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Contents

Report on the 3rd International Workshop on Total Diet Studies
14 - 21 May 2004, Paris, France

1. INTRODUCTION

Foods may contain thousands of chemicals which have the potential to affect human health. The health and economic impacts of human exposure to chemicals are well recognized in developed countries and programmes to continuously monitor their presence in the food supply are an integral part of food safety assurance systems. However, in developing countries the risks posed by chemicals in the food supply are largely unknown or often underappreciated. The World Health Organization (WHO) has for many years supported the concept of Total Diet Studies (TDS) as one of the most cost effective methods for generally assuring that the dietary intake of chemicals is within safe limits and for setting priorities for further study. WHO in collaboration with counterpart national agencies has sponsored the First and Second International Total Diet Study Workshops in Kansas City in July 1999 and in Brisbane in February 2002, respectively. Subsequently; two regional TDS workshops were held in Buenos Aires in July 2002 and Brno/Prague in November 2002. The present workshop reflects the continued support by WHO and it's Member States of TDS approach, especially promotion of TDS in developing countries.

2. THE WORKSHOP

The workshop was cosponsored by WHO and the National Agricultural Research Institute (INRA) with the participation of the Food and Agricultural Organization of the United Nations (FAO). The workshop was preceded by a one-week training course on TDS for national representatives from francophone countries in order to promote TDS in these countries. The programme for the training course, which was conducted in French, is given in Annex I. The workshop, which was simultaneously translated into English and French, included presentations and discussions concerning planned, on-going and completed TDS from around the world. The agenda for the workshop is given in Annex II. Fifty-five representatives from 35 countries were present. A list of participants is given in Annex III.

The objectives of the workshop were to:

- promote and support TDS in all member countries;
- help prepare francophone countries to conduct TDS;
- update recent developments in the field of TDS;
- promote reliable and comparable TDS through harmonized approaches and exchange of international 'best practices' and expertise;
- establish a network of national counterparts for undertaking regional TDS projects; and
- promote electronic submission to and use of total diet study data from the WHO Global Environmental Monitoring System/Food Contamination Monitoring and Assessment Programme (GEMS/Food).

Opening Remarks

On behalf of the WHO, Dr Gerald Moy, GEMS/Food Manager, WHO Headquarters, welcomed the participants who had come from many different countries, some of which are quite far from Paris. He noted that WHO continues to consider chemical contamination of food to be a major public health concern and recognized the need for all countries to undertake TDS as an important component of their monitoring responsibilities. As international trade in food has grown

significantly, the health of consumers everywhere has become increasingly dependent on all food safety agencies assuming their proper roles and responsibilities in assuring that food does not contain chemicals that would cause short- or long-term health problems. In this effort, he encouraged workshop participants to make the results of their total diet work more known to consumers and decision-makers. In this regard, he offered to assist in preparing a brochure on TDS and to organize a book on the subject. Both would hopefully be available in English, French and perhaps other languages. Finally, he expressed his appreciation to the Toshiba Company for their donation of computer equipment for utilization in the area of TDS in WHO Member States.

Dr Philippe Verger, INRA, stated that, as the host institute for the workshop, it was a privilege and pleasure to welcome participation of 35 countries. He especially noted that the participation of 14 francophone countries demonstrated that the efforts of WHO and INRA were justified and will be followed by an improvement of the involvement of those countries in data collection and research on TDS methodologies

Dr Verger stated that one of the three main areas of study chosen by the INRA for the years to come is food, whose assurance of biological and chemical safety is a major challenge. INRA's research fields involve studies to quantify the risks for human health, which will be used by decision-makers responsible for the regulation of chemicals and the safety of food products. The collaboration between INRA and WHO began very naturally in 1999. The first step was the adaptation of the OPAL software for francophone countries allowing an easier involvement in the GEMS/Food system of data collection. After having participated in the 1st and 2nd workshops in Kansas-City and Brisbane, this 3rd international TDS workshop in Paris marks the beginning of more active participation of the INRA in the work of GEMS/Food. Through its new research unit on food risk analysis methodologies, Met@risk, the collection of contamination data and the assessment of the possible impact of those contaminants on human health will be developed using research programmes dedicated to new approaches and to the improvement of classical ones.

Workshop Overview

The workshop elected Dr Philippe Verger to be the Chair. Various topics were presented by participants over the course of the workshop. Summaries of many of these are presented in Annex IV. Among its various activities, the workshop:

- reviewed the status of ongoing TDS in different countries;
- addressed technical points associated with them;
- reached consensus on certain issues of harmonization;
- focused on the urgent need for conducting TDS in all countries, especially developing countries;
- illustrated the importance of more intensive dietary intake monitoring on isolated examples of higher than acceptable risk and substantial surveillance gaps;
- illustrated that the difficulties of conducting TDS in remote location;
- promoted the reporting of monitoring data and TDS results using GEMS/Food OPAL I and II to the WHO SIGHT databases;
- promoted the importance of such studies for assessment of nutrient intakes;
- presented the inherent linkages of the studies with the assessment, management and communication of risks; and

- recommended further actions for national and international health authorities in relation to TDS.

Closing Remarks

The Chairman was optimistic about conclusions of the workshop given the active participation of all parties. He noted the TDS are an approach capable of refining exposure assessments and in many cases, of allowing conclusions in terms of relevance for public health to be made for certain contaminants. A lot of countries are faced with food safety problems and this technique can be implemented with limited resources at national and sub-regional levels. He acknowledged all participants for their efforts in producing clear and realistic recommendations and looked forward to being able to submit positive results during the 4th WHO international workshop on TDS.

On behalf of WHO, Dr Moy thanked the participants for their enthusiasm and contributions during the workshop. In recognizing the excellent local arrangements, he acknowledged the efforts of Drs Philippe Verger and Jean-Charles Leblanc, and the entire staff of the INRA in making the workshop run smoothly, efficiently and pleasantly. He expressed the hope that the workshop had established a strong foundation for future collaboration among all of the organizations present.

3. CONCLUSIONS AND RECOMMENDATIONS

The workshop participants revisited and unanimously endorsed the recommendations made at the 2nd International Total Diet Study Workshop in Brisbane (see Annex V). In addition, the following recommendations were made:

Total diet study in each country

All countries should conduct total diet studies to assess the safety and nutritional quality of their diets.

Laboratory capacity

Responsible authorities in all countries should substantially strengthen laboratory capacity to monitor baseline levels of toxic chemicals in foods and address weaknesses in surge capacity and emergency preparedness.

GEMS/Food should maintain an expanded global inventory of laboratory capacities by chemical, food matrix, and detection limits. Also, a list of individuals with analytical, toxicological and other expertise should be compiled.

WHO Food Safety Databases

Existing GEMS/Food databases (aggregate food/contaminant and dietary intake by cohorts) should continue to be supported and refined.

Individual countries should support GEMS/Food databases by submitting monitoring data in the OPAL format.

Software should be developed to allow individual countries to calculate dietary intake of contaminants by integrating their concentration data with their food intake data.

Risk communication

Consultations should be conducted with all interested parties including government, academia, industry and consumer groups in the design of total diet studies, and results of those studies should be promptly, fully and openly reported in a format easily understandable to all. Risks to the public should be reported fully and in perspective by scientists with the best knowledge of the issue. The public also must be informed about the best management practices to minimize risk of the main identified chemical hazards.

International total diet studies workshops

On-line training software should be developed to supplement regional and international TDS training courses.

The practice of holding regional and international total diet studies workshops on a regular basis should be continued with the support of WHO Headquarters and its Regional Offices as well as other international and national organizations and donors.

A brochure and a book on the total diet studies should be prepared to promote knowledge of their importance for public health, trade and consumer confidence.

Support for TDS in developing countries (Recommendations from training course)

- Exposure to chemical contaminants should be estimated using a step-by-step approach in countries, including total diet studies;
- The role of participants from the French-speaking countries as contact points for GEMS/FOOD should be formalized;
- A report on the situation in the developing countries in respect of chemical risks in food should be drawn up and strengths and weaknesses in the following areas should be identified: analytical capacity, personnel training, data on food consumption, data on food contamination and data on dietary exposure;
- Developed countries should encourage regional or subregional organizations in the developing countries to make the safety of food a priority and to strengthen regional training in total diet studies and evaluation of food risks;
- Technical assistance in the preparation of total diet studies projects at regional or subregional levels should be provided to take advantage of economies of scale;
- A French-speaking network of *GEMS/Food* on total diet studies should be established;
- INRA should be designated as coordinator of the French-speaking countries to help the network evaluate chemical risk in food;
- Priorities that are suited to regional circumstances should be set for groups of foods and contaminants (dietary composition and contamination of locally consumed foods);
- National working groups should be set up to prepare future total diet studies;
- All countries should provide the resources necessary to evaluate the risk of contamination of food and call upon technical assistance from international organizations, such as WHO, FAO and other donor organizations, to support their efforts;

- The Regional Offices of WHO (including the Regional Food Safety Advisers) should be more deeply involved in assisting and organizing national food safety systems and the national Codex committees;
- Developed countries should support the national Codex committees and help them to develop regulations on food contaminants;
- A system of regional surveillance of chemical contamination of food should be developed together with an early warning system; and
- Participants in the workshop should help to inform consumers of food safety issues in order to develop better awareness of the need for risk assessment of contaminated food.

Annex I

Programme for Total Diet Studies Training for Participants from Francophone Countries, 10-14 May 2004, INRA, Paris, France

Monday 10 May

Session 9h00 –10h30

Welcome and opening remarks

(Rémi Toussain, Director, INRA P-G, Philippe Verger, INRA, speaker from Ministry of Foreign Affairs, Gerald Moy, GEMS/Food Manager, WHO Headquarters)

Coffee Break 10h30-11h00

Session 11h00-12h00

Overview of training

Lunch 13h00-14h00

Session 14h00-17h00

Risk analysis paradigm (Jean-Charles Leblanc, INRA, Paris)

- Risk assessment
- Risk management
- Risk communication

Exposure assessment (Jean-Charles Leblanc, INRA, Paris)

- Predicting versus assessing exposure
- Monitoring commodities
- Duplicate diet
- Total diet
- Bio monitoring

Tuesday 11 May

Session 9h00-13h00

Why conduct a total diet study (Philippe Verger, INRA, Paris)

- Assessing intakes of chemicals in food
- Assessing intakes of nutrients
- Formulating priorities for risk management
- Establishing standards and norms
- Identifying population subgroups at risk
- Formulating/revising agricultural and manufacturing policies and practices
- Assessing effectiveness of risk management interventions

Presentations from participants about their national situations in terms of assessing and managing exposure to chemicals in food.

Session 14h00-18h00

Total diet study components

- Food consumption data (Jean-Charles Leblanc)
- Importance of various aspects of TDS (Robert Dabeka, FRD, Canada)
- Sample collection, processing and preparation (Richard Vannoort)
- Methods of analysis, including AQA (Max Feinberg, INRA, Paris)
- Data handling and exchange (Lawrence Grant)
    - OPAL I and II
    - SIGHT
- Reporting (Lawrence Grant)

Wednesday 12 and Thursday 13 May
(Participants divided into two groups)

Group 1

Practical exercises in total diet study components (Richard Vannoort and Chris Sack)

- Constructing a total diet study timeline (Richard Vannoort)
- Review of food consumption data (Richard Vannoort)
- Develop own country TDS food list. Richard Vannoort)
- Sampling Plan tutorial (Richard Vannoort)
- Analytical methods, including quality control and assurance (Chris Sack)

Group 2
Hands-on training in data handling in computer room (Lawrence Grant and Jean-Charles Leblanc)

- Contaminant in food data - OPAL I
- Contaminant in diet data - OPAL II
- Submitting data to GEMS/Food - SIGHT
- Generating reports

Friday 14 May

Morning:
Visit to wholesale food market (Mr Ganneau) and food control laboratory of the Ministry of Agriculture (Mr Guignard)

Afternoon:
Conclusions and final remarks

Course evaluation and preparation for presentation country reports for second week

Annex II

Agenda for the 3rd International Workshop on Total Diet Studies
17-21 May 2004, INRA, Paris, France

Monday 17 May

Session 9h30 – 10h30

1. Welcome and opening remarks (Rémi Toussain, Director, INRA P-G and Gerald Moy, GEMS/Food Manager, WHO Headquarters)
2. Keynote address (Thierry Klinger, General Director of Food, Ministry of Agriculture)
3. Report on the first week training course and presentation of certificates

Coffee Break 10h30-11h00

Session 11h00-12h30

4. Overview of GEMS/Food (Gerald Moy, WHO Headquarters)
5. Activities of GEMS/Food-Euro (Cristina Tirado, WHO Regional Office for Europe)
6. Selected country reports on current status of TDS and food contamination monitoring
   Australia (Peter Wallner, Food Standards Australia New Zealand)

Lunch 12h30-14h00

Session 14h00-15h30

Canada (Robert Dabeka, Food Research Division, Health Canada)
China (Junquan Gao, Institute of Nutrition and Food Hygiene)
France (Jean-Charles Leblanc, National Institute for Agricultural Research)

Coffee Break 15h30-16h00

Session 16h00-17h30

Germany (Guenter Sommerfeld, Federal Office of Consumer Protection and Food Safety)
Indonesia (Roy Sparringa, Ministry of Health)
Netherlands (Piet von Zoonen, RIVM)

Evening

Workshop Dinner
Opening (Michel Thibier, General Director of Education and Research, Ministry of Agriculture)

Tuesday 18 May

Session 9h00-10h30

7. The role of the European Food Safety Authority in exposure assessment (Djien Liem, European Food Safety Agency, Brussels)

8. Recent advances in OPAL I and II and SIGHT (Lawrence Grant, WHO Consultant and Guenter Sommerfeld, Federal Office of Consumer Protection and Food Safety, Germany)

Coffee Break 10h30-11h00

Session 11h00-12h30

9. Monitoring of pesticide residues on food of plant origin in the EU - Planning, Implementation, Results and Follow-up (Patrizia Pitton, Food and Veterinary Office of the General Directorate, Health and Consumer Protection, of the European Commission, Ireland)
10. EFCOSUM protocol: A model food consumption survey (Ruth Charrondiére, FAO)
11. Selected country reports on current status of TDS and food contamination monitoring (continued)
    Ireland (Christina Tlustos, Food Safety Authority of Ireland)

Lunch 12h30-14h00

Session 14h00-15h30

Korea, Republic of (Hae Yoon, Korean Food and Drug Administration)
Lithuania (Maura Olechnivic, National Nutrition Center)
New Zealand (Cherie Flynn, New Zealand Food Safety Authority and
Richard Vannoort, Institute of Environmental and Scientific Research)

Coffee Break 15h30-16h00

Session 16h00-17h30

Pacific Islands (Bill Aalbersberg, University of the South Pacific)
Slovakia (Slavka Krizova, Food Research Institute)
Spain (Lourdes Suárez González, Spanish Food Safety Agency)

Wednesday 19 May

Session 9h00-10h30

12. LANGUAL - a multipurpose food classification system (Jayne Ireland, French Food Safety Agency)
13. Advances in analytical methodologies (Chris Sack, US Food and Drug Administration)
14. Probabilistic methods in TDS (Jean-Luc Volatier, French Food Safety Agency)

Coffee Break 10h30-11h00

Session 11h00-12h30

15. Involvement of special interest population groups in TDS (Cherie Flynn, New Zealand Food Safety Authority)
16. Implications of lowering the PTWI for methyl mercury (Jiri Ruprich, Centre for Hygiene of Food-chains)
17. TDS in remote locations: Case study in Papua New Guinea (Keith Bentley, WHO Consultant)

Lunch 12h30-14h00

Session 14h00-15h30

18. Selected country reports on current status of TDS and food contamination monitoring (continued)
    Czech Republic (Jiri Ruprich, Centre for Hygiene of Food-chains)
    USA (Katie Egan, US Food and Drug Administration)
    United Kingdom (Barbara Gallini and Simona Origgi, Food Standards Agency)

Coffee Break 15h30-16h00

Session 16h0-17h30

IUPAC Experience (Sue-Sen Wong, IUPAC Representative)
Other countries to be announced

Thursday 20 May

Working group on regional TDS in developing countries
Working group on promotion of TDS

Friday 21 May

Session 9h00-10h30

19. TDS in highly polluted areas: Case study in the Aral Sea area (Peter Fürst, CUVA)
20. Evaluating the Stockholm Convention on Persistent Organic Pollutants: Monitoring of breast milk and other foods (Rainer Malisch, CUVAFR)

Coffee Break 10h30-11h00

Session 11h00-12h30

21. New substances for TDS (Group discussion)
    Acrylamide
    Inorganic arsenic

Lunch 12h30-14h00

Session 14h00-16h00

22. Regional TDS in developing countries
23. Promotion of TDS
24. Conclusions and recommendations
25. Closing remarks

Annex III

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Annex IV

SUMMARY OF SELECTED PRESENTATIONS

Current Status of GEMS/Food

Gerald Moy, WHO, Geneva, Switzerland

The Global Environment Monitoring System (GEMS) was established by the United Nations Environment Programme (UNEP) in 1976 and included three components, air, water and food. The World Health Organization (WHO), which was the lead agency for food, collaborated with UNEP and the Food and Agriculture Organization of the United Nations (FAO) to implement the GEMS Food Contamination Monitoring and Assessment Programme, which is widely known as GEMS/Food. The main purpose of this programme is to compile data on food contamination and human exposure for global synthesis, evaluation and presentation. The focus of GEMS/Food is on health-oriented population-based dietary exposure to major food contaminants. This is in contrast to trade-oriented targeted sampling and analysis programmes, which is used for compliance purposes. GEMS/Food currently includes institutions located in over 80 countries around the world. GEMS/Food is interested in levels of contaminants in individual foods and in the total diet as reflected in the software programs OPAL I and II, which have been developed expressly to collect and manage such data. SIGHT (Summary Information on Global Health Trends) was developed as a Web-based dissemination tool that offers the public and other specific users access to the GEMS/Food database. Among such users, JECFA and JMPR receive GEMS/Food data on chemicals that are scheduled for evaluation by these bodies. GEMS/Food also provides data to the Codex Alimentarius Commission on request. Additionally, GEMS/Food is involved in the generation of data on chemicals in human milk and is organizing the Fourth Round of WHO Coordinated Studies of Dioxins, Dibenzofurans and Polychlorinated Biphenyls in Human Milk, which will be used in assessing the effectiveness of the Stockholm Convention on Persistent Organic Pollutants (POPs). GEMS/Food is responding to the potential intentional contamination of food by maintaining an inventory of monitoring capabilities of GEMS/Food institutions and other food laboratories in order to provide support in the event of terrorist incidents or other food safety emergencies.

Activities of the GEMS/Food Programme in Europe

Cristina Tirado, WHO Regional Office in Europe, European Centre for Environment and Health, Rome, Italy

GEMS/Food Euro was re-established in 2001 at the European Centre for Environment and Health in Rome to address specific priorities and needs of the European Region. The Advisory Committee Meeting held in 2001 evaluated the commitment of the Collaborating Centres (CC) and Participating Institutions (PI) and defined the future lines of work in the Programme. The meeting updated the GEMS/Food Euro core, intermediate and comprehensive lists of contaminants and food commodities and it was recommended that these should be revised regularly. In collaboration with these CC and PI the Food Safety Programme in Europe has been supporting the countries to build their capacity, organizing trainings on Total Diet Studies (TDS), on data submission with the Operating Programs for Analytical Laboratories (OPAL) and on analytical methodologies. In 2002 GEMS/Food Euro organized, in collaboration with the National Institute of Public Health of the Czech Republic and the University of Prague, a Sub-regional training on TDS for accession countries from Central and Eastern Europe. As a follow-up the Baltic countries requested specific training at the national level on the Operating Programs for Analytical Laboratories for the electronic submission of data, OPAL I (for contaminants) and OPAL II (for total diet studies), in 2003. This training provided an opportunity to provide tools for transformation of national data into GEMS/Food format and to explore the possibilities of importing individual data in a way that they can be used to report to the European Commission (EC).

The aggregated submissions of exposure data provided by European countries shows that most of the data submitted correspond to persistent organic pollutants, followed by heavy metals and pesticides residues. Mycotoxins have been reported to a lower extent although they are a growing concern in many countries in Central and Eastern Europe. GEMS/Food has recently created a European database section of the Summary Information on Global Health Trends database (SIGHT), to disseminate the European exposure and intake data online: http://www.euro.who.int/eprise/main/WHO/Progs/FOS/Chemical/20040728_1

One of the main objectives of the GEMS/Food Euro is to promote the participation of all the countries belonging to the European Region and particularly newly established states. The participation of the countries from the former Soviet Union is being particularly promoted, since at least 20 countries suffered under the Soviet time from environmental negligence and chemical contamination of food via the environment which might have a large impact on the health of a population. GEMS/Food Euro wants to promote the coordination of its activities with the current calls of JECFA and JMPR, the monitoring programmes within the EC and eventually with the European Food Safety Authority to encourage synergy and to avoid duplication of efforts. More information about GEMS/Food Euro can be found at: http://www.euro.who.int/eprise/main/WHO/Progs/FOS/Chemical/20020816_1

Update on the Australian Total Diet Survey

Peter Wallner, Food Standards Australia New Zealand, Canberra, Australia

Australia's Total Diet Study (ATDS) has a fairly long history and has been conducted since 1970 (it was previously known as the Market basket survey). Food Standards Australia New Zealand conducts the ATDS with sample collections undertaken by the 8 different States and Territories of Australia.

The results from the 21st ATDS are currently being assessed and the sampling for the 22nd ATDS is about to commence. In the past the ATDS had typically analysed pesticide and contaminant residues however, recently there was a shift towards using this annual activity to examine other chemicals of interest including food additives and essential elements such as iodine and selenium. The reasons for the change were explained and included; the consistently low results yielded for pesticide and contaminants over many years, the need to protect public health and safety, supporting standards setting and responding to emerging international issues.

The table below summarizes recent ATDS.

ATDS No.	Sampled Published	No. Foods	No. Composite Samples	Analytes
19th	1998 2001	69	1,107	**Pesticide residue screen**: chlorinated organic pesticides, organophosphorus pesticides, synthetic pyrethroid pesticide & fungicides **Contaminants**: antimony, arsenic, cadmium, copper, lead, mercury, selenium, tin, zinc Dithiocarbamate fungicides – Fruit vegetables Toxins: Aflatoxins - walnuts, tahina, peanuts, milk (M1)
20th	2000/2001 2003	65	1,107	**Pesticide residue screen**: chlorinated organic pesticides, organophosphorus pesticides, synthetic pyrethroids, carbamates & fungicides **Contaminants**: antimony, arsenic, cadmium, copper, lead, mercury, selenium, tin, zinc **Toxins**: Aflatoxins & ochratoxins (A) – bread, biscuits, cereals, instant coffee, peanut butter, almonds, chocolate Inhibitory substances: Penicillin G streptomycin oxytetracycline – meats, offal, dairy products, eggs, infant formula
21st	2003 2004	60	702	**Additives**: suphites, nitrates, nitrites, benzoates, sorbates – mainly processed foods
22nd	2004 2005	95	1,128	**Essential trace elements**: iodine, chromium, molybdenum, selenium and copper plus nitrates and nitrite

ATDS are published on the FSANZ website and the results of the 21st and 22nd ATDS should both be published during 2005: http://www.foodstandards.gov.au/recallssurveillance/australiantotaldiets1914.cfm.

Canadian Total Diet Study

Robert. W. Dabeka and Xu-Liang Cao, Health Canada, Ottawa, Canada

Between 1992 and 1999, about 200 foods were picked up from each of 4 supermarkets in 9 Canadian cities. Foods were prepared as for consumption, combined into 135 different food composites for each city, and homogenized. The composites were analysed for background concentrations of PCBs, dibenzofuran and dioxin congeners, 59 pesticides, and toxic and nutritional trace elements.

For the overwhelming majority of chemicals tested, concentrations of the chemicals in the composites were below regulatory limits, and dietary intakes of the chemicals were within international guidelines. There were several exceptions. For the pesticides, there was one instance when the level exceeded the maximum residue limit, and this was for captan in one of the strawberry composites. The dietary intake of methyl parathion reached 10% of the acceptable daily intake by infants 0-3 months age. The dioxin and PCB toxic equivalent (TEQ) intakes by all children and infants under 5 years old exceed the JECFA PTDI, with dairy products contributing most to the TEQ intakes.

Point sources of dioxin contamination of foods were also detected, examples being the egg composite from Toronto in 1992 and a cottage cheese composite from Whitehorse City in the north of Canada. Zinc

intakes were slightly higher than the upper safe level of intake recommended by the US National Academy of Sciences. More extensive dietary monitoring is recommended to identify at-risk population groups, and to eliminate point sources of dioxin and PCB contamination. In addition, the food intake data used for estimating dietary intakes are outdated, and new distributional data are needed to supplement average data to identify the percentage of population groups at greater risk because of higher than average intakes.

The 2000 Chinese Total Diet Study: Methodology and Results

Junquan Gao, National Institute for Nutrition and Food Safety, Beijing, China

The Chinese Total Diet Study conducted in 2000 used the consumption of 2 030 foods by Chinese residents which were then aggregated into 662 representative individual foods. The 662 foods were further prepared to obtain four market baskets, each comprised of 12 food composites with a total of 48 composites. The dietary intake of chemical contaminants and nutrients can be obtained for an average adult man in four geographical areas using analytical data from the 12 food composites and 10 specific age-sex groups in each of the 12 provinces using analytical data from 662 individual foods. In case of high results from composite samples, the geographical and food source of contamination can be identified by further analyzing individual foods. The analytes in the 2000 Chinese Total Diet Study included the heavy metals lead, cadmium, mercury and arsenic, the pesticides HCH, DDT, methamidophos, dichlorvos, parathion, parathion-methyl, trichlofon, dimethoate, acephate, disulfoton, fenitrothion, malathion, fenthion and phosmet, the industrial contaminants dioxins and PCBs, the natural contaminants aflatoxins B1, B2, G1, G2 and M1, minerals and trace elements potassium, sodium, calcium, magnesium, phosphorus, iron, zinc, copper, manganese and selenium and the macronutrients lipid fat, cholesterol and fatty acids

As an example of the results, the following results are for adult males: Cadmium in North 1 and South 1 exceeded 49% and 27% national limit standard in aquatic foods respectively; mercury and total arsenic in South 1 exceeded 27.3% and 39.6% national limit standard in aquatic foods respectively; lead in South 2 exceeded 8.1% national limit standard for eggs; organophosphorus pesticides and aflatoxins were not detected, dioxins and PCBs were detected in four animal food samples to give an estimated dietary intake 36.24 pg/kg bw/month for PCDD/Fs. Similar analyses were carried out for other age and gender groups, particularly children.

In future TDS, inorganic arsenic content in different foods and intake by different age-sex groups will be determined. Research into the intake of iron, zinc, selenium and other macro and micro elements in different age-sex groups will be conducted, including a study on trace elements and health.

Implementation and Results of the First French Total Diet Study

Jean-Charles Leblanc, INRA, Paris, France

Performed at the initiative of France's General Food Directorate (DGAL), attached to the Ministry of Agriculture, Food, Fishing and Rural Affairs, and the National Institute on Agronomic Research (INRA) and with the collaboration of the French Food Safety Agency (AFSSA), this TDS of French consumers is the first major study covering exposure to mycotoxins, trace elements and minerals present in "as-consumed" foods. It provides a first panorama of intakes and exposure to these food components for the French population.

Food consumption data for the total population and specifically for vegetarians were used to develop the food list of the total diet survey. The total diet was based on the last national survey of individual food consumption for the total population (n=3003) (INRA, 1999) and another specific survey of individual food consumption for vegetarians (n=138) (Leblanc et al., 2000). The total diet included 338 foods items where all foods consumed in average of more than 1g/day/person were taken into account in the food list.

These criteria allow coverage of between 82 and 99 percent of the total diet for minerals and trace element and mycotoxins. Additional information concerning the mode of purchase and supply by households as a function of the percentage of the market share and supplies sources were obtained from our national household database (SECODIP, 1996) to get the best representatives in food list sampling. After sampling, foods were mixed and prepared as consumed by a cook in a special kitchen at the French superior school of cooking. 1080 composites samples were analysed for 18 traces elements/sample (lead, cadmium, arsenic, mercury, aluminium, selenium, calcium, chromium,...) with a ICP-MS by our national laboratory of reference for traces elements. Furthermore 456 composites samples were analysed for different mycotoxins of interest (aflatoxins B, G, M^1, ochratoxin A, patulin, zearalenone, fumonisins and almost 10 tricothecenes of group A and B) with immunoaffinity HPLC and GC-MS by the National Institute of Beverages and Brewery Industry.

This study reveals that, for the French population, the observed levels of the mycotoxins and mineral contaminants studied in representative diets is globally satisfactory with respect to current regulations. It also confirms, for the populations concerned, the low probability of nutritional or health risks due to food consumption. However, certain consumer groups are subject to a non-negligible risk of nutrient intake below the recommended minimum levels or to exposure to contaminants exceeding the reference toxicological values.

Exposure Assessment Based on the Results of the German Food Monitoring Programme

Günter Sommerfeld, BVL, Berlin, Germany

On the legal basis of the German Food and Commodities Act, food monitoring became an independent task of the official food surveillance in Germany in 1995. This food monitoring is aimed at estimating the intakes of contaminants and evaluating them from a health point of view. For that purpose, a market basket was compiled on the basis of the National Consumption Study (NVS). The market basket, which includes approximately 120 food items, was the basis for planning the German Food Monitoring Programme. Approximately 4 700 samples of about 20 different food items were analysed every year. The number of samples analysed totalled more than 31 000 in the period from 1995 to 2002. The substances examined included about 120 different plant protection products and persistent organochlorine compounds, 14 elements and 12 mycotoxins.

The exposure assessments presented by Germany are based on the contamination data of the Food Monitoring Programme and on consumption data, which stem from the National Consumption Study conducted from 1985 to 1988. Intake assessments of this study shall enable an evaluation of the intakes of undesired substances with food from a health point of view. To this end, the average intakes of the substances of interest were determined and compared with accepted reference values (ADI, PTWI). Intake amounts were firstly calculated by a deterministic procedure. This procedure, however, only applied to a quarter of the substances studied, because the large majority of substances could not be quantified in most foods.

The results of these exposure assessments are quite different between the groups of substances. For the majority of pesticides and organochlorine compounds considered, intake levels were below 1% of the corresponding toxicological reference value. Intake levels above 1% of the toxicological reference value were only found with dithiocarbamates and vinclozolin.

The average intakes of mycotoxins are relatively high (23 to 83%) in relation to the accepted reference values (PTDI, PTWI). The contamination of some food items (e.g. spices, oil seeds, nuts) must be monitored. For heavy metals the ratios between intake and accepted reference values (PTWI) lies in the range of 6 to 36%. The intake of nitrate is in the range of 23 to 40% of the ADI (3.65 mg/kg bw). The results of the intake study will be compared with those of other international studies. They will help to identify critical substances and critical food groups. This may result in the need to modify the market or

to go more into detail with some food groups. It is planned to repeat the exposure assessment after all food items in the market basket have been analysed once more. This work will take probably 5 years.

Pilot Programmes and the Preparation for National Total Diet Study in Indonesia

Roy A Sparringa, National Agency for Drug and Food Control (NADFC), Jakarta, Republic of Indonesia

The objective of the presentation was to report on several pilot programmes for the preparation of the National Total Diet Study (TDS) in Indonesia. The pilot programmes were discussed, such as the development of exposure assessment of food additives based on the maximum national limit; the exposure assessment of elementary school students to food additives with TDS; and pilot project of integrated individual dietary intake survey for purposes of exposure assessment and nutrition. The action plan for the preparation, such as the capacity assessment for the implementation of TDS in Indonesia was included in the presentation.

The presentation focused on the result of exposure assessment of elementary school students to food additives with TDS. The present study was to estimate the daily intake of types of food products; to obtain basic data for the market-basket based study; and to identify the intake of food additives by elementary school students, such as cyclamate, saccharine and benzoate that exceed the acceptable daily intake (ADI) level. This project consisted of a food consumption survey and use of the survey data to derive intakes of the food additives.

Seventy two respondents ranging 7-12 year-old male and female children were randomly selected from three elementary schools representing low, middle and high social class-schools in Malang, East Java, Indonesia. Each respondent was surveyed for her/his food intakes over six successive day periods. Food dairy and dietary recall approaches were used to determine individual food consumption. The enumerator validated the respondent's record combined with dietary recall of respondents during the interview. The interview was conducted twice a day, after and before school time to obtain a 24 hour individual intake record during and after school time. The shopping list generated from the consumption data was utilized for a market basket of food reflecting a defined total diet of a consumer in the study.

The food composite approach was used by mixing the individual food items into groups of similar foods to be analyzed. One hundred ninety seven food items were recorded in the consumption data and 81 food items were sampled and analyzed in the present study accounted for 95% of the total food weight intakes, consisted of 31 national food items, 6 local food items, 9 unregistered food items and 35 ready-to-eat food items. Ready-to-eat foods were the highest contribution to 70 % of the total weight intake which were dominated by cereal food group accounted for 33% of RTE foods consumed. The highest average intakes of cyclamate were estimated from beverages and snack food types, especially derived from cereals and other food groups exceeded the JECFA ADI value about 240%. The daily intake of benzoate and saccharine by the respondents was bellow the JECFA ADI accounted for about 74% and 12% respectively. The results were utilized by the National Agency for Drug and Food Control (NADFC) for reviewing the food sweeteners standard in Indonesia.

The integrated individual dietary survey for purposes of food safety and nutrition concerns, such as contaminants, food additives, nutrient adequacy, and high level of nutrients was also conducted in Bogor District as a pilot programme. Some of the assessments are in progress. This project will be useful for the preparation and implementation of TDS in Indonesia.

Dietary Exposure Studies at the Dutch National Institute of Health and the Environment

Piet van Zoonen, RIVM, Bilthoven, The Netherlands.

RIVM has been conducting dietary intake studies since the 1970s. The relevant items of the programme are: 1. National Dutch food consumption survey (NDFS) with a 5-year base; 2. Specific intake studies e.g. POP's with a 10-year base; 3. Human milk studies with a 5-year base; and, 4. Duplicate diets with a 10-year base. In 2002-03 a complete cycle of the above activities has been completed and the programme for 2004 and later has been started. Food consumption data will be gathered in a series of smaller surveys that will focus on specific sub-populations and completed with a comprehensive national food consumption survey in the 5th year, thus allowing more refined intake assessments at the level of specific groups in the near future. Sampling of human milk has recently been completed and the study is presently in the stage of sample analysis.

A new duplicate diet study has commenced in 2004, the first sampling round (60 samples) as completed in March 2004; a second sampling round is planned for the second half of 2004. Tentatively the following compounds will be analysed: 1. macro components: fibre, fat, carbohydrates, proteins, alcohols, sterols, iron, potassium, sodium, and nitrate/nitrite; and 2. microcomponets: acrylamide, aflatoxins, DON, fumosins, glycoalkaloids (including solanines), POP's and brominated flame retardants (12 composite samples), Se, Pb, Cd, Hg, and As. At this moment no specific intake studies are planned. However the levels of dioxins and PCBs are regularly monitored and a trend analysis shows that at present the levels are still slightly decreasing (typical levels 0.1-0.4 pg WHO TEQ/g fat).

The Role of the European Food Safety Authority in Exposure Assessment

Djien Liem, European Food Safety Authority, Brussels, Belgium

The regulation which provides the legal basis for the establishment of the European Food Safety Authority (EFSA) was formally adopted on 28th January, 2002. As set out in this regulation, the core task of the Authority will be to provide independent scientific advice and support and to set up a network for close cooperation with similar bodies in Member States. It will assess risks related to the food-chain and give the general public information about food risks. The Authority has six main tasks, including collection and analysis of data on dietary exposure and other information relevant to any potential risks necessary to monitor safety along the food-chain in the EU. Its mandate is broad, so that it can take a comprehensive view of the food-chain and provide a coherent scientific basis for policy and legislation. Therefore the Authority will cover all issues having a direct or indirect impact on the safety of food including plant health, animal health and welfare. It covers also scientific issues related to nutrition. It will also provide scientific opinions on any issue related to genetically modified organisms for reason of scientific coherence.

The European Food Safety Authority is composed of four bodies: a Management Board, an Executive Director, an Advisory Forum and a coordinating scientific committee and eight scientific panels on various topics, relevant to food safety, including a panel on contaminants in the food-chain. A Scientific Committee is responsible for the general coordination necessary to ensure the consistency in the scientific opinions of the different panels. This Committee is composed of the chairpersons of the scientific panels and six independent experts who do not belong to any panel. The names of the members of the Scientific Panels and Committee have been published on the internet (http://www.efsa.eu.int/science_en.html).

The Authority will carry out assessments of risks to the food-chain and indeed can carry out scientific assessment on any matter that may have a direct or indirect effect on the safety of the food supply, including matters relating to animal health, animal welfare and plant health. Exposure assessments will usually form an integral part of the risk assessment process. In case information on exposure to a certain substance is lacking, EFSA could be requested to conduct a study aimed at collection and subsequent evaluation of occurrence and exposure data. In these cases, the Advisory Forum could be consulted to

exchange information with national scientific organizations on potential risks and for pooling knowledge. When preparing exposure and risk assessments at European level, EFSA is frequently confronted with inadequate sampling strategies, insufficient quality of applied analytical methodologies and a miss-match of the food consumption data for different populations across the EU. Possible strategies on how EFSA will consider these problems were presented and discussed.

Recent Advances in OPAL I and II and SIGHT

Lawrence Grant, WHO Consultant, Geneva, Switzerland

The GEMS/Food global databases on (a) individual measurements of chemical contaminants in food commodities, (b) aggregated data on chemical contaminants in food commodities, and (c) dietary intakes of contaminants from TDS were presented. The structure and definition of these data collections was given. The presentation emphasized the contents of these data collections. The collection on aggregated data on chemical contaminants in food commodities comprises more than 37 000 records and dietary intakes of contaminants from the TDS data collection contains more than 1 700 records of measurements of contaminants for specific cohorts. Graphs were shown which depict the composition of the data collections with regard to contaminant type, geographical region, food type and year. The trend of data submission to GEMS/Food is shown to be substantially increasing since the introduction of the electronic submission protocol and the OPAL software.

The OPAL software has been extended to allow the capture of individual measurements and to convert these measurements into aggregated records on contaminants in food commodities. This improvement should allow countries to easily submit data to GEMS, and thereby continue the trend of database growth. Dissemination of the aggregated chemical concentration data and the total diet exposure data is enabled through the WHO SIGHT system, which has been enhanced to facilitate access and allow sorting of the result tables.

Monitoring for Pesticide Residues on Food of Plant Origin in the European Union – Planning and Implementation in Member States, Results and Follow up

Patrizia Pitton, European Commission, Dunsany, Ireland

Pesticide residues in foodstuffs of plant origin are monitored throughout the European Union. As required by Council Directive 86/362/EEC for cereals and Council Directive 90/642/EEC for certain products of plant origin, including fruit and vegetables, Member States draw up annual national monitoring plans and report the results to the Commission Services. The objective of these plans is mainly the enforcement of Maximum Residue Levels (MRLs).

In addition, the Directives lay down provisions for a European coordinated programme whose objective is the estimation of the actual pesticide dietary exposure of the European consumer.

The coordinated Community programme is a multi-annual rolling programme with an initial timescale of 5 years, the first cycle having been completed in 2000. A selected group of main commodities and active substances were defined for harmonized evaluation as well as the number of samples to be taken.

The national programmes, however, are not harmonized. Therefore, they vary greatly in the priorities set, in the choice of commodities and pesticides analysed, in the number of samples, in the proportion of domestic and imported products, in the analytical capabilities of the laboratories and in the national MRLs. This leads to great variation in the results obtained by the participating countries and caution is therefore necessary when comparing those results.

Information on monitoring activities has also been collected in the inspections reports of the Food and Veterinary Office (FVO) which is part of the General Directorate Health and Consumer Protection of the

European Commission. The FVO has since 1998 carried out inspections to all Member States with the objective of assessing the Member States' control systems on pesticide residues and on marketing and use of plant protection products.

To overcome the difficulty of comparability of national plans and to collect the data of the EU coordinated programme for a European Monitoring Report, a guidance document is agreed annually within the Standing Committee on the Food-chain and Animal Health. The guidance establishes reporting requirements and table formats. The Monitoring Reports published since 1996 are available at the Health and Consumer Protection's webpage http://europa.eu.int/comm/food/fs/inspections/fnaoi/reports/annualeu/index_en.html.

Since 1996, all 15 Member States and Norway reported monitoring data to the Commission Services and from 2000 Iceland and Liechtenstein, also participated in the monitoring exercise and reported data. While the overall number of samples analysed in the years has remained almost constant with regard to the national plans, the average number of active substances detectable for fruit and vegetables has greatly increased, from 100 to 170. The percentage of samples without detectable residues is comparable over these years. It was 60% in 1996 and 59% in 2001 with a peak in 1999 at 64%. The percentages of samples with residues above MRL has increased from 3% in 1996 to 3.9% in 2001 with oscillations in the years and a peak in 2000 at 4.5%. However, the comparison of these data is not only affected by the variations in the planning and implementation of the national plans but also by the change in the legislative framework, which has been particularly rapid in the last years with the setting of more and more harmonized MRLs.

The annual data of the EU coordinated programme have been submitted to a deterministic evaluation for dietary risk assessment, based on "Guideline for predicting dietary intake of pesticide residues" (WHO/FAO Geneva 1997). The results of the evaluations demonstrate that Acceptable Daily Intake values were not exceeded for the examined pesticide/commodity combinations. However, for the assessment of acute exposure, carried out on the basis of the highest residues found in a composite sample, the Acute Reference Dose was exceeded in a limited number of cases.

The Commission is following up the monitoring data collected during the first 5-year cycle of coordinated programmes (1996-2000), in a scientific study. This study, which is currently ongoing, aims to evaluate the actual exposure of consumers to pesticides residues in food in the European Union. The first results are expected by the end of this year.

EFCOSUM Protocol: A Model Food Consumption Survey

Ruth Charrondiére, FAO, Rome, Italy

In order to be able to compare food consumption data across countries and time similar, survey methodology and protocols have to be used. Otherwise artificial differences might be introduced which are difficult to account for in the interpretation of results. In the presentation, the advantages and disadvantages of food consumption and supply study methodologies were presented, as well as what they cover. Then, the EFCOSUM (European Food Consumption Survey Method) was presented, which proposes a harmonization of available and future food consumption data. For future food consumption surveys in Europe, it is proposed to carry out repeated 24-hour-recalls, either as the sole method or as a calibration method, with computerized data entry software such as EPIC-SOFT, or another software using at least its principles. It will also be necessary to harmonize food composition data when comparing nutrient intakes across countries. EFCOSUM also proposes a common food classification system for the proposed minimum set of dietary indicators for health, and gives guidelines for the study protocol and the analysis and presentation of results. In view of future research questions and user requirements, some of the recommendations might need to be adapted.

Lithuania: Current Status of Food Contamination Monitoring and Total Diet Studies

Maura Olechnovic, National Nutrition Center, Vilnius, Lithuania

Lithuanian food contamination monitoring programme was designed according to GEMS/Food guidelines and was launched in 1993. National food consumption monitoring started in 1997. Both programmes are conducted by the National Nutrition Center (NNC) of the Ministry of Health.

Consumption studies and dietary intake studies using the 24 hours food consumption recall method took place. During the first phase of the investigations (1997 - 1998), 3 000 Lithuanian people were randomly selected: 1 431 men and 1 569 women, aged 20-64 years. The second phase of fieldwork started in 2001 and 1 499 men and 1 501 women aged 20-64 years were included. The same standardized questionnaire was used (converting demographic characteristics, eating habits and health behaviours), as well as height and weight measurements.

National food contamination monitoring comprises basic foodstuffs and common popular contaminants for Lithuania including the groups of heavy metals, nitrates, residues of pesticides, mycotoxins and the PCBs. The samples are taken in specially designated places by trained inspectors and analyzed in accredited laboratories.

A total of 11 059 foodstuff samples were analyzed during the 1993-1999 period. In 28% of samples analyzed, contaminants were detected. Every year a decrease of the contaminated samples was observed (from 44% to 15%). Analyzed contaminants and consumption data (by 24 hours food consumption recall method) showed that none of the consumed contaminants exceeded ADI values. No statistically reliable differences found in different population groups for contaminant consumption in Lithuania.

In 2002 a number of monitored foodstuffs and contaminants were changed to new ones. Investigation of non-contaminated foodstuffs was discontinued. Lead still is monitored in potato, fish, meat of cattle, poultry meat and cattle milk. Cadmium is still monitored in potato, fish, and meat of cattle and poultry meat. Residues of pesticides carbendazim, dimethoate, and azinphos-methyl are monitored in apple and mandarins, Thiabendazole in apple, banana and mandarins, Dithiocarbamates in apple and cucumber, endosulfan in apple, banana, cucumber and mandarins, dicofol in mandarins, methamidophos in cucumber and tomato are monitored. The specified pesticides monitored are also included in the EU controlled pesticide residues monitoring programme. Aflatoxins (total) will be monitored in pistachio nuts.

2003/04 New Zealand Total Diet Survey – Introduction and Preliminary Results

Cherie Flynn, NZFSA, Wellington and Richard Vannoort, ESR, Christchurch, New Zealand

New Zealand (NZ) is now undertaking its sixth TDS. They are carried out on a periodic basis, dating back to 1974. In the current NZ total diet study, there are 121 foods, of which 58 are 'regional' foods and 63 'national' foods. All are sampled over two seasons, with regional foods sampled from four regional sites, and national foods from one nationally representative site. Foods purchased are prepared 'table ready' before analysis of 230 pesticide residues and metabolites, four contaminant elements (lead, cadmium, arsenic and mercury) and four selected nutrients of relevance to NZ (iodine, selenium, sodium and iron).

As the 2003/04 NZTDS is still in progress, the strengths of a TDS were demonstrated using examples from the 1997/98 NZTDS. For pesticides, 94% of estimated dietary exposures were less than 1% of the ADI, the internationally established health standard. For the five contaminant elements, the estimated dietary exposures were all well within the PTWI. The effectiveness of risk management strategies, such as discouraging use of lead solder in canned foods, and phasing out of lead in petroleum products, was

clearly evident in the downward trend of estimated lead dietary exposures found over successive NZ TDS.

For iodine, the downward trend of intakes, now well below the Australian RDI and the US RDA, was demonstrated. Although discretionary salt was not considered in the NZ total diet study, the trend of low levels of iodine intakes means continued monitoring of iodine intake and status is considered imperative.

A summary of progress results of the 2003/04 NZTDS was given. With two of the four quarters completed, 105 000 analytical results have been generated. A very high iodine level in soy milk was reported, due to added kelp (seaweed). Fingerprinting of raw material sources by looking at cadmium and selenium ratios was demonstrated for North and South Island breads. A newspaper headline demonstrated that no matter how positive an overall picture a TDS will paint, vested interest parties will continue to pick out data to suit their causes. We were reminded that the TDS is not a compliance survey, but a dietary exposure and public health risk assessment tool. It is not what is in the food, but the dose that makes the poison.

NZ total diet study reports can be found at: http://www.moh.govt.nz, then go to Online Publications, then to March 2000, then to 1997/98 New Zealand Total Diet Survey. The 2003/04 NZTDS Quarterly analytical results reports can be found at http://www.nzfsa.govt.nz, then under 'Science and technology' hit Research projects and then 'New Zealand Total Diet Survey'. The final interpretative report, including exposure estimates, will be available in 2005.

Monitoring of Contaminants in Food in the Pacific

Bill Aalbersberg, University of the South Pacific, Suva, Fiji

The South Pacific islands are usually viewed as idyllic retreats for which chemical food contamination would not be a problem. The reality, of course, is that these islands are part of the globalization trend. In the last few years samples exported to Australia have been refused entry due to both pesticide and heavy metal contamination. This has alerted Pacific island countries to the need for more knowledge about local chemical contamination of food.

Given limited financial and laboratory resources, gaining this knowledge will not be easy. A strategic approach is being taken to work regionally and prioritized contaminants that may be of highest concern. Working the WHO targeted contaminant studies are being performed on mercury in fish, Salmonella in eggs and poultry, arsenic in water, and cadmium in taro. Breast milk samples from Fiji have also been studied for persistent organic pollutants. Fiji is also in the planning stages for a Total Diet Study.

To date a major finding has been high levels of mercury in certain predator fish which suggest women of child-bearing age should eat them only once a week. These fish are often sold as tuna by-catch to low income families. This raises a delicate question of risk analysis and communication as most fish have very low mercury values and fish consumption is a daily occurrence in rural subsistence areas and important nutritionally and culturally. Through use of the total diet study weekly contaminant intake will be determined to help prioritize further food contaminant work.

Progress in Risk Evaluation Procedures of Selected Chemicals to Population by Food Consumption in the Slovak Republic

Slávka Krížová, Food Research Institute, Bratislava, Slovakia

Department for Evaluation of Food Contaminants Occurrence established in the framework of Food Research Institute in 1986, collects and evaluates data from monitoring of contaminants occurrence in the food-chain constituents (soil, water, entries into soil, feedstuffs, raw materials and foodstuffs) in agricultural sector. The results of analyses are processed by computer and serves partly for evaluation of

immediate state of contamination in given area or in given commodity, as well as for evaluation of the contamination evolution of the food-chain with regard to geographical information system. The centre is a guarantor for Partial Information System about contaminants and Partial Monitoring System "Food and Feed Contamination". In the last few years the evaluation was focused on exposure assessment. This issue has been solved in the framework of next projects Evaluation of Contaminants and Additives Exposure to Population and semi-finished risk evaluation procedures of selected chemicals to population by food consumption.

The project "Food Safety in Europe: Risk assessment of chemicals in food and Diet" was the source of exposure assessment, which utilized the extensive database on occurrence of contaminants in food. The first contaminant evaluated in the study was lead. Sampling and analyses were carried out by the SR State Veterinary and Food Administration, the Food Research Institute (Bratislava), the Dairy Research Institute (Žilina) and Administrations of Public Health. All laboratories have been involved in the national food AQA (Analytical Quality Assurance) system since 1994. Since 2000, they have regularly taken part at the international proficiency test schemes oriented to food analyses, such as FAPAS (Food Analyses Performance Assessment Scheme) and GEMS/Food. The study of the dietary intake of lead was presented in detail.

Monitoring and Surveillance on Chemicals in Food: Spain

Lourdes Suárez González, Spanish Agency for Food Safety, Madrid, Spain

The Spanish Agency for Food Safety was created in the year 2001 as an autonomous body accountable to the Ministry of Health and Consumption. The Agency's work is based in scientific evidence, transparency and independence. This Agency has a Chairman and an Executive Director. Other ministries (e.g. Agriculture and Fisheries, Environment), autonomous regions, local entities and consumers are represented on the Management Board. A Scientific Committee which consists of independent scientists with recognized prestige is responsible for risk assessment about 20 experts from different areas linked to food safety such as toxicology, microbiology, epidemiology, and nutrition.

In order to control and monitor the chemical contamination of food, the Agency carries out different programs that include: monitoring and assessment of yearly programmes and surveillance of contamination programmes and, hopefully, in the near future, a total diet study.

Each year, the Agency designs a program for the evaluation of foodstuffs released into the market, with a number of objectives, including: monitoring the compliance to legislation, evaluating the nutritional quality of products, and controlling fraud, and additives, nutrients and contaminants that are already regulated are investigated.

LANGUAL – A Polyvalent System of Food Identification

Jayne Ireland, French Food Safety Agency, Paris, France

Databases on food composition (nutrients, bioactive substances, contaminants) all have the same problem of food identification. The preparation of reliable data on food requires precise identification of foods. Even data of good quality can be a source of error if they are derived from foods that are not clearly defined. Moreover, it is difficult to exchange data on foods, or to understand and compare consumptions of different countries or individuals, without a coherent description of foods in databases.

At the end of the 1970s there began a cooperative effort of specialists in food technology, information science and nutrition, to standardize description of foods cited in literature, reports or surveys, while conserving the original level of detail. The Center for Food Safety and Applied Nutrition (CFSAN) of the United States Food and Drug Administration (FDA) thus published the "Factored Food Vocabulary", a facetted thesaurus for indexing retrieval of information on foods. Thanks to international collaboration,

the thesaurus has become multilingual and renamed LanguaL (Langua alimentarius, the language of foods). The thesaurus and its documentation are available free of charge at the website. http//www.langual.org.

A food can be described according to several points of view (facets). The LanguaL thesaurus is organized in fourteen facets characteristic of the nutritional and/or hygienic quality of foods. The official version of the thesaurus maintained by the International Secretariat is in English, but the descriptors have been translated in several languages (French, Danish, Hungarian, Spanish, and Flemish) by national centres. Each descriptor of the LanguaL thesaurus possesses a code that can be stored in a database with the codes of foods it describes.

A large number of foods have already been indexed using the LanguaL thesaurus. A prototype food product indexer, using a library of LanguaL food descriptions, is being developed by the Danish Institute for Food and Veterinary Research. A user interface, based on LanguaL descriptors, will also allow the search of foods available in published databases.

The LanguaL thesaurus is flexible. It has been enriched to meet needs of different databases (e.g. BASIS). Moreover, an application or database may choose to use only the part of the descriptors that correspond to its needs (EPIC SOFT, GEMS, and BASIS).

International cooperation will enrich our mutual knowledge of foods and improve the information recorded in data bases. This collaboration and harmonization offer also the possibility of creating reliable links between databases.

Analytical Methods and Quality Assurance

Chris A. Sack, US Food and Drug Administration, Kansas City, USA

The analytical methods for the analysis of United States total diet study samples were summarized and reviewed, including multiresidued methods for the determination of pesticides and industrial chemicals in fatty and nonfatty food items, chlorophenoxy acids, carbamates, phenylurea herbicides, benzimidazole fungicides, ethylenethiourea, volatile organic organic compounds, acrylamide, dioxins, minerals by ICP, including arsenic, selenium, antimony, lead, cadmium, nickel, mercury and iodine.

ISO guide 17025 “General Requirements for the Competence of Testing and Calibration Laboratories” was adopted in December 1999. Because compliance with this guide is required internationally for laboratory accreditation, an examination of its contents is necessary. The guide provides a holistic approach to Quality Assurance (QA) combining management and technical requirements. Selected requirements were briefly discussed.

Laboratory accreditation requires the demonstration of analytical accuracy and precision. Quality controls (QC), including the analysis of blanks, spikes, replicates, certified reference materials and proficiency samples. The reliability and accuracy of analytical instrumentation must also be demonstrated by using initial calibration, and continuing calibration verification and use of standard solutions. The principles of using QC were discussed and examples of actual QC results were presented.

Pesticide analysis QC includes blanks, fortifications, and replicates. Fortification recoveries of specific “marker” compounds are evaluated against statistically evaluated limits. Analytical results are generally confirmed using the multiple determinations on different chromatography systems. Mass spectrometry (MS) confirmations must contain at least 3 ions with ratio within 20 %. MS/MS confirmations require a minimum of one parent/daughter combination. Instruments are calibrated upon use. Pesticides standards are prepared annually and compared to current standard solutions. Worksheets are reviewed for procedure, instrument performance, accuracy, recovery, and replication. Results are reviewed for

consistency with historical findings and compliance with applicable laws. The results of each market basket are reported in a Total Diet Market Basket Report (TDMBR), including QC charts, tables of replicates, explanation of anomalies and unusual findings.

Probabilistic Approaches in TDS?

J-L. Volatier, AFSSA DERNS/ OCA-CIQUAL, Paris, France

Two main approaches are used in chronic exposure assessment: the deterministic approach and the probabilistic one. The classical deterministic approach consists of calculating the statistical distribution of exposure with a descriptive method. This method combines individual dietary intakes and mean contamination of foods. The intake data at the individual level is estimated with national dietary surveys for adults and less often for children. The mean contamination data is estimated by the TDS. The underlying assumption in using the mean contamination for each food category is that, during a lifetime, there is no correlation among the contaminations of the foods you eat.

The probabilistic exposure assessment is more and more being used because of the availability of software capable of Monte-Carlo simulations. The combination of random selection of intake and contamination values allows estimating statistical distributions of exposure. This estimation may be based on direct non-parametric sampling in intake and contamination data or may use preliminary parametric estimates of statistical distributions of both variables. Here, the underlying assumption is that, during a lifetime, there is some correlation among the contaminations of the foods you eat. This correlation may be explained by the fact that people can buy or use foods produced in a delimited area where contaminations are lower or higher than in a country or region. Consumption of home produced foods by individuals living near contaminated sites may lead to higher exposure. However, the principle of TDS is to pool the sampled foods in order to limit the number and the costs of analysis. This method doesn't allow taking into account such local situations.

In conclusion, the interest of the probabilistic approach in TDS is clear when individual intake data is not available and when statistical distribution of intakes is needed. Uncertainties estimates may also need probabilistic approaches. On another side, statistical distribution of exposure estimated from TDS may be used as input in multimedia probabilistic exposure assessments.

Involving Interest Groups in the Development of a Total Diet Survey

Cherie Flynn, New Zealand Food Safety Authority, Wellington, New Zealand

When the New Zealand Food Safety Authority (NZFSA) was established in July 2002 two of the objectives for the new organization were 'to ensure efficient use of government and interest group resources' and 'to be effective in coordinating and communicating with interest groups'. To contribute to the meeting of these objectives the NZFSA has established extensive communication and consultation links with a wide range of interest and stakeholder groups and organizations. This presentation outlined the approach, process, participants, content, timeframes and results of the communication and consultation process undertaken in the development of the 2003/04 New Zealand Total Diet Survey. The final decisions taken by the NZFSA for the content and conduct of the 2003/04 TDS were outlined along with the reasons behind these decisions and how the decisions were communicated. Finally the intended future processes were discussed and comment made on what lessons were learnt from the New Zealand experience.

Implications of Lowering the PTWI for Methylmercury

Jiri Ruprich, NIPH, Prague, Czech Republic

Toxicity of methylmercury (MeHg) has been re-evaluated recently by JECFA. MeHg is readily absorbed (up to 95%) following oral exposure. MeHg effectively crosses both the blood–brain barrier and the

placenta. It is resulting in higher levels of mercury in the fetal than the maternal brain. The major route of elimination is in the bile and faeces. The most nervous system, a very sensitive target for MeHg (JECFA, 2003). Neurotoxic effects observed in humans poisoned with MeHg via the consumption of contaminated seafood are also known as Minamata disease. Mercury poisoning can result in mental retardation, cerebral paralysis, deafness and blindness, and cardiotoxicity (high blood pressure).

Ranges of total Hg in foods in the Czech TDS (TDS data for 1999-2003, 1852 results, 1005 results >LoQ, LoQ = 0.01-0.2 ug/kg, (Ruprich et al., 2003) are relatively narrow and is visible the food groups: sea fish, freshwater fish, smoked fish, marinated fish and canned fish, and less for fish salads. From other food groups, only for spices and liver are mostly worthy. Based on these analytical results and average food consumption data the point estimate of exposure dose for total Hg has been calculated. The average exposure dose for the Czech population has been estimated 0.08 ug of total mercury /kg bw/week, which is only about 5% of revised JECFA PTWI for methylmercury.

The comparison of TDS results and calculated intake according to blood level of mercury has been done for children and adults. Calculations based on biomarkers compared to TDS for children show acceptable correlation, but not for adults where blood levels were much higher (4 times) than expected according to dietary intake. One explanation might be the great uncertainties in other exposures, e.g. exposure to amalgam inlays and other environmental factors of exposure.

The new JECFA PTWI for MeHg has serious implications for fish based dietary guidelines. Decreasing of the PTWI can have also economical implications for some parts of fishery industry. There is still no effective method to evaluate benefits and risks from fish/seafood consumption. New data on fish/seafood consumption and contamination are requested for better exposure assessment. MeHg can raise serious problem in safe nutrition for fishery/seafood oriented diets (for some people in some regions).

Full report available at: http://www.chpr.szu.cz/publications/2004/methylmercury.pdf.

Total Diet Studies in Remote Locations: Case Study in Papua New Guinea

Keith Bentley, Centre for Environmental Health, Canberra, Australia

Total Diet Studies including studies of food frequency and measurement of unit food consumption, together with analysis of a range of food products derived from a constructed food list were used as one component of establishing health risk assessments for impacted and control villages proximal to, and down river from, major mining operations in Papua New Guinea. The methodologies adopted were those of the Australian Market Basket Survey, which themselves are directly derived from the principles established by WHO for food consumption studies and Codex Alimentarius for the collection, sampling, pre-preparation and analysis. The foods were analyzed for a range of metals, selenium and arsenic.

The conduct of TDS in remote locations is subject to a number of constraints and confounding factors. The constraints are mainly in relation to the establishment of food consumption patterns and the food sampling programme. Food consumption, using questionnaires, was achieved for the linguistically and culturally diverse communities using pre-trained local people, familiar with the cultural environment. These environments varied from conventional highland urban settings, with access to ready-to-eat foods from commercial sources ("trade stores") through to investigation in remote environments where subsistence agriculture and harvesting of natural resources was the exclusive source of food. The target communities for the TDSs, thus included both conventional urban sampling and sampling of villages both in highland and lowland remote environments, which have very different core food consumption and food availability. For example, the highland communities have tubers as their primary carbohydrate source, whereas the lowland villagers are dependent on wild sago and plantains.

Food sampling in these remote environments also presents challenges with the majority of foods being collected either by helicopter, or from some remote villages, using dug out canoes. Transporting and shipment of samples also presents difficulties, which were largely overcome using mobile refrigeration and careful planning, based on agreed standard operating procedures.

The results of the work for the food consumption studies indicated that the range of foods consumed and frequency of consumption was generally consistent between the impact and control communities within each geographical zone. Between zones there were (as expected) marked differences in dietary patterns, primarily as a consequence of food availability (e.g. trade store goods), climate and altitude. Of particular note, was the very high total food consumption in the subsistence agriculture-dependent rural highland communities, where mean adult consumption of 3.5 – 4 kg/day was the norm.

The results of the analytical study for the contaminant (arsenic, cadmium, lead and mercury) and essential (copper, selenium and zinc) metals indicated that within any of the five geographical zones, the metal content of food products does not differ markedly between the control and impact villages. When the measured metal concentrations were compared with the results of the Australian and US FDA TDS, the majority of foods monitored fell within the range for these TDS.

Using conventional methods for calculation of dietary intakes for the remote Papua New Guinea communities, all age and sex populations, had values below the corresponding WHO PTWIs, other than for lead in the remote rural highland communities and mercury at Lake Murray. The elevated lead values can be attributed to both natural mineralization and the very high individual food consumption values. Exposures to methyl-mercury over established tolerable limits (some three – 15-fold the WHO PTWI) has been observed previously and corresponds to both the highly methylating environment at Lake Murray and the very high level of fish and other aquatic food consumption.

Total Diet Study in the Czech Republic: Chemical Contaminants - 2004

Jiri Ruprich, NIPH, Prague, Czech Republic

The Czech TDS is realized as a part of broader monitoring programme named "Environment and Health Monitoring System" and suggested by the Ministry of Health. TDS itself is an integral part of food safety monitoring (organized independently by the food control system). The history of the TDS has 3 monitoring periods. The first period was in 1994 -1998 when annually 46 food groups collected from 12 towns were analyzed. The second period was in 1999 – 2003 when annually 108 food groups from 4 regions (every region had 3 towns for collection of samples) were analyzed. The third period started in 2004. Biannually analyzed 143 food groups from 4 regions (3 towns like in previous period) are analyzed. A higher number of analyzed food groups reflect changes in the market and in dietary habits. The total number of analyzed samples is practically same. The selection of foods for TDS analyzes has been done according to the database from the national food consumption study (HBS1997) which contains average consumption for about 500 food groups. Foods were selected for TDS which may influence considerably exposure. The final number of selected foods represents more than 95 % of the weight of a usual Czech diet.

As a new part of TDS, during the year 2003 20 composite samples were analyzed for acrylamide which together represent 41 different foods or 492 individual food samples (from 12 towns). The estimated exposure dose was about 0.3 ug/kg b.w./day but other potential acrylamide sources were not taken into account.

Full report available at http://www.chpr.szu.cz/publications/2004/methylmercury.pdf.

Update on the US FDA's Total Diet Study

Katie Egan, US Food and Drug Administration, College Park, USA

The US FDA's Total Diet Study (TDS) has been conducted continuously since 1961. The design and scope of the TDS has changed over time to include more foods and analytes. Currently, four regional market baskets of approximately 280 different foods each are collected each year.

The list of foods collected in the US TDS, as well as the food consumption amounts (TDS diets) used to calculate intakes from TDS analytical results, are based on national food consumption surveys. Both are updated periodically as new consumption data become available. The most recent update was completed in 2002 and implemented with the first market basket of 2003. While many of the TDS foods are staples of the American diet and tend not to change over time, the updated list reflects the increase in the consumption of lower-fat products and certain types of beverages (especially fruit drinks and carbonated beverages) that was reported in the recent consumption survey. The updated food list also includes more convenience foods and utilizes microwave ovens in preparing many of the foods.

TDS foods are routinely analyzed for about 300 different substances including pesticides residues, metals, industrial chemicals, and radionuclides. The majority of analytical results from 1991 to the present are posted on FDA's TDS website at (http://vm.cfsan.fda.gov/~comm/tds-toc.html). In recent years, TDS foods have also been analyzed for dioxin (since 1999) and acrylamide (since 2003). For both analytes, the main goals in analyzing TDS samples were to obtain more comprehensive data on background levels in foods and to estimate the dietary exposure through the average American diet. Results of TDS analyses have been used in conducting risk assessments, which will help FDA identify appropriate risk management options. A summary of these analytical results and estimates of dietary exposures were provided.

The UK Total Diet Study (TDS) and Intake Calculations of Dioxins

Barbara Gallani, Food Standard Agency, London, United Kingdom

The UK Total Diet Study (TDS) began in the early 1960's and is carried out on a continuous annual basis, to provide an estimate of the average intake of different food constituents and contaminants of current concern. This allows the Food Standards Agency to make estimates of the current average or background exposure to nutrients and contaminants in the diet for both groups of consumers and the population as a whole.

Food samples are bought from a wide variety of retail outlets at fortnightly intervals, on each occasion in a different area selected on a random basis, to be representative of the UK as a whole. The foods are rapidly transported to one centre where they are prepared and cooked (where necessary) according to normal domestic practice. Grilling, baking, boiling and steaming (using distilled water) are used in preference to frying (except for chips) in order to avoid the introduction of constituents of the oils and fats groups into other food groups. Where a food might be eaten either raw or cooked, (e.g. tomatoes) it is included raw to maximize any residue present. After preparation, the constituents of each food are thoroughly homogenized, frozen and dispatched in special containers which have been tested for chemical migration to food research laboratories, for analysis.

Food groups are analysed for a number of substances, including pesticide residues, dioxins and heavy metals, and are also periodically analysed for selected nutrients. Since 1991, samples from England and Wales have been analysed for radioactive contamination to assess the radiation dose which the majority of the population received from the normal supply of nationally available foodstuffs.

Dioxins and dioxin-like polychlorinated biphenyls (PCBs) were analysed in samples of the food groups that made up the 2001 UK Total Diet Study. The estimated average intakes by adults of the sum of

dioxins and dioxin-like PCBs from the UK diet have fallen from 1.8 pg WHO-TEQ/kg bodyweight/day in 1997 to 0.9 pg WHO-TEQ/kg bodyweight/day respectively in 2001. Average adult intakes are well within the new UK safety limit (Tolerable Daily Intake - TDI). The percentage of adults estimated to exceed the TDI from the whole diet fell from 35% in 1997 to 1.1% in 2001. The estimated average intakes by schoolchildren of the sum of dioxins and dioxin-like PCBs from the UK diet have fallen from 1.6-4.0 pg WHO-TEQ/kg bodyweight/day in 1997 to 0.7-1.8 pg WHO-TEQ/kg bodyweight/day respectively in 2001, with younger children being at the upper end of each of these ranges. The percentage of children estimated to exceed the TDI from the whole diet fell from 62% in 1997 to 10% in 2001.

Intakes of dioxins and dioxin-like PCBs from the diets of toddlers have also fallen, and average intakes are estimated to be close to or slightly over the new UK safety guideline. The percentage of toddlers estimated to exceed the TDI from the whole diet fell from 97% in 1997 to 37% in 2001. The concentrations of dioxins found were all below relevant EU regulatory limits.

Dietary Intake Studies in Korea

Hae Jung Yoon, KFDA, Seoul, Republic of Korea

Dietary intake studies in Korea had been limited until the late 1990s. Consumption of food used to be estimated using food supply surveys (market disappearance) data or estimated for only foods whose intake amount were known. Most studies used to be focused on gathering information on levels of chemicals in each food in order to confirm food standard settings or justify MRLs. In 1998 the National Health and Nutritional Survey was changed, basically from household inventories to individual food intake surveys. Many regional and national data are available even though considerable differences still exist among these data.

An attempt has been made to estimate 9 kinds of food additive intakes theoretically using the budget method as the screening method and compared with estimation of daily intakes based on National Health and Nutrition Survey in 1998. A total of 264 food samples that use of preservatives permitted under Korea Food Additive Code were purchased and analyzed. The intakes showed less than 0.50% of the Acceptable Daily Intake of benzoate for average consumers while it reached 37.6% of the Acceptable Daily Intake for 90th percentile of consumers only. Foods that contributed most to the daily intakes of benzoates were from the categories of beverages and soy sauce.

A representative food list was established using the food intake data from the National Health and Nutrition Survey conducted in 2001. Considerations in preparing the representative food list included that how much and how often Koreans consume the specific food or commodity and ratio of energy intake, and their relation to gender, age and habits as well as geographical region. Including kimch, 109 dishes were selected and analyzed for heavy metals and mineral residues. The estimated dietary intakes of heavy metals were well below the safe limits while the average intakes of minerals were rather lower than RDA.

There are a number of considerations to be addressed as a part of defining the appropriate total diet study procedures. Korea is developing a proper model for inclusion of pesticide residues and mycotoxins as well as any other food contaminants, recognizing that assumptions and additional data should be selected with care.

Evaluating the Stockholm Convention on Persistent Organic Pollutants: Monitoring of Breast Milk and other Foods

Rainer Malisch, State Institute for Chemical and Veterinary Analysis of Food, Freiburg, Germany

Persistent organic pollutants (POPs) are chemicals being persistent, globally distributed and lipophilic. As a result, they accumulate in the food-chain and are stored in fatty tissues of living organs in general, including humans. They are toxic to humans and wildlife. The Stockholm Convention on Persistent Organic Pollutants (POPs) is a global treaty to take action against certain POPs. The Stockholm Convention POPs comprise aldrin (pesticide), chlordane (pesticide), DDT (pesticide), Dieldrin (pesticide), Endrin (pesticide), Heptachlor (pesticide), Mirex (pesticide), Toxaphene (pesticide), HCB (pesticide, industrial chemical and by-product), PCBs (industrial chemical and by-product) and PCDD and PCDF (by-product).

An effectiveness evaluation is required by Art 16 of the Stockholm Convention. For this, comparable monitoring data have to be provided. The effectiveness should be evaluated four years after the date of entry into force and periodically thereafter at intervals. A global POPs Monitoring Programme was developed to support the effectiveness evaluation of the Stockholm Convention (see UNEP Workshop, Geneva 2003, http://www.chem.unep.ch/gmn/Files/popsmonprg_proc.pdf). As matrices, air, bivalves (mussels, oysters, and clams), wildlife species (fish, bird's eggs, and marine mammals) and human milk were selected.

To ensure the reliability of exposure data and to improve comparability of analytical results from different laboratories, the WHO Regional Office for Europe and the WHO European Centre for Environment and Health, Bilthoven Division, have coordinated a number of inter-laboratory quality assessment studies. The fourth round on levels of PCBs, PCDDs and PCDFs in human milk was conducted between February 1996 and April 1997. The objective was to identify laboratories, whose results could be accepted by WHO for the third round of exposure assessment studies. As only the State Institute for Chemical and Veterinary Analysis of Food met all criteria for analyses of PCDDs, PCDFs, dioxin-like PCBs, marker PCBs and fat in human milk, this laboratory was selected as reference laboratory for the third round of the WHO exposure study. The applied analytical method for determination of PCDDs, PCDFs and PCBs in human milk and the quality control for samples of the third round of WHO-coordinated exposure study was published by R Malisch and FXR van Leeuwen in Organohalogen Compounds (2002) 56: 317 - 320.

WHO GEMS/Food suggested to extend the study to include also other POPs and brominated diphenyl ethers. These additional results gave a completely different picture of the situation in different countries: Regions at the upper end of the usual ranges with PCDD/F- or PCB-contamination could have a low pesticide contamination, and another region would have high PBDE-results. As a general result, breast milk studies are an important tool to get an overview of the exposure in different regions.

TDS in Highly Polluted Areas: Case Study in the Aral Sea Area Peter Fürst**,** Chemisches Landes und Staatliches Veterinäruntersuchungsamt, Münster, Germany

Pesticides have been massively used in agriculture over forty years in the regions of the former Soviet Republic in Central Asia. In 1999, a study carried out on women in Karakalpakstan, a Republic within Uzbekistan, revealed the presence of Persistent Organic Pollutants (POPs) in cord blood and breast milk. Moreover, a broad range of serious health problems was also observed in children. This finding led to initial research aimed at establishing a link between human findings and food currently consumed by the population of this region. Analyses of organochlorine pesticides (OCP), organophosphorous pesticides (OPP), polychlorinated biphenyls (PCB), polychlorinated dibenzo-p-dioxins (PCDD), and polychlorinated dibenzofurans (PCDF) were carried out on 36 food samples sold at marketplaces in the three towns Nukus, Chimbay and Kanlikul of Karakalpakstan. All specimens (12 different types of food

in each of the three towns) were cross-sectionally sampled according to internationally recognized sampling methods, specified by Codex Alimentarius Commission. In each case a number of units was collected from 4-5 randomly selected places and sellers and then pooled.

Analyses revealed consistently the presence of polychlorodibenzo-p-dioxins, including 2,3,7,8-tetrachloro-p-dibenzodioxin (2,3,7,8-TCDD) in sheep fat, cream, eggs, and edible cottonseed oil amongest others. Pattern found in the samples with the highest TCDD levels suggest contaminated 2,4,5-trichlorophenoxyacetic acid (herbicide) as the source. PCB levels were relatively low in all samples, except for fish. Persistent organochlorine pesticides and their metabolites were found in different types of food, but were mainly detected in onions and carrots, which are low-cost components of many traditional dishes. Based on a cross-sectional survey on dietary habits performed in Nukus and the analytical results, monthly intake values were calculated for different POPs. The estimations revealed that the monthly intake of dioxins and dioxin-like PCBs amounts to 191 pg WHO-TEQ/kg body weight which is almost three times higher than the Provisional Tolerable Monthly Intake standard of 70 pg WHO-TEQ/kg body weight determined by the World Health Organization.

Although this survey can not be considered as being a representative total diet study, nevertheless it allows a first assessment of the risk associated with the consumption of certain types of food products in Karakalpakstan/Uzbekistan.

ANNEX IV

RECOMMENDATIONS OF THE 2ND INTERNATIONAL TOTAL DIET STUDY WORKSHOP, BRISBANE, AUSTRALIA, 4 - 15 February, 2002

Workshop participants, after intensive discussion adopted the following recommendations for consideration by national and international health authorities:

1 TDS in each country.

Scientific risk assessments are the fundamental basis of decisions dealing with both health and trade aspects of food. For scientific risk assessment it is essential to know background concentrations of chemicals in foods so that the actual dietary exposure to these chemicals can be assessed. In every country, the diet and dietary customs are different.

> Thus, it is recommended that all countries conduct TDS to assess actual dietary intake of toxic and nutritionally important chemicals. This is particularly relevant for institutions already participating in GEMS/Food (see Annex IV). In addition, it is recommended that the WHO prepare a booklet describing and promoting TDS.

2 Support for TDS in developing countries.

For various reasons, in many developing countries, there is little or no monitoring of the food supply for toxic chemicals. As a result, information about the safety of foods is, more often than not, non-existent. With global trade, however, a food safety problem in one country may become a trade and health problem for many countries.

> Thus, it is recommended that each developing country be given international assistance to conduct its own total diet study. This may be considered on a regional basis to reduce costs and promote regional cooperation.

3 Laboratory capacity.

Knowledge of background levels of toxic chemicals in foods is critical for knowing whether or not foods are safe. The numbers of laboratories capable of measuring background concentrations of toxic chemicals in foods are few and the costs of these analyses are relatively high. As a result, there is a paucity of background monitoring data. The costs for building up laboratory capacity, however, are minor compared with the health and economic consequences of not being able to deal with crises. For example, the economic consequences of the Belgium dioxin incident totalled $2 billion, most of which was borne by the food industry, both in Belgium and internationally. Obviously, consumer confidence in the food supply also suffered.

> It is recommended that all countries provide additional funding to health departments to substantially strengthen laboratory capacity to establish and monitor baseline levels of toxic chemicals in foods.

4 Emergency preparedness.

Food safety emergencies have occurred periodically, often with enormous health and economic costs. In addition, the food supply is a key target for terrorism, and without the ability to monitor for chemical toxicants, the populations of countries and world trade are at risk.

> It is recommended that an inventory of laboratory capacities by chemical, matrix and detection limit be prepared by GEMS/Food. In addition, WHO Collaborating Centres for Food Contamination Monitoring should consider expanding their terms of reference to address this issue.

5 WHO food safety databases.

With the globalization of trade and harmonization of food safety standards, it is critical that global food safety databases be maintained. These should include background concentration data for chemicals in individual foods and food groups, and dietary intake estimates from TDS conducted in individual countries.

It is recommended that:

1. existing GEMS/Food databases OPAL I, II and III, and SIGHT should continue to be supported and refined; and
2. individual countries should support GEMS/Food databases by regularly submitting data in the OPAL format.

6 Analytical training.

The chemical analyses required for TDS are among the most difficult of all food analyses because of the low detection limits which must be obtained.

It is recommended that, wherever possible, training be provided by more experienced laboratories for those analysts with less experience. Special emphasis should be placed on providing support and training to analysts in developing countries.

7 Persistent organic pollutants in breast milk.

Humans accumulate persistent organic pollutants in their stores of fat. Some of these are transferred into the fat portion of breast milk of mothers. Thus, breast milk is one of the few and least expensive mechanisms of assessing human exposure to these chemicals and monitoring this exposure with time can provide information on trends. Breast milk surveys can also be used to identify environmental sources of these chemicals and to monitor the effectiveness of risk management measures.

It is recommended that:

1. in light of the Stockholm Convention on POPs, countries should endeavour to participate in the ongoing 3rd WHO coordinated study of PCBs, PCDDs and PCDFs in breast milk; and
2. countries should as a matter of balanced risk communication strongly emphasize the benefits of breast feeding whenever reporting the results of studies of this type.

8 Risk assessment.

The primary user of total diet study results is the risk assessor. Internationally and in individual countries, there is an urgent need for risk assessments on many chemicals. For example, the Codex Committee on Food Additives and Contaminants had requested data to decide whether to set the maximum limit for patulin in apple juice at 50 or 25 ppm.

It is recommended that risk assessors and statisticians be consulted when a total diet study is designed so that the study results can be directly used in making scientifically valid risk assessments for at-risk population groups. Thus, it is important to be able to, as a minimum, estimate both average and upper percentile intakes of chemicals for each target population group. For nutrients, the ability to estimate lower percentile intakes is also critical.

9 Design and structure of TDS.

Numerous aspects of TDS can and should be harmonized if the results are to be comparable. However, it is important to also recognize that each study should reflect the health concerns and resources of the country in which it is conducted. The following recommendations deal with these aspects:

1. All countries should cooperate and coordinate their activities in the development and harmonization of standard protocols for TDS.

2. A team approach should be used when conducting TDS, with all team members, including those recognizable for sample collection, sample processing, risk assessment, statistics and laboratory analysis, involved at the planning stage.

3. Each total diet study should be documented in detail when it is reported. As a result of resource limitations or for strategic reasons, there will always be differences, such as analytical detection limits or choice of samples, in the design of studies in each country. These can have a major impact on the dietary intake results obtained for the survey and their interpretation.

4. When comparing results of TDS from different countries, due care should be taken to ensure that the most recent data are used and to consider potential impact of individual differences in the design and implementation of the compared studies. Factors, such as different foods, age-sex groups, climates, agricultural practices, limits of detection / reporting and quality assurance and control practices, can affect results.

5. Drinking water, taken as water, should be included in each total diet study except where resources do not allow for this. This should include bottled water and tap water taken from the sample pick-up areas. Thus, it is important that drinking water be included when food intake surveys are conducted.

6. Where possible, distilled water should be used for sample preparation. Otherwise, the water used should be separately analyzed.

7. There are some chemicals which, because of their nature, limited distribution or homogeneity, are better assessed in commodity surveys rather than TDS. Some mycotoxins, for example, are not homogeneously distributed in foods, and it would take a very large sample size to obtain a reasonable estimate of their concentration.

8. Analytes for TDS should focus on those recommended for in the GEMS/Food Core, Intermediate and Comprehensive Lists of Contaminant / Commodity Combinations (see Annex V). Countries should consider including in their own TDS the following groups of chemicals: persistent organic pollutants (PCBs, dioxins, dibenzofurans); toxic elements (Pb, Hg, Cd, As, Cr); mycotoxins (such as aflatoxin, patulin and deoxynivalenol); specific chemical species (such as organotin compounds, methylmercury, nitrate, nitrite and nitrosamines), volatile organic compounds and nutrients such as vitamins, minerals and essential fatty acids.

9. Prioritization when selecting analytes should be based on a) information available (has the analyte been included recently in a total diet study), b) toxicity (could the analyte act by itself or additively with other toxic chemicals to cause harm at low concentrations), c) susceptibility to technology changes, and d) potential for adventitious or deliberate contamination. Among the chemicals considered important enough for monitoring with every total diet study are pesticides, dioxins, PCBs, and the heavy metals Pb, Hg and Cd.

10. When selecting chemicals for TDS, countries should consider less common chemicals which may pose a significant health risk to their population.

11. Managers of TDS should define the limit of reporting required of the laboratory performing the analyses so that the exposure results will be meaningful and cost-effective.

12. Dietary exposures can vary widely depending on how results at or below the limit of reporting are handled. Regardless of the approach taken, it should be clearly described when the total diet study results are reported. Managers of TDS should define how results below the limit of reporting are to be used in risk assessment. The technique used should be practical, logical, scientifically valid and consistently applied. While there is still no general agreement about how this should be done, the workshop drew attention to the GEMS/Food EURO workshop recommendations that appear as Appendix V to the

GEMS/Food Instructions for Electronic Submission of Data on Chemical Contaminants in Food, available at the WHO Website www.who.int/foodsafety.

13. Food consumption data used for TDS should be as recent as possible and maintained current. Because local dietary patterns may change quickly, the date and basis of the consumption data should be defined in each study.

14. While national consumption data are critical for the highest accuracy of total diet study results, GEMS/Food Regional Diets are a useful starting alternative for countries without their own food intake information.

15. Appropriate quality assurance and control at all stages of a total diet study are critical and cannot be overemphasized.

16. In addition to estimating exposure for adults or the general population, it is critical to estimate dietary intakes for infants and children who face the greatest risk due to their high consumption/body weight ratio. In addition, countries should conduct exposure estimates on other population sub-groups, such as ethnic populations, if their diet patterns are expected to be different.

17. Foods should be prepared "as normally consumed" and concentration data recorded as such. If not so, moisture content should be included in the data submitted.

18. TDS should be planned so that food composites are analyzed shortly after they are prepared. Even if the foods are kept frozen, some chemicals may gradually decompose over time or become bound to the food matrix.

19. When dealing with the possibility of terrorist threats or other food safety emergency, each total diet study should contain an annex to deal with highly contaminated samples quickly, so that the source of contamination can be identified and managed.

10 Risk communication.

It is recognized that information on concentrations of chemicals in foods and the dietary intake of these chemicals can be misinterpreted by the public, and thus discourage the public from eating foods which are nutritionally beneficial.

It is recommended that:

1. total diet study results are fully and openly reported immediately after they are analytically validated;

2. individuals reporting these results are scientists from government and academia with closest knowledge of the study;

3. total diet study results be reported in a way that is easily understood by the public, such as providing a direct comparison of the intake with the PTWI or ADI of the chemical; and

4. When reporting results to the public, emphasis is on the risk rather than the hazard, and putting the risk into perspective and that it is presented in a format easily understandable to the public.

11 International total diet workshops.

TDS are complex and require expertise from many different areas, including management, analytical chemistry, nutrition, food consumption patterns, food preparation, and statistics. Transfer of this expertise to countries starting their own TDS, exchange of information among scientists already conducting studies, and sharing of resources are critical.

It is recommended that another international total diet workshop be held focusing on:

1. progress of TDS, particularly in developing countries;

2. results of new TDS;
3. international dietary risk assessment issues;
4. techniques of food analysis, consumption studies, and exposure estimates; and
5. training for less developed countries.

It is also recommended that regional total diet workshops be held, especially where groups of developing countries are interested in initiating new TDS.