The First Hong Kong Total Diet Study Report No. 8 : Organochlorine Pesticide Residues

29 May 2014

The 1st HKTDS

- First time carrying out in HK
- Period:2010-2014
- Objectives:
  - To estimate the dietary exposures of the HK population and various population subgroups to a range of substances, including contaminants and nutrients
  - To assess any associated health risks

Pesticides

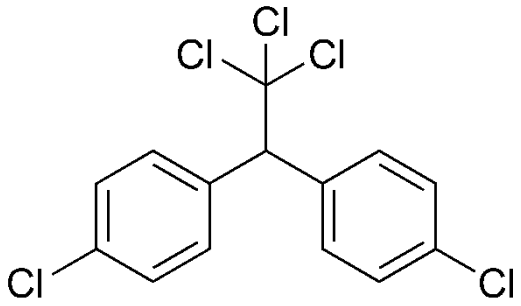
- Pesticides are chemicals that are used to kill pests, including insects, rodents, fungi, unwanted plants (weeds), etc.
- Potentially toxic to other organisms, including humans
- Need to be used properly according to Good Agricultural Practices (GAP)

Organochlorine Pesticides (OCPs)

- Used in agriculture and vector-borne disease control
- Banned or heavily restricted in many countries in response to public concern and increasing scientific evidence of their adverse effects on living organisms and the environment
- Continue monitoring OCP residues in food and assessing the associated risks are warranted because food commodities may still contain low levels of OCP residues

Characteristics of OCPs

- Consist of carbon, hydrogen and chlorine
- Toxic chemicals
- Persist in soil → environmental pollution
- Fat-soluble → accumulation in fatty tissues of living organisms→concentrating up the food chain



DDT

OCPs under Stockholm Convention

Initial Persistent Organic Pollutants (POPs)	New POPs
Aldrin	Alpha-hexachlorocyclohexane (α-HCH)
Chlordane	Beta-hexachlorocyclohexane (β-HCH)
DDT	Chlordecone
Dieldrin	Lindane (γ-HCH)
Endrin	Pentachlorobenzene
Heptachlor	Technical Endosulfan and its related isomers
Hexachlorobenzene(HCB)	
Mirex	
Toxaphene	

*Dicofol and δ-HCH tested in this study are not listed as POPS

Occurrence of OCPs

- OCPs enter environment by
  - Past or current pesticide applications
  - Disposal of contaminated wastes into landfills
  - Releases from manufacturing plants
- Food commodities may contain low levels of OCP residues due to environmental pollution

Sources of Exposure

- Diet is the main source of exposure of general population
- Higher concentrations were found in fish and meats
- Contaminated drinking water and air are minor sources
- Infants can be exposed through breast milk, and the foetus can be exposed in utero via the placenta

Toxicity of OCPs

- Acute toxic
  - Toxic to nervous system
  - In high dose, e.g. accidental exposures of DDT in humans, acute toxicity includes vomiting, tremor, and seizures
- Chronic toxicity
  - Human health effects from low doses were unknown
  - Animal studies showed chronic exposure to OCPs was linked to elevated rates of liver, thyroid or kidney cancer in animals

Organochlorine Pesticides	Evaluation of Carcinogenicity by International Agency Research for Cancer (IARC)
Aldrine	3
Dieldrin	3
Chlordane	2B
Chlordecone	2B
DDT	2B
Dicofol	3
Endosulfan	-
Endrin	3
Heptachlor	2B
HCB	2B
HCH (α,β,γ and δ)	2B
-Lindane (HCH-γ)	2B
Mirex	2B
Pentachlorobenzene	-
Toxaphene	2B

Health-based guidance values (HBGVs) of OCPs

Organochlorine Pesticides	HBGVs (mg/kg bw/day)
Aldrine	0.0001 (Aldrine+Dieldrin)
Dieldrin	
Chlordane	0.0005
Chlordecone	0.0003
DDT	0.01
Dicofol	0.002
Endosulfan	0.006
Endrin	0.0002
Heptachlor	0.0001
HCB	0.0008
HCH (α,β,γ and δ)	0.005
-Lindane (HCH-γ)	0.005
Mirex	0.0002
Pentachlorobenzene	0.0008
Toxaphene	0.002

Methodology

- **Food sampling and preparation:**
  - 4 occasions from March 2010 to February 2011
  - 1800 samples (150 items x 4 occasions x 3 samples) were collected
  - Prepared as consumed
  - 3 samples of the same item→1 composite sample
  - Total 600 composite samples

Methodology (2)

Laboratory analysis performed by Food Research Laboratory

1. Aldrin
2. Dieldrin
3. Chlordane (*cis*-chlordane, *trans*-chlordane, oxychlordane, *cis*-nonachlor, *trans*-nonachlor)
4. Chlordecone
5. DDT (*2,4'* DDD, *4,4'*- DDD, *2,4'* DDE, *4,4'*-DDE, *2,4'*-DDT, *4,4'*-DDT)
6. Dicofol (*2,4'*-dicofol, *4,4'*-dichlorobenzophenone)
7. Endosulfan (*alpha*-endosulfan, *beta*-endosulfan, endosulfan sulfate)
8. Endrin (endrin, endrin aldehyde, endrin ketone)
9. Heptachlor (heptachlor, *cis*-heptachlor epoxide, *trans*-heptachlor epoxide)
10. Hexachlorobenzene
11. Hexachlorocyclohexane (*alpha-, beta-, gamma*-and *delta*-)
12. Mirex
13. Pentachlorobenzene
14. Toxaphene (Parlars 26, 32, 42, 50, 56 and 62)

Results-Levels of OCP Residues in Food

- 332 (55%) composite samples contained low levels of OCP residues
- The most commonly detected OCPs were DDT, HCB and endosulfan
- Chlordecone was not detected in any samples
- The rest of the OCPs were detected in 10% or less of the composite samples

Results-Dietary Exposure to OCP Residues

OCPs	HBGVs (μg/kg bw/day)	Dietary exposure estimate (μg/kg bw/day) (Contribution to HBGVs)	
		Average	High consumer
Aldrin+Dieldrin	0.1	0.0003-0.0059 (0.3-5.9%)	0.0012-0.0096(1.2-9.6%)
Chlordane	0.5	0.0002-0.0142 (0-2.8%)	0.0010-0.0230(0.2-4.6%)
DDT	10	0.0238-0.0399 (0.2-0.4%)	0.0912-0.1099 (0.9-1.1%)
Dicofol	2	0.0005-0.0060 (0-0.3%)	0.0018-0.0098 (0.1-0.5)
Endosulfan	6	0.0085-0.0166 (0.1-0.3%)	0.0258-0.0359 (0.4-0.6%)
Endrin	0.2	0.0010-0.0091 (0.5-4.5%)	0.0021-0.0145 (1.0-7.3%)

Results-Dietary Exposure to OCP Residues (2)

OCPs	HBGVs (μg/kg bw/day)	Dietary exposure estimate (μg/kg bw/day) (Contribution to HBGVs)	
		Average	High consumer
Heptachlor	0.1	0-0.0084 (0-8.4%)	0-0.0136 (0-13.6%)
HCB	0.8	0.0024-0.0048 (0.3-0.6%)	0.0052-0.0084 (0.6-1.0%)
HCH (α,β,γ and δ)	5	0.0008-0.0120 (0-0.2%)	0.0023-0.0195 (0-0.4%)
-Lindane (HCH-γ)	5	0.0001-0.0029 (0-0.1%)	0.0002-0.0046 (0-0.1%)
Mirex	0.2	0-0.0028 (0-1.4%)	0.0001-0.0045 (0-2.3%)
Pentachlorobenzene	0.8	0.0003-0.0030 (0-0.4%)	0.0008-0.0049 (0.1-0.6%)
Toxaphene	2	0.0002-0.0171 (0-0.9%)	0.0011-0.0276 (0.1-1.4%)

Results-International Comparison of Dietary Exposure (μg/kg bw/day)

	China	Canada	France	Australia	New Zealand		This study
Target group	Men 18-45	All age	Adults	Adults 17 yrs or above	25+yr males	25+yr females	Adults (20-84)
Treatment of not detected (ND) values	ND=0	ND=0	ND=0 and ND=LOD	ND=0	ND=0	ND=0	ND=0 and ND=LOD
Aldrin and Dieldrin	-	-	-	0.0059(mean) 0.012(P90)	0.00004 (mean)	0.00005 (mean)	0.0003-0.0059 (mean) 0.0012-0.0096 (P95)
Chlordane	0.006 (mean) 0.013 (P95)	0.001 (mean)	-	-	-	-	0.0002-0.0142 (mean) 0.0010-0.0230 (P95)
DDT	0.016 (mean) 0.052 (P95)	0.006 (mean)	-	-	0.0099 (mean)	0.0073 (mean)	0.0238-0.0399 (mean) 0.0912-0.1099 (P95)
Dicofol	-	0.003 (mean)	-	0.011(mean) 0.031(P90)	0.00002 (mean)	0.00003 (mean)	0.0005-0.0060(mean) 0.0018-0.0098 (P95)
Endosulfan	-	0.017 (mean)	0.001 - 0.415 (mean) 0.005 - 0.713 (P95)	0.033(mean) 0.072(P90)	0.0031 (mean)	0.0036 (mean)	0.0085-0.0166 (mean) 0.0258-0.0359 (P95)

P90=90th percentile exposure level and P95=95th percentile exposure level

Results-International Comparison of Dietary Exposure (μg/kg bw/day) (2)

	China	Canada	France	Australia	New Zealand		This study
Target group	Men 18-45	All age	Adults	Adults 17 yrs or above	25+yr males	25+yr females	Adults (20-84)
Treatment of not detected (ND) values	ND=0	ND=0	ND=0 and ND=LOD	ND=0	ND=0	ND=0	ND=0 and ND=LOD
Endrin	-	0.000 (mean)	-	-	-	-	0.0010-0.0091 (mean) 0.0021-0.0145(P95)
Heptachlor	0.001 (mean) 0.001 (P95)	0.001 (mean)	-	-	-	-	0-0.0084(mean) 0-0.0136 (P95)
HCB	0.009 (mean) 0.015 (P95)	0.001 (mean)	0.000 - 0.103 (mean) 0.000 - 0.185 (P95)	-	-	-	0.0024-0.0048 (mean) 0.0052-0.0084 (P95)
HCH	0.002 (mean) 0.007 (P95)	0.004 (mean)	-	-	-	-	0.0008-0.0120 (mean) 0.0023-0.0195 (P95)
-Lindane (γHCH)	-	-	0.001 - 0.176 (mean) 0.01 - 0.287 (P95)	-	-	-	0.0001-0.0029 (mean) 0.0002-0.0046 (P95)

Results-Comparison to Previous Study

	DDT mean concentration in fish and seafood (μg/kg)	Dietary exposure to DDT (μg/kg bw/day) (Contribution to HBGVs)	
		Average	High consumer
RA study 2006*	29.7	0.145 (1.45%)	0.291 (2.91%)
Current study	18	0.0238-0.0399 (0.24-0.40%)	0.0912-0.1099 (0.91-1.1%)

*Risk assessment study 2006: Dietary Exposure to DDT of secondary school students

This finding was consistent with the declining trends of DDT in food and DDT dietary exposure reported by Mainland China as well as other countries since it was banned.

Summary of Findings

- Among 600 composite samples, 55% were detected with low levels of OCP residues
- DDT, HCB and endosulfan were the most commonly detected OCPs
- The DDT concentrations in fish and seafood samples and dietary exposure to DDT found in this study were lower than those reported by the 2006 RA study
- The estimated dietary exposures to OCP residues were well below their respective HBGVs

Limitations of Study

- A limited number of food items have been sampled
- To reflect the exposure from the whole diet, a set of food mapping was applied
  - Occurrence of OCP residues in different food items even within the same food group may vary

Conclusion

- The findings suggested that dietary exposures to all the OCP residues analysed in this study would be unlikely to pose unacceptable health risks to the general population in Hong Kong

Recommendations to Trade

- The farmers are advised to observe Good Agricultural Practices (GAP)
  - using only pesticides registered with the competent authority
  - applying the minimum quantities necessary to achieve adequate pest control
  - use the pesticides in strict accordance with the label requirements
    - e.g. do not harvest the crops within the specified withholding period after the last pesticide application

Recommendations to the Public

- The public is advised to have a balanced and varied diet which includes a wide variety of fruits and vegetables and reduce fat intake

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