# The application of risk assessment in food safety control in mainland China

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## Risk Analysis Framework


FAO/WHO encourages member countries to develop national food control measures based on risk assessment, in order to assure proper protection level to consumers and facilitate fair trade.

This is particularly important for developing countries, because it is clearly stated in the SPS Agreement that: SPS measures should be based on risk assessment techniques developed by relevant international organizations.

## Importance of risk assessment

- As scientific basis for food standard development;
- For setting up priorities in food inspection and control;
- For evaluating the success of various food safety control measures; and
- Important sources of information for risk communication.

## Basic components of risk assessment

- Hazard identification
- Hazard characterization
- Exposure assessment
- Risk characterization

It is not necessary for each country to conduct own risk characterization.

However, it is necessary to conduct exposure assessment by each individual country, because exposure to food chemicals varies from country to country.

In mainland China, risk assessment of food chemicals has been applied in developing national food safety standards (e.g. heavy metals, pesticides residues, food additives, etc.) and assessing emerging chemical hazards in food (e.g. choloropropanols, acrylamide, dioxins etc.).

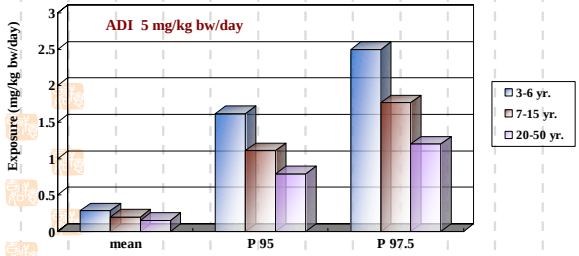
## Examples of exposure assessment

- Food additives
- Dioxins
- Choloropropanols - 3-MCPD
- Acrylamide

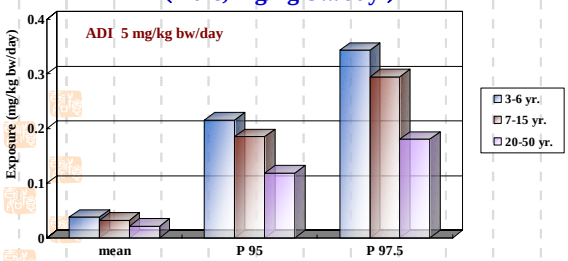
## Food additives

- Dietary exposure of 10 common food additives was assessed using probabilistic model
- Data – (1) food consumption data of 3-6, 7-15 and 20-50 year-old group from 2002 National Nutrition and Health Survey, N= 47,439. (2) maximum use level and national monitoring data of food additives.
- Dietary intakes of each additive was compared with JECFA ADI.

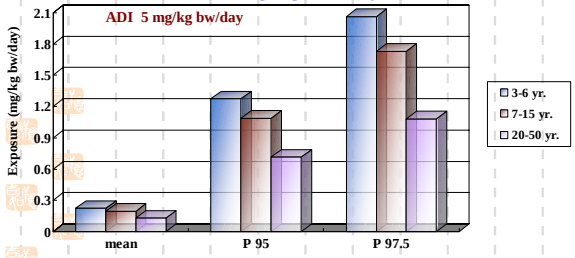
## Exposure assessment of saccharin – based on maximum use level (male, mg/kg bw/day)



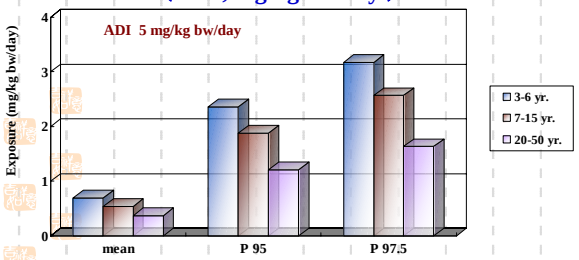

## Exposure assessment of saccharin – based on average detected level (male, mg/kg bw/day)




## Exposure assessment of saccharin – based on P97.5 detected level (male, mg/kg bw/day)



## Exposure assessment of sodium benzoate – based on maximum use level (male, mg/kg bw/day)

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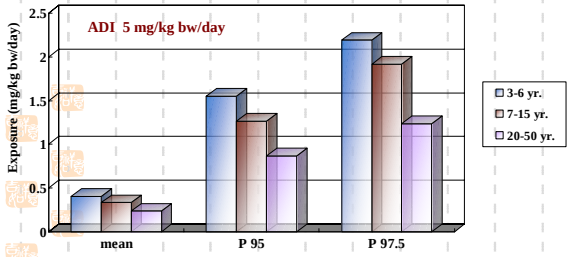


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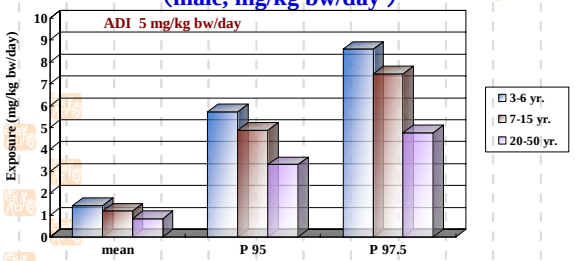


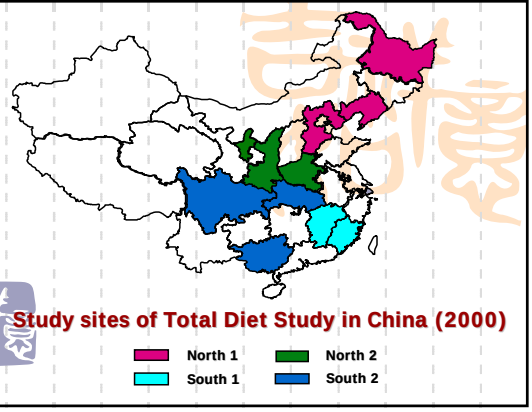


Dioxins

## Levels of PCDD/Fs and Dioxin-like PCBs in Chinese food (pg WHO-TEQ/g)

| | North 1 | | North 2 | | South 1 | | South 2 | |
|---|---|---|---|---|---|---|---|---|
| | PCDD/Fs | PCBs | PCDD/Fs | PCBs | PCDD/Fs | PCBs | PCDD/Fs | PCBs |
| Egg | 0.089 | 0.05 | 0.031 | 0.04 | 0.054 | 0.07 | 0.118 | 0.07 |
| Meat | 0.211 | 0.05 | 0.062 | 0.04 | 0.123 | 0.07 | 0.066 | 0.04 |
| Fish | 0.183 | 0.24 | 0.101 | 0.17 | 0.276 | 0.16 | 0.138 | 0.09 |
| Milk | 0.026 | 0.012 | 0.023 | 0.008 | 0.041 | 0.01 | 0.044 | 0.01 |

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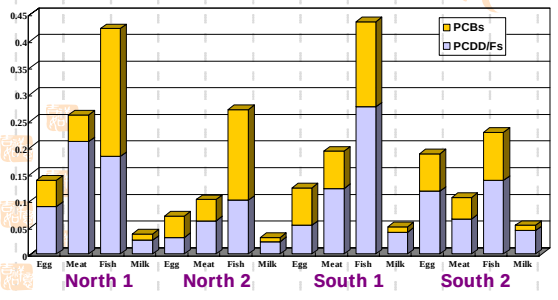
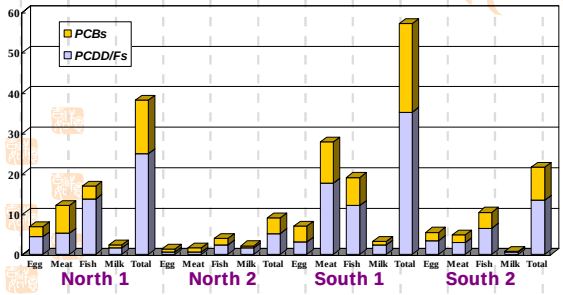


## Dietary intakes of PCDD/Fs and Dioxin–like PCBs and contribution from each food group (pg WHO-TEQ/person*/day)

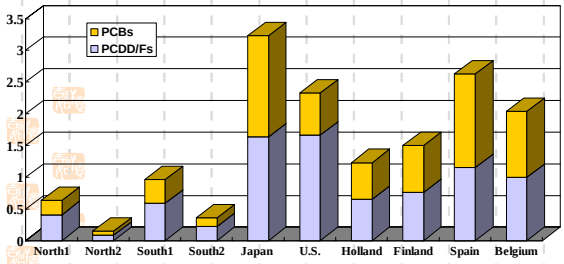
| | North 1 | | | North 2 | | | South 1 | | | South 2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PCDD/Fs | PCBs | sum | PCDD/Fs | PCBs | sum | PCDD/Fs | PCBs | sum | PCDD/Fs | PCBs | sum |
| Egg | 4.42 | 2.49 | 6.91 (18.1%) | 0.59 | 0.76 | 1.35 (14.9%) | 3.04 | 3.95 | 6.99 (12.2%) | 3.43 | 2.04 | 5.47 (25.4%) |
| Meat | 5.22 | 6.84 | 12.06 (31.6%) | 0.61 | 1.02 | 1.63 (18%) | 17.61 | 10.21 | 27.82 (48.7%) | 2.94 | 1.92 | 4.86 (22.5%) |
| Fish | 13.67 | 3.24 | 16.91 (44.3%) | 2.4 | 1.55 | 3.95 (43.6%) | 12.12 | 6.89 | 19.01 (33.3%) | 6.49 | 3.94 | 10.43 (48.4%) |
| Milk | 1.58 | 0.73 | 2.31 (6%) | 1.58 | 0.55 | 2.13 (23.5%) | 2.4 | 0.88 | 3.28 (5.7%) | 0.59 | 0.21 | 0.80 (3.7%) |
| Total | 24.89 [65.2%] | 13.3 [34.8%] | 38.19 | 5.18 [57.2%] | 3.88 [42.8%] | 9.06 | 35.17 [61.6%] | 21.93 [38.4%] | 57.1 | 13.45 [62.4%] | 8.11 [37.6%] | 21.6 |

* Adult male

## Dietary intakes of PCDD/Fs and Dioxin-like PCBs in China (pg WHO-TEQ/person/day)




## Comparison of dietary intakes of PCDD/Fs and Dioxin-like PCBs between countries (pg TEQ/kg bw/day)




choloropropanols

## Concentrations of 3-MCPD in foods from 2000 China TDS (μg/kg)

| Food | South 1 | South 2 | North 1 | North 2 | Average |
|---|---|---|---|---|---|
| Cereals | 3.7 | ND | 3.3 | 6.6 | 3.4 |
| Potatoes | ND | 42.0 | 5.2 | 4.0 | 12.8 |
| Legumes | 66.4 | 18.0 | 8.6 | 40.4 | 33.4 |
| Vegetables | 8.7 | 23.7 | 22.9 | 10.1 | 16.4 |
| Fruits | ND | ND | ND | 4.5 | 1.1 |
| Meat | 8.3 | 34.5 | 74.5 | 30.0 | 36.8 |
| Egg | ND | 24.7 | 42.3 | ND | 16.8 |
| Aquatic foods | 10.6 | 128 | 38.4 | 16.7 | 48.4 |
| Milk | 3.6 | ND | ND | 5.7 | 2.3 |
| Sugar | ND | ND | ND | ND | 0.0 |
| Beverages | ND | ND | ND | ND | 0.0 |
| Alcohol | ND | ND | ND | ND | 0.0 |

## Comparison on dietary intakes of 3-MCPD among countries

| Region | μg/kg bw/day | % PMTDI |
|---|---|---|
| South 1 | 0.21～0.26 | 10.2%～12.3 |
| South 2 | 0.32～0.42 | 15.1%～20.1 |
| North 1 | 0.35～0.39 | 16.4%～18.4 |
| North 2 | 0.27～0.27 | 12.9%～13.5 |
| China average | 0.29～0.34 | 14.0%～16.4 |
| Australia | 0.21~0.81 | 10.5%～40.5 |
| Holland | 1.48 | 74 |

## Acrylamide

### Study in Beijing

- **Subjects** – 15-55 years-old, N=315
- **Food items** – fried potato products, fried wheat flour sticks, instant noodle, traditional Chinese snacks, biscuits, pastries and breads, coffee (instant) and chocolate. N=150.

## Concentrations of acrylamide in foods, μg/kg

| Food | N | Min. | Mean | P50 | P90 | P95 | P97.5 | Max. |
|---|---|---|---|---|---|---|---|---|
| Fried potato | 50 | ND | 751.7 | 409.5 | 1743.8 | 3015.2 | 3435.4 | 5269.0 |
| Fried wheat sticks | 8 | 13 | 79.1 | 63.5 | 155.0 | 176 | 186.5 | 197.0 |
| Instant noodles | 14 | ND | 24.3 | 6.5 | 56.3 | 92.48 | 118.7 | 145.0 |
| Chinese snacks | 50 | ND | 111.7 | 48.0 | 321.4 | 433.2 | 543.4 | 734.0 |
| Biscuits | 13 | ND | 367.4 | 183.0 | 835.8 | 1202.4 | 1385.7 | 1569.0 |
| Cakes, breads | 15.0 | ND | 32.6 | 20.0 | 53.2 | 104.9 | 148.0 | 191.0 |
| Coffee | 8 | 47 | 164.3 | 95.0 | 372.9 | 384.4 | 390.2 | 396.0 |
| Chocolate | 8 | 23 | 189.8 | 153.5 | 338.6 | 437.3 | 486.6 | 536.0 |
| Infant formula, rice | 10 | ND | 15 | 10 | 36 | 37 | 37 | 37 |
| Infant formula, milk | 6 | ND | 6 | 7 | 8 | 9 | 9 | 9 |
| Complimentary foods | 4 | 7 | 43 | 21 | 97 | 111 | 118 | 125 |

## Dietary intakes of acrylamide (μg/kg bw/day)

| Contamination level (μg/kg) \ Food consumption (g/d) | Mean | P50 | P90 | P95 | P97.5 |
|---|---|---|---|---|---|
| Mean | 0.29 | 0.05 | 0.66 | 1.26 | 1.61 |
| P50 | 0.15 | 0.02 | 0.34 | 0.62 | 0.80 |
| P90 | 0.66 | 0.11 | 1.57 | 3.07 | 3.83 |
| P95 | 0.97 | 0.16 | 2.33 | 4.58 | 5.68 |
| P97.5 | 1.14 | 0.20 | 2.77 | 5.45 | 6.74 |

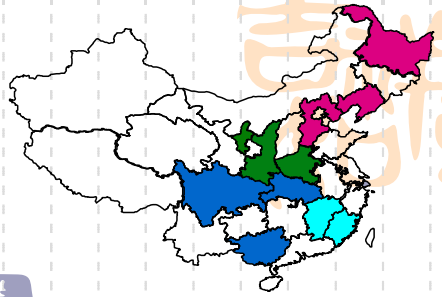
## Contribution of various types of food to total dietary exposure of acrylamide (%)

| Food | mean | P50 | P90 | P95 | P97.5 |
|---|---|---|---|---|---|
| Fried potato | 22.6 | 23.3 | 22.6 | 26.7 | 25.9 |
| Fried wheat sticks | 7.4 | 11.2 | 6.2 | 4.8 | 4.4 |
| Instant noodles | 3.7 | 1.9 | 3.7 | 4.2 | 4.6 |
| Chinese snacks | 19.9 | 16.2 | 24.6 | 22.7 | 24.2 |
| Biscuits | 27.7 | 26.1 | 27.1 | 26.7 | 26.1 |
| Cakes, breads | 3.6 | 0.8 | 3.2 | 4.5 | 5.5 |
| Coffee | 5.5 | 6.0 | 5.3 | 3.8 | 3.3 |
| Chocolate | 9.5 | 14.6 | 7.3 | 6.5 | 6.1 |
| Cereal (2~5) | 62.3 | 56.2 | 64.8 | 62.9 | 64.8 |

## MOE calculation based on JECFA approach (carcinogenicity)

| Dietary intakes (μg/kg bw/day) | MOE |
|---|---|
| 0.29* | 1,034 (general population) |
| 1.61** | 186 (high consumers) |

* Mean concentration x Mean consumption
** Mean concentration x P 97.5 consumption



Study sites of Total Diet Study in China (2000)

North 1 North 2
South 1 South 2

## Composite food samples:

- Cereal
- Legume
- Nuts
- Tuber
- Meat & poultry
- Egg
- Sea food
- Dairy
- Vegetable
- Fruit
- Sugar
- Beverage
- Alcohol drinks
- Water

## Acrylamide content of food in 2000 TDS (μg/kg)

| Region | Cereal | Legume | Tubers | Meat | Egg | Aquatic foods | Milk | Veg. | Fruits | Sugar | Alcohol | Beve-rages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South 1 | ND | 3.2 | 8.6 | ND | ND | ND | ND | 6.4 | ND | 5.8 | 0.52 | ND |
| South 2 | 3.9 | 3.2 | 18.0 | ND | ND | ND | ND | 8.3 | ND | 7.0 | 1.28 | ND |
| North 1 | 2.1 | 14.1 | 23.6 | ND | ND | 1.5 | ND | 19.3 | ND | 4.5 | 0.5 | ND |
| North 2 | ND | 6.2 | 15.4 | ND | ND | 3.4 | ND | 25.9 | ND | 5.1 | 0.6 | ND |
| Average (lower limit) | 1.6 | 6.7 | 16.4 | 0.0 | 0.0 | 1.8 | 0.0 | 15.0 | 0.0 | 5.6 | 0.7 | 0.0 |

**Vegetables, tubers, cereals and legumes accounted for 78% of total acrylamide intake.**

## Exposure assessment and MOE calculation

| Region | Exposure (μg/kg bw/day) | MOE |
|---|---|---|
| South 1 | 0.06 | 5,000 |
| South 2 | 0.11 | 2,727 |
| North 1 | 0.20 | 1,500 |
| North 2 | 0.19 | 1,579 |
| China, average | 0.14 | 2,143 |

## Comparison of China and JECFA evaluation

| | AA intake (μg /kg bw/day) | | MOE | |
|---|---|---|---|---|
| | General population | High consumer | General population | High consumer |
| JECFA | 1 | 4 | 300 | 75 |
| China | | | | |
| Beijing | 0.29 | 1.61 | 1,034 | 186 |
| TDS | 0.14 | — | 2,143 | — |

## Summary

- The application of risk assessment in food safety control in mainland China has just started. It is necessary to follow the international practice to conduct national RA and learned experience from developed countries.
- Provisions on risk assessment should be specified in the national food legislation and independent expert risk RA bodies need to be established.