The First Hong Kong Total Diet Study:

➢ Pesticide Residues

Trade Consultation Forum

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Use of pesticides

- Common practice in modern agriculture
- Proper use of pesticides
  - Protect crops from contamination by harmful microorganisms, including toxin producing fungi
  - Protect the nutritional integrity of food
  - Enhance and stabilise crop yield

Good agricultural practice (GAP)

- Safe use of registered pesticides under actual conditions
  - Effective and reliable pest control
  - Reduce the residues to minimal levels
  - Include:
    - Recommended frequency and amount of application
    - Withholding period after the last pesticide application
- With the adoption of strict GAP, only acceptable amounts of pesticide residues should remain in the crops or, in connection, foods of animal origin

Maximum residue limits (MRLs)

- Established according to the data from field trials
  - Scientific studies according to GAP:
    - Pesticides are applied to crops in accordance with the label requirement to reflect actual conditions
  - Toxicologically acceptable
    - i.e. Not lead to acute and chronic effects in human
- Residue levels > MRLs
  - Not strictly mean that it will pose human health risk
  - It reflects that the GAP is not strictly followed

Risk assessment on pesticide residues (1)

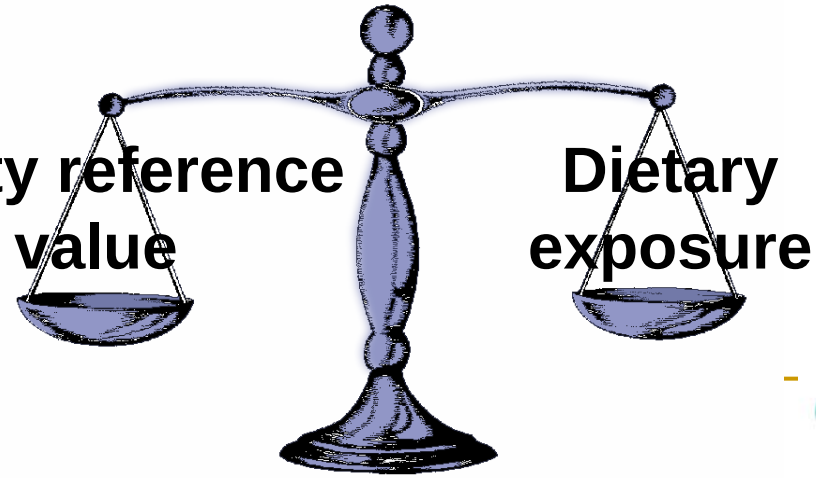
- Pesticide residues in food ≠ unsafe
- In assessing the health risks of pesticide residues, apart from their toxic nature, the amount and the duration of exposure must also be considered

Risk assessment on pesticide residues (2)

Dietary exposure to pesticide residues =

Food consumption amount X Pesticide residue levels in food

To assess the health risk



Risk assessment on pesticide residues (3)

- **Chronic safety reference values**
  - Set based primarily on the toxic nature of the pesticides in animal models
  - Estimate of the amount of a pesticide residue in the diet, expressed on a body weight (bw) basis, that can be ingested daily by a person **over a lifetime without appreciable health risk**
  - Usually have large safety margins and also include benchmarks for prolonged exposure
  - For pesticide residues, it usually refers to Acceptable Daily Intake (ADI)

Risk assessment on pesticide residues (4)

- A dietary exposure above the ADI does not automatically mean that health is at risk
- Transient excursion above the ADI would have no health consequences provided that the average exposure over long period is not exceeded as the emphasis of ADI is a lifetime exposure

Pesticide residues analysed

- Present report includes 85 commonly encountered pesticides or their metabolites under 4 pesticide groups
  1. **Organophosphorus pesticides (OPPs)**
  2. **Carbamates**
  3. **Pyrethrins and pyrethroids**
  4. **Dithiocarbamate metabolites**

Adverse health effects

- **OPPs and carbamates**
  - Inhibitors of the neurotransmitter, acetylcholinesterase (AChE)
  - May lead to signs of neurotoxicity
- **Pyrethrins and pyrethroids**
  - Acute toxic effects: related to the adverse effects on the nervous system
- **Dithiocarbamates**
  - 2 metabolites: Ethylene thiourea (ETU) & Propylene thiourea (PTU)
    - Thyroid toxicity
      - Of greater concerns than their respective parent compounds

Safety reference values

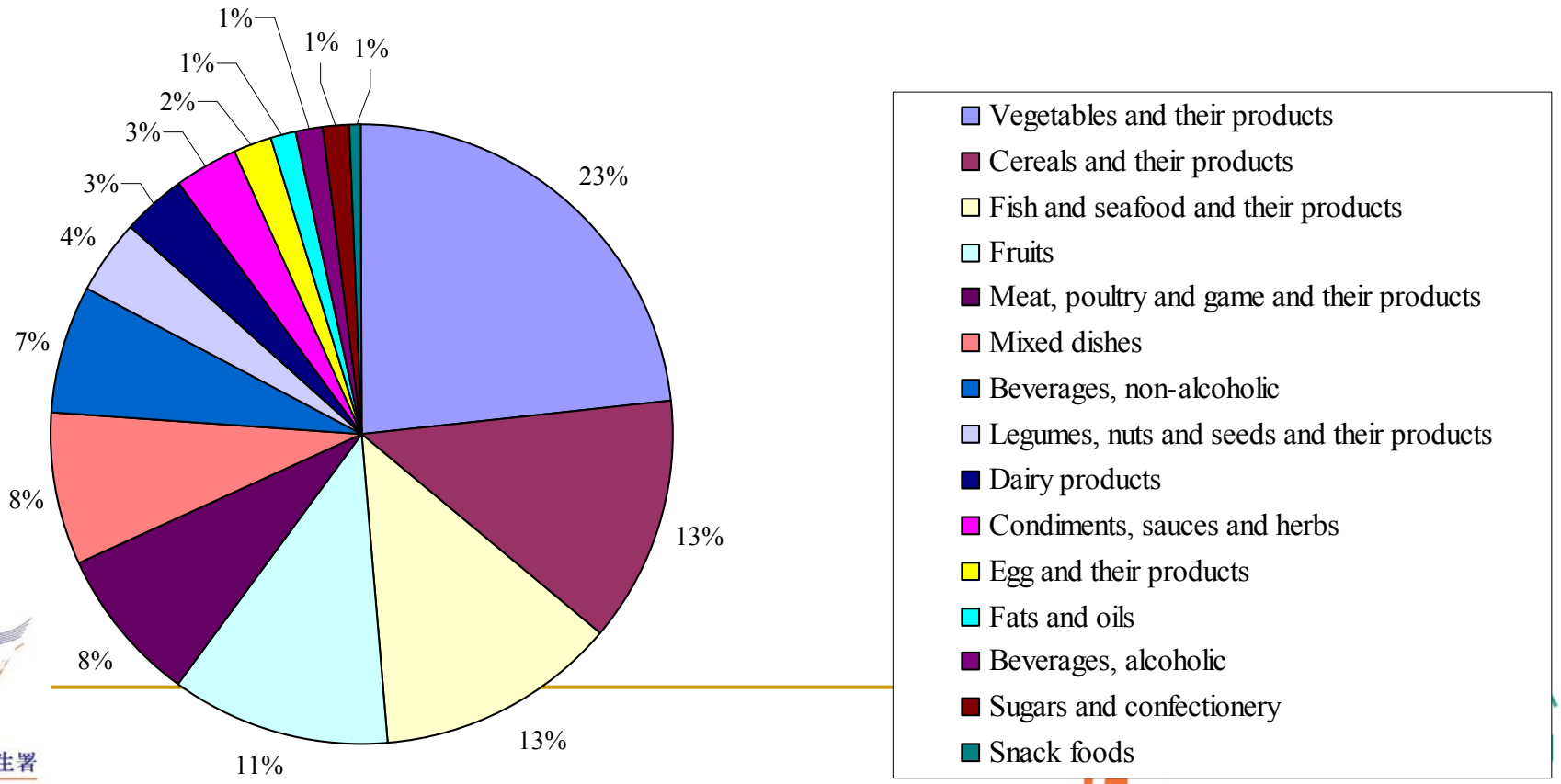
- OPPs
  - 0.00007 – 0.3 mg/kg bw/day
- Carbamates
  - 0.00065 – 0.4 mg/kg bw/day
- Pyrethrins and pyrethroids
  - 0.004 – 0.05 mg/kg bw/day
- Dithiocarbamate metabolites
  - ETU: 0.004 mg/kg bw/day
  - PTU: 0.0003 mg/kg bw/day

The 1st HKTDS (1)

- **Period: 2010 ~ 2014**
- **Objective:**
  - To estimate the dietary exposures of the HK population and population subgroups to a range of substances, including contaminants and nutrients
  - To assess any associated health risks
- Cover over 130 substances
  - Pesticide residues, POPs, metallic contaminants, mycotoxins, nutrients, elements, etc.

The 1st HKTDS (2)

- **Food consumption data source**
  - Population-Based Food Consumption Survey (FCS)
  - 150 TDS food items selected based on food consumption pattern



The 1st HKTDS (3)

- **Methodology:**
  - **Food sampling and preparation**
    - 4 occasions from March 2010 to February 2011
    - Samples were collected and prepared as consumed
    - A total of 1800 samples were collected and combined into 600 composite samples (3 individual samples of the same food item were combined into a composite sample)
  - **Laboratory Analysis**
    - Mainly conduct by the Food Research Laboratory (FRL) of the CFS
    - Perform in batches with reference to the nature and stability of the selected substances

The 1st HKTDS (4)

- Focus on substances in the **whole diet**
- Prepare foods as **table-ready form**
  - Prepare in a mannar consistent with cultural habits in Hong Kong
  - Take into consideration the impact of cooking
- Assess dietary exposure to **substances actually ingested** by the population, rather than concentrations of substances in food

Pesticide residues analysed

- Analysed 85 pesticides or their metabolites under the 4 pesticide groups
  - 48 OPPs
  - 20 Carbamates
  - 15 Pyrethrins & Pyrethroids
  - 2 Dithiocarbamate metabolites (ETU & PTU)
- Analysed in all 600 composite samples involving 150 TDS food items

Results (1)

- Detected in 198 out of 600 composite samples (33%) *
  - Limits of detection (LOD): 1 – 2 ppb
- As expected, detected at only low levels largely in samples of plant origin such as vegetables and fruits
- Not detected in any composite samples of 4 food groups
  - Meat, poultry & game & their products
  - Egg & their products
  - Dairy products
  - Sugars and confectionery

* This % just reflected the detection of pesticide residues in composite samples but it could not reflect the situation in individual samples. The % of the detection in individual samples was probably lower than that of composite samples.

Results (2)

- ppb: Parts per billion (ppb)
- 1 ppb = 1 part per 1,000,000,000 parts
  - 1 part in 10^9
  - 1×10^{-9}
  - Equivalent to:
    - About one drop of water out of the amount of water drank by a person over 68 years (assuming that a person drinks 8 glasses of water per day)
    - About 3 seconds out of a century
- **Concentration: 1 ppb = 1μg/kg**

Results (3)

- Limits of detection (LODs)
  - More sophisticated methods of analysis for pesticide residues
    - Achieve very low LODs
      - 1 - 2 ppb (μg/kg)
- Compare with MRLs
  - Generally express as ppm (i.e. mg/kg)
    - Parts per million
    - 1 ppm = 1000 ppb

Results (4)

Pesticide group (no. pesticides detected)	% composite samples * with detectable levels	Mean level in TDS food item (μg/kg)
OPPs (21)	17%	0 – 240
Pyrethrins and pyrethroids (10)	15%	0 – 130
Dithiocarbamate metabolites (2)	13%	0 – 120
Carbamates (8)	10%	0 – 350
Overall (41)	33%	

* This % just reflected the detection of pesticide residues in composite samples but it could not reflect the situation in individual samples. The % of the detection in individual samples was probably lower than that of composite samples.

Most commonly detected pesticide residues

Pesticide residues (including metabolites)	Composite samples with detectable levels	
	No.	% *
ETU	80	13
Cypermethrin	66	11
Propamocarb	31	5
Chlorpyrifos	29	5

* This % just reflected the detection of pesticide residues in composite samples but it could not reflect the situation in individual samples. The % of the detection in individual samples was probably lower than that of composite samples.

Estimated dietary exposures (1)

Pesticide group (No. pesticides detected)	Dietary exposure estimate (μg/kg bw/day) (Contribution to ADIs) * #	
	Average	High consumer
OPPs (21)	0 – 0.105 (0 – 5.2%)	0 – 0.476 (0 – 23.8%)
Carbamates (8)	0 – 0.291 (0 – 0.2%)	0.001 – 1.145 (0 – 1.0%)
Pyrethrins and pyrethroids (10)	0 – 0.058 (0 – 0.3%)	0 – 0.191 (0 – 1.0%)
Dithiocarbamate metabolites (2)	0.002 – 0.040 (0.7 – 1.0%)	0.011 – 0.107 (2.7 – 3.8%)

* Figures for dietary exposure estimates and contributions to ADIs were rounded to three and one decimal places, respectively.

\# Values of "0" denote < 0.0005 μg/kg bw/day for dietary exposure estimates and < 0.05% for contributions to ADIs.

Estimated dietary exposures (2)

- Dietary exposures to all 85 pesticides
  - Dimethoate and omethoate
    - Highest contribution to the ADI
      - Average: 5.2% of ADI
      - High consumer: 23.8% of ADI
  - Well below their respective Acceptable Daily Intakes (ADIs)
  - → Unlikely to pose unacceptable health risks to both the average and high consumer of the local population

Comparison with other places

- Overall, the dietary exposures of the general population to the relevant pesticide residues for Hong Kong, Australia, New Zealand and the USA were at very low levels
  - Contribute to only a small % of their respective ADIs.

Conclusion

- As expected, pesticide residues were detected at only low levels largely in food samples of plant origin such as vegetables and fruits
- Dietary exposures to all the pesticide residues analysed would be unlikely to pose unacceptable health risks to the local population

Advice to farmers

- Observe Good Agricultural Practice (GAP), such as
  - 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

Advice to public

- The findings re-affirmed the safety of basic dietary advice on healthy eating
  - i.e. have a balanced and varied diet which includes a wide variety of foods, including fruits and vegetables
- To minimise the potential exposure to water soluble pesticide residues, the public can:
  - wash vegetables and fruits thoroughly in clean running water
  - soak the vegetables in water for one hour and then rinse, or alternatively blanch the vegetables in boiling water for one minute and discard the water
- To further reduce their pesticide exposure, the public can also remove the outer leaves of the vegetables or peel the vegetables and fruits as appropriate

Publicity

- **Study report on pesticide residues**
  - Upload to the webpage of CFS
- **Other TDS reports**
  - Will be released in phases and uploaded onto the webpage of CFS

The End