil represents the main source of these contaminants in frying potato products.

Keywords: 3-chloropropane-1,2-diol; 3-MCPD; bound 3-MCP; potato products
Chloroesters in foods: An emerging issue

In November 2007, the German food safety agency (Bundesinstitut für Risikobewertung: BfR) called for levels of 3-MCPD esters to be reduced in oil-containing foods such as infant formula and margarine as well as in deep-frying fats, despite the absence of any indication of risk from bound 3-MCPD. In its assessment, BfR assumed that 100% of the bound
3 MCPD

• Tidak hanya pada kecap & HVP

- 3-MCPD esters have been found in all refined vegetable oils.
- 3-MCPD esters are found in French fries, toasted bread, bread crust, donuts, salty crackers, roasted coffee, roasted chicory (coffee surrogate), roasted barley, roasted dark malt and coffee creamer, and in fermented foods like pickled herring and sausage.
  → Reported levels were between 0.2 and 6.6 mg/kg in most of the analysed foodstuffs and the levels of esterified 3-MCPD were much higher than the levels of free 3-MCPD.
3 MCPD

- Tidak hanya pada kecap & HVP

**SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

Recent studies have identified high levels of 3-MCPD esters in refined edible fats, such as margarine and oils, and in fat-containing foods including infant formula (both starter and follow-on) and human milk. Other related ester compounds such as 2-MCPD esters and chlorinated esters are also expected to occur.

No toxicological data are available on 3-MCPD esters. The full hydrolysis of these esters in the gastrointestinal tract would result in significant exposures to free 3-MCPD. Considering the highest levels of 3-MCPD esters found in oils and fats, and assuming 100% hydrolysis, exposures of 10- to 20-fold the 3-MCPD tolerable daily intake (TDI) could be calculated for infants fed on formulas, and fivefold for adult men on a fat-rich diet.

**Food Contact Materials**

**Food packaging – What is the purpose?**

- Protection from the ‘outside’
  - Environment, to prevent the transfer of substances ‘in’ and ‘out’ of the packaged food.
    - air (oxygen)
    - loss of gas (carbonated beverages)
    - moisture loss/ incorporation
    - light (and UV radiation)
    - foreign aroma compounds
    - microbial contamination
    - temperature instability
    - mechanical influences
- Marketing, ETC
Food Contact Materials

Food packaging – **BUT?**

It may interact with food inside:

- **Food Contact Material products (FCM)**
  - Plastic
  - Glass
  - Metals and alloys
  - Ceramics
  - Paper and board
  - Rubber and elastomers
  - Regenerated cellulose

---

Food Contact Materials

Food packaging – **PLASTIC?**

**The Most Popular!**

- Light-weight
- Various shapes (flexible – rigid)
- Colors
- High level of protection – hygiene
- They do not brake compare to other materials (e.g. glass)
- Versatility (various applications)
Food Contact Materials

Food packaging – PLASTIC?

...... BUT .....

- Long life (environmental non-friendly)
- Cost of production
- Migration of substances to foods

Food Contact Materials

Food packaging – PLASTIC?

Plastic is a polymer?

“..organic macromolecular compounds obtained by polymerization, polycondensation, polyaddition or any other similar process from molecules with a lower molecular weight or by chemical alteration of natural macromolecules.” Directive 2002/72/EC
Food Contact Materials

Food packaging – *PLASTIC*?

Materials for... concern:

- Monomers/oligomers (e.g. ethylene, propylene, etc.)
- Additives used in the production of plastic FCMs:
  - Plasticizers (15-40% in PVC, i.e. Phthalates)
  - Anti-ageing (Antioxidants< 1%),
  - Surface properties modifiers (Anti-static, lubricants 1-4%),
  - Colorants
  - Foaming agents (e.g. carbon dioxide)
  - Improving substances (e.g. Flame retardants, fillers, biocides, mold release agents, reinforcements etc.)
- Adhesives
- Printing inks

Food Contact Materials

- Esters of phthalic acid
- primarily as plasticizers:
  - General applications (building and construction materials, medical devices, toys, cosmetics), and
  - Food applications:
    - Food contact materials (FCMs):
      - cap-sealing resins
      - sealing gaskets,
      - PVC films
      - PVC glove
      - Utensils, and
      - Packaging/film.

Food Contact Materials Case of Phthalate

Plasticizer: provide flexibility and softness to plastics \(\rightarrow\) PVC --- (1)

An article published in Food and Science magazine in China has confirmed that plastic instant noodle packaging contains phthalate plasticizer that may decompose and contaminate the food. The article did not specify which brands may be affected, however, according to the Yangdong County government.

Liu Chuncheng, the county’s director and associate professor of clinical microbiology, said that phthalates could enter the food chain during processing or cooking.
Plasticizer: provide flexibility and softness to plastics → PVC --- (2)

- Esters of phthalic acid

![Di(2-ethylhexyl) Phthalate](image)

Food Contact Materials. Case of Phthalate

Plasticizer: provide flexibility and softness to plastics → PVC --- (3)

- Esters of phthalic acid

![Di(2-ethylhexyl) Phthalate](image)
Food Contact Materials. Case of Pthalate

Plasticizer: provide flexibility and softness to plastics → PVC --- (4)

- Esters of phthalic acid

\[
\begin{align*}
\text{DEHP, DBP and BBP:} \\
\text{Subgroup of “Low Molecular Weight (LMW)” phthalates}
\end{align*}
\]

Food Contact Materials. Case of Pthalate

Plasticizer: provide flexibility and softness to plastics → PVC --- (5)

- Esters of phthalic acid

\[
\begin{align*}
\text{Subgroup of “High Molecular Weight (HMW)” phthalates}
\end{align*}
\]

Molecular formula \( \text{C}_{26}\text{H}_{42}\text{O}_{4} \)
Food Contact Materials. Case of Phthalate

Plasticizer: provide flexibility and softness to plastics \(\rightarrow\) PVC \(\rightarrow\) (6)

- Some foods, especially high fat foods, have a greater potential to extract additives from the FCMs
- Food may also be contaminated with phthalates through different kinds of environmental sources, or during processing.
- EFSA has established TDI:
  - TDI for bis(2-Ethylhexyl) phthalate (DEHP) \(\rightarrow\) 50 μg/kg body weight/day (EFSA 2005a).
  - TDI for diisononyl phthalate (DINP) \(\rightarrow\) 0.15 mg/kg body weight/day (EFSA, 2005b), and
  - TDI for di-N-Butyl phthalate (DBP) \(\rightarrow\) 0.1 mg/kg body weight/day (EFSA, 2005b).

\[\text{TDI} = \text{Tolerable Daily Intake}; \text{ estimate of the amount of a contaminant or natural toxicant, expressed on a body weight basis that can be ingested daily over a lifetime without appreciable risk.}\]

Food Contact Materials. Case of Phthalate

Plasticizer: provide flexibility and softness to plastics \(\rightarrow\) PVC \(\rightarrow\) (7)

- The European Union (EU) has also set SML:
  - Di(2-ethylhexyl) phthalate, DEHP, SML=1.5 mg/Kg food
  - Diisononyl phthalate, DINP, SML=9 mg/Kg food
  - Butyl benzyl phthalate, BBP SML=30 mg/Kg food
  - Diisodecyl phthalate, DIDP SML=9 mg/Kg food

\[\text{SML = Specific Migration Limit}; \text{ means the maximum permitted amount of a given substance released from a material or article into food or food simulants, expressed in milligrams per kilogram of the food (mg/kg)}.\]
Faktor yang berpengaruh pada migrasi

Karakteristik Bahan Pengemas
Waktu kontak antara bahan pangan dan bahan pengemas (lama simpan)

Ratio Bahan Pengemas

Karakteristik Bahan Pangan
- Kadar lemak
- Ukuran (luas permukaan)

Alergen

Major allergens in foods

- Milk
- Eggs
- Fish (e.g. bass, flounder, cod)
- Shellfish (e.g. crab, lobster, shrimp)
- Tree nuts (e.g. almonds, walnuts, pecans)
- Peanuts
- Wheat
- Soybeans
**Alergen**

- **Major Concern**

**US (USFDA):**
- ~ 2 - 2.5%: true food allergies
- 150-200 mati per tahun
- No Cure
- Avoidance is the only way to prevent an allergic reaction
- Labeling

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**Emerging Issues from International Trade**

*The Trade Standards Compliance Report, 2010 (UNIDO)*

Number of EU rejections of food and feed exports from Indonesia, 2002-2008

- Other
- Herbs & spices
- Fish & fishery products
- Nuts & seeds
- Fruit & vegetables
Emerging Issues from International Trade

The Trade Standards Compliance Report, 2010 (UNIDO)

Number of EU rejections of food and feed exports from Indonesia, 2002-2008

- Other
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Emerging Issues from International Trade

The Trade Standards Compliance Report, 2010 (UNIDO)

Number of EU rejections of food and feed exports from Indonesia, 2002-2008

Reasons for EU rejections of food products, 2002-08 (The Trade Standards Compliance Report, 2010; UNIDO)

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<thead>
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<th>Country</th>
<th>Mycotoxins</th>
<th>Microbiological/contamination</th>
<th>Veterinary disease</th>
<th>Heavy metals</th>
<th>Unauthorised food additives</th>
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### Reasons for EU rejections of food products, 2002-08 (The Trade Standards Compliance Report, 2010; UNIDO)

<table>
<thead>
<tr>
<th>Country</th>
<th>Mycotoxins</th>
<th>Microbiological contamination</th>
<th>Heavy metals</th>
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Purwiyatno Hariyadi
hariyadi@seafast.org
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## Comparison of Reasons for US & EU rejections of food products, 2002-08 (The Trade Standards Compliance Report, 2010; UNIDO)


Emerging FOOD SAFETY Challenges
New Regulations? US-FDA-FSMA

Why is the law needed?

- Globalization
  - 15 percent of U.S. food supply is imported
- Food supply more high-tech and complex
- More foods in the marketplace
- New hazards in foods not previously seen
- Shifting demographics
- Growing population (about 30%) of individuals are especially "at risk" for foodborne illness

http://www.fda.gov/food/foodsafety/fsma/default.htm
New Regulations? US-FDA-FSMA

Prevention: The cornerstone

- Comprehensive preventive controls for food and feed facilities
- Prevention is not new, but Congress has given FDA explicit authority to use the tool more broadly
- Strengthens accountability for prevention
- Produce safety standards
- Intentional adulteration standards
- Transportation

New Regulations? US-FDA-FSMA

General Approach to Preventive Controls

1. Identify Hazard
2. Understand Cause
3. Implement Preventive Controls
4. Monitor Effectiveness
5. Review & Adjust

Purwiyatno Hariyadi
hariyadi@seafast.org
New Regulations? US-FDA-FSMA

Prevention Standards Mandates

Sec. 103. Hazard analysis and risk-based preventive controls

- Requires food and feed facilities to evaluate hazards that could affect food safety; identify and implement preventive controls to prevent hazards; monitor controls and maintain monitoring records; and conduct verification activities.

New Regulations? US-FDA-FSMA

Managing Intentional contamination/
Adulteration:
From Farm to Table
- Fokus pada rantai produksi pangan

Potensi “Intentional Contaminations”:

- Pestisida?
- Air irigasi?
- Air pengolahan (untuk pendinginan/pencucian produk/buah/sayuran)?
- Tempat penyimpanan sementara?
- Pupuk?
- Pekerja??
- dll

- Fokus pada rantai produksi pangan

Potensi “intentional contamination”

- Bahan baku dan ingridien
- Bahan pengemas
- Sabotase?
- Pemalsuan (adulterated ingredients)
- Errors in process (GMP and HACCP) vs true bio-terrorism
- Disgruntled employees
New Regulations? Managing Intentional Contamination

- Fokus pada rantai produksi pangan

Melamine?

New Regulations? US-FDA-FSMA

Managing Intentional contamination/Adulteration: From Farm to Table

Melamine?

How

• To detect
• To Deter
• To Prevent Intentional Contamination?
Implication for Indonesian Food Industries?

• Indonesia Food industry need to be aware to the new development in food safety issues and regulation

• More collaboration: **Government-Industry-Academia**
  i. Update good practices: Updated guideline/regulations
  ii. Better support of laboratory analysis

• **Industry**: Strengthen food safety measures → FSM
  • Focus on prevention
  • Include **Food Defense Management System**

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**Perlu ada paradigma baru:**
• Paradigma “**Food Defense”**

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**Food Safety Programs**

**Food Defense Enhancements**
- Industry and Consumer Guidance
Implication for Indonesian Food Industries?

Perlu ada paradigma baru:
- Paradigma “Food Defense”

In today’s world it is important to be ALERT to protect your business.

- How do you **ASSURE** that the supplies and ingredients you use are from safe and secure sources?
- How do you **LOOK** after the security of the products and ingredients in your facility?
- What do you know about your **EMPLOYEES** and people coming in and out of your facility?
- Could you provide **REPORTS** about the security of your products while under your control?
- What do you do and who do you notify if you have a **THREAT** or issue at your facility, including suspicious behavior?

Terimakasih